How to Navigate This Book

last

next

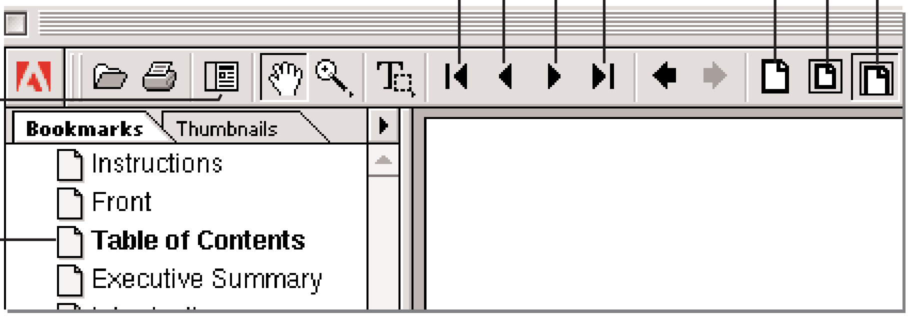
previous

first

fit width

fit in window

actual size



click icon to display or hide navigation panel

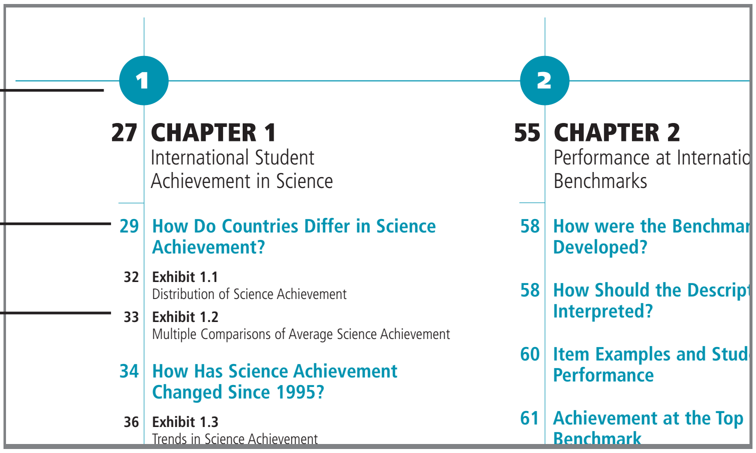
click on section icon in navigation panel to display section

Contents Pages

click on chapter number to display chapter

click on section title to display section

click on exhibit number to display exhibit



1

27 **CHAPTER 1**
International Student Achievement in Science

29 How Do Countries Differ in Science Achievement?

32 Exhibit 1.1
Distribution of Science Achievement

33 Exhibit 1.2
Multiple Comparisons of Average Science Achievement

34 How Has Science Achievement Changed Since 1995?

36 Exhibit 1.3
Trends in Science Achievement

2

55 **CHAPTER 2**
Performance at Internatio
Benchmarks

58 How were the Benchmar
Developed?

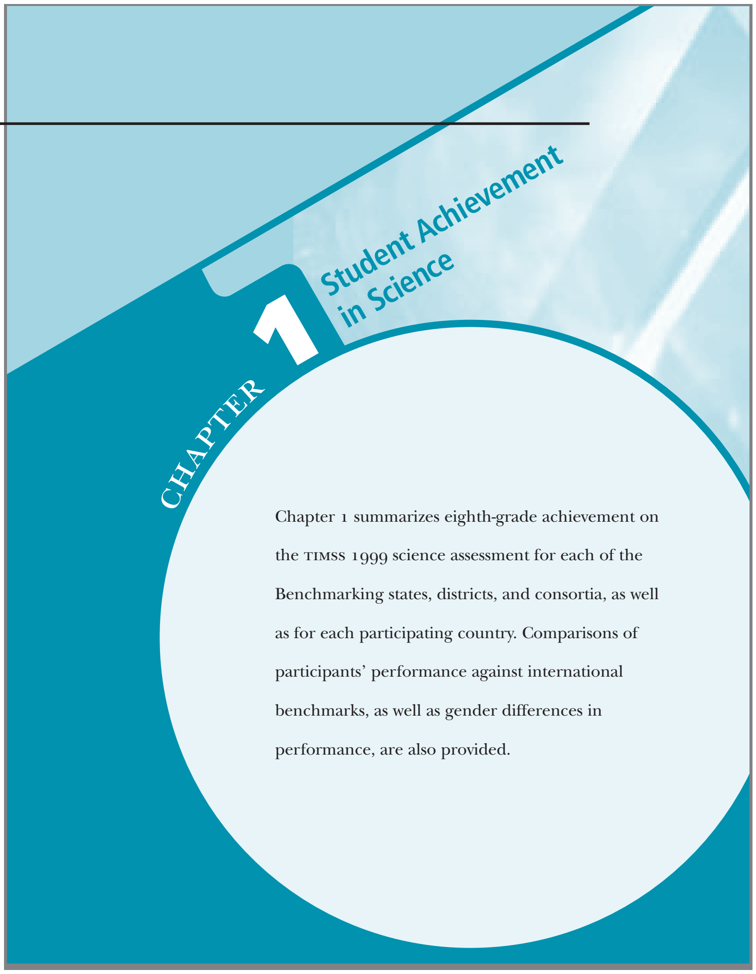
58 How Should the Descript
Interpreted?

60 Item Examples and Stud
Performance

61 Achievement at the Top
Benchmark

Cover Pages

click anywhere on page to return to the table of contents



Chapter 1 summarizes eighth-grade achievement on the TIMSS 1999 science assessment for each of the Benchmarking states, districts, and consortia, as well as for each participating country. Comparisons of participants' performance against international benchmarks, as well as gender differences in performance, are also provided.

next

Text Pages

click on section title to return to table of contents

click on first mention of exhibit to jump to exhibit

click on arrow to jump to indicated page of text

click on number to jump to another chapter

click here to return to the table of contents

What Activities Do Students Do in Their Science Lessons?

Because it can affect pedagogical strategies, class size data are shown in Exhibit 6.7. Across countries the average class size was 31 students. However, there was considerable variation, from 40 to 50 students in Indonesia, Korea, the Philippines, South Africa, Thailand, and Turkey to 20 or fewer students in Belgium (Flemish), Finland, and Italy. In most of the Asian countries, including Chinese Taipei, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand, more than two-thirds of the students were taught in classes of 36 or more. In South Africa, 85 percent were in classes of this size. The relationship between class size and achievement is difficult to disentangle, given the variety of policies and practices and the fact that smaller classes can be used for both advanced and remedial learning. As shown in Exhibit 6.8, Cyprus, Korea, and Slovenia significantly reduced the average size of their science classes between 1995 and 1999, and no countries showed increases.

Exhibit 6.9 presents a profile of the activities most commonly encountered in science classes around the world, as reported by science teachers. On average internationally, the most common activity was teacher lecture (24 percent of class time), followed by students conducting experiments (15 percent) and teacher-guided student practice (14 percent). Re-teaching and clarification of content and procedures, student independent practice, tests and quizzes, and teacher demonstrations of experiments each occupied 10 percent of class time. Of the 12 countries in which teachers reported that students conduct experiments for at least 20 percent of class time, eight had average science achievement significantly above the international average. The percentage of time spent on teacher lecture ranged from 43 percent in Bulgaria to 12 percent in Tunisia. Homework review took up 23 percent of class time in Jordan but only three percent in Japan and England.

To gain a student perspective on the activities in science class, students were asked to indicate how often they and their teachers do various activities. As shown in Exhibit 6.10, at least 80 percent of the students in general/integrated science, physics, and chemistry classes reported that the teacher shows them how to do science problems almost always or pretty often, compared with only 60 percent for earth science and 54 percent for biology. Differences among the science subjects also appeared in the percentages of students reporting that they work on science projects. On average, 51 percent of students in general/integrated science reported working on science projects almost always or pretty often, compared with 40 percent in physics, 44 percent in chemistry, and about 30 percent each

text continued
page 222

Exhibit Pages

click on exhibit number to jump to text discussion of that exhibit

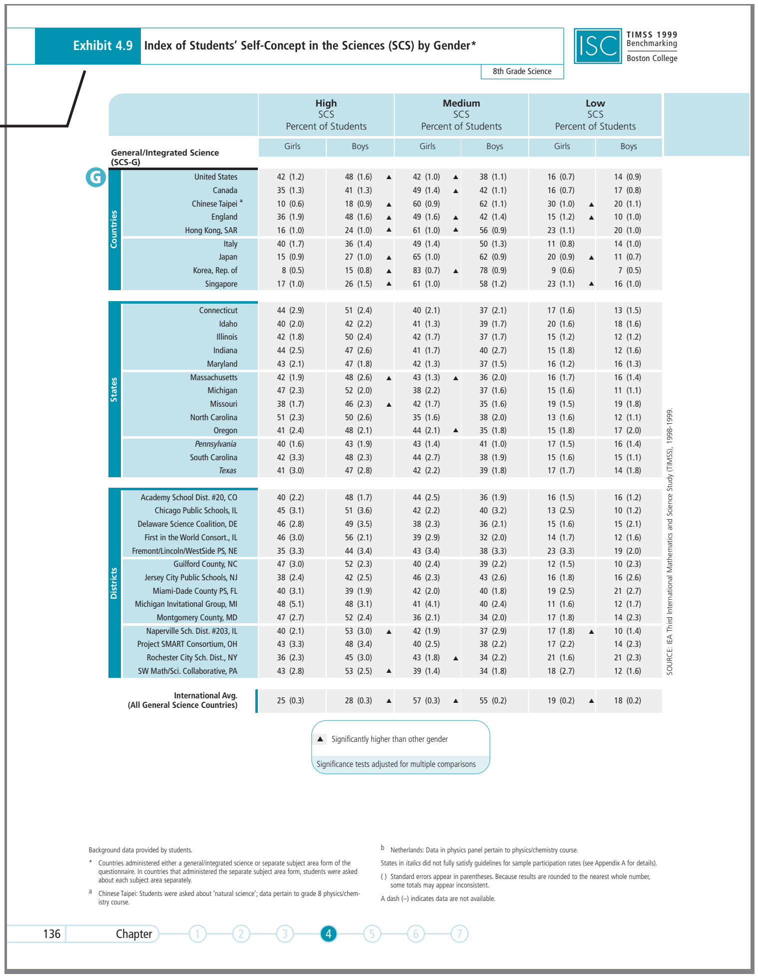


Exhibit 4.9 Index of Students' Self-Concept in the Sciences (SCS) by Gender*

TIMSS 1999 Benchmarking
Boston College

8th Grade Science

	General/Integrated Science (SCS-G)	High SCS Percent of Students		Medium SCS Percent of Students		Low SCS Percent of Students	
		Girls	Boys	Girls	Boys	Girls	Boys
Countries	United States	42 (1.2)	48 (1.6) ▲	42 (1.0) ▲	38 (1.1)	16 (0.7)	14 (0.9)
	Canada	35 (1.3)	41 (1.3)	49 (1.4) ▲	42 (1.1)	16 (0.7)	17 (0.8)
	Chinese Taipei [a]	10 (0.6)	18 (0.9) ▲	60 (0.9)	62 (1.1)	30 (1.0) ▲	20 (1.1)
	England	36 (1.9)	48 (1.6) ▲	49 (1.6) ▲	42 (1.4)	15 (1.2) ▲	10 (1.0)
	Hong Kong, SAR	16 (1.0)	24 (1.0) ▲	61 (1.0) ▲	56 (0.9)	23 (1.1)	20 (1.0)
	Italy	40 (1.7)	36 (1.4)	49 (1.4)	50 (1.3)	11 (0.8)	14 (1.0)
	Japan	15 (0.9)	27 (1.0) ▲	65 (1.0)	62 (0.9)	20 (0.9) ▲	11 (0.7)
	Korea, Rep. of	8 (0.5)	15 (0.8) ▲	83 (0.7) ▲	78 (0.9)	9 (0.6)	7 (0.5)
	Singapore	17 (1.0)	26 (1.5) ▲	61 (1.0)	58 (1.2)	23 (1.1) ▲	16 (1.0)
States	Connecticut	44 (2.9)	51 (2.4)	40 (2.1)	37 (2.1)	17 (1.6)	13 (1.5)
	Idaho	40 (2.0)	42 (2.2)	41 (1.3)	39 (1.7)	20 (1.6)	18 (1.6)
	Illinois	42 (1.8)	50 (2.4)	42 (1.7)	37 (1.7)	15 (1.2)	12 (1.2)
	Indiana	44 (2.5)	47 (2.6)	41 (1.7)	40 (2.7)	15 (1.8)	12 (1.6)
	Maryland	43 (2.1)	47 (1.8)	42 (1.3)	37 (1.5)	16 (1.2)	16 (1.3)
	Massachusetts	42 (1.9)	48 (2.6) ▲	43 (1.3) ▲	36 (2.0)	16 (1.7)	16 (1.4)
	Michigan	47 (2.3)	52 (2.0)	38 (2.2)	37 (1.6)	15 (1.6)	11 (1.1)
	Missouri	38 (1.7)	46 (2.3) ▲	42 (1.7)	35 (1.6)	19 (1.5)	19 (1.8)
	North Carolina	51 (2.3)	50 (2.6)	35 (1.6)	38 (2.0)	13 (1.6)	12 (1.1)
	Oregon	41 (2.4)	48 (2.1)	44 (2.1) ▲	35 (1.8)	15 (1.8)	17 (2.0)
	Pennsylvania	40 (1.6)	43 (1.9)	43 (1.4)	41 (1.0)	17 (1.5)	16 (1.4)
	South Carolina	42 (3.3)	48 (2.3)	44 (2.7)	38 (1.9)	15 (1.6)	15 (1.1)
	Texas	41 (3.0)	47 (2.8)	42 (2.2)	39 (1.8)	17 (1.7)	14 (1.8)
Districts	Academy School Dist. #20, CO	40 (2.2)	48 (1.7)	44 (2.5)	36 (1.9)	16 (1.5)	16 (1.2)
	Chicago Public Schools, IL	45 (3.1)	51 (3.6)	42 (2.2)	40 (3.2)	13 (2.5)	10 (1.2)
	Delaware Science Coalition, DE	46 (2.8)	49 (3.5)	38 (2.3)	36 (2.1)	15 (1.6)	15 (2.1)
	First in the World Consort., IL	46 (3.0)	56 (2.1)	39 (2.9)	32 (2.0)	14 (1.7)	12 (1.6)
	Fremont/Lincoln/WestSide PS, NE	35 (3.3)	44 (3.4)	43 (3.4)	38 (3.3)	23 (3.3)	19 (2.0)
	Guilford County, NC	47 (3.0)	52 (2.3)	40 (2.4)	39 (2.2)	12 (1.5)	10 (2.3)
	Jersey City Public Schools, NJ	38 (2.4)	42 (2.5)	46 (2.3)	43 (2.6)	16 (1.8)	16 (2.6)
	Miami-Dade County PS, FL	40 (3.1)	39 (1.9)	42 (2.0)	40 (1.8)	19 (2.5)	21 (2.7)
	Michigan Invitational Group, MI	48 (5.1)	48 (3.1)	41 (4.1)	40 (2.4)	11 (1.6)	12 (1.7)
	Montgomery County, MD	47 (2.7)	52 (2.4)	36 (2.1)	34 (2.0)	17 (1.8)	14 (2.3)
	Naperville Sch. Dist. #203, IL	40 (2.1)	53 (3.0) ▲	42 (1.9)	37 (2.9)	17 (1.8) ▲	10 (1.4)
	Project SMART Consortium, OH	43 (3.3)	48 (3.4)	40 (2.5)	38 (2.2)	17 (2.2)	14 (2.3)
	Rochester City Sch. Dist., NY	36 (2.3)	45 (3.0)	43 (1.8) ▲	34 (2.2)	21 (1.6)	21 (2.3)
	SW Math/Sci. Collaborative, PA	43 (2.8)	53 (2.5) ▲	39 (1.4)	34 (1.8)	18 (2.7)	12 (1.6)
	International Avg. (All General Science Countries)	25 (0.3)	28 (0.3) ▲	57 (0.3) ▲	55 (0.2)	19 (0.2) ▲	18 (0.2)

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

begin book

Book Navigation
Instructions

Science Benchmarking Report
TIMSS 1999 – Eighth Grade

Achievement for U.S. States and Districts in an International Context

Michael O. Martin
Ina V.S. Mullis
Eugenio J. Gonzalez
Kathleen M. O'Connor
Steven J. Chrostowski
Kelvin D. Gregory
Teresa A. Smith
Robert A. Garden

ISC
BOSTON COLLEGE
The International Study Center
Lynch School of Education

IEA
The International Association
for the Evaluation of
Educational Achievement

A BRIDGE TO SCHOOL IMPROVEMENT

April 2001

Science Benchmarking Report: TIMSS 1999 –
Eighth Grade / by Michael O. Martin, Ina V.S. Mullis,
Eugenio J. Gonzalez, Kathleen M. O'Connor, Steven
J. Chrostowski, Kelvin D. Gregory, Teresa A. Smith,
Robert A. Garden

Publisher: International Study Center
Lynch School of Education
Boston College

Library of Congress
Catalog Card Number: 2001087824

ISBN 1-889938-20-3

For more information about TIMSS contact:

The International Study Center
Lynch School of Education
Manresa House
Boston College
Chestnut Hill, MA 02467
United States

For information on ordering this report,
write to the above address or call
+1-617-552-1600

This report also is available on the
World Wide Web: http://www.timss.org

Funding for the TIMSS 1999 Benchmarking Study was provided by the National Center for Education Statistics and the Office of Educational Research and Improvement of the U.S. Department of Education, the U.S. National Science Foundation, and participating jurisdictions.

Printed and bound in the United States

CONTENTS

CONTENTS

4

109 CHAPTER 4
Students' Backgrounds and Attitudes Towards Science

5

147 CHAPTER 5
The Science Curriculum

6

205 CHAPTER 6
Teachers and Instruction

CONTENTS

7

263 CHAPTER 7
School Contexts for Learning and Instruction

R 1

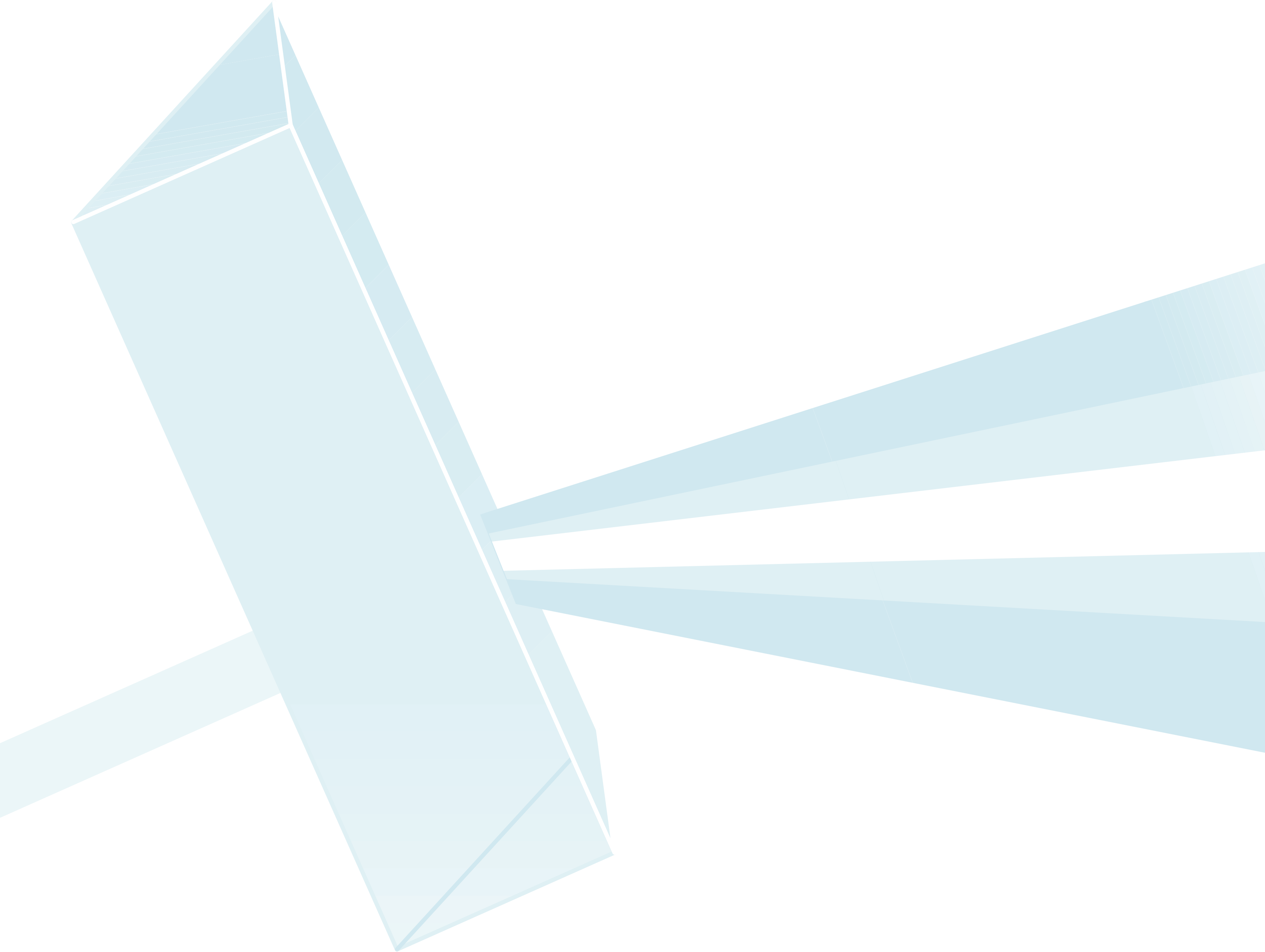
287 REFERENCE 1
Students' Backgrounds and Attitudes Towards Science

CONTENTS

Executive Summary

TIMSS 1999 Benchmarking

A Bridge to School Improvement



Executive Summary

TIMSS 1999, a successor to the acclaimed 1995 Third International Mathematics and Science Study (TIMSS), focused on the mathematics and science achievement of eighth-grade students. Thirty-eight countries including the United States participated in TIMSS 1999 (also known as TIMSS-Repeat or TIMSS-R).[1] Even more significantly for the United States, however, TIMSS 1999 included a voluntary Benchmarking Study. Twenty-seven jurisdictions from all across the nation, including 13 states and 14 districts or consortia (see below), participated in the Benchmarking Study.

TIMSS 1999 Benchmarking Participants

States	**Districts and Consortia**
Connecticut	Academy School District #20, Colorado Springs, CO
Idaho	Chicago Public Schools, IL
Illinois	Delaware Science Coalition, DE
Indiana	First in the World Consortium, IL
Maryland	Fremont/Lincoln/Westside Public Schools, NE
Massachusetts	Guilford County, NC
Michigan	Jersey City Public Schools, NJ
Missouri	Miami-Dade County Public Schools, FL
North Carolina	Michigan Invitational Group, MI
Oregon	Montgomery County, MD
Pennsylvania	Naperville School District #203, IL
South Carolina	Project SMART Consortium, OH
Texas	Rochester City School District, NY
	Southwest Pennsylvania Math and Science Collaborative, PA

Each jurisdiction had its own reasons for taking part in the TIMSS 1999 Benchmarking Study. In general, participation provided an unprecedented opportunity for jurisdictions to assess the comparative international standing of their students' achievement and to evaluate their mathematics and science programs in an international context. Participants were also able to compare their achievement with that of the United States as a whole,[2] and in the cases where they both participated, school districts could compare with the performance of their states.

Each participating entity invested valuable resources in this effort, primarily for data collection and team building, but also for staff development to facilitate use of the TIMSS 1999 results as an effective tool for school improvement. Despite each participant's deep commitment to educational improvement by virtue of its participation in such a venture, it took courage and initiative to join such a high profile enterprise as the TIMSS 1999 Benchmarking Study. Whether students' achievement fell at the top, middle, or bottom of the range of results for countries internationally, each participant will be asked to explain the results to its parents and communities.

---

[1] IEA's International Study Center at Boston College reported the international results for TIMSS 1999 as well as trends between 1995 and 1999 in two companion volumes – the *TIMSS 1999 International Mathematics Report* and the *TIMSS 1999 International Science Report*. Performance in the United States relative to that of other nations was reported by the U.S. National Center for Education Statistics in *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999*. (See the Introduction for full citations.)

[2] For the most part, the U.S. TIMSS national sample was separate from the students assessed in each of the Benchmarking jurisdictions. Each Benchmarking participant had its own sample to provide comparisons to each of the TIMSS 1999 countries including the United States. Collectively, the Benchmarking participants are not representative of the United States even though the effort was substantial in scope.

This report provides a preliminary overview of the results for the Benchmarking Study in science. The real work will take place as each participating entity begins to examine its curriculum, teaching force, instructional approaches, and school environment in an international context. As those working on school improvement know full well, there is no "silver bullet" or single factor that is the answer to higher achievement in science or any other school subject. Making strides in raising student achievement requires tireless diligence, as policy makers, administrators, teachers, and communities work to make improvements in a number of important areas related to educational quality.

Unlike in many countries around the world where educational decision making is highly centralized, in the United States the opportunities to learn science derive from an educational system that operates through states and districts, allocating opportunities through schools and then through classrooms. Improving students' opportunities to learn requires examining every step of the educational system, including the curriculum, teacher quality, availability and appropriateness of resources, student motivation, instructional effectiveness, parental support, and school safety.

Particularly since *A Nation at Risk*[3] was issued eighteen years ago, many states and school districts have been working on the arduous task of improving education in their jurisdictions. During the past decade, content-driven systemic school reform has emerged as a promising model for school improvement.[4] That is, curriculum frameworks establishing what students should know and be able to do provide a coherent direction for improving the quality of instruction. Teacher preparation, instructional materials, and other aspects of the system are then aligned to reflect the content of the frameworks in an integrated way to reinforce and sustain high-quality teaching and learning in schools and classrooms.

There has been concerted effort across the nation at the state and local levels in writing and revising academic standards in various academic subjects. In science, most states are in the process of implementing new content or curriculum standards or revising existing ones.[5] All but four states now have standards in science.[6] Twenty-nine states also have some type of criterion-referenced science assessment aligned to state standards.[7] Much of this effort has been based on work done at the national level over the past decade to develop standards aimed at increasing the science literacy of all students. The two most prominent documents are the American Association for the Advancement of Science (AAAS)

---

[3] *A Nation at Risk: The Imperative for Education Reform* (1983), Washington, DC: National Commission on Excellence in Education.

[4] O'Day, J.A. and Smith, M.S. (1993), "Systemic Reform and Educational Opportunity" in S.H. Fuhrman (ed.), *Designing Coherent Education Policy: Improving the System,* San Francisco, CA: Jossey-Bass, Inc.

[5] Glidden, H. (1999), *Making Standards Matter 1999*, Washington, DC: American Federation of Teachers.

[6] *Key State Education Policies on K-12 Education: 2000* (2000), Washington, DC: Council of Chief State School Officers.

[7] Orlofsky, G.F. and Olson, L. (2001), "The State of the States" in *Quality Counts 2001, A Better Balance: Standards, Tests, and the Tools to Succeed,* Education Week, 20(17).

Benchmarks for Science Literacy and the National Research Council's *National Science Education Standards* (NSES), both of which define standards for the teaching and learning of science that many state and local educational systems have used to fashion their own curricula.[8]

Despite considerable energy devoted to educational improvement, achievement in science has shown only modest gains since 1982.[9] The TIMSS results show little change in eighth-grade science achievement between 1995 and 1999. In 1999, the U.S. eighth graders performed significantly above the TIMSS international average in science, but about in the middle of the achievement distribution of the 38 participating countries (above 18 countries, similar to 5, and below 14). In TIMSS 1999, the world class performance levels in science were set essentially by four Asian countries and a central European one. Chinese Taipei, Singapore, Hungary, Japan, and the Republic of Korea had the highest average performance. The Netherlands, Australia, the Czech Republic, and England also performed very well (see Exhibits 1.1 and 1.2 in Chapter 1).

---

[8] Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

[9] Campbell, J.R., Hombo, C.M., and Mazzeo, J. (2000), *NAEP 1999 Trends in Academic Progress: Three Decades of Student Performance*, NCES 2000-469, Washington, DC: National Center for Education Statistics.

Major Findings from the TIMSS 1999 Benchmarking Study

- Average performance in science for the 13 Benchmarking states was generally clustered in the upper half of the international distribution of results for the 38 countries. All but three of the Benchmarking states performed significantly above the international average.

- The top-performing Benchmarking participants – the Naperville School District and the First in the World Consortium (both in Illinois), the Michigan Invitational Group, and the Academy School District (in Colorado) – all had average achievement comparable to the world class performance of Chinese Taipei and Singapore. However, the Benchmarking Study underscores the extreme importance of looking beyond the averages to the range of performance found across the nation, as performance across the participating school districts and consortia reflected nearly the full range of achievement internationally. In contrast to the top performers, urban districts with high percentages of students from low-income families – the Rochester City School District, the Chicago Public Schools, the Jersey City Public Schools, and the Miami-Dade County Public Schools – performed more similarly to lower-performing countries such as Jordan, Iran, Indonesia, Turkey, and Tunisia, but significantly higher than the lowest-scoring countries.

- The TIMSS 1999 Benchmarking Study provides evidence that some schools in the U.S. are among the best in the world, but that a world-class education is not available to all children across the nation. The TIMSS index of home educational resources (based on books in the home, availability of study aids, and parents' education level) shows that students with more home resources have higher science achievement. Furthermore, the Benchmarking jurisdictions with the greatest percentages of students with high levels of home resources were among the top-performing jurisdictions, and those with the lowest achievement were four urban districts that also had the lowest percentages of students with high levels of home resources. These and other TIMSS 1999 Benchmarking results support research indicating that students in urban districts with a high proportion of low-income families and minorities often attend schools with fewer resources than in non-urban districts, including less experienced teachers, fewer appropriate instructional materials, more emphasis on lower-level content, less access to gifted and talented programs, higher absenteeism, more inadequate buildings, and more discipline problems.

- It is disappointing that in science at the eighth grade, the TIMSS 1999 Benchmarking Study shows relatively unequal average achievement for girls and boys in many of the Benchmarking jurisdictions, and in the United States overall. Boys had significantly higher average science achievement than girls in 10 of the 13 Benchmarking states, with Massachusetts, South Carolina, and Texas the exceptions. Gender differences were less prevalent among the Benchmarking districts and consortia, with significant differences in just four jurisdictions: the First in the World Consortium, Guilford County, Naperville, and the Southwest Pennsylvania Math and Science Collaborative. This follows the national and international pattern where the United States was one of 16 countries in 1999 where boys significantly outperformed girls.

- Of the six science content areas assessed by TIMSS, U.S. eighth graders performed higher than the international average in earth science, life science, chemistry, environmental and resource issues, and scientific inquiry and the nature of science, but only at the international average in physics. In life science and in scientific inquiry and the nature of science, the two areas in which the United States performed best, some of the lowest-performing Benchmarking participants had more success than in the other content areas. It will be important, however, for each participant to determine its specific relative strengths and weaknesses in science achievement.

- Although many countries teach eighth-grade science as separate subjects (namely, earth science, biology, physics, and chemistry), most jurisdictions in the United States teach science as a single general or integrated subject. It naturally follows, then, that teachers in the U.S. overall and in the majority of the Benchmarking entities reported a relatively heavy emphasis given to general/integrated science among the science content areas. In the U.S., teachers of 41 percent of the students reported that general science was emphasized most in their classes, compared with 28 percent for earth science, 21 percent for physical science (chemistry/physics), five percent for biology, three percent for chemistry, and two percent for physics. Although results for many of the Benchmarking jurisdictions were similar to the national profile, the content area emphasis differed substantially from jurisdiction to jurisdiction. For example, teachers in Idaho, the Academy School District, Jersey City, and Rochester reported emphasizing physical science for half or more of their students, while those in North Carolina, Texas, the Delaware Science Coalition, the Fremont/Lincoln/Westside Public Schools, and Guilford County did so for less than 10 percent.

- Research shows that higher achievement in science is associated with teachers having a bachelor's and/or master's degree in science.[10] According to their teachers, however, U.S. eighth-grade students were less likely than those in other countries to be taught science by teachers with a major area of study in science, and more likely to be taught by teachers with a major in general education. In the U.S., 47 percent of students were taught science by a teacher whose major area of study was biology, 13 percent physics, 21 percent chemistry, 43 percent science education, 14 percent mathematics or mathematics education, 56 percent general education, and 45 percent some other area.[11] Among Benchmarking participants, in almost every jurisdiction the majority of students were in science classes in which the teacher's major area was science education or general education. Teachers with a major in physics or chemistry were rare; only in the Academy School District, Naperville, and Project SMART were more than 30 percent of students taught by such teachers.

- In general, teachers in many Benchmarking entities and in the United States overall expressed much less confidence in their preparation to teach eighth-grade science than mathematics. In the U.S. as a whole, 87 percent of the students had teachers who felt "very well prepared" to teach across a range of general mathematics topics covered by TIMSS,[12] compared with 27 percent for science. This figure for science ranged from 56 percent in the Academy School District to 14 percent in the Delaware Science Coalition across the Benchmarking entities, with half of them exceeding the national average. Teachers in a number of the lower-scoring jurisdictions reported relatively high levels of confidence in their preparation, possibly because they are teaching a science curriculum that is not very demanding.

- Since entering teachers make up a relatively small percentage of the teaching force, improving teacher quality depends on providing opportunities for professional development. Science teachers in the United States reported a relatively heavy focus on curriculum, pedagogy, and content knowledge in their professional development activities. Although the national pattern held in many jurisdictions,

---

[10] Goldhaber, D.D. and Brewer, D.J. (1997), "Evaluating the Effect of Teacher Degree Level on Educational Performance" in W. Fowler (ed.), *Developments in School Finance, 1996*, NCES 97-535, Washington DC: National Center for Education Statistics; Darling-Hammond, L. (2000), *Teacher Quality and Student Achievement: A Review of State Policy Evidence*, Education Policy Analysis Archives, 8(1).

[11] Because teachers can have dual majors, or different majors at the undergraduate and graduate level, percentages do not add to 100.

[12] Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., O'Connor, K.M., Chrostowski, S.J., Gregory, K.D., Garden, R.A., and Smith, T.A. (2001), *Mathematics Benchmarking Report, TIMSS 1999 – Eighth Grade: Achievement for U.S. States and Districts in an International Context*, Chestnut Hill, MA: Boston College.

there was variation across the Benchmarking participants. For example, the percentage of students whose teachers reported an emphasis on content knowledge ranged from 24 percent in the Delaware Science Coalition to 59 percent in Miami-Dade.

- The choices teachers make determine, to a large extent, what students learn. An important aspect of teaching science is the emphasis placed on scientific investigation. The TIMSS 1999 results show that higher science achievement is related to the emphasis that teachers place on experiments or practical investigations. In the United States as a whole, 31 percent of the students were in science classes with a high degree of emphasis on scientific investigation, compared with 38 percent internationally for countries with general/integrated science. There was great variation among the Benchmarking participants, from 79 percent in Naperville, more than in any TIMSS 1999 country, to 17 percent in the Delaware Science Coalition. Eighteen of the Benchmarking entities were above the U.S. average. In addition to Naperville, more than 50 percent of students were in such classes in Maryland, the First in the World Consortium, the Academy School District, Connecticut, and the Fremont/Lincoln/Westside Public Schools.

- In general, the TIMSS 1999 data reveal that the focus in most science classes was on teacher-centered activities. In the United States overall, 69 percent of students reported that their teacher shows them how to do science problems almost always or pretty often, while only 59 percent reported that they work on science projects this frequently. According to U.S. science teachers, class time is spent as follows: 19 percent on lecture style teacher presentation; 23 percent on teacher-guided or independent student practice; 17 percent on students conducting experiments; eight percent on teachers demonstrating experiments; nine percent on re-teaching and clarification; nine percent on tests and quizzes, eight percent on homework review; six percent on administrative tasks; and three percent on other activities. The results for the Benchmarking participants generally resembled the national profile.

- The TIMSS 1999 data indicate that the instructional time for learning science, beyond being spent largely on teacher-centered activities, becomes further eroded by non-instructional tasks. In Japan and Korea, more than half the students were in classes that never had interruptions for announcements or administrative tasks. Among the Benchmarking participants, the results ranged from 30 percent of the eighth graders in such classes in Naperville to only seven percent in the Academy School District. Also, 57 percent of the U.S. students reported that they began their science homework during class almost always or pretty often, compared with the international average of 41 percent. In most Benchmarking jurisdictions, the results followed the national pattern, although the percentage varied from 41 to 74 percent.

- The Benchmarking Study shows that students in schools that are well-resourced have higher science achievement. Among the Benchmarking participants, three-fourths or more of the students in the Academy School District, the First in the World Consortium, and Naperville were in schools where the capacity to provide science instruction was largely unaffected by shortages or inadequacies in instructional materials, supplies, buildings, space, laboratory equipment and materials, computers and computer software, calculators, library materials and audio-visual resources. These high percentages exceeded those of all the TIMSS 1999 countries, with the highest percentages (43 to 60 percent) reported by Belgium (Flemish),[13] Singapore, and the Czech Republic.

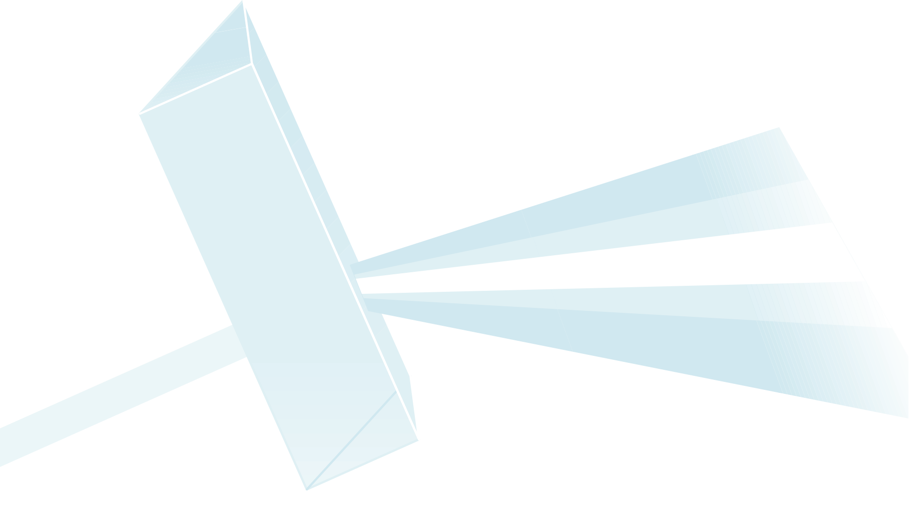
- Discipline that maintains a safe and orderly atmosphere conducive to learning is very important to school quality, and research indicates that urban schools have conditions less conducive to learning than non-urban schools.[14] For example, urban schools report more crime against students and teachers at school and that physical conflict among students is a serious or moderate problem. Among the Benchmarking participants there was considerable variation in principals' reports about the seriousness of a variety of potential discipline problems. In several of the urban districts, however, 10 percent or more of the students were in schools where absenteeism, classroom disturbances, and physical injury to students were felt to be serious problems. Also in several of these districts, 20 percent or more of the students were in schools where intimidation or verbal abuse among students was a serious problem.

---

[13] Belgium has two separate educational systems, Flemish and French. The Flemish system participated in TIMSS 1999.

[14] Mayer, D.P., Mullens, J.E., and Moore, M.T. (2000), *Monitoring School Quality: An Indicators Report*, NCES 2001-030, Washington, DC: National Center for Education Statistics; Kaufman, P., Chen, X., Choy, S.P., Ruddy, S.A., Miller, A.K., Fleury, J.K., Chandler, K.A., Rand, M.R., Klaus, P., and Planty, M.G. (2000), *Indicators of School Crime and Safety, 2000*, NCES 2001-017/NCJ-184176, Washington, DC: U.S. Departments of Education and Justice.

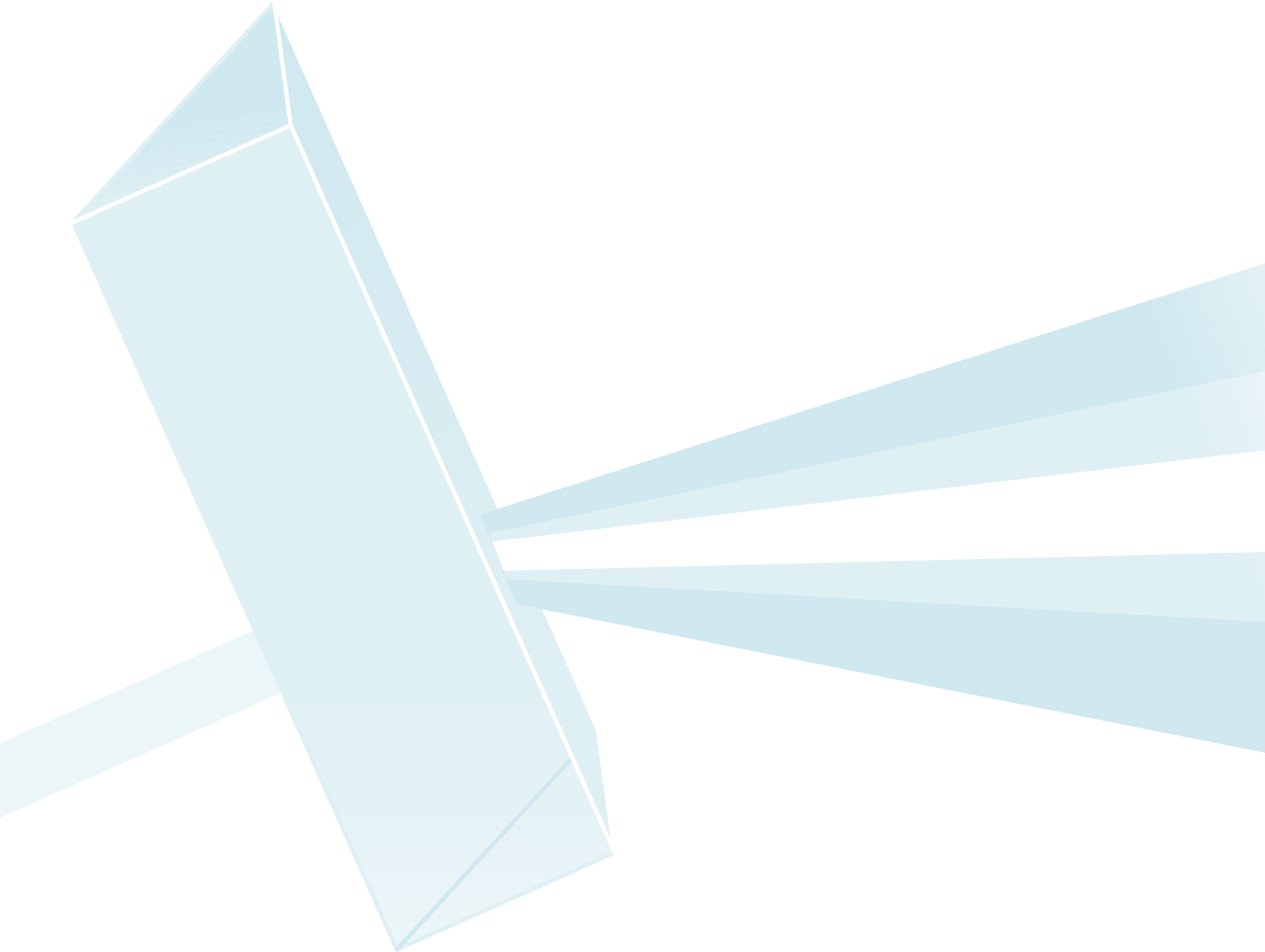
Among the 27 participants in the TIMSS 1999 Benchmarking Study, there was particularly extreme variation in science achievement among the school districts and consortia, but less among the states. Several districts in relatively wealthy communities had comparatively high achievement in science, while others in urban areas with high percentages of students from low-income families had relatively low achievement, compared with the TIMSS 1999 results internationally. Regardless of its performance, however, each state, district, and consortium now has a better idea of the challenges ahead and access to a rich array of data about various facets of its educational system. The TIMSS 1999 data provide an excellent basis for examining how best to move from developing a curriculum framework or standards in science to meeting the extraordinary challenge of actually implementing the standards in schools and classrooms often characterized by considerable cultural, social, and experiential diversity.



TIMSS 1999 BENCHMARKING

1 Introduction

I



Over the last decade, many states and school districts have created content and performance standards targeted at improving students' achievement in mathematics and science. In science, most states are in the process of implementing new standards or revising existing ones.[1] All but four states now have content or curriculum standards in science.[2] Much of this effort has been based on work done at the national level during this period to develop standards aimed at increasing the science literacy of all students. The two most prominent documents are the American Association for the Advancement of Science (AAAS) *Benchmarks for Science Literacy* and the National Research Council's *National Science Education Standards* (NSES), both of which define standards for the teaching and learning of science that many state and local educational systems have used to fashion their own curricula.[3]

Particularly during the past decade, there has been an enormous amount of energy expended in states and school districts not only on developing science content standards but also on improving teacher quality and school environments as well as on developing assessments and accountability measures.[4] Participating in an international assessment provides states and school districts a global context for evaluating the success of their policies and practices aimed at raising students' academic achievement.

What Is TIMSS 1999 Benchmarking?

TIMSS 1999, a successor to the 1995 Third International Mathematics and Science Study (TIMSS), focused on the mathematics and science achievement of eighth-grade students. Thirty-eight countries including the United States participated in TIMSS 1999 (also known as TIMSS-Repeat or TIMSS-R). Even more significantly for the United States, however, TIMSS 1999 included a voluntary Benchmarking Study. Participation in the TIMSS 1999 Benchmarking Study at the eighth grade provided states, districts, and consortia an unprecedented opportunity to assess the comparative international standing of their students' achievement and evaluate their mathematics and science programs in an international context. Participants were also able to compare their achievement with that of the United States as a whole, and in the cases where they both participated, school districts could compare with the performance of their states.

---

[1] Glidden, H. (1999), *Making Standards Matter 1999*, Washington, DC: American Federation of Teachers.

[2] *Key State Education Policies on K-12 Education: 2000* (2000), Washington, DC: Council of Chief State School Officers.

[3] Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

[4] Orlofsky, G.F. and Olson, L. (2001), "The State of the States" in *Quality Counts 2001, A Better Balance: Standards, Tests, and the Tools to Succeed, Education Week*, 20(17).

Originally conducted in 1994-1995,[5] TIMSS compared the mathematics and science achievement of students in 41 countries at five grade levels. Using questionnaires, videotapes, and analyses of curriculum materials, TIMSS also investigated the contexts for learning mathematics and science in the participating countries. TIMSS results, which were first reported in 1996, have stirred debate, spurred reform efforts, and provided important information to educators and decision makers around the world. The findings from TIMSS 1999, a follow-up to the earlier study, add to the richness of the TIMSS data and their potential to have an impact on policy and practice in mathematics and science teaching and learning.

Twenty-seven jurisdictions from all across the nation, including 13 states and 14 districts or consortia, participated in the Benchmarking Study (see Exhibit 1). To conduct the Benchmarking Study, the TIMSS 1999 assessments were administered to representative samples of eighth-grade students in each of the participating districts and states in the spring of 1999, at the same time and following the same guidelines as those established for the 38 countries.

In addition to testing achievement in mathematics and science, the TIMSS 1999 Benchmarking Study involved administering a broad array of questionnaires. TIMSS collected extensive information from students, teachers, and school principals as well as system-level information from each participating entity about mathematics and science curricula, instruction, home contexts, and school characteristics and policies. The TIMSS data provide an abundance of information making it possible to analyze differences in current levels of performance in relation to a wide variety of factors associated with classroom, school, and national contexts within which education takes place.

Why Did Countries, States, Districts, and Consortia Participate?

The decision to participate in any cycle of TIMSS is made by each country according to its own data needs and resources. Similarly, the states, districts, and consortia that participated in the Benchmarking Study decided to do so for various reasons.

Primarily, the Benchmarking participants are interested in building educational capacity and looking at their own situations in an international context as a way of improving mathematics and science teaching and learning in their jurisdictions. International assessments provide an excellent basis for gaining multiple perspectives on educational issues and

---

[5] TIMSS was administered in the spring of 1995 in northern hemisphere countries and in the fall of 1994 in southern hemisphere countries, both at the end of the school year.

examining a variety of possible reasons for observed differences in achievement. While TIMSS helps to measure progress towards learning goals in mathematics and science, it is much more than an educational Olympics. It is a tool to help examine such questions as:

- How demanding are our curricula and expectations for student learning?
- Is our classroom instruction effective? Is the time provided for instruction being used efficiently?
- Are our teachers well prepared to teach science concepts? Can they help students understand science?
- Do our schools provide an environment that is safe and conducive to learning?

Unlike in many countries around the world where educational decision making is highly centralized, in the United States the opportunities to learn science derive from an educational system that operates through states and districts, allocating opportunities through schools and then through classrooms. Improving students' opportunities to learn requires examining every step of the educational system, including the curriculum, teacher quality, availability and appropriateness of resources, student motivation, instructional effectiveness, parental support, and school safety.

Which Countries, States, Districts, and Consortia Participated?

Exhibit 1 shows the 38 countries, 13 states, and the 14 districts and consortia that participated in TIMSS 1999 and the Benchmarking Study.

The consortia consist of groups of entire school districts or individual schools from several districts that organized together either to participate in the Benchmarking Study or to collaborate across a range of educational issues. Descriptions of the consortia that participated in the project follow.

Delaware Science Coalition. The Delaware Science Coalition (DSC) is a coalition of 15 school districts working in partnership with the Delaware Department of Education and the business-based Delaware Foundation for Science and Mathematics Education. The mission of the DSC is to improve the teaching and learning of science for all students in grades K-8. The Coalition includes more that 2,200 teachers who serve more than 90 percent of Delaware's public school students.

First in the World Consortium. The First in the World Consortium consists of a group of 18 districts from the North Shore of Chicago that have joined forces to bring a world-class education to the region's students and to improve mathematics and science achievement in their schools. Resulting from meetings of district superintendents in 1995, the consortium decided to focus on three main goals: benchmarking their performance to educational standards through participating in the original TIMSS in 1996 and again in 1999; creating a forum to share the vision with businesses and the community of benchmarking to world-class standards; and establishing a network of learning communities of teachers, researchers, parents, and community members to conduct the work needed to achieve their goal.

Fremont/Lincoln/Westside Public Schools. The Fremont/Lincoln/Westside consortium is comprised of three public school districts in Nebraska. These districts joined together specifically to participate in the TIMSS 1999 Benchmarking Study.

Michigan Invitational Group. The Michigan Invitational Group is a heterogeneous and socioeconomically diverse group composed of urban, suburban, and rural schools across Michigan. Schools invited to participate as part of this consortia were those that were using National Science Foundation (NSF) materials, well-developed curricula, and provided staff development to teachers.

Project SMART Consortium. SMART (Science & Mathematics Achievement Required For Tomorrow) is a consortium of 30 diverse school districts in northeast Ohio committed to continuous improvement, long term systemic change, and improved student learning in science and mathematics in grades K-12. It is jointly funded by the Ohio Department of Education and the Martha Holden Jennings Foundation. The schools that participated in the project represent 17 of the 30 districts.

Southwest Pennsylvania Math and Science Collaborative. The Southwest Pennsylvania Math and Science Collaborative, established in 1994, coordinates efforts and focuses resources on strengthening math and science education in the entire southwest Pennsylvania workforce region that has Pittsburgh as its center. Committed to gathering and using good information that can help prepare its students to be productive citizens, the Collaborative is composed of all 118 "local control" public districts, as well as the parochial and private schools in the nine-county region. Several of these districts are working together in selecting exemplary materials, developing curriculum frameworks, and building sustained professional development strategies to strengthen math and science instruction.

Exhibit 1 Participants in TIMSS 1999 Benchmarking

8th Grade Science

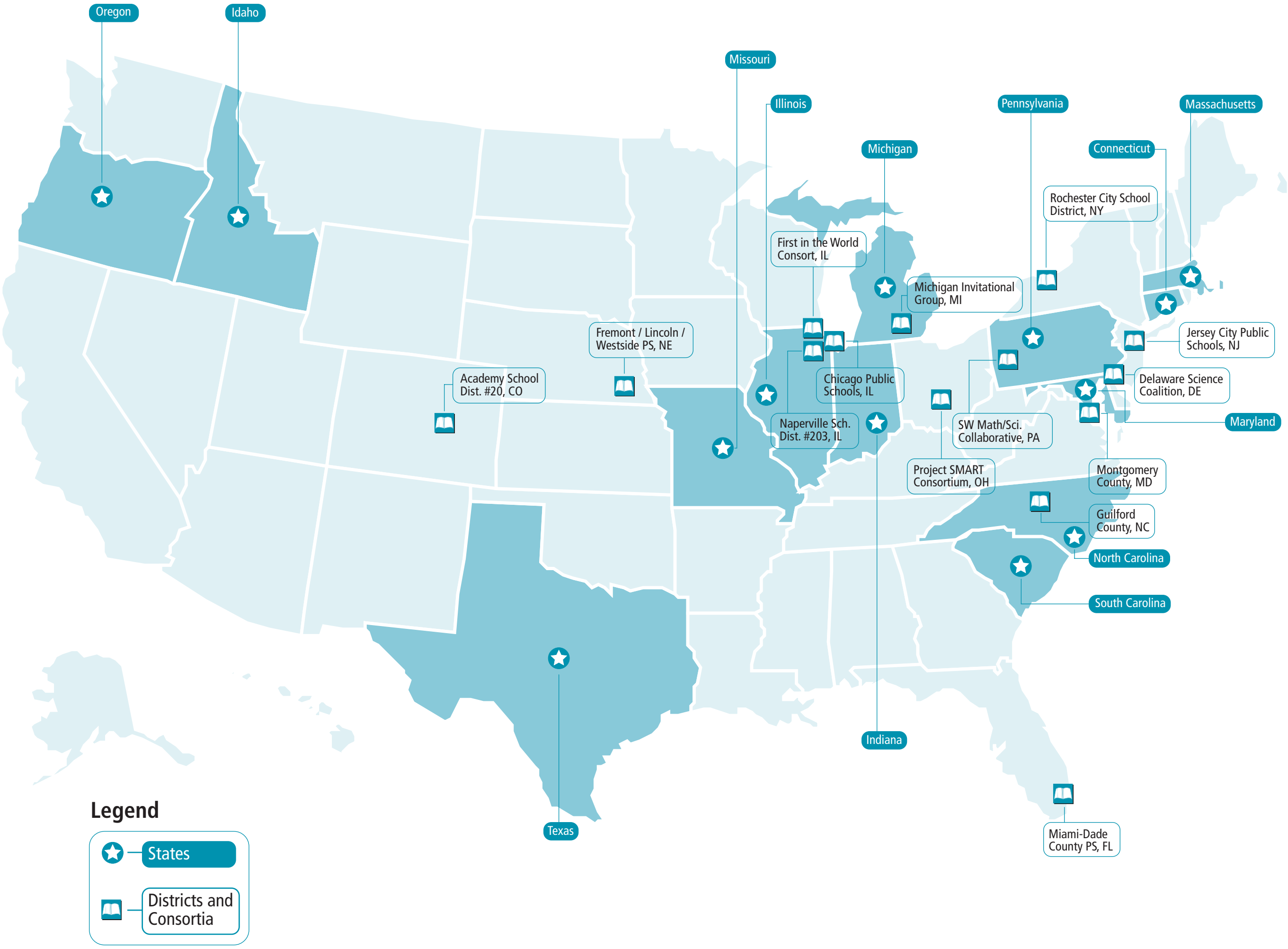


Exhibit 1
(Continued)

Participants in TIMSS 1999 Benchmarking

States

- Connecticut
- Idaho
- Illinois
- Indiana
- Maryland
- Massachusetts
- Michigan
- Missouri
- North Carolina
- Oregon
- Pennsylvania
- South Carolina
- Texas

Districts and Consortia

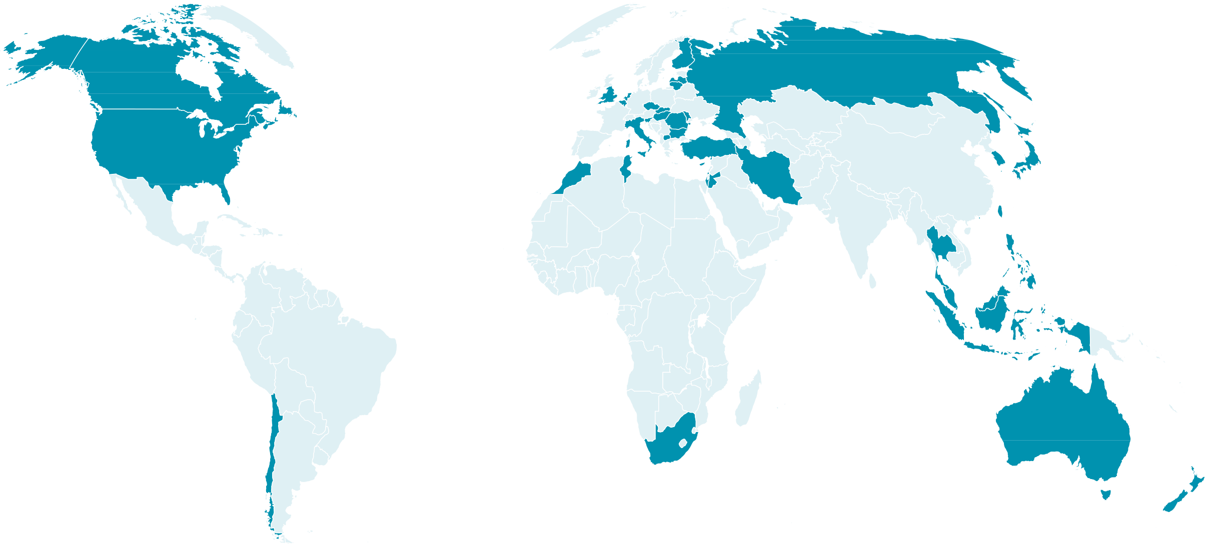
- Academy School District #20, Colorado Springs, CO
- Chicago Public Schools, IL
- Delaware Science Coalition, DE
- First in the World Consortium, IL
- Fremont/Lincoln/Westside Public Schools, NE
- Guilford County, NC
- Jersey City Public Schools, NJ
- Miami-Dade County Public Schools, FL
- Michigan Invitational Group, MI
- Montgomery County, MD
- Naperville Community Unit School District #203, IL
- Project SMART Consortium, OH
- Rochester City School District, NY
- Southwest Pennsylvania Math and Science Collaborative, PA

Countries

- Australia
- Belgium (Flemish)
- Bulgaria
- Canada
- Chile
- Chinese Taipei
- Cyprus
- Czech Republic
- England
- Finland
- Hong Kong, SAR
- Hungary
- Indonesia
- Iran, Islamic Republic
- Israel
- Italy
- Japan
- Jordan
- Korea, Republic of
- Latvia (LSS)
- Lithuania
- Macedonia, Republic of
- Malaysia
- Moldova
- Morocco
- Netherlands
- New Zealand
- Philippines
- Romania
- Russian Federation
- Singapore
- Slovak Republic
- Slovenia
- South Africa
- Thailand
- Tunisia
- Turkey
- United States

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries Participating in TIMSS 1999



What Is the Relationship Between the TIMSS 1999 Data for the United States and the Data for the Benchmarking Study?

The results for the 38 countries participating in TIMSS 1999, including those for the United States, were reported in December 2000 in two companion reports – the *TIMSS 1999 International Science Report* and the *TIMSS 1999 International Mathematics Report*.[6] Performance in the United States relative to that of other nations was reported by the U.S. National Center for Education Statistics in *Pursuing Excellence*.[7] The results for the United States in those reports, as well as in this volume and its companion mathematics report,[8] were based on a nationally representative sample of eighth-grade students drawn in accordance with TIMSS guidelines for all participating countries.

Because having valid and efficient samples in each country is crucial to the quality and integrity of TIMSS, procedures and guidelines have been developed to ensure that the national samples are of the highest quality possible. Following the TIMSS guidelines, representative samples were also drawn for the Benchmarking entities. Sampling statisticians at Westat, the organization responsible for sampling and data collection for the United States, worked in accordance with TIMSS standards to design procedures that would coordinate the assessment of separate representative samples of students within each Benchmarking entity.

For the most part, the U.S. TIMSS 1999 national sample was separate from the students assessed in each of the Benchmarking jurisdictions. Each Benchmarking participant had its own sample to provide comparisons with each of the TIMSS 1999 countries including the United States. In general, the Benchmarking samples were drawn in accordance with the TIMSS standards, and achievement results can be compared with confidence. Deviations from the guidelines are noted in the exhibits in the reports. The TIMSS 1999 sampling requirements and the outcomes of the sampling procedures for the participating countries and Benchmarking jurisdictions are described in Appendix A. Although taken collectively the Benchmarking participants are not representative of the United States, the effort was substantial in scope involving approximately 1,000 schools, 4,000 teachers, and 50,000 students.

---

[6] Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Gregory, K.D., Smith, T.A., Chrostowski, S.J., Garden, R.A., and O'Connor, K.M. (2000), *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College; Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., and Smith, T.A. (2000), *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College.

[7] Gonzales, P., Calsyn, C., Jocelyn, L., Mak, K., Kastberg, D., Arafeh, S., Williams, T., and Tsen, W. (2000), *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999*, NCES 2001-028, Washington, DC: National Center for Education Statistics.

[8] Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., O'Connor, K.M., Chrostowski, S.J., Gregory, K.D., Garden, R.A., and Smith, T.A. (2001), *Mathematics Benchmarking Report, TIMSS 1999 – Eighth Grade: Achievement for U.S. States and Districts in an International Context*, Chestnut Hill, MA: Boston College.

How Was the TIMSS 1999 Benchmarking Study Conducted?

The TIMSS 1999 Benchmarking Study was a shared venture. In conjunction with the Office of Educational Research and Improvement (OERI) and the National Science Foundation (NSF), the National Center for Education Statistics (NCES) worked with the International Study Center at Boston College to develop the study. Each participating jurisdiction invested valuable resources in the effort, primarily for data collection including the costs of administering the assessments at the same time and using identical procedures as for TIMSS in the United States. Many participants have also devoted considerable resources to team building as well as to staff development to facilitate use of the TIMSS 1999 results as an effective tool for school improvement.

The TIMSS studies are conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), an independent cooperative of national and governmental research agencies with a permanent secretariat based in Amsterdam, the Netherlands. Its primary purpose is to conduct large-scale comparative studies of educational achievement to gain a deeper understanding of the effects of policies and practices within and across systems of education.

TIMSS is part of a regular cycle of international assessments of mathematics and science that are planned to chart trends in achievement over time, much like the regular cycle of national assessments in the U.S. conducted by the National Assessment of Educational Progress (NAEP). Work has begun on TIMSS 2003, and a regular cycle of studies is planned for the years beyond.

The IEA delegated responsibility for the overall direction and management of TIMSS 1999 to the International Study Center in the Lynch School of Education at Boston College, headed by Michael O. Martin and Ina V.S. Mullis. In carrying out the project, the International Study Center worked closely with the IEA Secretariat, Statistics Canada in Ottawa, the IEA Data Processing Center in Hamburg, Germany, and Educational Testing Service in Princeton, New Jersey. Westat in Rockville, Maryland, was responsible for sampling and data collection for the Benchmarking Study as well as the U.S. component of TIMSS 1999 so that procedures would be coordinated and comparable.

Funding for TIMSS 1999 was provided by the United States, the World Bank, and the participating countries. Within the United States, funding agencies included NCES, NSF, and OERI, the same group of organizations supporting major components of the TIMSS 1999 Benchmarking Study for states, districts, and consortia, including overall coordination as well as data analysis, reporting, and dissemination.

What Was the Nature of the Science Test?

The TIMSS curriculum frameworks developed for 1995 were also used for 1999. They describe the content dimensions for the TIMSS tests as well as the performance expectations (behaviors that might be expected of students in school science).[9] Six content areas were covered in the TIMSS 1999 science test. These areas and the percentage of the test items devoted to each are earth science (15 percent), life science (27 percent), physics (27 percent), chemistry (14 percent), environmental and resource issues (nine percent), and scientific inquiry and the nature of science (eight percent). The performance expectations include understanding simple information (39 percent), understanding complex information (31 percent), theorizing, analyzing, and solving problems (19 percent), using tools, routine procedures, and science processes (seven percent), and investigating the natural world (four percent).

The test items were developed through a cooperative and iterative process involving the National Research Coordinators (NRCs) of the participating countries. All of the items were reviewed thoroughly by subject matter experts and field tested. Nearly all the TIMSS 1999 countries participated in field testing with nationally representative samples, and the NRCs had several opportunities to review the items and scoring criteria. The TIMSS 1999 science test contained 146 items representing a range of science topics and skills.

About one-fourth of the questions were in the free-response format, requiring students to generate and write their answers. These questions, some of which required extended responses, were allotted about one-third of the testing time. Responses to the free-response questions were evaluated to capture diagnostic information, and some were scored using procedures that permitted partial credit. Chapter 2 of this report contains 20 example items illustrating the range of science concepts and processes covered in the TIMSS 1999 test. Appendix D contains descriptions of the topics and skills assessed by each item.

---

[9] Robitaille, D.F., McKnight, C.C., Schmidt, W.H., Britton, E.D., Raisen, S.A., and Nicol, C. (1993), *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science*, Vancouver, BC: Pacific Educational Press.

Testing was designed so that no one student took all the items, which would have required more than three hours of testing time. Instead, the test was assembled in eight booklets, each requiring 90 minutes to complete. Each student took only one booklet, and the items were rotated through the booklets so that each item was answered by a representative sample of students.

How Does TIMSS 1999 Compare with NAEP?

The National Assessment of Educational Progress (NAEP) is an ongoing program that has reported the science achievement of U.S. students for some 30 years. TIMSS and NAEP were designed to serve different purposes, and this is evident in the types of assessment items as well as the content areas and topics covered in each assessment. TIMSS and NAEP both assess students at the eighth grade, and both tend to focus on science as it is generally presented in classrooms and textbooks. However, TIMSS is based on the curricula that students in the participating countries are likely to have encountered by the eighth grade, while NAEP is based on an expert consensus of what students in the United States should know and be able to do in science and other academic subjects at that grade. For example, TIMSS 1999 appears to place more emphasis on the physical sciences (physics and chemistry) than does NAEP, while NAEP appears to distribute its focus more equally among physical science, earth science, and life science.[10]

Whereas NAEP is designed to provide comparisons among and between states and the nation as a whole, the major purpose of the TIMSS 1999 Benchmarking Study was to provide entities in the United States with a way to compare their achievement and instructional programs in an international context. Thus, the point of comparison or "benchmark" consists primarily of the high-performing TIMSS 1999 countries. The sample sizes were designed to place participants near the top, middle, or bottom of the TIMSS continuum of performance internationally, but not necessarily to detect differences in performance among different Benchmarking participants. For example, all 13 of the participating states performed similarly in science in relation to the TIMSS countries – in the upper half of the international distribution of results. As findings from the NAEP assessment in 2000 are released, it is important to understand the differences and similarities in the assessments to be able to make sense of the findings in relation to each other.

---

[10] Nohara, D. (working paper 2001), *A Comparison of Three Educational Assessments: NAEP, TIMSS-R, and PISA*, Washington, DC: National Center for Education Statistics.

How Do Country Characteristics Differ?

International studies of student achievement provide valuable comparative information about student performance, instructional practice, and curriculum. Accompanying the benefits of international studies, though, are challenges associated with making comparisons across countries, cultures, and languages. TIMSS attends to these issues through careful planning and documentation, cooperation among the participating countries, standardized procedures, and rigorous attention to quality control throughout.[11]

It is extremely important, nevertheless, to consider the TIMSS 1999 results in light of countrywide demographic and economic factors. Some selected demographic characteristics of the TIMSS 1999 countries are presented in Exhibit 2. Countries ranged widely in population, from almost 270 million in the United States to less than one million in Cyprus, and in size, from almost 17 million square kilometers in the Russian Federation to less than one thousand in Hong Kong SAR and Singapore. Countries also varied widely on indicators of health, such as life expectancy at birth and infant mortality rate, and of literacy, including adult literacy rate and daily newspaper circulation. Exhibit 3 shows information for selected economic indicators, such as gross national product (GNP) per capita, expenditure on education and research, and development aid. The data reveal that there is great disparity in the economic resources available to participating countries.

One fundamental way in which countries can differ is the way in which science instruction is organized at the eighth grade. In some countries science at the eighth grade is taught as a single general or integrated subject, while in others it is taught as separate science subjects, namely earth science, biology, physics, and chemistry. The majority of countries teach science at the eighth grade as a single integrated subject, although in many countries, particularly the European ones, it is common practice to teach science as separate subjects. In the U.S. it is more common to teach science at the eighth grade as a single subject. Exhibit 5.1 in the curriculum chapter details for each country and Benchmarking participant the science subjects offered up to and including the eighth grade.

---

[11] Appendix A contains an overview of the procedures used. More detailed information is provided in Martin, M.O., Gregory, K.A., and Stemler, S.E., eds., (2000), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

Exhibit 2 Selected Characteristics of TIMSS 1999 Countries

	Population Size (in millions)[1]	Area of Country (1000 square kilometers)[2]	Life Expectancy at Birth[3]	Infant Mortality Rate (per 1000 live births)[4]	Adult Literacy Rate (%)[5]	Daily Newspaper Circulation (per 1000)[6]
United States	267.6	9159	76	7	99.0	212
Australia	18.5	7682	78	5	99.0	296
Belgium (Flemish) [7]	10.2	33	77	6	99.0	161
Bulgaria	8.3	111	71	18	98.2	254
Canada	30.3	9221	79	6	99.0	158
Chile	14.6	749	75	11	95.2	98
Chinese Taipei [8]	22.1	36	75	8	–	–
Cyprus [9]	0.8	9	–	6	95.9	111
Czech Republic	10.3	77	74	6	99.0	254
England [10]	50.0	130	–	–	99.0	–
Finland	5.1	305	77	4	99.0	455
Hong Kong	6.5	1	79	5	92.4	786
Hungary	10.2	92	71	10	99.0	186
Indonesia	200.4	1812	65	47	85.0	23
Iran, Islamic Rep.	60.9	1622	69	32	73.3	26
Israel [11]	6.1	21	78	7	95.4	288
Italy	57.5	294	78	5	98.3	104
Japan	126.1	377	80	4	99.0	578
Jordan	4.4	89	71	29	87.2	42
Korea, Rep.	46.0	99	72	9	97.2	394
Latvia	2.5	62	69	15	99.0	247
Lithuania	3.7	65	71	10	99.0	93
Macedonia	2.0	25	72	16	94.0	21
Malaysia	21.7	329	72	11	85.7	163
Moldova	4.3	33	67	20	98.3	60
Morocco [12]	27.3	711	67	51	45.9	27
Netherlands	15.6	34	78	5	99.0	306
New Zealand	3.8	268	77	7	99.0	216
Philippines	73.5	298	68	35	94.6	82
Romania	22.6	230	69	22	97.8	298
Russian Federation	147.3	16889	67	17	99.0	105
Singapore	3.1	1	76	4	91.4	324
Slovak Republic	5.4	48	73	9	99.0	184
Slovenia	2.0	20	75	5	99.0	199
South Africa	40.6	1221	65	48	84.0	34
Thailand	60.6	511	69	33	94.7	64
Tunisia	9.2	155	70	30	67.0	31
Turkey [13]	62.5	815	69	40	83.2	110

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

[1] Estimates for 1997 based, in most cases, on a de facto definition. Refugees not permanently settled in the country of asylum are generally considered to be part of their country of origin. World Bank (1999) World Development Indicators, p. 42-44.

[2] Area is the total surface area in square kilometers, comprising all land area and inland waters. World Bank (1999) World Development Indicators, p. 120-122.

[3] Number of years a newborn infant would live if prevailing patterns of mortality at its birth were to stay the same throughout its life. World Bank (1999) World Development Indicators, p. 110-112.

[4] Infant mortality rate is the number of deaths of infants under one year of age during 1997 per 1,000 live births in the same year. World Bank (1999) World Development Indicators, p.16-18.

[5] Population aged 15 years and over. UNDP (1999) Human Development Report 1999 (134-137).

[6] A newspaper issued at least four times a week is considered to be a daily newspaper. Circulation figures show the average circulation. UNESCO (1999) Statistical Yearbook, IV (106-133).

[7] Figures for Belgium (Flemish) are for the whole country of Belgium.

[8] Data provided by Department of Statistics, Ministry of Interior, Republic of China.

[9] Data for population, area, and infant mortality provided by Cypriot Government Statistics Department.

[10] The Statesman's Yearbook, 1998-99. Edited by Barry Turner, p.1411.

[11] Data provided by Israel's Central Bureau of Statistics, publication no. 1133.

[12] Data provided by Ministere du plan et de l'initiation economique: Annuaire de Maroc, 1999.

[13] Data provided by Turkey's State Institute of Statistics.

A dash (–) indicates data are not available.

Exhibit 3 Selected Economic Indicators of TIMSS 1999 Countries

	Gross National Product per Capita (in US dollars)[1]	GNP per Capita (Purchasing Power Parity)[2]	Expenditure on Education as % of Gross National Product[3]	Expenditure on Research and Development as % of Gross National Product[4]	Total Unemployment (% of total labor force)[5]	Aid per Capita[6]
United States	29080	29080	5.4	2.6	5.0	–
Australia	20650	19510	5.5	1.8	8.4	–
Belgium (Flemish)[7]	26730	23090	3.1	1.6	12.7	–
Bulgaria	1170	3870	3.2	0.6	11.1	25
Canada	19640	21750	6.9	1.7	9.4	0
Chile	4820	12240	3.6	0.6	5.3	9
Chinese Taipei[8]	13235	–	4.9	2.0	2.9	–
Cyprus	–	–	4.5	0.2	–	–
Czech Republic	5240	10380	5.1	1.2	3.1	10
England	–	–	–	–	–	–
Finland	24790	19660	7.5	2.8	14.7	–
Hong Kong	25200	24350	2.9	0.3	2.2	–
Hungary	4510	6970	4.6	0.7	10.5	16
Indonesia	1110	3390	1.4	0.1	–	4
Iran, Islamic Rep.	1780	5690	4.0	0.5	–	3
Israel[9]	16180	17680	10.1	2.4	7.7	204
Italy	20170	20100	4.9	2.2	12.1	–
Japan	38160	24400	3.6	2.8	3.2	–
Jordan	1520	3350	7.9	0.3	–	104
Korea, Rep.	10550	13430	3.7	2.8	2.7	-3
Latvia	2430	3970	6.3	0.4	7.0	33
Lithuania	2260	4140	5.5	0.7	7.1	27
Macedonia	1100	3180	5.1	–	38.8	75
Malaysia	4530	7730	4.9	0.2	2.5	-11
Moldova	460	1450	10.6	0.9	1.6	15
Morocco	1260	3210	5.3	–	17.8	17
Netherlands	25830	21300	5.1	2.1	6.2	–
New Zealand	15830	15780	7.3	1.0	6.0	–
Philippines	1200	3670	3.4	0.2	7.9	9
Romania	1410	4270	3.6	0.7	6.3	9
Russian Federation	2680	4280	3.5	0.9	3.4	5
Singapore	32810	29230	3.0	1.1	2.4	0
Slovak Republic	3680	7860	5.0	1.1	12.6	13
Slovenia	9840	11880	5.7	1.5	13.9	49
South Africa	3210	7190	8.0	0.7	–	12
Thailand	2740	6490	4.8	0.1	0.9	10
Tunisia	2110	5050	7.7	0.3	–	21
Turkey	3130	6470	2.2	0.5	6.6	0

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

[1] World Bank (1999) World Development Indicators, p. 12-14.

[2] An international dollar has the same purchasing power over GNP as a U.S. dollar in the United States. World Bank (1999) World Development Indicators, p. 12-14.

[3] UNESCO (1999) Statistical Yearbook, p.II-(490-513); Belgium figure is for the Flemish community only; Cyprus is for Greek section only.

[4] UNESCO (1999) Statistical Yearbook, p.III-(6-17); Belgium figure is for the Flemish community only; Cyprus is for Greek section only.

[5] Unemployment is the share of the labor force that is without work but available for and seeking employment. Definitions of labor force and unemployment differ by country. World Bank (1999) World Development Indicators, p. 58-60.

[6] World Bank (1999) World Development Indicators, p. 352-355. Aid per capita includes official development assistance, which consists of disbursement of loans and grants, and official aid, which consists of capital projects, budget and balance of payments support, food and other commodity services, technical co-operation and emergency relief. A negative value indicates repayments exceed aid payments.

[7] Figures for Belgium (Flemish) are for the whole country of Belgium.

[8] Data provided by Department of Statistics, Ministry of Interior, Republic of China.

[9] Data Provided by Israel's Central Bureau of Statistics, publication no. 1133.

A dash (–) indicates data are not available or that aggregates cannot be calculated because of missing data in year shown.

How Do the Benchmarking Jurisdictions Compare on Demographic Indicators?

Together, the indicators in Exhibits 2 and 3 highlight the diversity of the TIMSS 1999 countries. Although the factors the indicators reflect do not necessarily determine high or low performance in science, they do provide a context for considering the challenges involved in the educational task from country to country. Similarly, there was great diversity among the TIMSS 1999 Benchmarking participants. Exhibit 4 presents information about selected characteristics of the states, districts, and consortia that took part in the TIMSS 1999 Benchmarking Study.

As illustrated previously in Exhibit 1, geographically the Benchmarking jurisdictions were from all across the United States, although there was a concentration of east coast participants with six of the states and several of the districts and consortia from the eastern seaboard. Illinois was well represented, by the state as a whole and by three districts or consortia – the Chicago Public Schools, the Naperville School District, and the First in the World Consortium. Several other districts and consortia also had the added benefit of a state comparison – the Michigan Invitational Group and Michigan, Guilford County and North Carolina, Montgomery County and Maryland, and the Southwest Pennsylvania Math and Science Collaborative and Pennsylvania.

As shown in Exhibit 4, demographically the Benchmarking participants varied widely. They ranged greatly in the size of their total public school enrollment, from about 244,000 in Idaho to nearly four million in Texas among states, and from about 11,000 in the Michigan Invitational Group to about 430,000 in the Chicago Public Schools among districts and consortia.

It is extremely important to note that the Benchmarking jurisdictions had widely differing percentages of limited English proficient and minority student populations. They also had widely different percentages of students from low-income families (based on the percentage of students eligible to receive free or reduced-price lunch). Among states, Texas had more than half minority students compared with less than one-fifth in Idaho, Indiana, and Michigan. Among the school districts, those in urban areas had more than four-fifths minority students, including the Chicago Public Schools (89 percent), the Jersey City Public Schools (93 percent), the Miami-Dade County Public Schools (93 percent), and the Rochester City School District (84 percent).

These four districts also had very high percentages of students from low-income families. In comparison, Naperville and the Academy School District had less than one-fifth minority students and less than five percent of their students from low-income families.

Research on disparities between urban and non-urban schools reveals a combination of factors, often interrelated, that all mesh to lessen students' opportunities to learn in urban schools. Students in urban districts with high percentages of low-income families and minorities often attend schools with higher proportions of inexperienced teachers.[12] Urban schools also have fewer qualified teachers than non-urban schools. In reviewing the U.S. Department of Education's 1994 Schools and Staffing Survey, *Education Week* prepared a 1998 study on urban education that found that urban school districts experience greater difficulty filling teacher vacancies, particularly for certain fields including science, and that they are more likely than non-urban schools to hire teachers who have an emergency or temporary license.[13] Studies of under-prepared teachers indicate that such teachers have more difficulty with classroom management, teaching strategies, curriculum development, and student motivation.[14] Teacher absenteeism is also a more serious problem in urban districts. An NCES report on urban schools found they have fewer resources, such as textbooks, supplies, and copy machines, available for their classrooms.[15] It also found that urban students had less access to gifted and talented programs than suburban students. Additionally, several large studies have found urban school facilities to be functionally older and in worse condition than non-urban ones.[16]

---

[12] Mayer, D.P., Mullens, J.E., and Moore, M.T. (2000), *Monitoring School Quality: An Indicators Report*, NCES 2001-030, Washington, DC: National Center for Education Statistics.

[13] *Quality Counts 1998, The Urban Challenge: Public Education in the 50 States*, Education Week, 17(17).

[14] Darling-Hammond, L. and Post, L. (2000), "Inequality in Teaching and Schooling: Supporting High Quality Teaching and Leadership in Low-Income Schools" in R. Kahlenberg (ed.), *A Notion at Risk: Preserving Public Education as an Engine for Social Mobility*, Century Foundation Press.

[15] Lippman, L., Burns, S., and McArthur, E. (1996), *Urban Schools: The Challenge of Location and Poverty*, NCES 96-184, Washington, DC: National Center for Education Statistics.

[16] Lewis, L., Snow, K., Farris, E., Smerdon, B., Cronen, S., Kaplan, J., and Greene, B. (2000), *Condition of America's Public School Facilities: 1999*, NCES 2000-032, Washington, DC: National Center for Education Statistics; *School Facilities: America's Schools Report Differing Conditions* (1996), GAO/HEHS-96-103, Washington, DC: U.S. General Accounting Office.

Exhibit 4 Selected Characteristics of States, Districts and Consortia*

	Total Public Enrollment (All Grades)	Percentage of Students				Per Pupil Expenditure[3]
		Special Needs	Limited English Proficient	Minority[1]	Low Income[2]	
States						
Connecticut	544698	14	4	26	20	8827
Idaho	244722	11	7	17	37	4808
Illinois	2011530	14	6	35	31	6481
Indiana	988094	15	3	17	25	6420
Maryland	841671	13	2	45	28	7412
Massachusetts	962317	18	13	26	28	8064
Michigan	1720266	5	–	18	17	7330
Missouri	912445	14	1	22	34	5663
North Carolina	1254821	13	2	38	44	5367
Oregon	542809	11	7	20	33	6920
Pennsylvania	1816414	11	–	22	30	7409
South Carolina	664592	13	0	37	45	5204
Texas	3945367	12	14	53	48	5567
Districts and Consortia						
Academy School Dist. #20, CO	15821	7	–	18	4	4767
Chicago Public Schools, IL	430914	12	16	89	71	5784
Delaware Science Coalition, DE [4]	19830			37	40	
First in the World Consort., IL	35802	13	8	26	14	8924
Fremont/Lincoln/WestSide PS, NE	40769	15	2	17	23	5915
Guilford County, NC	61154	14	3	43	37	5431
Jersey City Public Schools, NJ	32505	9	–	93	89	9653
Miami-Dade County PS, FL	352536	11	14	93	59	5845
Michigan Invitational Group, MI [4]	10947			12	22	
Montgomery County, MD	127933	12	6	50	25	8223
Naperville Sch. Dist. #203, IL	18473	11	1	18	2	5988
Project SMART Consortium, OH [4]	15266			21	22	
Rochester City Sch. Dist., NY	38121	17	–	84	73	8490
SW Math/Sci. Collaborative, PA [5]	403347	11	–	13	33	6858

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* All data except percent minority and percent low income are from the Common Core of Data (CCD) published by the National Center for Education Statistics (NCES) of the U.S. Department of Education. The nonfiscal data are from School Year 1998-99; the state fiscal data are from Fiscal Year 1997-98, and the district/consortium fiscal data are from Fiscal Year 1996-97. A dash (–) indicates data were not reported to NCES; a blank indicates data are not available for a consortium. All percentages are rounded to the nearest whole number.

[1] Percent minority is the percentage of non-white students as reported by participating schools (also shown in Exhibit 4.4, which provides the breakdown by race/ethnicity).

[2] Percent low income is the percentage of students eligible to receive free or reduced-price lunch through the National School Lunch Program as of October 1, 1998, as reported by participating schools (also shown in Exhibit 7.1). Because school response data were available for less than 50% of students in Miami-Dade, its low-income figure shown is that reported by the Florida Department of Education's Bureau of Education Information and Accountability Services.

[3] Per pupil expenditure is net current expenditures as defined by Hawkins-Stafford Education Amendments of 1988 (P.L. 100-297), divided by average daily attendance for states and by total enrollment for districts/consortia.

[4] Data shown are for participating schools only.

[5] Enrollment includes students attending private schools that are part of the consortium.

How Is the Report Organized?

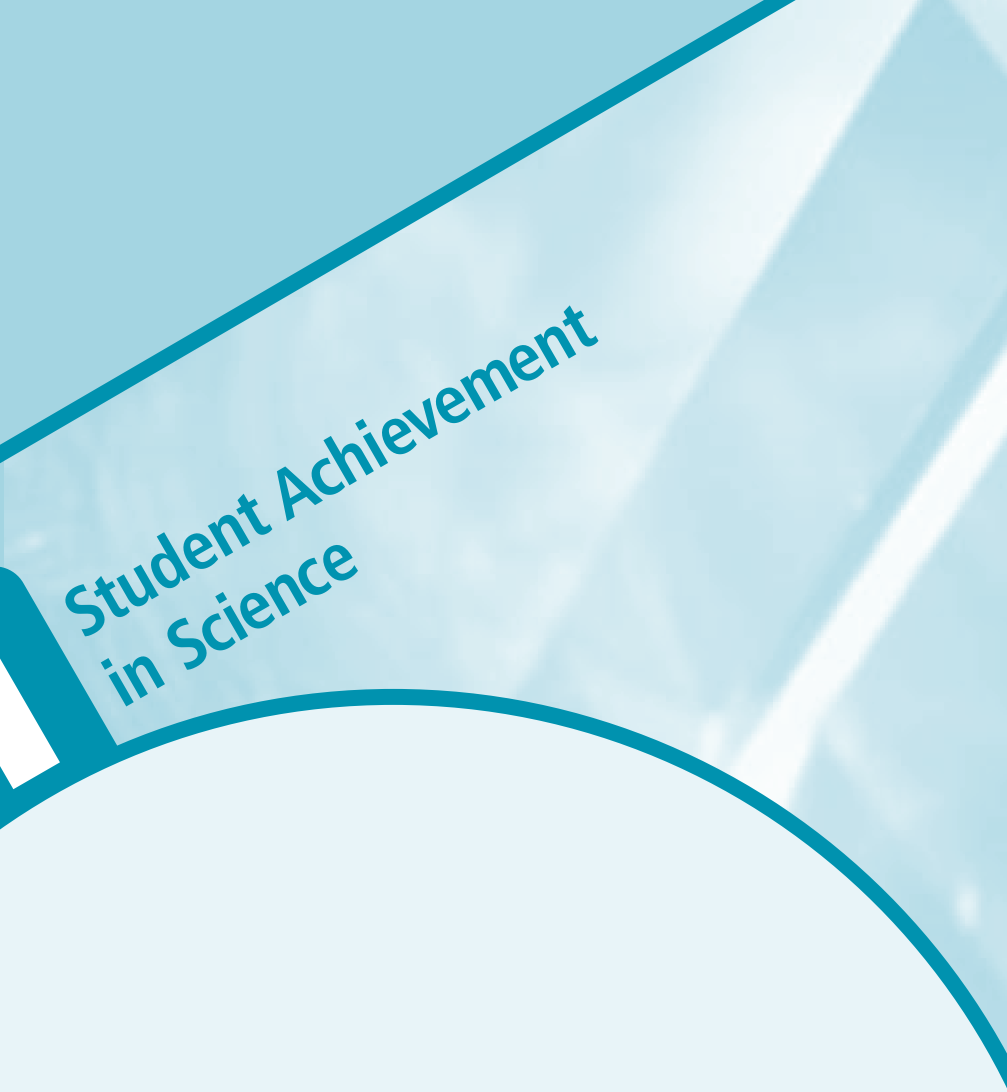
This report provides a preliminary overview of the science results for the Benchmarking Study. The real work will take place as policy makers, administrators, and teachers in each participating entity begin to examine the curriculum, teaching force, instructional approaches, and school environment in an international context. As those working on school improvement know full well, there is no "silver bullet" or single factor that is the answer to higher achievement in science or any other school subject. Making strides in raising student achievement requires tireless diligence in all of the various areas related to educational quality.

The report is in two sections. Chapters 1 through 3 present the achievement results. Chapter 1 presents overall achievement results. Chapter 2 shows international benchmarks of science achievement illustrated by results for individual science questions. Chapter 3 gives results for the six science content areas. Chapters 4 through 7 focus on the contextual factors related to teaching and learning science. Chapter 4 examines student factors including the availability of educational resources in the home, how much time they spend studying science outside of school, and their attitudes towards science. Chapter 5 provides information about the curriculum, such as the science included in participants' content standards and curriculum frameworks as well as the topics covered and emphasized by teachers in science lessons. Chapter 6 presents information on science teacher preparation and professional development activities as well as on classroom practices. Chapter 7 focuses on school factors, including the availability of resources for teaching science and school safety.

Each of chapters 4 through 7 is accompanied by a set of reference exhibits in the reference section of the report, following the main chapters. Appendices at the end of the report summarize the procedures used in the Benchmarking Study, present the multiple comparisons for the science content areas, provide the achievement percentiles, list the topics and processes measured by each item in the assessment, and acknowledge the numerous individuals responsible for implementing the TIMSS 1999 Benchmarking Study.

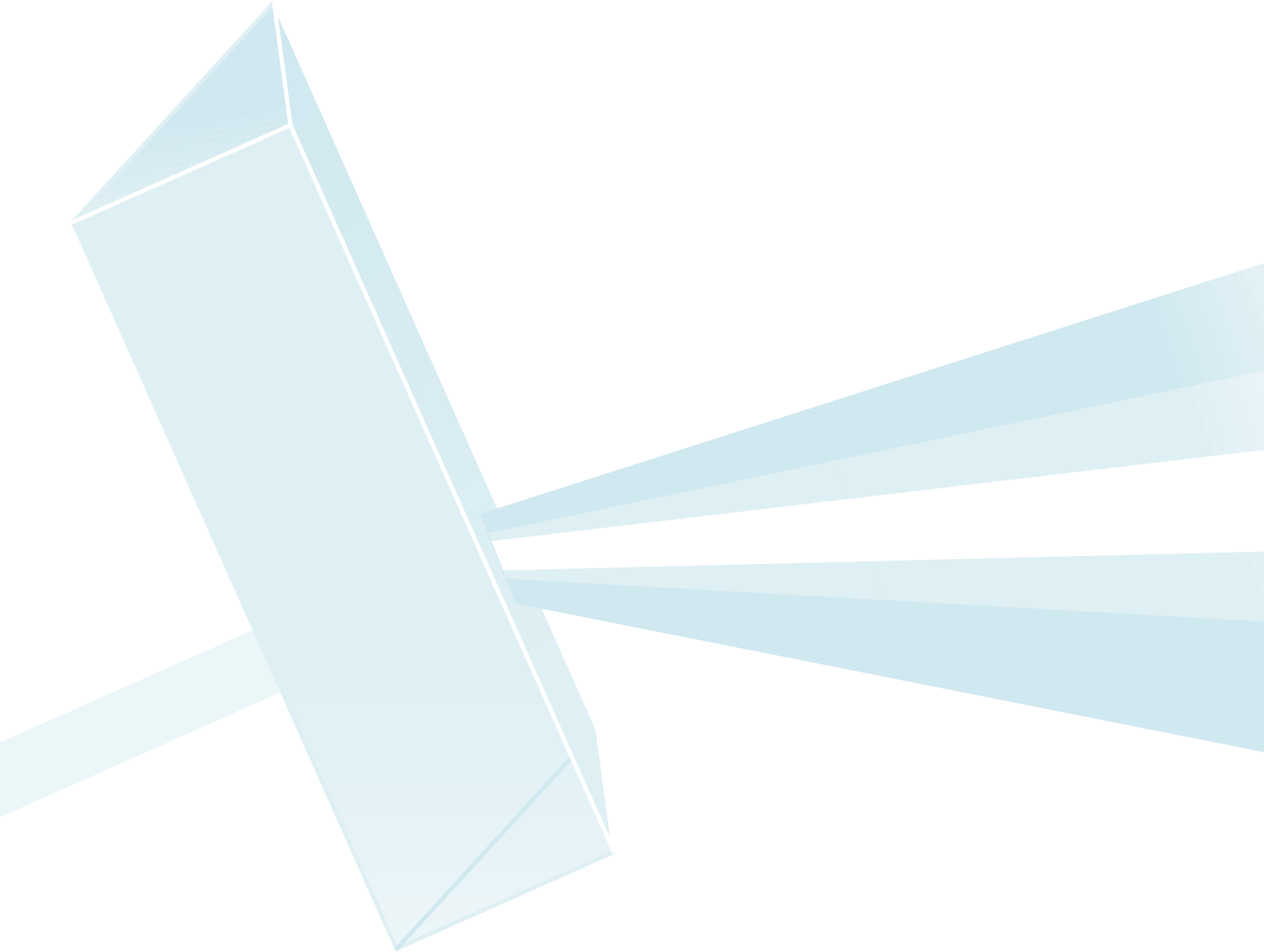
CHAPTER 1

Student Achievement in Science



Chapter 1 summarizes eighth-grade achievement on the TIMSS 1999 science assessment for each of the Benchmarking states, districts, and consortia, as well as for each participating country. Comparisons of participants' performance against international benchmarks, as well as gender differences in performance, are also provided.

1



How Do Participants Differ in Science Achievement?

Exhibit 1.1 presents the distribution of student achievement for the 38 TIMSS 1999 countries and the 27 Benchmarking participants in a two-page display.[1] The left-hand page shows countries and Benchmarking participants together, in decreasing order of average (mean) scale score, and indicates whether the average for each participant is significantly higher or lower than the international average of 488. The international average was obtained by averaging across the mean scores for each of the 38 participating countries. On the right-hand page is a tabular display of average achievement, along with the number of years of formal schooling and the average age of students tested.

Many of the Benchmarking participants performed fairly well on the TIMSS 1999 science assessment. Average performance for the 13 Benchmarking states was generally clustered in the upper half of the international distribution of results for the 38 countries. All but three of the Benchmarking states performed significantly above the international average. The United States as a whole also had average science achievement just above the international average.

The Benchmarking Study underscores the extreme importance of looking beyond the averages to the range of performance found across the nation. Performance across the participating school districts and consortia reflected nearly the full range of achievement internationally. The highest-achieving Benchmarking participants were the Naperville School District, the First in the World Consortium, the Michigan Invitational Group, and the Academy School District. These were four of the Benchmarking participants with the lowest percentages of students from low-income families (Naperville, 2 percent; First in the World, 14 percent; Michigan Invitational Group, 22 percent; Academy School District, 4 percent).[2] Benchmarking participants with the lowest average science achievement included four urban school districts with high percentages of students from low-income families – the Rochester City School District (73 percent), the Chicago Public Schools (71 percent), the Jersey City Public Schools (89 percent), and the Miami-Dade County Public Schools (59 percent). Although not quite as low as the lowest-scoring countries in TIMSS 1999, the range of average performance across the Benchmarking districts and consortia was almost as broad as across all the TIMSS 1999 countries.

---

[1] TIMSS used item response theory (IRT) methods to summarize the achievement results on a scale with a mean of 500 and a standard deviation of 100. Given the matrix-sampling approach, scaling averages students' responses in a way that accounts for differences in the difficulty of different subsets of items. It allows students' performance to be summarized on a common metric even though individual students responded to different items in the test. For more detailed information, see the "IRT Scaling and Data Analysis" section of Appendix A.

[2] Low-income figures are percentages of students eligible to receive free or reduced-price lunch through the National School Lunch Program, as reported by participating schools.

That achievement is distributed broadly within as well as across participating entities is graphically illustrated in Exhibit 1.1 showing the distribution of student performance within each entity. Achievement for each participant is shown for the 25th and 75th percentiles as well as for the 5th and 95th percentiles.[3] Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25 percent of the eighth-grade students in each participating entity performed below the 25th percentile for that entity, and 75 percent performed above the 25th percentile. The range between the 25th and 75th percentiles represents performance by the middle half of students. In most entities, the range of performance for the middle group was between 100 and 150 scale-score points. Performance at the 5th and 95th percentiles represents the extremes in both lower and higher achievement. The range of performance between these two score points, which includes 90 percent of the population, is between 250 and 300 points for most participants. The dark boxes at the midpoints of the distributions show the 95 percent confidence intervals around the average achievement in each entity.[4]

As well as showing the wide spread of student achievement within each entity, the percentiles also provide a perspective on the size of the differences among entities. Even though performance generally differed very little between one participant and the next higher- or lower-performing one, the range across participants was very large. For example, average performance in Chinese Taipei exceeded performance at the 95th percentile in the lower-performing countries such as the Philippines, Morocco, and South Africa. This means that only the most proficient students in the lower-performing countries approached the level of achievement of students of average proficiency in Chinese Taipei.

Exhibit 1.2 compares overall mean achievement in science among individual entities. This figure shows whether or not the differences in average achievement between pairs of participants are statistically significant. Selecting a participant of interest and reading across the exhibit, a triangle pointing up indicates significantly higher performance than the comparison participant listed across the top; a circle indicates no significant difference in performance; and a triangle pointing down indicates significantly lower performance.

The data in Exhibit 1.2 reinforce the point that, when ordered by average achievement, adjacent participants usually did not significantly differ from each other, although the differences in achievement between the high-performing and low-performing participants were very large.

---

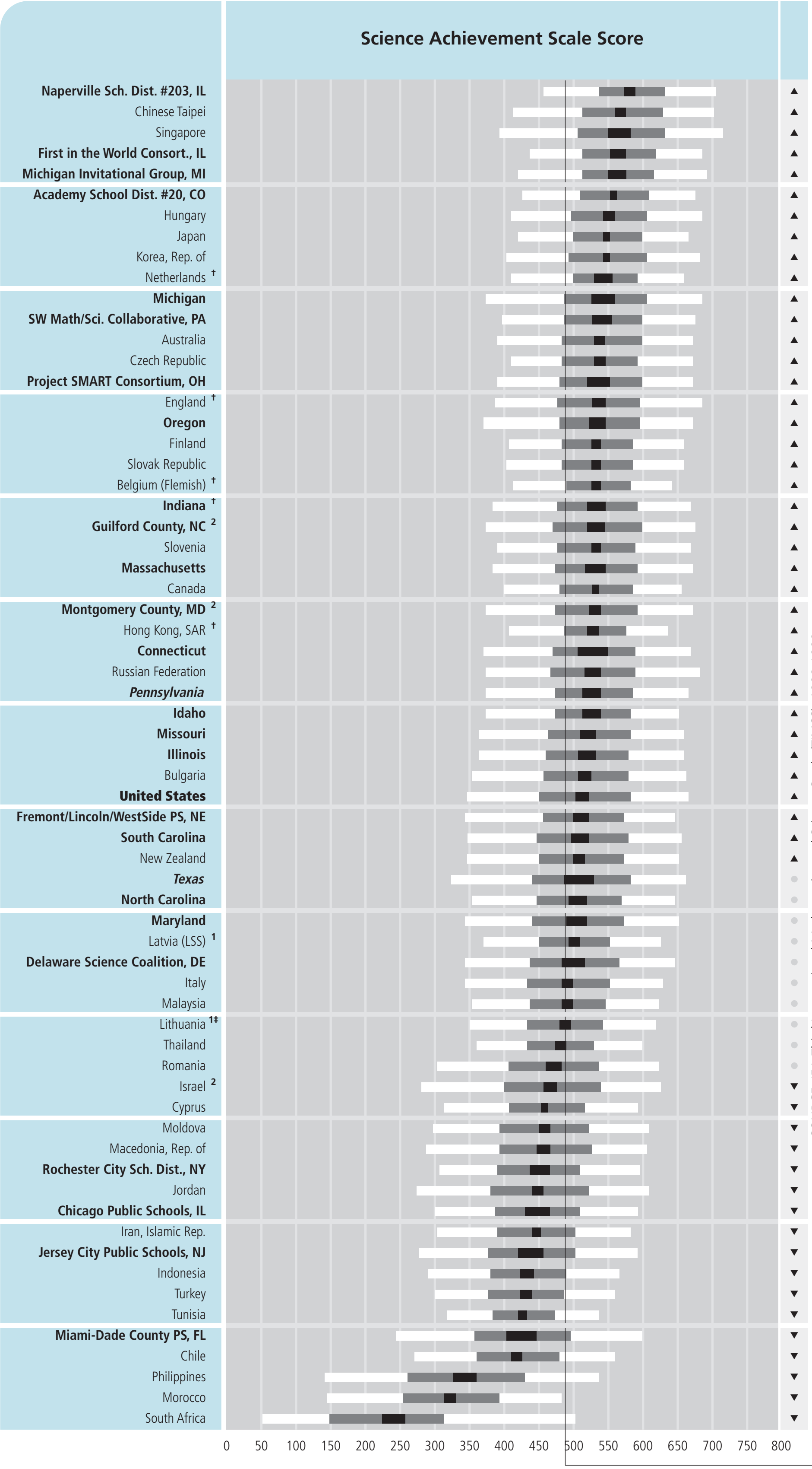
[3] Tables of the percentile values and standard deviations for all participants are presented in Appendix C.

[4] See the "IRT Scaling and Data Analysis" section of Appendix A for more details about calculating standard errors and confidence intervals for the TIMSS statistics.

The Naperville School District, Chinese Taipei, Singapore, the First in the World Consortium, the Michigan Invitational Group, and the Academy School District had the highest average performance, closely followed by Hungary, Japan, and Korea. Naperville, First in the World, the Michigan Invitational Group, and the Academy School District all had average achievement comparable to that of high-performing Chinese Taipei and Singapore. The difference in performance from one participant to the next was often negligible. Among Benchmarking jurisdictions, Michigan, the Southwest Pennsylvania Math and Science Collaborative, the Project SMART Consortium, Oregon, Indiana, Guilford County, Massachusetts, and Connecticut were outperformed by very few entities, and had higher average achievement than almost half of them. Montgomery County, Pennsylvania, Idaho, Missouri, and Illinois also had very similar performance, each scoring above slightly more than 20 other entities and being outscored by nine or fewer. Another group with roughly similar achievement includes the Fremont/Lincoln/Westside Public Schools, South Carolina, North Carolina, Maryland, and the Delaware Science Coalition. Each of these performed better than about 20 other entities and was outperformed by about 20 entities. Texas had similar achievement, but its large standard error reduced the number of statistically significant differences. The Rochester City School District, the Chicago Public Schools, the Jersey City Public Schools, and the Miami-Dade County Public Schools had average eighth-grade science performance lower than most of the TIMSS 1999 countries and comparable to that of Jordan, Iran, Indonesia, Turkey, and Tunisia.

Exhibit 1.1 Distribution of Science Achievement

8th Grade Science



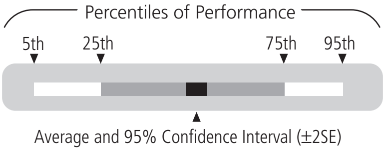
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Participant average significantly higher than international average

● No statistically significant difference between participant average and international average

▼ Participant average significantly lower than international average

Significance tests adjusted for multiple comparisons



International Average = 488 (0.7)
(Average of All Country Averages)

Exhibit 1.1 (Continued)

Distribution of Science Achievement

8th Grade Science

Countries	Average Scale Score	Years of Formal Schooling	Average Age
United States	▲ 515 (4.6)	8	14.2
Australia	▲ 540 (4.4)	8 or 9	14.3
Belgium (Flemish) †	▲ 535 (3.1)	8	14.1
Bulgaria	▲ 518 (5.4)	8	14.8
Canada	▲ 533 (2.1)	8	14.0
Chile	▼ 420 (3.7)	8	14.4
Chinese Taipei	▲ 569 (4.4)	8	14.2
Cyprus	▼ 460 (2.4)	8	13.8
Czech Republic	▲ 539 (4.2)	8	14.4
England †	▲ 538 (4.8)	9	14.2
Finland	▲ 535 (3.5)	7	13.8
Hong Kong, SAR †	▲ 530 (3.7)	8	14.2
Hungary	▲ 552 (3.7)	8	14.4
Indonesia	▼ 435 (4.5)	8	14.6
Iran, Islamic Rep.	▼ 448 (3.8)	8	14.6
Israel [2]	▼ 468 (4.9)	8	14.1
Italy	● 493 (3.9)	8	14.0
Japan	▲ 550 (2.2)	8	14.4
Jordan	▼ 450 (3.8)	8	14.0
Korea, Rep. of	▲ 549 (2.6)	8	14.4
Latvia (LSS) [1]	● 503 (4.8)	8	14.5
Lithuania [1‡]	● 488 (4.1)	8.5	15.2
Macedonia, Rep. of	▼ 458 (5.2)	8	14.6
Malaysia	● 492 (4.4)	8	14.4
Moldova	▼ 459 (4.0)	9	14.4
Morocco	▼ 323 (4.3)	7	14.2
Netherlands †	▲ 545 (6.9)	8	14.2
New Zealand	▲ 510 (4.9)	8.5 to 9.5	14.0
Philippines	▼ 345 (7.5)	7	14.1
Romania	● 472 (5.8)	8	14.8
Russian Federation	▲ 529 (6.4)	7 or 8	14.1
Singapore	▲ 568 (8.0)	8	14.4
Slovak Republic	▲ 535 (3.3)	8	14.3
Slovenia	▲ 533 (3.2)	8	14.8
South Africa	▼ 243 (7.8)	8	15.5
Thailand	● 482 (4.0)	8	14.5
Tunisia	▼ 430 (3.4)	8	14.8
Turkey	▼ 433 (4.3)	8	14.2
International Avg. (All Countries)	488 (0.7)		

States	Average Scale Score	Years of Formal Schooling	Average Age
Connecticut	▲ 529 (10.4)	8	14.0
Idaho	▲ 526 (6.6)	8	14.2
Illinois	▲ 521 (6.5)	8	14.2
Indiana †	▲ 534 (7.0)	8	14.4
Maryland	● 506 (7.7)	8	13.9
Massachusetts	▲ 533 (7.4)	8	14.1
Michigan	▲ 544 (8.6)	8	14.1
Missouri	▲ 523 (6.5)	8	14.3
North Carolina	● 508 (6.5)	8	14.2
Oregon	▲ 536 (6.1)	8	14.2
Pennsylvania	▲ 529 (6.5)	8	14.2
South Carolina	▲ 511 (6.7)	8	14.2
Texas	● 509 (10.4)	8	14.3

Districts and Consortia	Average Scale Score	Years of Formal Schooling	Average Age
Academy School Dist. #20, CO	▲ 559 (2.1)	8	14.2
Chicago Public Schools, IL	▼ 449 (9.5)	8	14.2
Delaware Science Coalition, DE	● 500 (8.4)	8	14.1
First in the World Consort., IL	▲ 565 (5.3)	8	14.2
Fremont/Lincoln/WestSide PS, NE	▲ 511 (5.8)	8	14.2
Guilford County, NC [2]	▲ 534 (7.1)	8	14.2
Jersey City Public Schools, NJ	▼ 440 (9.8)	8	14.3
Miami-Dade County PS, FL	▼ 426 (10.9)	8	14.3
Michigan Invitational Group, MI	▲ 563 (6.2)	8	14.1
Montgomery County, MD [2]	▲ 531 (4.3)	8	14.0
Naperville Sch. Dist. #203, IL	▲ 584 (4.1)	8	14.1
Project SMART Consortium, OH	▲ 539 (8.4)	8	14.2
Rochester City Sch. Dist., NY	▼ 452 (7.4)	8	14.2
SW Math/Sci. Collaborative, PA	▲ 543 (7.4)	8	14.2

▲ Participant average significantly higher than international average

● No statistically significant difference between participant average and international average

▼ Participant average significantly lower than international average

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[1] National Desired Population does not cover all of International Desired Population (see Exhibit A.3). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

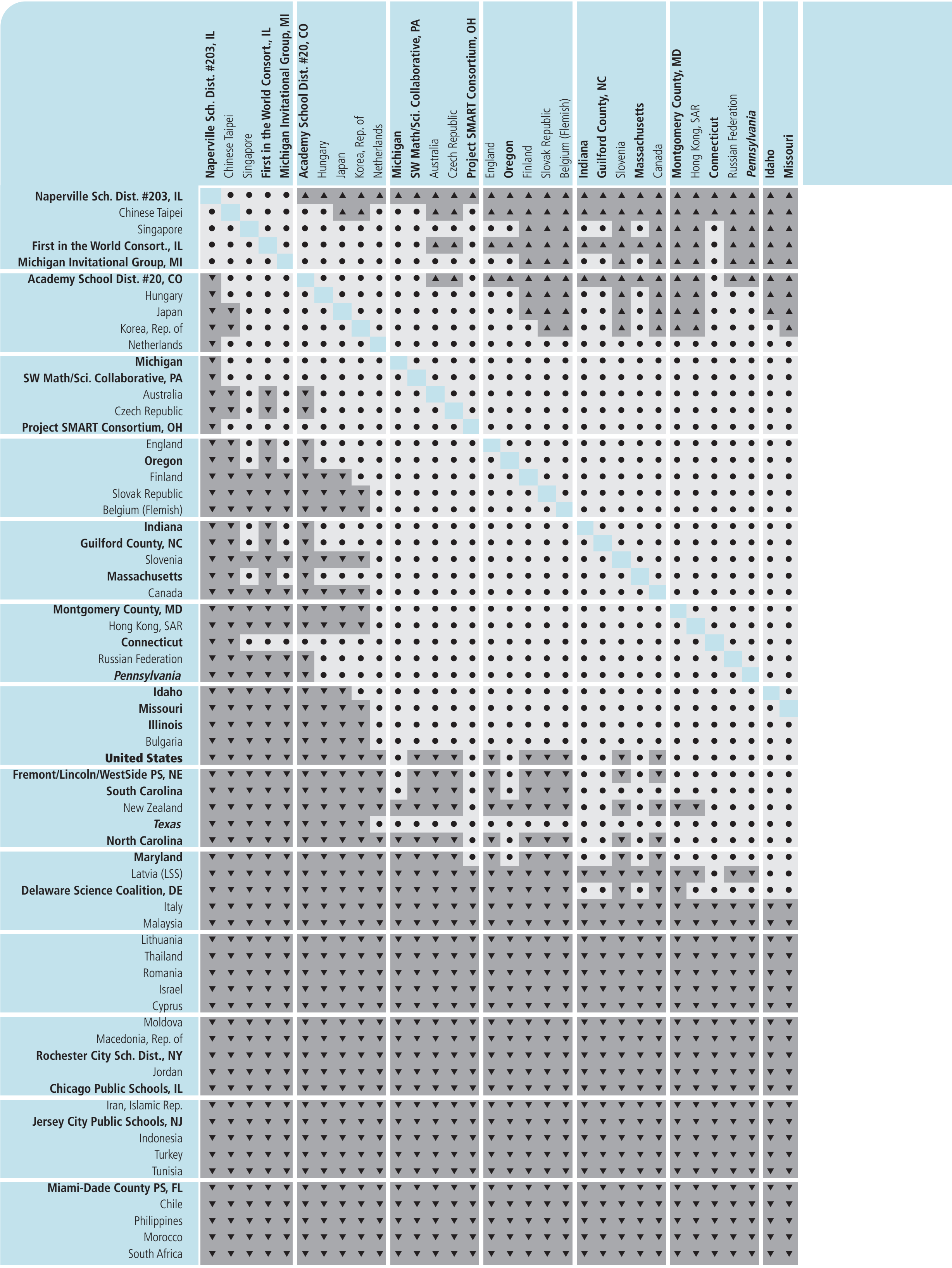
‡ Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 1.2 Multiple Comparisons of Average Science Achievement

8th Grade Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.



	Naperville Sch. Dist. #203, IL	Chinese Taipei	Singapore	**First in the World Consort., IL**	**Michigan Invitational Group, MI**	**Academy School Dist. #20, CO**	Hungary	Japan	Korea, Rep. of	Netherlands	**Michigan**	**SW Math/Sci. Collaborative, PA**	Australia	Czech Republic	**Project SMART Consortium, OH**	England	**Oregon**	Finland	Slovak Republic	Belgium (Flemish)	**Indiana**	**Guilford County, NC**	Slovenia	**Massachusetts**	Canada	**Montgomery County, MD**	Hong Kong, SAR	**Connecticut**	Russian Federation	***Pennsylvania***	**Idaho**	**Missouri**
Naperville Sch. Dist. #203, IL		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	●		●	●	●	●	●	▲	▲	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	●	▲	●	▲	▲	▲	●	▲	▲	▲	▲
First in the World Consort., IL	●	●	●		●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	●	▲	▲	▲	▲
Michigan Invitational Group, MI	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	●	▲	●	▲	▲	▲	●	▲	▲	▲	▲
Academy School Dist. #20, CO	▼	●	●	●	●		●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	●	▲	▲	▲	▲
Hungary	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	●	▲	●	▲	▲	▲	●	●	●	▲	▲
Japan	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	●	●	▲	●	▲	▲	▲	●	●	●	▲	▲
Korea, Rep. of	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	●	●	▲	●	▲	▲	▲	●	●	●	●	▲
Netherlands	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SW Math/Sci. Collaborative, PA	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Australia	▼	▼	●	▼	●	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Czech Republic	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Project SMART Consortium, OH	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Finland	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Indiana	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Guilford County, NC	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Slovenia	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Massachusetts	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Canada	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Connecticut	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Russian Federation	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Pennsylvania	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Idaho	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Missouri	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Illinois	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bulgaria	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	▼	●	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	▼	●	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●
South Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼	●	●	▼	●	▼	▼	▼	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	▼	●	●	●	●	●	●
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

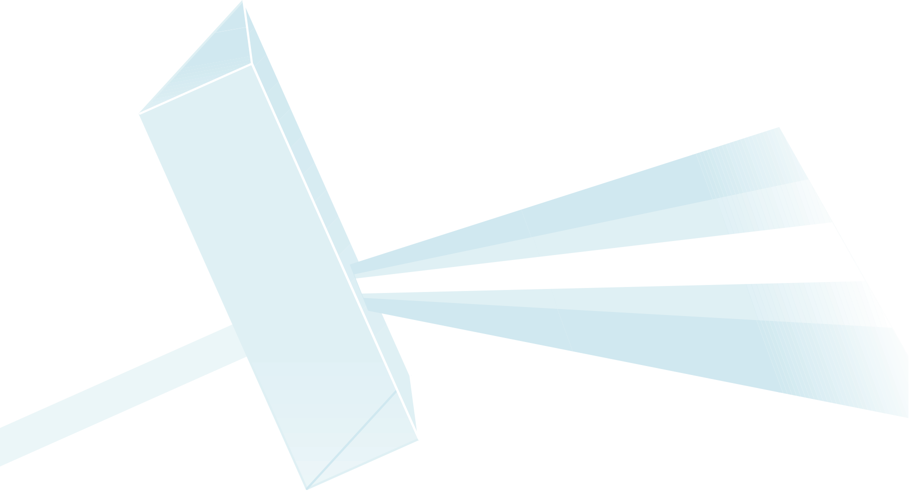
Multiple Comparisons of Average Science Achievement

	Illinois	Bulgaria	**United States**	**Fremont/Lincoln/WestSide PS, NE**	**South Carolina**	New Zealand	***Texas***	**North Carolina**	**Maryland**	Latvia (LSS)	**Delaware Science Coalition, DE**	Italy	Malaysia	Lithuania	Thailand	Romania	Israel	Cyprus	Moldova	Macedonia, Rep. of	**Rochester City Sch. Dist., NY**	Jordan	**Chicago Public Schools, IL**	Iran, Islamic Rep.	**Jersey City Public Schools, NJ**	Indonesia	Turkey	Tunisia	**Miami-Dade County PS, FL**	Chile	Philippines	Morocco	South Africa
Naperville Sch. Dist. #203, IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hungary	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Korea, Rep. of	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
SW Math/Sci. Collaborative, PA	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Project SMART Consortium, OH	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Oregon	●	●	●	●	●	▲	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Finland	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovak Republic	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Belgium (Flemish)	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Indiana	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Guilford County, NC	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	●	●	▲	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Massachusetts	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	●	●	▲	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Montgomery County, MD	●	●	●	●	●	▲	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong, SAR	●	●	●	●	●	▲	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Connecticut	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Russian Federation	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Pennsylvania	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Idaho	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Missouri	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Illinois		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Bulgaria	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Fremont/Lincoln/WestSide PS, NE	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
South Carolina	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Texas	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
North Carolina	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Maryland	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Delaware Science Coalition, DE	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Italy	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Malaysia	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Lithuania	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Thailand	▼	▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●	●		●	●	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Romania	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	●	●	●	●	▲	▲	▲	●	▲	▲	▲	▲
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	▲	▲	▲	●	▲	▲	▲	▲
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲	▲	●	▲	▲	▲	▲
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	▲	●	▲	▲	▲	▲
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	▲	●	▲	▲	▲	▲
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	▲	▲	▲
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	▲	▲	▲
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●		●	●	▲	▲	▲
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	▲	▲	▲
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●		▲	▲	▲
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	▲
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

▲	Average achievement significantly higher than comparison participant
●	No statistically significant difference from comparison participant
▼	Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.



How Do Benchmarking Participants Compare with International Benchmarks of Science Achievement?

The TIMSS science achievement scale summarizes student performance on test items designed to measure a wide range of student knowledge and proficiency. In order to provide meaningful descriptions of what performance could mean in terms of the science that students know and can do, TIMSS identified four points on the scale for use as international benchmarks[5] or reference points, and conducted an ambitious scale anchoring exercise to describe students' performance at these benchmarks. Exhibit 1.3 shows the four international benchmarks of science achievement and briefly describes what students scoring at these benchmarks typically know and can do. More detailed descriptions appear in Chapter 2, together with example test items illustrating performance at each benchmark.

The Top 10% Benchmark is defined at the 90th percentile on the TIMSS science scale, taking into account the performance of all students in all countries participating in 1999. It corresponds to a scale score of 616 and is the point above which the top 10 percent of students in the TIMSS 1999 assessment scored. Students performing at this level demonstrated a grasp of some complex and abstract science concepts in earth science, life science, physics, and chemistry, and showed an understanding of the fundamentals of scientific investigation.

The Upper Quarter Benchmark is the 75th percentile on the science scale. This point, corresponding to a scale score of 558, is the point above which the top 25 percent of students scored. Students scoring at this benchmark typically demonstrated conceptual understanding of some science cycles, systems, and principles.

The Median Benchmark, with a score of 488, corresponds to the 50th percentile, or median. This is the point above which the top half of students scored on the TIMSS 1999 assessment. Students performing at this level typically were able to recognize and communicate basic scientific information across a range of topics.

The Lower Quarter Benchmark is the 25th percentile and corresponds to a scale score of 410. This score point is reached by the top 75 percent of students and may be used as a benchmark of performance for lower-achieving students. Students scoring at this level typically could recognize some basic facts from the earth, life, and physical sciences presented in non-technical language.

---

[5] Readers should be careful not to confuse the international benchmarks, which are points on the international science achievement scale chosen to describe specific achievement levels, with the benchmarking exercise itself, which is a process by which participants compare their achievement, curriculum, and instructional practices with those of the best in the world.

Exhibit 1.4 displays the percentage of students in each participating entity that reached each international benchmark, in decreasing order by the percentage reaching the Top 10% Benchmark. If student achievement in science were distributed alike in every entity, then each entity would be expected to have about 10 percent of its students reaching the Top 10% Benchmark, 25 percent the Upper Quarter Benchmark, 50 percent the Median Benchmark, and 75 percent the Lower Quarter Benchmark. Although countries such as Latvia (LSS),[6] Italy, Israel, Malaysia, and Lithuania, and Benchmarking participants such as the Delaware Science Coalition, came fairly close, no entity followed this pattern exactly. Instead, the high-performing entities generally had greater percentages of students reaching each benchmark, and the low-performing entities had lesser percentages.

Among the high performers, for example, the Naperville School District, Singapore, and Chinese Taipei had more than 30 percent of their students reaching the Top 10% Benchmark, more than half reaching the Upper Quarter Benchmark, four-fifths or more reaching the Median Benchmark, and almost all (94 percent or more) reaching the Lower Quarter Benchmark.

In contrast, the four lowest-performing Benchmarking participants, all urban districts, had no more than four percent of their students reaching the Top 10% Benchmark, 10 to 12 percent reaching the Upper Quarter Benchmark, and just about one-third reaching the Median Benchmark. The lowest-performing countries of South Africa and Morocco had almost no students reaching the Top 10% Benchmark, only one or two percent reaching the Upper Quarter Benchmark, five or six percent reaching the Median Benchmark, and no more than 20 percent reaching the Lower Quarter Benchmark.

Although Exhibit 1.4 is organized to draw particular attention to the percentage of high-achieving students in each entity, it conveys information about the distribution of middle and low performers also. For example, several countries, including Belgium (Flemish),[7] Hong Kong, Malaysia, Lithuania, and Thailand, had greater percentages of students reaching the Median and Lower Quarter Benchmarks than might be expected from their percentages of high-performing students.

---

[6] Because coverage of its eighth-grade population falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

[7] Belgium has two separate educational systems, Flemish and French. The Flemish system participated in TIMSS 1999.

Exhibit 1.3 TIMSS 1999 International Benchmarks of Science Achievement

8th Grade Science

● Top 10% Benchmark

Students demonstrate a grasp of some complex and abstract science concepts. They can apply understanding of earth's formation and cycles and of the complexity of living organisms. They show understanding of the principles of energy efficiency, phase change, thermal expansion, light properties, gravitational force, basic structure of matter, and chemical versus physical changes. They demonstrate detailed knowledge of environmental and resource issues. They understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations and use diagrams to communicate scientific knowledge.

90th Percentile: 616

● Upper Quarter Benchmark

Students demonstrate conceptual understanding of some science cycles, systems, and principles. They have some understanding of the earth's processes, biological systems and populations, chemical reactions, and composition of matter. They solve physics problems related to light, speed, heat, and temperature and demonstrate basic knowledge of major environmental concerns. They demonstrate some scientific inquiry skills. They can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge in the life sciences.

75th Percentile: 558

● Median Benchmark

Students can recognize and communicate basic scientific knowledge across a range of topics. They recognize some characteristics of the solar system, ecosystems, animals and plants, energy sources, force and motion, light reflection and radiation, sound, electrical circuits, and human impact on the environment. They can apply and briefly communicate practical knowledge, extract tabular information, extrapolate from data presented in a simple linear graph, and interpret representational diagrams.

50th Percentile: 488

● Lower Quarter Benchmark

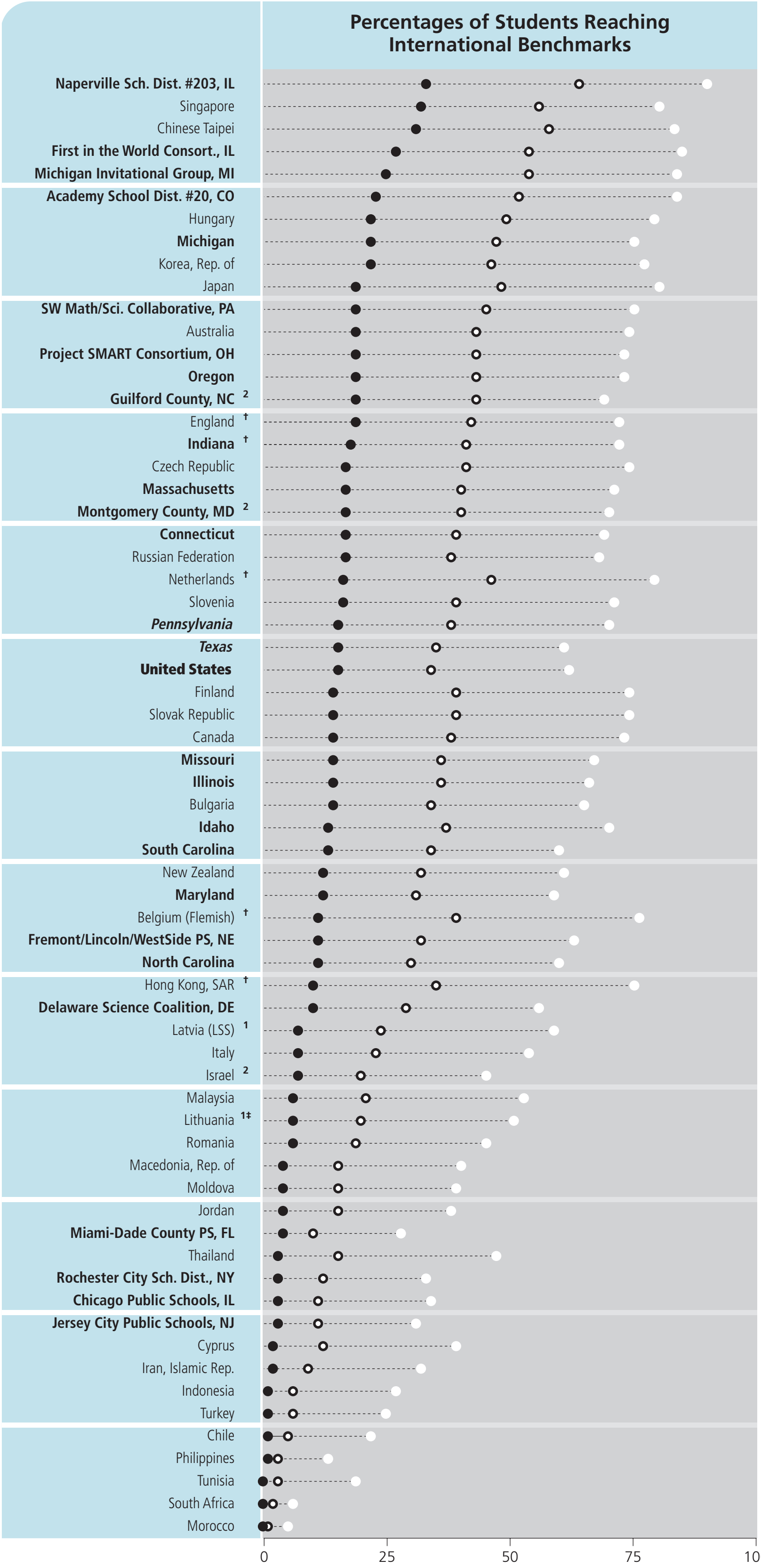
Students recognize some basic facts from the earth, life, and physical sciences presented using non-technical language. They can identify some of the earth's physical features, have some knowledge of the human body, and demonstrate familiarity with everyday physical phenomena. They can interpret and use information presented in simple diagrams.

25th Percentile: 410

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

The international benchmarks are based on the combined data from the countries participating in 1999.

Exhibit 1.4 Percentages of Students Reaching TIMSS 1999 International Benchmarks of Science Achievement



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Top 10% Benchmark (90th Percentile) = 616

Upper Quarter Benchmark (75th Percentile) = 558

Median Benchmark (50th Percentile) = 488

Lower Quarter Benchmark (25th Percentile) = 410

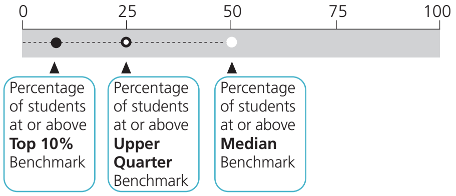


Exhibit 1.4
(Continued)

Percentages of Students Reaching TIMSS 1999 International Benchmarks of Science Achievement

8th Grade Science

Countries	Top 10%	Upper Quarter	Median	Lower Quarter
United States	15 (1.2)	34 (1.9)	62 (2.0)	85 (1.3)
Australia	19 (1.6)	43 (2.3)	74 (2.0)	93 (0.9)
Belgium (Flemish) [†]	11 (1.4)	39 (1.6)	76 (1.8)	96 (1.1)
Bulgaria	14 (2.1)	34 (2.5)	65 (2.2)	88 (1.5)
Canada	14 (0.9)	38 (1.3)	73 (1.2)	94 (0.6)
Chile	1 (0.4)	5 (1.0)	22 (1.6)	56 (1.7)
Chinese Taipei	31 (1.9)	58 (2.0)	83 (1.3)	95 (0.7)
Cyprus	2 (0.5)	12 (0.8)	39 (1.6)	74 (1.4)
Czech Republic	17 (1.7)	41 (2.2)	74 (1.8)	95 (0.8)
England [†]	19 (1.9)	42 (2.3)	72 (2.0)	92 (1.0)
Finland	14 (1.4)	39 (1.9)	74 (1.5)	95 (0.7)
Hong Kong, SAR [†]	10 (1.1)	35 (2.1)	75 (2.1)	95 (1.0)
Hungary	22 (1.4)	49 (1.7)	79 (1.4)	95 (0.8)
Indonesia	1 (0.3)	6 (0.9)	27 (1.6)	64 (2.4)
Iran, Islamic Rep.	2 (0.3)	9 (1.0)	32 (1.7)	68 (1.7)
Israel [2]	7 (0.6)	20 (1.2)	45 (1.9)	72 (2.0)
Italy	7 (0.9)	23 (1.7)	54 (2.0)	83 (1.2)
Japan	19 (1.1)	48 (1.4)	80 (1.0)	96 (0.5)
Jordan	4 (0.5)	15 (1.0)	38 (1.5)	66 (1.6)
Korea, Rep. of	22 (1.1)	46 (1.2)	77 (1.0)	94 (0.5)
Latvia (LSS) [1]	7 (1.3)	24 (2.5)	59 (2.0)	88 (1.4)
Lithuania [1‡]	6 (0.9)	20 (1.9)	51 (2.1)	83 (1.8)
Macedonia, Rep. of	4 (0.5)	15 (1.6)	40 (1.9)	70 (2.2)
Malaysia	6 (0.9)	21 (1.9)	53 (2.2)	85 (1.5)
Moldova	4 (0.5)	15 (1.2)	39 (1.8)	70 (1.6)
Morocco	0 (0.0)	1 (0.2)	5 (0.5)	20 (1.1)
Netherlands [†]	16 (2.3)	46 (3.8)	79 (3.5)	95 (1.6)
New Zealand	12 (1.4)	32 (2.1)	61 (2.2)	86 (1.6)
Philippines	1 (0.3)	3 (0.7)	13 (1.7)	31 (2.6)
Romania	6 (0.8)	19 (1.9)	45 (2.5)	75 (2.1)
Russian Federation	17 (2.4)	38 (2.8)	68 (2.5)	90 (1.0)
Singapore	32 (3.3)	56 (3.5)	80 (2.6)	94 (1.4)
Slovak Republic	14 (1.4)	39 (2.0)	74 (1.7)	94 (0.7)
Slovenia	16 (1.1)	39 (1.7)	71 (1.5)	93 (0.7)
South Africa	0 (0.2)	2 (0.6)	6 (1.4)	13 (2.0)
Thailand	3 (0.7)	15 (2.0)	47 (2.5)	84 (1.3)
Tunisia	0 (0.1)	3 (0.4)	19 (1.5)	62 (2.0)
Turkey	1 (0.2)	6 (0.8)	25 (1.8)	62 (2.4)

States	Top 10%	Upper Quarter	Median	Lower Quarter
Connecticut	17 (3.0)	39 (4.4)	69 (4.6)	90 (2.5)
Idaho	13 (1.8)	37 (3.2)	70 (3.3)	91 (1.8)
Illinois	14 (1.9)	36 (3.0)	66 (3.0)	88 (1.5)
Indiana [†]	18 (2.5)	41 (3.6)	72 (2.8)	92 (1.4)
Maryland	12 (1.3)	31 (3.0)	59 (3.5)	84 (2.5)
Massachusetts	17 (2.4)	40 (3.0)	71 (3.4)	92 (1.7)
Michigan	22 (2.6)	47 (3.6)	75 (3.4)	91 (2.2)
Missouri	14 (2.3)	36 (3.0)	67 (2.8)	89 (1.8)
North Carolina	11 (1.4)	30 (2.9)	60 (3.4)	85 (2.1)
Oregon	19 (2.3)	43 (2.7)	73 (2.6)	91 (1.9)
Pennsylvania	15 (1.5)	38 (2.5)	70 (3.2)	91 (1.6)
South Carolina	13 (1.8)	34 (2.7)	60 (3.4)	85 (1.7)
Texas	15 (2.1)	35 (3.6)	61 (4.5)	83 (3.3)
Districts and Consortia				
Academy School Dist. #20, CO	23 (1.6)	52 (1.5)	84 (1.2)	97 (0.6)
Chicago Public Schools, IL	3 (1.1)	11 (2.4)	34 (3.9)	67 (3.8)
Delaware Science Coalition, DE	10 (1.8)	29 (4.0)	56 (4.2)	83 (2.1)
First in the World Consort., IL	27 (3.7)	54 (3.6)	85 (2.0)	97 (0.9)
Fremont/Lincoln/WestSide PS, NE	11 (1.7)	32 (3.1)	63 (3.2)	86 (2.1)
Guilford County, NC [2]	19 (2.5)	43 (3.6)	69 (3.5)	90 (2.0)
Jersey City Public Schools, NJ	3 (1.5)	11 (3.1)	31 (3.6)	64 (3.5)
Miami-Dade County PS, FL	4 (1.4)	10 (2.4)	28 (3.0)	58 (3.7)
Michigan Invitational Group, MI	25 (3.1)	54 (3.0)	84 (2.1)	96 (1.1)
Montgomery County, MD [2]	17 (1.1)	40 (2.5)	70 (2.3)	91 (1.3)
Naperville Sch. Dist. #203, IL	33 (2.5)	64 (2.2)	90 (1.2)	98 (0.6)
Project SMART Consortium, OH	19 (3.6)	43 (5.0)	73 (3.3)	93 (1.1)
Rochester City Sch. Dist., NY	3 (1.3)	12 (2.5)	33 (3.7)	68 (3.0)
SW Math/Sci. Collaborative, PA	19 (3.1)	45 (3.6)	75 (3.5)	94 (1.7)

Top 10% Benchmark (90th Percentile) = 616
Upper Quarter Benchmark (75th Percentile) = 558
Median Benchmark (50th Percentile) = 488
Lower Quarter Benchmark (25th Percentile) = 410

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[1] National Desired Population does not cover all of International Desired Population (see Exhibit A.3). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

[‡] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

What Are the Gender Differences in Science Achievement?

Exhibit 1.5 presents average science achievement separately for girls and boys for each of the participating entities, as well as the difference between the means, in increasing order of the difference. The gender difference for each entity is shown by a bar indicating the amount of the difference, whether its direction favored girls or boys, and whether it is statistically significant (a darkened bar).

It is disappointing that in science at the eighth grade, the TIMSS 1999 Benchmarking Study shows relatively unequal average achievement for girls and boys in many of the Benchmarking jurisdictions, and in the United States overall. Boys had significantly higher average science achievement than girls in 10 of the 13 Benchmarking states, with Massachusetts, South Carolina, and Texas the exceptions. Gender differences were less prevalent among the Benchmarking districts and consortia, with significant differences in just four jurisdictions: the First in the World Consortium, Guilford County, Naperville, and the Southwest Pennsylvania Math and Science Collaborative. On average across all TIMSS 1999 countries, there was a significant difference of 15 scale-score points favoring boys, although this varied considerably from country to country. Differences large enough to be statistically significant were found in 16 of the 38 countries, including the U.S.

Exhibit 1.6 provides information on gender differences in science achievement among students with high performance compared with those in the middle of the achievement distribution. For each entity, score levels were computed for the highest-scoring 25 percent of students, called the upper quarter level, and for the highest-scoring 50 percent, called the median level. The percentages of girls and boys in each entity reaching each of the two levels were computed. For equitable performance, 25 percent each of girls and boys should have reached the upper quarter level, and 50 percent the median level.

As may be seen from Exhibit 1.6, in all Benchmarking states but Maryland, Massachusetts, and South Carolina, the percentage of boys reaching the upper quarter level was significantly greater than the percentage of girls. There was a significantly greater percentage of boys reaching the median level in all states but Connecticut, Massachusetts, and South Carolina. Among the Benchmarking districts and consortia, significantly greater percentages of boys reached the upper quarter level in the First in the World Consortium, Guilford County, and the Southwest Pennsylvania Math and Science Collaborative. Only in the latter did a significantly greater percentage of boys reach the median level.

The gender difference in science at the country level is more apparent among high-performing students, although internationally it was about the same at both the upper quarter and median levels. On average across countries, 29 percent of boys reached the upper quarter level, compared with 21 percent of girls, a statistically significant difference of eight percentage points. Similarly, the international average percentage of boys reaching the median level was 54 percent and of girls 46 percent, also a significant difference of eight percentage points. Perhaps more important, however, Exhibit 1.6 shows that in 21 countries the percentage of boys reaching the upper quarter level was significantly greater than the percentage of girls, whereas this was the case in 13 countries at the median level. In no country did the percentage of girls reaching either level significantly exceed the percentage of boys.

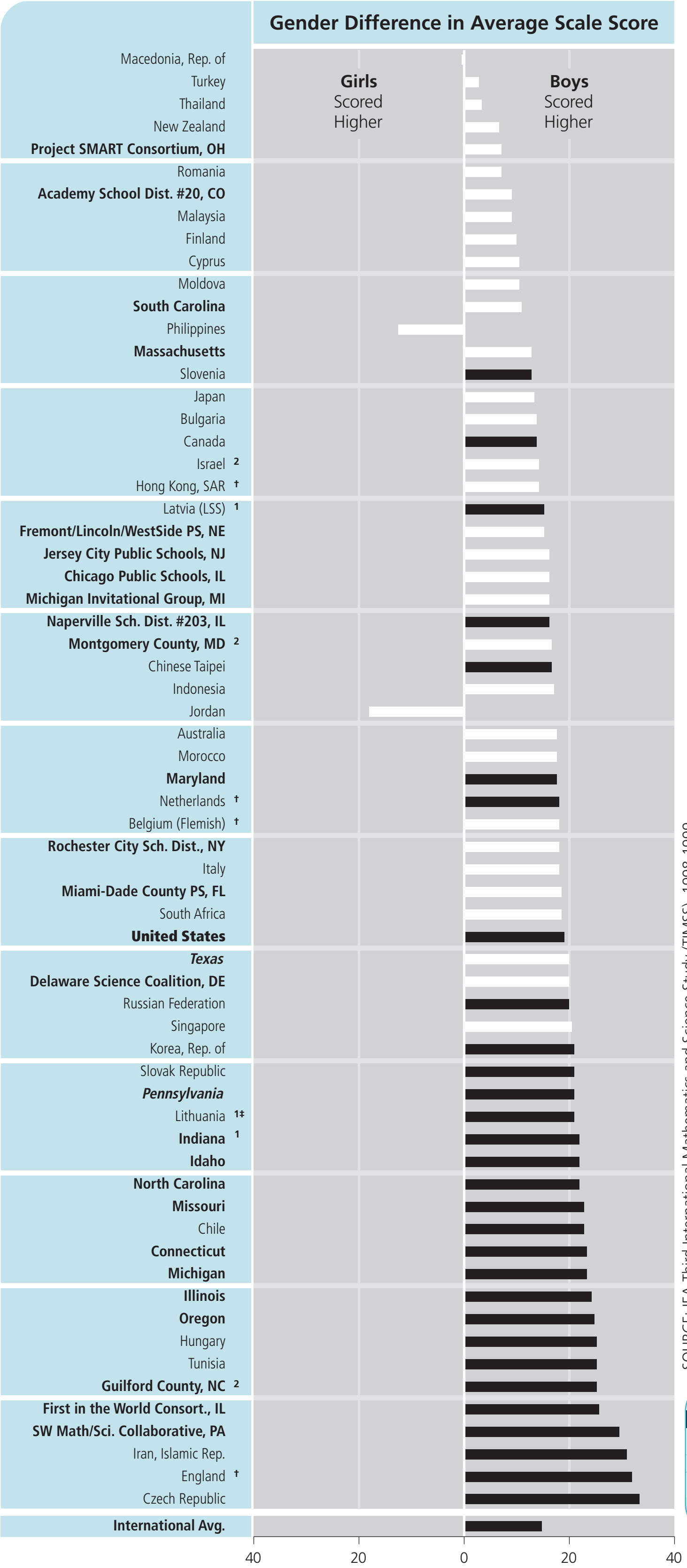
The gender differences found among the Benchmarking states are consistent with the results of TIMSS in both 1995 and 1999, which showed a pervasive difference in science achievement favoring boys, far more evident than in mathematics.[8] They are also consistent with the results from the second IEA science study conducted in 1983-84, which for 14-year-olds found standard score differences favoring boys in all 23 of the participating countries.[9]

---

[8] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996), *Mathematics Achievement in the Middle School Years: The IEA's Third International Mathematics and Science Study (TIMSS)*, Chestnut Hill, MA: Boston College; Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., and Smith, T.A. (2000), TIMSS *1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College.

[9] Postlethwaite, T.N. and Wiley, D.E. (1992), *The IEA Study of Science II: Science Achievement in Twenty-Three Countries*, New York, NY: Pergamon Press.

Exhibit 1.5 Gender Differences in Average Science Achievement



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

■ Gender difference statistically significant

□ Gender difference not statistically significant

Significance tests adjusted for multiple comparisons

Exhibit 1.5 (Continued)

Gender Differences in Average Science Achievement

8th Grade Science

Countries	Girls' Average Scale Score	Boys' Average Scale Score	Difference (Absolute Value)
United States	505 (4.6)	524 (5.5) ▲	19 (4.1)
Australia	532 (5.1)	549 (6.0)	18 (6.8)
Belgium (Flemish) †	526 (4.6)	544 (7.2)	18 (10.3)
Bulgaria	511 (5.8)	525 (6.5)	14 (6.2)
Canada	526 (3.2)	540 (2.4) ▲	14 (3.9)
Chile	409 (4.3)	432 (5.1) ▲	23 (6.2)
Chinese Taipei	561 (3.9)	578 (5.7) ▲	17 (4.2)
Cyprus	455 (3.1)	465 (3.0)	10 (3.9)
Czech Republic	523 (4.8)	557 (4.9) ▲	33 (4.8)
England †	522 (6.2)	554 (5.3) ▲	32 (6.6)
Finland	530 (4.0)	540 (4.5)	10 (5.0)
Hong Kong, SAR †	522 (4.4)	537 (5.1)	14 (6.1)
Hungary	540 (4.0)	565 (4.5) ▲	25 (4.2)
Indonesia	427 (6.5)	444 (4.8)	17 (6.8)
Iran, Islamic Rep.	430 (5.7)	461 (4.4) ▲	31 (7.6)
Israel [2]	461 (6.0)	476 (5.5)	14 (6.1)
Italy	484 (4.1)	503 (5.6)	18 (5.8)
Japan	543 (2.8)	556 (3.6)	14 (4.6)
Jordan	460 (5.0)	442 (5.9)	18 (8.2)
Korea, Rep. of	538 (4.0)	559 (3.2) ▲	21 (5.1)
Latvia (LSS) [1]	495 (5.6)	510 (4.8) ▲	15 (4.0)
Lithuania [1]‡	478 (4.4)	499 (5.0) ▲	21 (4.6)
Macedonia, Rep. of	458 (6.0)	458 (5.4)	1 (4.6)
Malaysia	488 (5.5)	498 (5.8)	9 (7.0)
Moldova	454 (4.4)	465 (5.4)	11 (5.4)
Morocco	312 (5.9)	330 (5.9)	18 (8.3)
Netherlands †	536 (7.1)	554 (7.3) ▲	18 (4.1)
New Zealand	506 (5.4)	513 (7.0)	7 (7.8)
Philippines	351 (8.2)	339 (8.9)	12 (8.4)
Romania	468 (6.4)	475 (6.5)	7 (5.4)
Russian Federation	519 (7.1)	540 (6.2) ▲	20 (3.9)
Singapore	557 (7.9)	578 (9.7)	20 (7.9)
Slovak Republic	525 (3.4)	546 (4.5) ▲	21 (4.5)
Slovenia	527 (3.7)	540 (3.7) ▲	13 (3.7)
South Africa	234 (9.2)	253 (7.7)	19 (6.7)
Thailand	481 (4.6)	484 (4.4)	3 (4.3)
Tunisia	417 (3.3)	442 (4.3) ▲	25 (3.4)
Turkey	431 (4.8)	434 (4.3)	3 (2.9)
International Avg. (All Countries)	480 (0.9)	495 (0.9) ▲	15 (0.8)

States	Girls' Average Scale Score	Boys' Average Scale Score	Difference (Absolute Value)
Connecticut	518 (10.2)	542 (11.4) ▲	24 (6.6)
Idaho	515 (6.4)	537 (7.5) ▲	22 (4.4)
Illinois	508 (7.5)	533 (6.7) ▲	25 (5.0)
Indiana †	523 (7.0)	545 (7.5) ▲	22 (4.3)
Maryland	498 (7.7)	516 (8.3) ▲	18 (4.1)
Massachusetts	527 (7.5)	540 (8.0)	13 (4.8)
Michigan	533 (8.9)	556 (8.9) ▲	24 (4.8)
Missouri	512 (7.0)	534 (7.2) ▲	23 (6.1)
North Carolina	498 (6.9)	520 (7.3) ▲	22 (5.0)
Oregon	524 (6.5)	549 (7.3) ▲	25 (6.5)
Pennsylvania	519 (7.1)	540 (6.9) ▲	21 (4.6)
South Carolina	506 (7.7)	517 (7.4)	11 (6.9)
Texas	499 (9.9)	519 (12.2)	20 (6.8)

Districts and Consortia	Girls' Average Scale Score	Boys' Average Scale Score	Difference (Absolute Value)
Academy School Dist. #20, CO	554 (3.6)	563 (3.4)	9 (5.6)
Chicago Public Schools, IL	442 (10.1)	458 (10.0)	16 (6.6)
Delaware Science Coalition, DE	491 (9.2)	511 (9.5)	20 (8.3)
First in the World Consort., IL	553 (6.2)	578 (6.0) ▲	26 (5.9)
Fremont/Lincoln/WestSide PS, NE	503 (6.5)	519 (7.6)	15 (8.1)
Guilford County, NC [2]	522 (7.2)	547 (8.7) ▲	25 (7.3)
Jersey City Public Schools, NJ	432 (10.5)	448 (10.7)	16 (7.0)
Miami-Dade County PS, FL	416 (9.4)	435 (12.8)	18 (6.9)
Michigan Invitational Group, MI	555 (6.3)	572 (7.4)	16 (5.9)
Montgomery County, MD [2]	523 (5.7)	540 (5.6)	17 (7.4)
Naperville Sch. Dist. #203, IL	576 (4.8)	592 (4.6) ▲	17 (4.9)
Project SMART Consortium, OH	536 (8.9)	543 (9.0)	7 (6.2)
Rochester City Sch. Dist., NY	443 (8.7)	461 (8.2)	18 (8.0)
SW Math/Sci. Collaborative, PA	529 (7.6)	558 (7.7) ▲	30 (3.5)

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[1] National Desired Population does not cover all of International Desired Population (see Exhibit A.3). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

‡ Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 1.6 Percentages of Girls and Boys Reaching Each Participant's Own Upper Quarter and Median Levels of Science Achievement

Countries	Upper Quarter		Median	
	Percent of Girls	Percent of Boys	Percent of Girls	Percent of Boys
United States	20 (1.6)	30 (2.0) ▲	46 (2.1)	54 (2.2) ▲
Australia	20 (1.8)	30 (2.4) ▲	46 (2.9)	55 (3.0)
Belgium (Flemish) †	20 (1.7)	30 (2.5)	44 (2.6)	56 (3.5)
Bulgaria	21 (2.6)	29 (2.9)	47 (2.8)	53 (3.2)
Canada	21 (1.5)	29 (1.3) ▲	46 (1.7)	54 (1.7)
Chile	19 (1.6)	31 (2.3) ▲	45 (2.2)	55 (2.3)
Chinese Taipei	20 (1.6)	30 (2.1) ▲	46 (2.0)	54 (2.4) ▲
Cyprus	21 (1.4)	29 (1.3) ▲	47 (1.4)	53 (1.4)
Czech Republic	18 (1.8)	32 (2.4) ▲	42 (2.5)	58 (2.5) ▲
England †	19 (2.5)	31 (2.4) ▲	43 (3.0)	56 (2.3) ▲
Finland	22 (2.0)	28 (2.1)	47 (2.3)	53 (2.3)
Hong Kong, SAR †	20 (2.5)	30 (2.4)	45 (2.8)	55 (2.6)
Hungary	19 (1.6)	31 (1.9) ▲	44 (2.0)	56 (2.1) ▲
Indonesia	22 (1.7)	28 (2.0)	46 (2.6)	55 (3.1)
Iran, Islamic Rep.	18 (2.4)	30 (2.1) ▲	40 (2.9)	57 (2.1) ▲
Israel [2]	21 (1.5)	29 (1.8) ▲	48 (2.4)	53 (2.3)
Italy	21 (1.8)	30 (2.0) ▲	45 (2.1)	55 (2.1) ▲
Japan	21 (1.3)	29 (1.4) ▲	46 (2.0)	54 (1.7)
Jordan	26 (1.8)	24 (1.6)	53 (1.9)	47 (2.3)
Korea, Rep. of	21 (1.4)	29 (1.4) ▲	44 (1.7)	55 (1.5) ▲
Latvia (LSS) [1]	21 (1.7)	29 (2.0) ▲	46 (2.3)	54 (2.2)
Lithuania [1]‡	20 (2.0)	30 (2.4) ▲	46 (2.4)	54 (2.4) ▲
Macedonia, Rep. of	25 (1.9)	25 (1.8)	51 (2.6)	49 (2.2)
Malaysia	23 (2.2)	27 (3.0)	48 (2.6)	52 (3.0)
Moldova	23 (1.6)	28 (1.8)	47 (2.4)	53 (2.4)
Morocco	22 (1.8)	27 (1.3)	45 (2.3)	53 (1.9)
Netherlands †	21 (2.5)	30 (3.4) ▲	45 (4.1)	56 (4.0)
New Zealand	23 (2.1)	27 (2.9)	48 (2.7)	52 (3.3)
Philippines	26 (2.7)	24 (2.4)	52 (2.9)	47 (2.6)
Romania	24 (2.2)	26 (2.4)	49 (2.6)	51 (2.6)
Russian Federation	21 (2.7)	29 (2.8) ▲	45 (3.1)	55 (2.6) ▲
Singapore	20 (2.9)	30 (4.0)	45 (3.9)	55 (4.2)
Slovak Republic	19 (1.7)	31 (2.1) ▲	44 (2.0)	56 (2.2) ▲
Slovenia	21 (1.3)	29 (1.4) ▲	47 (1.7)	53 (2.0) ▲
South Africa	23 (2.7)	27 (2.5)	47 (2.5)	53 (2.1)
Thailand	24 (2.5)	26 (2.3)	49 (2.7)	51 (2.4)
Tunisia	19 (1.4)	31 (1.7) ▲	42 (1.6)	58 (1.6) ▲
Turkey	23 (1.9)	26 (1.6)	48 (2.1)	51 (2.0)
International Avg. (All Countries)	21 (0.3)	29 (0.4) ▲	46 (0.4)	54 (0.4) ▲

▲ Significantly greater percentage than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[1] National Desired Population does not cover all of International Desired Population (see Exhibit A.3). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

‡ Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 1.6 (Continued)

Percentages of Girls and Boys Reaching Each Participant's Own Upper Quarter and Median Levels of Science Achievement

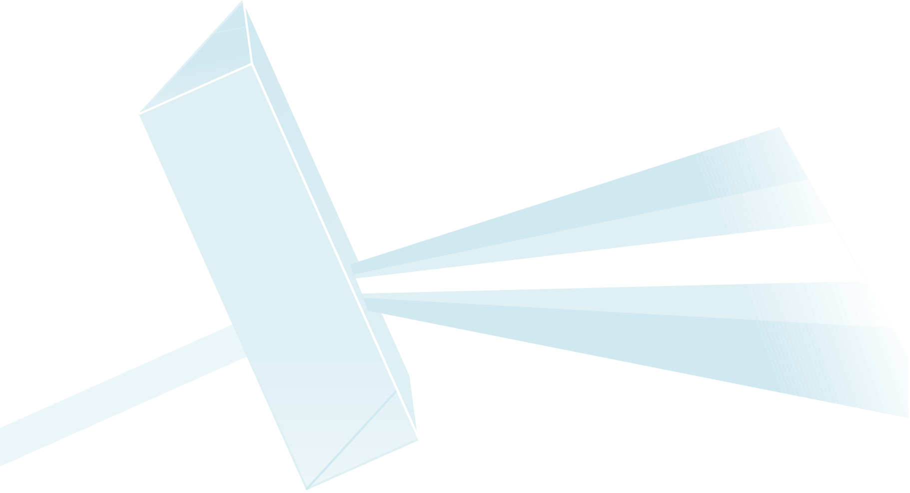
8th Grade Science

	Upper Quarter		Median	
	Percent of Girls	**Percent of Boys**	**Percent of Girls**	**Percent of Boys**
States				
Connecticut	20 (2.7)	30 (4.5) ▲	45 (4.7)	55 (5.0)
Idaho	19 (2.4)	31 (3.2) ▲	44 (3.6)	56 (3.2) ▲
Illinois	20 (2.5)	30 (3.3) ▲	46 (3.4)	55 (3.2) ▲
Indiana †	19 (2.7)	31 (3.3) ▲	45 (3.4)	55 (4.0) ▲
Maryland	21 (2.3)	29 (2.7)	46 (3.4)	54 (3.3) ▲
Massachusetts	21 (2.9)	29 (2.8)	46 (3.7)	54 (3.3)
Michigan	19 (2.8)	31 (3.2) ▲	44 (3.6)	56 (3.5) ▲
Missouri	19 (2.9)	31 (2.8) ▲	44 (3.6)	56 (2.5) ▲
North Carolina	20 (2.6)	30 (3.0) ▲	45 (3.4)	55 (3.0) ▲
Oregon	19 (2.3)	31 (2.8) ▲	44 (2.9)	56 (3.3) ▲
Pennsylvania	20 (2.2)	31 (2.2) ▲	45 (4.4)	56 (3.0) ▲
South Carolina	21 (2.6)	29 (3.0)	48 (3.9)	52 (3.4)
Texas	20 (2.6)	30 (3.7) ▲	45 (4.2)	55 (4.9) ▲
Districts and Consortia				
Academy School Dist. #20, CO	22 (1.9)	28 (2.0)	46 (2.3)	54 (2.4)
Chicago Public Schools, IL	22 (3.7)	28 (4.3)	47 (4.9)	54 (5.1)
Delaware Science Coalition, DE	21 (3.7)	30 (4.3)	46 (4.9)	54 (4.5)
First in the World Consort., IL	18 (3.2)	33 (2.9) ▲	43 (3.4)	57 (4.2)
Fremont/Lincoln/WestSide PS, NE	21 (2.2)	29 (2.7)	47 (3.9)	53 (4.1)
Guilford County, NC ²	19 (2.3)	32 (3.4) ▲	44 (4.2)	57 (4.0)
Jersey City Public Schools, NJ	22 (3.8)	28 (4.2)	46 (3.9)	54 (4.2)
Miami-Dade County PS, FL	22 (3.3)	28 (3.5)	47 (4.4)	53 (4.2)
Michigan Invitational Group, MI	21 (2.5)	30 (3.3)	46 (3.3)	54 (4.6)
Montgomery County, MD ²	22 (1.4)	28 (2.8)	46 (2.6)	54 (2.3)
Naperville Sch. Dist. #203, IL	22 (2.8)	28 (2.6)	46 (3.3)	54 (3.0)
Project SMART Consortium, OH	22 (4.1)	28 (4.4)	47 (5.4)	53 (4.6)
Rochester City Sch. Dist., NY	21 (3.2)	29 (3.9)	47 (4.6)	54 (3.7)
SW Math/Sci. Collaborative, PA	18 (2.6)	32 (3.4) ▲	43 (3.6)	58 (4.2) ▲

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Significantly greater percentage than other gender

Significance tests adjusted for multiple comparisons



CHAPTER 2

Performance at International Benchmarks

The TIMSS 1999 international benchmarks delineate performance of the top 10 percent, top quarter, top half, and lower quarter of students in the entities participating in the study. To help interpret the achievement results, Chapter 2 describes eighth-grade science achievement at each of these benchmarks together with examples of the types of items typically answered correctly by students performing at the benchmark.

To provide an idea of the science understandings and skills displayed by students performing at different levels on the TIMSS science achievement scale, TIMSS described performance at four international benchmarks. The TIMSS 1999 international benchmarks delineate performance of the top 10 percent, top quarter, top half, and lower quarter of students in the countries participating in the TIMSS 1999 study. (The benchmarks were set at the 90th, 75th, 50th, and 25th percentiles, respectively.)

As states and school districts spend time and energy on improving students' science achievement, it is important that educators, curriculum developers, and policy makers understand what students know and can do in science, and what areas, concepts, and topics need more focus and effort. To help interpret the range of achievement results for the TIMSS 1999 Benchmarking participants presented in Chapter 1, this chapter describes eighth-grade science achievement at each of the TIMSS 1999 international benchmarks, explaining the types of science understandings and skills typically displayed by students performing at the benchmarks. The benchmark descriptions are presented together with examples of the types of science test questions typically answered correctly by students reaching the benchmark. Appendix D contains the descriptions of the understandings and skills assessed by each item in the TIMSS 1999 assessment at each benchmark.[1]

For each of the example test questions, the percentages of correct responses are provided for selected countries as well as for the jurisdictions participating in the TIMSS 1999 Benchmarking project. The countries and Benchmarking jurisdictions are presented in descending order, with those performing highest shown first. The countries included for purposes of comparison are the United States as well as a dozen European and Asian countries of interest. These include several high-performing European countries (Belgium (Flemish), the Czech Republic, the Netherlands, and the Russian Federation), countries that are major economic trading partners of the United States (Canada, England, and Italy), and the top-scoring Asian countries of Chinese Taipei, Hong Kong, Japan, Korea, and Singapore.

Presented previously in Chapter 1, Exhibit 1.4 shows the percentages of students in each participating entity reaching each international benchmark – Top 10%, Upper Quarter, Median, and Lower Quarter. If an entity had high average achievement in science and a large percentage of its students at or above the upper benchmarks, this indicates that the students are concentrated among the highest-achieving students internationally. For example, top-performing Singapore had nearly

---

[1] For a detailed description of the items and benchmarks for TIMSS 1995 at fourth and eighth grades and how they compare to the National Research Council's National Science Education Standards, see Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

one-third (32 percent) of its students reaching the Top 10% Benchmark and more than half (56 percent) reaching the Upper Quarter Benchmark – the point on the scale that typically only 25 percent of the students would be expected to reach if achievement were distributed equally from country to country. Four-fifths of the Singaporean students (80 percent) reached the Median Benchmark. Performance in the United States was a little better than might be expected if achievement were distributed the same from country to country: 15 percent of the students reached the Top 10% Benchmark, 34 percent reached the Upper Quarter Benchmark, and 62 percent reached the Median Benchmark.

The analysis of performance at these benchmarks in science suggests that six primary factors appeared to differentiate performance at the four levels:

- The depth and breadth of content area knowledge
- The level of understanding and use of technical vocabulary
- The context of the problem (progressing from practical to more abstract)
- The level of scientific investigation skills
- The complexity of diagrams, graphs, tables, and textual information
- The completeness of written responses.

For example, there is evidence that students performing at the lower end of the scale could recognize basic facts from the earth, life, and physical sciences presented in non-technical language and could interpret and use information presented in simple diagrams. In contrast, students performing at the higher end of the scale demonstrated a grasp of more complex and abstract science concepts; applied knowledge to solve problems; interpreted and used information in diagrams, tables and graphs; and could provide written explanations to communicate their scientific knowledge.

How Were the Benchmark Descriptions Developed?

To develop descriptions of achievement at the TIMSS 1999 international benchmarks, the International Study Center used the scale anchoring method. Scale anchoring is a way of describing students' performance at different points on the TIMSS 1999 achievement scale in terms of the types of items they answered correctly. It involves an empirical component in which items that discriminate between successive points on the scale are identified, and a judgmental component in which subject-matter experts examine the content of the items and generalize to students' knowledge and understandings.

For the scale anchoring analysis, the results of students from all the TIMSS 1999 countries were pooled, so that the benchmark descriptions refer to all students achieving at that level. (That is, it does not matter which country the students are from, only how they performed on the test.) Certain criteria were applied to the TIMSS 1999 achievement scale results to identify the sets of items that students reaching each international benchmark were likely to answer correctly and those at the next lower benchmark were unlikely to answer correctly.[2] The sets of items thus produced represented the accomplishments of students reaching each benchmark and were used by a panel of subject matter experts from the TIMSS countries to develop the benchmark descriptions.[3] The work of the panel involved developing a short description for each item describing the scientific understandings demonstrated by students answering it correctly, summarizing students' knowledge and understandings across the set of items for each benchmark to provide more general statements of achievement, and selecting example items illustrating the descriptions.

How Should the Descriptions Be Interpreted?

In general, the parts of the descriptions that relate to the knowledge of science concepts and to skills are relatively straightforward. It needs to be acknowledged, however, that the cognitive behavior necessary to answer some items correctly may vary according to students' experience. An item may require only simple recall for a student familiar with the item's content and context, but necessitate problem-solving strategies from one unfamiliar with the material. Nevertheless, the descriptions are based on what the panel believed to be the way the great majority of eighth-grade students could be expected to perform.

It also needs to be emphasized that the descriptions of achievement characteristic of students at the international benchmarks are based solely on student performance on the TIMSS 1999 items. Since those items were developed in particular to sample the science domains prescribed for this study, neither the set of items nor the descriptions based on them purport to be comprehensive. There are undoubtedly other science curriculum elements on which students at the various benchmarks would have been successful if they had been included in the assessment.

---

[2] For example, for the Top 10% Benchmark, an item was included if at least 65 percent of students scoring at the scale point corresponding to this benchmark answered the item correctly and less than 50 percent of students scoring at the Upper Quarter Benchmark answered it correctly. Similarly, for the Upper Quarter Benchmark, an item was included if at least 65 percent of students scoring at that point answered the item correctly and less than 50 percent of students at the Median Benchmark answered it correctly.

[3] The participants in the scale anchoring process are listed in Appendix E.

Please note that students reaching a particular benchmark demonstrated the knowledge and understandings characterizing that benchmark as well as those characterizing the lower benchmarks. The description of achievement at each benchmark is cumulative, building on the description of achievement demonstrated by students at the lower benchmarks.

Finally, it must be emphasized that the descriptions of the international benchmarks are one possible way of beginning to examine student performance. Some students scoring below a benchmark may indeed know or understand some of the concepts that characterize a higher level. Thus, it is important to consider performance on the individual items and clusters of items in developing a profile of student achievement in each participating entity.

Several example items are included for each benchmark to complement the descriptions by giving a more concrete notion of the abilities students demonstrated. Each example item is accompanied by the percentage of correct responses for each TIMSS 1999 Benchmarking participant. Percentages are also provided for selected countries, as is the international average for all 38 countries that participated in TIMSS 1999. In general, the several entities scoring highest on the overall test also scored highest on many of the example items. Not surprisingly, this was true for items assessing the range of performance expectations – recognizing basic facts; understanding simple and complex information; applying scientific understanding to solve problems and provide explanations; interpreting and using data in tables, graphs and diagrams; and demonstrating scientific investigation skills.

Item Examples and Student Performance

The remainder of this chapter describes each benchmark and presents four to six example items illustrating what students know and can do at that level. The correct answer is circled for multiple-choice items. For open-ended items, the answers shown exemplify the types of student responses that were given full credit. The example items are ones that students reaching each benchmark were likely to answer correctly, and they represent the types of items used to develop the description of achievement at that benchmark.[4]

---

[4] Some of the items used to develop the benchmark descriptions are being kept secure to measure achievement trends in future TIMSS assessments and are not available for publication.

Achievement at the Top 10% Benchmark

Exhibit 2.1 describes performance at the Top 10% Benchmark. Students reaching this benchmark have demonstrated nearly full mastery of the content of the TIMSS 1999 science test, demonstrating a grasp of some complex and abstract concepts, the ability to apply knowledge to solve problems, and an understanding of the fundamentals of scientific investigation. They typically demonstrated success on the knowledge and skills represented by this benchmark, as well as those demonstrated at the three lower benchmarks.

Students performing at the Top 10% Benchmark could communicate scientific information, such as their understanding of plant growth. As illustrated by Example Item 1 in Exhibit 2.2, students could explain why a nail placed in the trunk of a tree remained at the same level from the ground while the tree increased in height. Internationally on average, 41 percent of the eighth-grade students correctly explained that trees grow in height from the tips of their stems or branches. In Belgium (Flemish), the comparison country with most success on this item, nearly two-thirds of the students gave a correct response. Among the Benchmarking participants, eighth graders in the Naperville School District did as well as their counterparts in Belgium, with 63 percent answering correctly. In Michigan, Oregon, and Montgomery County, also, the percentage of students answering correctly was significantly greater than the international average. Generally, students in the United States – in the country as a whole and in the Benchmarking jurisdictions – performed at about the international average on this item. Miami-Dade was the only Benchmarking participant where the students performed significantly below the international average.

Students at the Top 10% Benchmark typically were able to apply basic physical principles to solve quantitative problems and support their answers in writing. In Example Item 2 (see Exhibit 2.3), given data on fuel consumption and work accomplished for two machines, students were asked to explain which machine is more efficient. To answer correctly, students needed to interpret data in the table, compute the appropriate ratio, and explain their results. Internationally on average, 31 percent of the students identified machine B and gave an explanation comparing the volumes of water the two machines pumped with the same amount of gasoline. Only in the Netherlands, Korea, and Belgium (Flemish) did a majority of the students give a fully correct response. Among Benchmarking participants, students in Naperville and the Michigan Invitational Group performed significantly above the international average, and students in Maryland, North and South Carolina, Chicago, Miami-Dade, and Rochester performed below it.

• Top 10% Benchmark

Summary

Students demonstrate a grasp of some complex and abstract science concepts. They can apply understanding of earth's formation and cycles and of the complexity of living organisms. They show understanding of the principles of energy efficiency, phase change, thermal expansion, light properties, gravitational force, basic structure of matter, and chemical versus physical changes. They demonstrate detailed knowledge of environmental and resource issues. They understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations and use diagrams to communicate scientific knowledge.

Students can apply knowledge about earth processes such as formation of mountains and underground caves. Given a soil profile diagram, students can identify the layer containing the most organic material. They can diagram all steps in the water cycle, determine the direction of water flow from a contour map, and recognize precipitation patterns from a diagram of elevation and temperature. They also recognize that the seasons are related to the tilt in earth's axis.

Students show some understanding of the complexity of living organisms. They recognize the hierarchy of organization in living organisms, the definition of tissue, and some animal adaptations needed for survival including physical characteristics and temperature regulation. From a list of organisms, students can identify which one has been on earth for the longest time. They demonstrate understanding of tree growth and of the interrelationships in a food web. In addition, they are able to name a digestive substance found in the human stomach and describe its function.

Students show understanding of physics principles, including efficiency, phase change, thermal expansion, properties of light, and gravitational force. Given data on fuel consumption and work accomplished, students explain which of two machines is more efficient. They also can explain that mass does not change and temperature remains constant during phase change. They can apply knowledge of gas pressure and thermal expansion to explain the effect of heat on the volume of a balloon. They recognize why a red object appears black in green light and explain that a white reflector is more effective than a black one. They also can apply some properties of lenses to human vision and identify the ray diagram depicting light passing through a magnifying glass. Students recognize that gravity acts on a rocket at rest, while ascending, and when returning to earth. They also understand that the surface of a liquid remains horizontal in a tilted container.

Students demonstrate an understanding of the basic structure of matter as well as of chemical and physical changes. They recognize that the nuclei of most atoms are composed of protons and neutrons and that an ion is formed when a neutral atom gains an electron. They can distinguish between chemical and physical changes and recognize that a compound results from the reaction of two elements. They identify oxygen as the gas that causes rust formation and explain why steel beams should be galvanized. Students can distinguish between a pure substance and a mixture, identify a mixture that can be separated by filtration, and recognize that sugar molecules continue to exist when sugar is dissolved in water.

Students show familiarity with environmental and resource issues. They recognize that global warming may lead to rising ocean levels and can explain how acid rain is formed from the burning of fossil fuels. In addition, they can give two reasons why famine occurs.

Students demonstrate understanding of some fundamentals of scientific investigation. They can describe a simple procedure for investigating the effect of exercise on heart rate and recognize the need for repeated measurements.

Students can communicate scientific information. They apply basic physical principles to solve some quantitative problems and develop explanations involving abstract concepts. They can provide answers containing two reasons or consequences and also use diagrams to communicate knowledge.

90th Percentile: 616

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Students at the Top 10% Benchmark also demonstrated an understanding of gravitational force (see in Example Item 3 in Exhibit 2.4). On average across countries, 36 percent of students recognized that gravity acts on a rocket while it is on the launch pad, while it ascends under power, and while it parachutes back to earth. This was quite a difficult question internationally, with only three of the comparison countries performing significantly above the international average (the Czech Republic, Singapore, and Chinese Taipei), and four performing below it (Korea, Belgium (Flemish), Italy, and Hong Kong). Nearly one-third of students across countries selected option A, indicating their misconception that gravity acts on the rocket only when it is falling back to earth. Students in the United States and in many of the Benchmarking entities performed relatively well on this question, with 15 entities having above-average performance. Only the public school systems of Miami-Dade and Chicago had below-average performance.

At the Top 10% Benchmark, students typically demonstrated knowledge of most of the chemical concepts covered by the TIMSS 1999 science test, including the structure of matter as well as chemical and physical changes. As shown in Example Item 4 in Exhibit 2.5, students could apply knowledge of the process of filtration and of the difference between solutions and mixtures to identify a separable mixture. While 39 percent of students internationally correctly identified the heterogeneous mixture of pepper and water, a nearly equal number exhibited the misconception that a solution could be separated by filtration (option D or E). The Czech Republic had the highest performance, with 64 percent of its students responding correctly. Performance of the United States and the Benchmarking jurisdictions on this item generally was around the international average. Only in Naperville, the First in the World Consortium, and the Academy School District was performance significantly above the international average, and only in the Rochester City School District was it significantly below.

Students at the Top 10% Benchmark demonstrated some detailed knowledge of environmental and resource issues not seen at the lower benchmarks. Example Item 5 in Exhibit 2.6 shows that students recognized rising ocean levels as a predicted result of global warming. Internationally on average, only one-third of the eighth-grade students responded correctly. In contrast, more than half the students in Japan, Hong Kong, Chinese Taipei, and Singapore did so. Among Benchmarking participants, Naperville alone had above-average performance. Six of the participants had performance significantly below the international average: Pennsylvania, South Carolina, Project SMART, Rochester, North Carolina, and Jersey City. Many students incorrectly identified the thinning ozone layer (option D) as a result of global warming.

Exhibit 2.2 Top 10% TIMSS International Benchmark – Example Item 1

An Item That Students Reaching the Top 10% International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Life Science

Description: Applies knowledge of tree growth to explain why a nail placed in the trunk of a tree remained at the same level from the ground despite the increased height of the tree.

Ethan hammered a nail into the trunk of a young tree. Explain why the nail was still at the same height from the ground twenty years later even though the tree had grown to a height of 22 meters.

A tree grows from it's top up.
It doesn't keep coming out of the ground.

The answer shown illustrates the type of student response that was given credit.

	Overall Percent Correct	
Belgium (Flemish) †	65 (3.5)	▲
Naperville Sch. Dist. #203, IL	63 (4.2)	▲
Canada	59 (1.9)	▲
First in the World Consort., IL	58 (6.4)	●
Japan	57 (1.9)	▲
Netherlands †	56 (3.6)	▲
England †	55 (2.9)	▲
Academy School Dist. #20, CO	54 (4.7)	●
Michigan	54 (3.6)	▲
Chinese Taipei	53 (2.0)	▲
Oregon	53 (3.3)	▲
Montgomery County, MD [2]	52 (3.5)	▲
Project SMART Consortium, OH	51 (4.3)	●
SW Math/Sci. Collaborative, PA	50 (4.4)	●
Michigan Invitational Group, MI	50 (4.6)	●
Massachusetts	50 (4.0)	●
Singapore	49 (2.8)	●
Indiana †	49 (5.0)	●
Czech Republic	48 (3.1)	●
Russian Federation	48 (2.7)	●
Pennsylvania	47 (3.3)	●
Illinois	46 (3.9)	●
Idaho	46 (4.2)	●
Connecticut	45 (4.0)	●
United States	45 (2.2)	●
Maryland	45 (3.4)	●
Missouri	44 (2.0)	●
Italy	43 (2.7)	●
North Carolina	42 (2.9)	●
South Carolina	40 (2.7)	●
Hong Kong, SAR †	40 (2.1)	●
Fremont/Lincoln/WestSide PS, NE	39 (5.9)	●
Guilford County, NC [2]	39 (5.3)	●
Delaware Science Coalition, DE	37 (4.8)	●
Texas	35 (3.7)	●
Korea, Rep. of	33 (1.9)	▼
Chicago Public Schools, IL	31 (5.2)	●
Rochester City Sch. Dist., NY	28 (6.0)	●
Jersey City Public Schools, NJ	28 (4.6)	●
Miami-Dade County PS, FL	25 (3.2)	▼
International Avg. (All Countries)	41 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* This item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.3

Top 10% TIMSS International Benchmark – Example Item 2

An Item That Students Reaching the Top 10% International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Physics

Description: Given data on fuel consumption and work accomplished, determines and explains which of two machines is more efficient.

Machine A and Machine B are each used to pump water from a river. The table shows what volume of water each machine removed in one hour and how much gasoline each of them used.

	Volume of Water Removed in 1 Hour (liters)	Gasoline Used in 1 Hour (liters)
Machine A	1000	1.25
Machine B	500	0.5

a) Which machine is more efficient in converting the energy in gasoline to work?

Answer: B

b) Explain your answer.

1000 ÷ 1.25 = 800
500 ÷ .5 = 1000

Machine B is more efficient because for every liter of gasoline used it removed 1000L of water. With 1L of gasoline Machine A only removes 800L of water.

The answer shown illustrates the type of student response that was given credit.

	Overall Percent Correct	
Netherlands †	58 (3.9)	▲
Korea, Rep. of	52 (1.8)	▲
Belgium (Flemish) †	51 (3.5)	▲
Naperville Sch. Dist. #203, IL	51 (3.9)	▲
Singapore	49 (3.2)	▲
Michigan Invitational Group, MI	47 (3.7)	▲
Japan	46 (2.1)	▲
First in the World Consort., IL	45 (4.9)	●
Chinese Taipei	44 (2.1)	▲
Canada	43 (1.9)	▲
England †	42 (3.0)	▲
Academy School Dist. #20, CO	41 (4.3)	●
Oregon	38 (3.4)	●
Montgomery County, MD ²	38 (4.4)	●
Michigan	37 (3.7)	●
Massachusetts	34 (3.2)	●
Illinois	33 (4.0)	●
Project SMART Consortium, OH	33 (5.0)	●
Russian Federation	33 (2.6)	●
SW Math/Sci. Collaborative, PA	32 (4.5)	●
Hong Kong, SAR †	32 (2.0)	●
Czech Republic	30 (2.6)	●
United States	30 (1.9)	●
Connecticut	29 (3.2)	●
Guilford County, NC ²	29 (4.6)	●
Pennsylvania	28 (3.5)	●
Indiana †	26 (3.9)	●
Texas	25 (3.4)	●
Delaware Science Coalition, DE	23 (3.2)	●
Italy	23 (2.3)	●
Maryland	22 (1.8)	▼
Missouri	22 (3.2)	●
Idaho	22 (3.4)	●
South Carolina	22 (2.9)	▼
Jersey City Public Schools, NJ	21 (4.3)	●
Fremont/Lincoln/WestSide PS, NE	20 (5.7)	●
North Carolina	19 (3.0)	▼
Chicago Public Schools, IL	16 (4.4)	▼
Miami-Dade County PS, FL	12 (2.9)	▼
Rochester City Sch. Dist., NY	10 (3.4)	▼
International Avg. (All Countries)	31 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.4 Top 10% TIMSS International Benchmark – Example Item 3

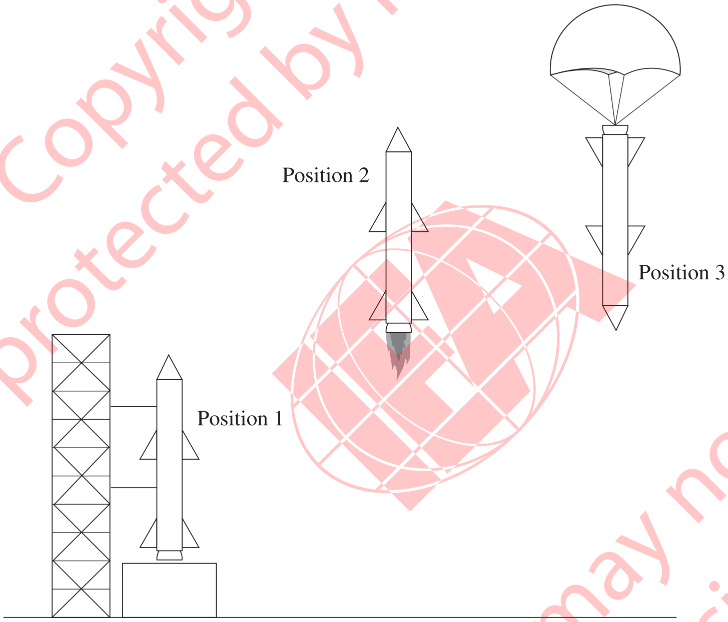
An Item That Students Reaching the Top 10% International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Physics

Description: Applies knowledge of gravitational force by recognizing that gravity acts on a rocket at rest, while ascending, and when returning to Earth.

The drawings show a rocket being launched from Earth and then returning.



In which of the three positions does gravity act on the rocket?

A. 3 only

B. 1 and 2 only

C. 2 and 3 only

[✓ D.] 1, 2 and 3

	Overall Percent Correct	
Michigan Invitational Group, MI	65 (4.1)	▲
Czech Republic	65 (3.1)	▲
Naperville Sch. Dist. #203, IL	64 (4.0)	▲
Academy School Dist. #20, CO	63 (3.6)	▲
Michigan	62 (3.4)	▲
First in the World Consort., IL	60 (4.7)	▲
Idaho	59 (4.7)	▲
Project SMART Consortium, OH	56 (4.3)	▲
SW Math/Sci. Collaborative, PA	56 (4.1)	▲
Massachusetts	55 (4.2)	▲
Fremont/Lincoln/WestSide PS, NE	54 (5.0)	▲
Oregon	53 (4.1)	▲
Guilford County, NC ²	52 (4.2)	▲
Indiana †	50 (3.4)	▲
South Carolina	49 (3.6)	▲
Singapore	49 (2.8)	▲
Chinese Taipei	48 (2.3)	▲
Missouri	48 (2.7)	▲
Pennsylvania	47 (4.0)	●
Maryland	46 (3.5)	●
United States	46 (2.3)	▲
Russian Federation	46 (3.4)	●
Canada	45 (3.3)	●
Illinois	44 (3.2)	●
England †	43 (3.0)	●
North Carolina	41 (2.9)	●
Connecticut	41 (3.6)	●
Japan	40 (2.0)	●
Montgomery County, MD ²	40 (3.3)	●
Netherlands †	39 (5.3)	●
Delaware Science Coalition, DE	39 (5.6)	●
Texas	36 (3.3)	●
Rochester City Sch. Dist., NY	34 (4.4)	●
Korea, Rep. of	29 (1.7)	▼
Belgium (Flemish) †	29 (2.2)	▼
Miami-Dade County PS, FL	26 (2.6)	▼
Jersey City Public Schools, NJ	25 (4.4)	●
Italy	25 (2.3)	▼
Hong Kong, SAR †	24 (1.6)	▼
Chicago Public Schools, IL	24 (3.7)	▼
International Avg. (All Countries)	36 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* This item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.5

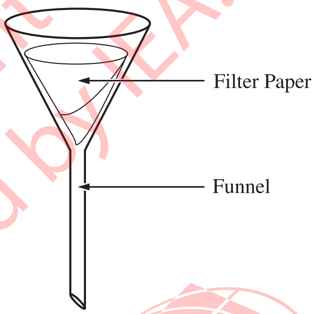
Top 10% TIMSS International Benchmark – Example Item 4

An Item That Students Reaching the Top 10% International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Chemistry

Description: Applies knowledge of the process of filtration and the difference between solutions and mixtures to identify a separable mixture.



Filtration using the equipment shown above can be used to separate which materials?

A. A mixture of salt and pepper

[✓ B.] A mixture of pepper and water

C. A mixture of oxygen and water

D. A solution of silver nitrate in water

E. A solution of sugar in water

	Overall Percent Correct	
Czech Republic	64 (3.3)	▲
Naperville Sch. Dist. #203, IL	60 (3.0)	▲
First in the World Consort., IL	57 (5.4)	▲
Academy School Dist. #20, CO	55 (4.5)	▲
Korea, Rep. of	51 (1.8)	▲
Russian Federation	50 (2.7)	▲
Canada	50 (1.9)	▲
Singapore	50 (2.6)	▲
Michigan Invitational Group, MI	50 (4.4)	●
Netherlands[†]	48 (3.7)	●
Oregon	48 (4.0)	●
Chinese Taipei	46 (2.0)	▲
Idaho	46 (4.2)	●
Michigan	45 (3.9)	●
SW Math/Sci. Collaborative, PA	44 (3.8)	●
Pennsylvania	43 (3.3)	●
Japan	42 (2.0)	●
Connecticut	42 (3.5)	●
Montgomery County, MD[2]	42 (5.9)	●
Project SMART Consortium, OH	41 (4.1)	●
Massachusetts	41 (2.8)	●
South Carolina	40 (3.5)	●
Illinois	40 (3.0)	●
United States	39 (2.1)	●
Maryland	39 (2.9)	●
Texas	39 (3.6)	●
Hong Kong, SAR[†]	38 (2.3)	●
Guilford County, NC[2]	38 (4.5)	●
Indiana[†]	37 (3.6)	●
Fremont/Lincoln/WestSide PS, NE	36 (6.4)	●
Missouri	34 (2.6)	●
England[†]	34 (2.6)	●
Belgium (Flemish)[†]	33 (2.0)	●
North Carolina	32 (3.7)	●
Miami-Dade County PS, FL	31 (3.6)	●
Italy	30 (2.1)	▼
Delaware Science Coalition, DE	29 (3.9)	●
Chicago Public Schools, IL	27 (4.4)	●
Jersey City Public Schools, NJ	26 (4.7)	●
Rochester City Sch. Dist., NY	18 (4.1)	▼
International Avg. (All Countries)	39 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.6

Top 10% TIMSS International Benchmark – Example Item 5

An Item That Students Reaching the Top 10% International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Environmental and Resource Issues

Description: Recognizes that rising ocean levels could result from global warming.

What is predicted to be a result of global warming?

[✓ A.] Rising ocean level

B. More severe earthquakes

C. Larger volcanic eruptions

D. Thinning ozone layer

	Overall Percent Correct	
Japan	67 (2.0)	▲
Hong Kong, SAR †	59 (2.3)	▲
Chinese Taipei	58 (2.2)	▲
Singapore	56 (3.1)	▲
Naperville Sch. Dist. #203, IL	48 (4.4)	▲
Italy	48 (2.5)	▲
Korea, Rep. of	47 (2.1)	▲
Academy School Dist. #20, CO	44 (3.8)	●
Massachusetts	40 (3.8)	●
Russian Federation	38 (3.2)	●
Montgomery County, MD [2]	37 (3.2)	●
Idaho	36 (3.2)	●
Missouri	36 (3.4)	●
First in the World Consort., IL	35 (6.3)	●
England †	33 (2.7)	●
Belgium (Flemish) †	33 (2.7)	●
Netherlands †	33 (3.5)	●
SW Math/Sci. Collaborative, PA	32 (3.9)	●
Delaware Science Coalition, DE	32 (4.3)	●
Czech Republic	32 (3.4)	●
Canada	31 (2.9)	●
Indiana †	31 (4.0)	●
United States	30 (2.1)	●
Connecticut	30 (4.1)	●
Fremont/Lincoln/WestSide PS, NE	30 (4.6)	●
Guilford County, NC [2]	30 (4.3)	●
Maryland	30 (2.9)	●
Michigan	29 (3.0)	●
Oregon	28 (3.7)	●
Michigan Invitational Group, MI	27 (7.4)	●
Illinois	27 (2.7)	●
Texas	26 (3.5)	●
Pennsylvania	25 (2.3)	▼
South Carolina	25 (2.5)	▼
Project SMART Consortium, OH	24 (3.0)	▼
Rochester City Sch. Dist., NY	23 (2.9)	▼
Miami-Dade County PS, FL	22 (3.9)	●
North Carolina	22 (2.5)	▼
Chicago Public Schools, IL	21 (5.3)	●
Jersey City Public Schools, NJ	20 (4.2)	▼
International Avg. (All Countries)	33 (0.4)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Achievement at the Upper Quarter Benchmark

As may be seen in Exhibit 2.7, students performing at the Upper Quarter Benchmark typically showed a developing understanding of biological systems. Example Item 6 (see Exhibit 2.8) required students to apply knowledge of energy flow to complete a food web diagram. Internationally, 55 percent of students indicated the correct order of energy flow from the providers to the consumers. Among the comparison countries, performance on this item was best in Chinese Taipei, Singapore, and Korea, with least at 85 percent of the students responding correctly. Students in Naperville performed about as well as students in those three countries. Other Benchmarking entities with performance significantly above the international average were the Academy School District, the Michigan Invitational Group, the Project SMART Consortium, and the state of Michigan. Those with significantly below-average performance were the public school systems of Jersey City, Chicago, Rochester, and Miami-Dade.

Even though students at the lower benchmarks demonstrated practical knowledge of rusting and burning, only at the Upper Quarter Benchmark did they typically recognize these as chemical reactions. As shown in Example Item 7 in Exhibit 2.9, 55 percent of students internationally recognized that burning releases energy. Performance in the United States (64 percent correct) and many Benchmarking jurisdictions was significantly above the international average. Miami-Dade was the only Benchmarking participant with below-average performance.

In Example Item 8 (see Exhibit 2.10), students were required to identify rusting as a chemical reaction from a list of chemical and physical changes. On average, slightly less than half the students internationally (49 percent) selected the correct response, compared with 87 percent in top-performing Chinese Taipei. A common misconception demonstrated by students in many countries was that the dissolving of sugar is a chemical reaction (option B). Performance in the United States overall was near the international average, although in six of the Benchmarking entities – the First in the World Consortium, the Academy School District, Michigan, Guilford County, Idaho, and Oregon – performance was significantly above average.

Example Item 9 in Exhibit 2.11 required some knowledge of insect populations, natural selection, and the effect of human control on the environment. Students at the Upper Quarter Benchmark recognized that insecticides become less effective over time because some insects pass their resistance to their offspring. While internationally slightly less than half the students (48 percent) chose the correct response, performance in the United States as a whole (62 percent) and in many of the Benchmarking jurisdictions was significantly above the international average. First in the World and Naperville had particularly good performance on this item, comparable to that in Chinese Taipei. Internationally, many students selected option C, which is a true statement on the effect of insecticides on the environment, but is not the correct explanation for the stated problem.

Students performing at the Upper Quarter Benchmark demonstrated basic scientific inquiry skills such as recognizing the variables to be controlled in an experiment and drawing conclusions from a set of observations. In Example Item 10 (see Exhibit 2.12), students identified the correct conclusion that can be drawn from observing the evaporation of two different liquids. Although internationally less than half the students (48 percent) chose the correct response, students in the United States performed very well (76 percent correct). All of the Benchmarking participants had significantly above-average performance on this question, with 17 of them performing comparably to or better than the two highest-performing countries, England and Singapore.

Exhibit 2.7

Description of Upper Quarter TIMSS International Benchmark of Science Achievement

8th Grade Science

• Upper Quarter Benchmark

Summary

Students demonstrate conceptual understanding of some science cycles, systems, and principles. They have some understanding of the earth's processes, biological systems and populations, chemical reactions, and composition of matter. They solve physics problems related to light, speed, heat, and temperature and demonstrate basic knowledge of major environmental concerns. They demonstrate some scientific inquiry skills. They can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge in the life sciences.

Students have some understanding of earth's processes. They can recognize a definition of sedimentary rock and that fossil fuels are formed from the remains of living things. They demonstrate some understanding of the water cycle and can recognize how a river changes as it flows from a mountain to a plain. Students recognize some features of the solar system, including the definition of an earth year and the relative distances of the Sun and Moon from the earth.

Students show a developing understanding of biological systems and populations. They interpret a diagram depicting the exchange of gases in a forest ecosystem and apply knowledge of energy flow in an ecosystem to complete a food web diagram. In addition, students recognize that the main function of chlorophyll in plants is to absorb light energy and that plants can extract minerals from natural fertilizers. They recognize that preventing sperm production will reduce the insect population and that insects pass on their resistance to insecticides. They also can identify distinguishing features of insects and determine characteristics used to sort animals into classification groups. Students also demonstrate understanding of some elements of the human circulatory and immune systems and are able to describe how the human body temperature is controlled.

Students can solve some basic problems related to light, heat, and temperature. For example, they can relate shadow size to distance from a light source and draw the image of an object reflected in a mirror. Students recognize that metal conducts heat faster than glass, wood, or plastic and why the height of an alcohol column in a thermometer rises with increasing temperature. Students also can determine speed from distance and time and complete a table showing a proportional relation between voltage and current.

Students have some understanding of chemical reactions and the composition of matter. They can identify burning and rusting as chemical reactions, recognize that burning releases energy, and that most of the chemical energy from burning gasoline in a car engine is wasted as heat. Students can explain which candle will be extinguished first based on the amount of oxygen available. They recognize that sugar is a compound composed of molecules made up of atoms and recognize that nothing remains of an object if all of its atoms are removed.

Students demonstrate basic knowledge of major environmental issues. They can explain why the depletion of the ozone layer may be harmful to people, recognize that increased carbon dioxide in the atmosphere may lead to global warming, and can identify coal as a non-renewable resource. Students can state two reasons why some people do not have enough water to drink.

Students demonstrate basic scientific inquiry skills. In an experimental situation, they recognize which variables to control, draw a conclusion from a set of observations, and distinguish an observation from other types of scientific statements.

Students can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge, particularly in the life sciences.

75th Percentile: 558

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 2.8 Upper Quarter TIMSS International Benchmark – Example Item 6

An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Life Science

Description: Applies knowledge of energy flow to complete a food web diagram.

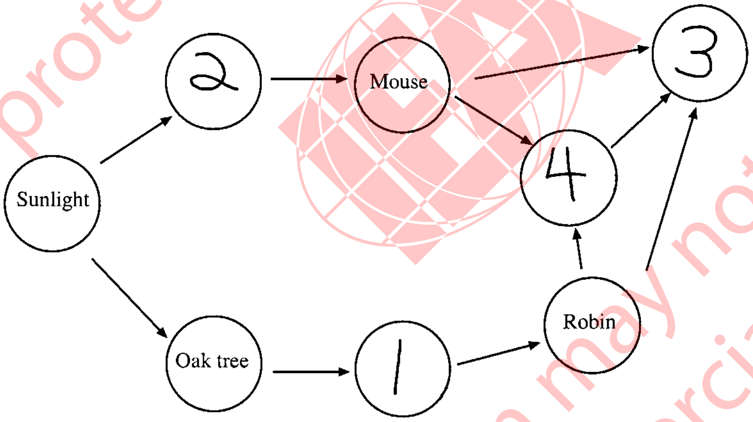
An incomplete food web has been drawn for you. Complete it by filling in each of the empty circles with the number of the correct animal or plant from the list. Remember that the arrows represent energy flow and go from the provider to the user.

1) Caterpillar

2) Corn

3) Hawk

4) Snake



The answer shown illustrates the type of student response that was given credit.

	Overall Percent Correct	
Chinese Taipei	89 (1.4)	▲
Singapore	89 (1.5)	▲
Korea, Rep. of	85 (1.2)	▲
Naperville Sch. Dist. #203, IL	84 (2.6)	▲
England †	75 (2.6)	▲
Academy School Dist. #20, CO	75 (3.8)	▲
Michigan Invitational Group, MI	73 (4.2)	▲
Project SMART Consortium, OH	73 (4.1)	▲
Michigan	70 (2.2)	▲
Japan	68 (2.0)	▲
Russian Federation	67 (3.2)	▲
Hong Kong, SAR †	64 (2.3)	▲
First in the World Consort., IL	64 (5.9)	●
Canada	63 (2.7)	●
Belgium (Flemish) †	62 (2.6)	●
Oregon	62 (3.1)	●
Texas	62 (4.2)	●
Idaho	62 (3.6)	●
Indiana †	61 (4.7)	●
Czech Republic	60 (2.9)	●
Missouri	60 (3.3)	●
South Carolina	59 (3.6)	●
Netherlands †	58 (3.1)	●
Illinois	57 (3.4)	●
Massachusetts	56 (4.4)	●
United States	56 (1.7)	●
Connecticut	56 (4.4)	●
Pennsylvania	56 (3.1)	●
SW Math/Sci. Collaborative, PA	55 (5.2)	●
Montgomery County, MD [2]	55 (4.2)	●
Maryland	53 (3.5)	●
Guilford County, NC [2]	53 (6.1)	●
Delaware Science Coalition, DE	50 (4.7)	●
Fremont/Lincoln/WestSide PS, NE	48 (6.5)	●
Italy	48 (2.3)	●
North Carolina	44 (3.8)	●
Jersey City Public Schools, NJ	37 (5.4)	▼
Chicago Public Schools, IL	35 (3.7)	▼
Rochester City Sch. Dist., NY	34 (4.8)	▼
Miami-Dade County PS, FL	31 (5.6)	▼
International Avg. (All Countries)	55 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.9 Upper Quarter TIMSS International Benchmark – Example Item 7

An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Chemistry

Description: Recognizes that burning wood releases energy.

If you are burning wood, the reaction will

[✓ A.] release energy

B. absorb energy

C. neither absorb nor release energy

D. sometimes release and sometimes absorb energy, depending on the kind of wood

	Overall Percent Correct	
Naperville Sch. Dist. #203, IL	82 (2.1)	▲
Chinese Taipei	82 (1.0)	▲
Academy School Dist. #20, CO	78 (2.0)	▲
First in the World Consort., IL	77 (2.4)	▲
Project SMART Consortium, OH	77 (2.8)	▲
Michigan Invitational Group, MI	75 (2.2)	▲
Guilford County, NC [2]	72 (2.4)	▲
Michigan	72 (2.8)	▲
Connecticut	70 (3.5)	▲
Indiana [†]	70 (2.7)	▲
Hong Kong, SAR [†]	70 (1.3)	▲
England [†]	68 (1.5)	▲
Singapore	68 (2.1)	▲
SW Math/Sci. Collaborative, PA	68 (3.2)	▲
Oregon	67 (2.4)	▲
Montgomery County, MD [2]	66 (2.4)	▲
Canada	66 (1.2)	▲
Pennsylvania	66 (2.7)	▲
Korea, Rep. of	65 (1.0)	▲
Russian Federation	65 (2.6)	▲
Idaho	65 (2.6)	▲
Missouri	65 (2.4)	▲
Illinois	65 (2.6)	▲
United States	64 (1.5)	▲
Netherlands [†]	64 (2.9)	●
Texas	63 (2.9)	●
Massachusetts	62 (2.3)	●
North Carolina	61 (2.3)	●
Belgium (Flemish) [†]	61 (1.6)	▲
Maryland	61 (2.0)	●
South Carolina	60 (3.1)	●
Japan	59 (1.2)	●
Delaware Science Coalition, DE	58 (3.2)	●
Fremont/Lincoln/WestSide PS, NE	56 (3.1)	●
Italy	54 (1.7)	●
Rochester City Sch. Dist., NY	51 (3.3)	●
Jersey City Public Schools, NJ	48 (3.8)	●
Chicago Public Schools, IL	47 (3.8)	●
Czech Republic	47 (1.9)	▼
Miami-Dade County PS, FL	41 (4.1)	▼
International Avg. (All Countries)	55 (0.3)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.10

Upper Quarter TIMSS International Benchmark – Example Item 8

An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Chemistry

Description: From a list of chemical and physical changes, identifies rusting as a chemical reaction.

Which is an example of a chemical reaction?

A. Water boiling

B. Sugar dissolving

[✓ C.] Nails rusting

D. Wax melting

	Overall Percent Correct	
Chinese Taipei	87 (1.1)	▲
Japan	76 (1.9)	▲
Hong Kong, SAR †	72 (2.2)	▲
England †	66 (3.1)	▲
First in the World Consort., IL	65 (3.8)	▲
Singapore	64 (2.8)	▲
Netherlands †	64 (2.7)	▲
Academy School Dist. #20, CO	63 (3.6)	▲
Michigan	62 (3.1)	▲
Michigan Invitational Group, MI	62 (4.5)	●
Guilford County, NC [2]	62 (3.3)	▲
Idaho	61 (2.6)	▲
Russian Federation	60 (2.7)	▲
Project SMART Consortium, OH	60 (6.3)	●
Korea, Rep. of	59 (1.7)	▲
Missouri	59 (4.6)	●
Oregon	58 (2.6)	▲
Naperville Sch. Dist. #203, IL	57 (3.3)	●
Massachusetts	56 (3.0)	●
Canada	55 (3.2)	●
Pennsylvania	54 (3.3)	●
Montgomery County, MD [2]	53 (4.6)	●
SW Math/Sci. Collaborative, PA	52 (4.4)	●
Texas	52 (4.5)	●
United States	52 (1.7)	●
Indiana †	51 (3.8)	●
Fremont/Lincoln/WestSide PS, NE	49 (6.3)	●
Belgium (Flemish) †	49 (3.1)	●
North Carolina	48 (3.7)	●
Italy	48 (2.5)	●
Czech Republic	47 (3.5)	●
Illinois	46 (3.8)	●
South Carolina	45 (3.3)	●
Connecticut	45 (4.3)	●
Delaware Science Coalition, DE	42 (5.6)	●
Maryland	42 (3.2)	●
Miami-Dade County PS, FL	39 (4.1)	●
Rochester City Sch. Dist., NY	35 (6.5)	●
Chicago Public Schools, IL	34 (4.8)	▼
Jersey City Public Schools, NJ	32 (3.5)	▼
International Avg. (All Countries)	49 (0.4)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.11

Upper Quarter TIMSS International Benchmark – Example Item 9

An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

Content Area: Environmental and Resource Issues

Description: Recognizes that insecticides become less effective over time because certain insects pass their resistance to the insecticide to their offspring.

Insecticides are used to control insect populations so that they do not destroy crops. Over time, some insecticides become less effective at killing insects, and new insecticides must be developed. What is the most likely reason insecticides become less effective over time?

A. Surviving insects have learned to include insecticides as a food source.

[✓ B.] Surviving insects pass their resistance to insecticides to their offspring.

C. Insecticides build up in the soil.

D. Insecticides are concentrated at the bottom of the food chain.

	Overall Percent Correct	
First in the World Consort., IL	78 (4.5)	▲
Naperville Sch. Dist. #203, IL	78 (3.3)	▲
Chinese Taipei	76 (1.7)	▲
Michigan Invitational Group, MI	75 (3.1)	▲
Hong Kong, SAR †	74 (2.2)	▲
Project SMART Consortium, OH	73 (3.7)	▲
Michigan	73 (2.9)	▲
Idaho	73 (3.6)	▲
Academy School Dist. #20, CO	72 (4.4)	▲
Montgomery County, MD ²	71 (3.4)	▲
SW Math/Sci. Collaborative, PA	70 (3.1)	▲
Oregon	69 (3.4)	▲
Singapore	69 (2.2)	▲
Connecticut	69 (3.8)	▲
Japan	68 (1.7)	▲
South Carolina	67 (3.3)	▲
Massachusetts	66 (3.4)	▲
Indiana †	66 (5.0)	▲
Guilford County, NC ²	65 (5.6)	●
Texas	64 (4.1)	▲
Pennsylvania	63 (3.6)	▲
Missouri	63 (2.9)	▲
United States	62 (1.8)	▲
Netherlands †	61 (3.5)	▲
Maryland	61 (2.5)	▲
Canada	60 (3.0)	▲
Russian Federation	60 (3.6)	●
Fremont/Lincoln/WestSide PS, NE	59 (5.6)	●
North Carolina	58 (3.6)	●
Illinois	58 (2.7)	▲
Delaware Science Coalition, DE	57 (5.4)	●
Czech Republic	57 (3.3)	●
England †	56 (2.6)	●
Belgium (Flemish) †	53 (2.7)	●
Chicago Public Schools, IL	51 (6.3)	●
Italy	50 (2.3)	●
Korea, Rep. of	47 (2.0)	●
Miami-Dade County PS, FL	46 (4.5)	●
Jersey City Public Schools, NJ	44 (3.9)	●
Rochester City Sch. Dist., NY	37 (4.5)	●
International Avg. (All Countries)	48 (0.4)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.12

Upper Quarter TIMSS International Benchmark – Example Item 10

An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Scientific Inquiry and the Nature of Science

Description: Identifies an appropriate conclusion from observations of evaporating liquids.

Two open bottles, one filled with vinegar and the other with olive oil, were left on a window sill in the Sun. Several days later it was observed that the bottles were no longer full. What can be concluded from this observation?

A. Vinegar evaporates faster than olive oil.

B. Olive oil evaporates faster than vinegar.

[✓ C.] Both vinegar and olive oil evaporate.

D. Only liquids containing water evaporate.

E. Direct sunlight is needed for evaporation.

	Overall Percent Correct	
Naperville Sch. Dist. #203, IL	90 (2.0)	▲
Project SMART Consortium, OH	86 (4.3)	▲
First in the World Consort., IL	85 (3.0)	▲
Indiana †	85 (2.5)	▲
SW Math/Sci. Collaborative, PA	85 (3.0)	▲
Guilford County, NC ²	84 (3.3)	▲
South Carolina	83 (2.6)	▲
Michigan Invitational Group, MI	82 (3.8)	▲
Missouri	82 (2.6)	▲
Academy School Dist. #20, CO	81 (3.9)	▲
Pennsylvania	81 (2.3)	▲
Oregon	80 (3.3)	▲
Illinois	79 (3.6)	▲
Massachusetts	79 (1.6)	▲
Montgomery County, MD ²	79 (1.7)	▲
Connecticut	79 (3.9)	▲
Michigan	78 (3.0)	▲
England †	78 (2.6)	▲
Singapore	78 (1.9)	▲
North Carolina	77 (2.4)	▲
Netherlands †	76 (2.8)	▲
United States	76 (1.4)	▲
Rochester City Sch. Dist., NY	76 (4.4)	▲
Idaho	76 (3.4)	▲
Texas	74 (3.6)	▲
Maryland	72 (3.2)	▲
Delaware Science Coalition, DE	72 (3.7)	▲
Fremont/Lincoln/WestSide PS, NE	69 (4.8)	▲
Chicago Public Schools, IL	69 (5.6)	▲
Miami-Dade County PS, FL	67 (4.0)	▲
Canada	64 (2.6)	▲
Jersey City Public Schools, NJ	64 (4.8)	▲
Korea, Rep. of	59 (2.0)	▲
Japan	50 (2.1)	●
Italy	49 (2.9)	●
Belgium (Flemish) †	49 (2.0)	●
Hong Kong, SAR †	49 (2.1)	●
Czech Republic	49 (3.4)	●
Chinese Taipei	44 (2.0)	●
Russian Federation	29 (2.3)	▼
International Avg. (All Countries)	48 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Achievement at the Median Benchmark

Exhibit 2.13 describes performance at the Median Benchmark. Students at this benchmark could recognize and communicate basic scientific knowledge across a range of topics. Internationally on average, 66 percent of students extracted relevant information from the data table of planetary conditions to describe why a condition would be hostile to human life (see Example Item 11 in Exhibit 2.14). The majority said that there was too little oxygen in the atmosphere on Proto to breathe. Other common responses that received credit referred to low temperatures due to the greater distance from the sun, and lack of an ozone layer to protect human beings from the sun's radiation. On this item, also, the United States and many of the Benchmarking jurisdictions had relatively good performance. The United States as a whole and 16 of the jurisdictions had performance significantly above the international average, and none had below-average performance.

At the Median Benchmark, students typically demonstrated some knowledge of the characteristics of animals and plants. In Example 12 (see Exhibit 2.15), 70 percent of students on average across countries recognized feeding milk to their young as a characteristic of mammals. This was not an area of strength in the United States, where performance was significantly below the international average. Only students in the Academy School District and the Michigan Invitational Group performed significantly above the international average, whereas students in Maryland, North Carolina, and the public school systems in Rochester, Miami-Dade, Chicago, and Jersey City performed below average.

Students at the Median Benchmark typically were familiar with some aspects of force and motion. As shown in Example Item 13 in Exhibit 2.16, students scoring at this level could identify the diagram showing forces that would result in rotation. Performance on this item was at the international average (62 percent correct) for the United States and for all Benchmarking participants except Chicago and Miami-Dade, which had below-average performance.

In Example Item 14 (see Exhibit 2.17), students had to apply an understanding of the concept of electrical circuits and the electrical conductivity of various materials to identify the diagrams that show a complete circuit. Internationally, 64 percent of students on average correctly identified the circuits connected to metallic materials. On this item, also, performance in the United States was at about the international average. Although seven of the comparison countries – Hong Kong, the Russian Federation, Belgium (Flemish), Chinese Taipei, Singapore, Korea, and the Netherlands – had above-average performance, only in Missouri and Naperville was performance significantly above the international average.

At the Median Benchmark, students were able to apply basic knowledge of the role of oxygen or air in rusting and burning. In Example Item 15 (see Exhibit 2.18), 67 percent of students internationally and more than 90 percent of those in top-performing Chinese Taipei recognized that painting iron surfaces inhibits rust by preventing exposure to oxygen and moisture. The United States and all but the four lowest-performing Benchmarking participants had average performance on this item.

Students at the Median Benchmark showed some elementary knowledge of the human impact on the environment, as illustrated by Example Item 16 in Exhibit 2.19. Over two-thirds (68 percent) of students on average internationally recognized that soil erosion is more likely in barren sloping areas. Although the United States overall had about average performance on this item, 13 of the Benchmarking participants performed significantly above the international average, including the Academy School District, which had performance comparable to high-scoring Chinese Taipei, Singapore, and Hong Kong.

• Median Benchmark

Summary

Students can recognize and communicate basic scientific knowledge across a range of topics. They recognize some characteristics of the solar system, ecosystems, animals and plants, energy sources, force and motion, light reflection and radiation, sound, electrical circuits, and human impact on the environment. They can apply and briefly communicate practical knowledge, extract tabular information, extrapolate from data presented in a simple linear graph, and interpret representational diagrams.

Students demonstrate some familiarity with the solar system. They can identify a planetary condition that would be hostile to human life and explain the effect of relative distance on the apparent size of the planets. Students also recognize that the Sun is the source of energy for earth's water cycle. In addition, they can select the best description of how long the plates making up the earth's surface have been moving.

Students have a basic understanding of ecosystems. They can describe one role of the Sun in ecosystems and can suggest a negative consequence of the introduction of a new species. They have some knowledge of the characteristics of animals and plants. They recognize that mammals feed milk to their young, wolves use their scent to mark their territories, and that seedlings growing in a forest have large leaves to gather light for photosynthesis. They also can identify some functions of blood.

In physics, students are acquainted with some aspects of energy and motion. They recognize examples of fossil fuels, that a compressed spring has stored energy, and that a given sequence of energy changes applies to gasoline burning to power a car. They recognize that an object will move in a straight line when released from a circular path. They can apply practical knowledge of levers to identify the best way to balance two objects of unequal weight and can identify forces resulting in rotation. Students demonstrate some knowledge of light reflection and radiation. They can identify the apparent position of a reflected image in a mirror, recognize that ultraviolet radiation from the sun causes sunburn and that a person feels cooler wearing light-colored clothes because they reflect more radiation. Students also recognize that sound needs to travel through some medium. They can identify a substance based on whether it is attracted to a magnet and apply knowledge of conductors to identify a complete electrical circuit.

In chemistry, students can apply basic knowledge about the role of air in rusting and burning. They recognize that painting iron prevents exposure to oxygen and moisture and that candles burning in closed containers will be extinguished due to a lack of air.

Students demonstrate elementary knowledge of human impact on the environment. They recognize that soil erosion is more likely in barren sloping areas and in areas subject to overgrazing. Students describe a positive effect on farming of a dam located upriver. Also, they provide one reason for the occurrence of famine.

Students can extract information from a table to draw conclusions and interpret representational diagrams. They also can extrapolate from data presented in a simple linear graph. Students can apply knowledge to practical situations and communicate their practical knowledge through brief descriptive responses.

50th Percentile: 488

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 2.14

Median TIMSS International Benchmark – Example Item 11

An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Earth Science

Description: Extracts information from a table of planetary conditions to describe a condition hostile to human life.

Diana and Mario were discussing what it might be like on other planets. Their science teacher gave them data about Earth and an imaginary planet Proto. The table shows these data.

	Earth	Proto
Distance from a star like the Sun	148 640 000 km	902 546 000 km
Atmospheric pressure at surface of planet	101 325 Pa	100 Pa
Atmospheric conditions • gas components	21% oxygen 0.03% carbon dioxide 78% nitrogen	5% oxygen 5% carbon dioxide 90% nitrogen
• ozone layer	yes	no
• cloud cover	yes	no

Write down one important reason why it would be difficult for humans to live on Proto if it existed. Explain your answer.

It would be near impossible to breath on Proto because there is too little oxygen in the atmosphere.

The answer shown illustrates the type of student response that was given credit.

	Overall Percent Correct	
First in the World Consort., IL	91 (3.4)	▲
Michigan Invitational Group, MI	87 (3.4)	▲
Guilford County, NC[2]	86 (3.1)	▲
Singapore	86 (1.7)	▲
SW Math/Sci. Collaborative, PA	85 (4.1)	▲
Indiana †	84 (2.7)	▲
North Carolina	82 (2.4)	▲
Canada	82 (2.4)	▲
Pennsylvania	82 (2.2)	▲
England †	82 (2.4)	▲
Netherlands †	81 (2.6)	▲
Naperville Sch. Dist. #203, IL	80 (4.0)	▲
Massachusetts	80 (2.7)	▲
Michigan	80 (2.9)	▲
Project SMART Consortium, OH	80 (3.5)	▲
Oregon	80 (2.8)	▲
Chinese Taipei	79 (1.5)	▲
Delaware Science Coalition, DE	79 (3.3)	▲
Idaho	78 (3.6)	▲
Academy School Dist. #20, CO	78 (3.3)	▲
Illinois	78 (2.2)	▲
United States	78 (1.6)	▲
South Carolina	78 (3.8)	●
Belgium (Flemish) †	77 (2.7)	▲
Korea, Rep. of	77 (1.5)	▲
Connecticut	77 (4.1)	●
Czech Republic	75 (3.0)	●
Montgomery County, MD[2]	74 (3.6)	●
Jersey City Public Schools, NJ	74 (4.1)	●
Chicago Public Schools, IL	74 (3.0)	●
Missouri	73 (3.0)	●
Russian Federation	73 (2.1)	▲
Texas	73 (4.6)	●
Maryland	73 (2.4)	●
Italy	70 (2.4)	●
Hong Kong, SAR †	70 (2.2)	●
Japan	69 (1.7)	●
Fremont/Lincoln/WestSide PS, NE	68 (5.8)	●
Rochester City Sch. Dist., NY	67 (3.6)	●
Miami-Dade County PS, FL	63 (5.4)	●
International Avg. (All Countries)	66 (0.4)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.15

Median TIMSS International Benchmark – Example Item 12

An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Life Science

Description: Recognizes that feeding milk to its young is a defining characteristic of mammals.

A small animal called the duckbilled platypus lives in Australia. Which characteristic of this animal shows that it is a mammal?

A. It eats other animals.

[✓ B.] It feeds its young milk.

C. It makes a nest and lays eggs.

D. It has webbed feet.

	Overall Percent Correct	
Japan	86 (0.8)	▲
Hong Kong, SAR †	83 (1.2)	▲
Academy School Dist. #20, CO	81 (1.7)	▲
Chinese Taipei	80 (1.1)	▲
Czech Republic	79 (1.9)	▲
Korea, Rep. of	77 (1.1)	▲
Michigan Invitational Group, MI	77 (2.0)	▲
Singapore	77 (1.8)	▲
Russian Federation	76 (2.1)	●
Belgium (Flemish) †	70 (1.7)	●
Michigan	70 (2.0)	●
Italy	70 (1.6)	●
First in the World Consort., IL	68 (2.2)	●
Idaho	68 (3.0)	●
South Carolina	68 (2.2)	●
Connecticut	68 (2.8)	●
Oregon	67 (2.2)	●
Montgomery County, MD ²	67 (2.9)	●
Canada	66 (1.0)	▼
Naperville Sch. Dist. #203, IL	66 (2.6)	●
Guilford County, NC ²	65 (3.2)	●
SW Math/Sci. Collaborative, PA	65 (2.0)	●
Texas	65 (3.6)	●
United States	65 (1.6)	▼
Indiana †	64 (2.1)	●
Missouri	64 (2.6)	●
Pennsylvania	64 (2.8)	●
Massachusetts	63 (2.3)	●
Netherlands †	62 (1.8)	▼
Project SMART Consortium, OH	61 (3.2)	●
Illinois	60 (3.0)	●
Maryland	60 (2.6)	▼
Delaware Science Coalition, DE	60 (3.7)	●
Fremont/Lincoln/WestSide PS, NE	60 (4.2)	●
North Carolina	58 (2.2)	▼
Rochester City Sch. Dist., NY	53 (2.9)	▼
England †	52 (2.0)	▼
Miami-Dade County PS, FL	51 (3.1)	▼
Chicago Public Schools, IL	51 (3.9)	▼
Jersey City Public Schools, NJ	44 (3.5)	▼
International Avg. (All Countries)	70 (0.2)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* This item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.16

Median TIMSS International Benchmark – Example Item 13

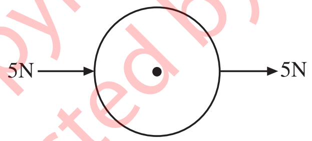
An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

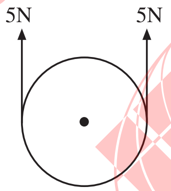
8th Grade Science

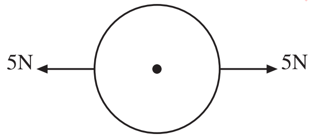
Content Area: Physics

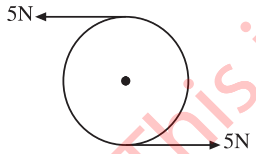
Description: Identifies the diagram that shows the forces acting on a wheel that will result in rotation.

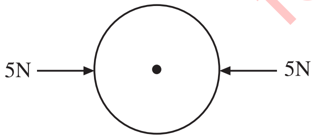
A uniform wheel is free to rotate on its axle at its center. It is acted on by two forces in the same plane. Each force has the same size, equal to 5N (Newtons). In which case will the wheel rotate?

A.


B.


C.


[✓ D.]


E.


	Overall Percent Correct	
Japan	76 (1.6)	▲
Czech Republic	69 (2.4)	●
Netherlands †	69 (3.3)	●
Russian Federation	68 (2.7)	●
Academy School Dist. #20, CO	68 (3.2)	●
First in the World Consort., IL	67 (5.5)	●
Idaho	66 (4.3)	●
Italy	66 (2.7)	●
Canada	66 (2.6)	●
Massachusetts	65 (3.7)	●
Oregon	65 (3.6)	●
SW Math/Sci. Collaborative, PA	65 (3.8)	●
Michigan Invitational Group, MI	64 (4.5)	●
Belgium (Flemish) †	64 (2.3)	●
Korea, Rep. of	63 (1.7)	●
Michigan	63 (2.9)	●
United States	62 (1.7)	●
Missouri	62 (3.6)	●
Hong Kong, SAR †	62 (1.9)	●
Connecticut	61 (3.8)	●
England †	61 (2.6)	●
Texas	60 (2.6)	●
Singapore	60 (2.3)	●
Montgomery County, MD [2]	60 (4.3)	●
Indiana †	59 (4.5)	●
Fremont/Lincoln/WestSide PS, NE	58 (7.5)	●
Guilford County, NC [2]	58 (4.8)	●
Chinese Taipei	58 (2.2)	●
Jersey City Public Schools, NJ	57 (5.2)	●
Delaware Science Coalition, DE	57 (5.1)	●
Pennsylvania	56 (5.7)	●
Illinois	56 (3.4)	●
Maryland	55 (2.5)	●
South Carolina	55 (3.1)	●
Naperville Sch. Dist. #203, IL	55 (4.4)	●
North Carolina	54 (3.3)	●
Project SMART Consortium, OH	53 (4.9)	●
Chicago Public Schools, IL	48 (4.3)	▼
Rochester City Sch. Dist., NY	42 (4.3)	▼
Miami-Dade County PS, FL	38 (3.7)	▼
International Avg. (All Countries)	62 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.17

Median TIMSS International Benchmark – Example Item 14

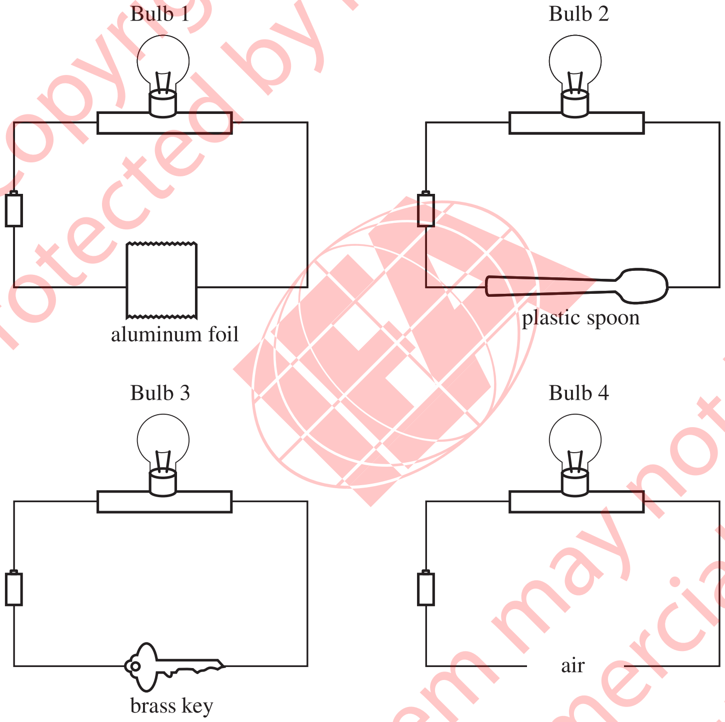
An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Physics

Description: Applies concept of electrical circuits and knowledge of conductors to identify diagrams that show a complete circuit.

The following diagrams show a battery and a bulb connected by wires to various materials.



Which of the bulbs will light?

A. 1 only

B. 2 and 3 only

[✓ C.] 1 and 3 only

D. 1, 3 and 4 only

E. 1, 2 and 3 only

	Overall Percent Correct	
Hong Kong, SAR †	84 (1.8)	▲
Russian Federation	82 (2.4)	▲
Belgium (Flemish) †	81 (1.9)	▲
Chinese Taipei	80 (1.6)	▲
Singapore	79 (2.1)	▲
Korea, Rep. of	78 (1.7)	▲
Netherlands †	78 (2.7)	▲
First in the World Consort., IL	75 (4.9)	●
Missouri	74 (2.2)	▲
Naperville Sch. Dist. #203, IL	73 (2.7)	▲
Academy School Dist. #20, CO	73 (3.5)	●
Illinois	72 (2.9)	●
Czech Republic	72 (2.7)	●
Massachusetts	72 (2.5)	●
Indiana †	71 (3.1)	●
SW Math/Sci. Collaborative, PA	70 (4.0)	●
Montgomery County, MD [2]	70 (3.3)	●
Michigan	69 (2.9)	●
Fremont/Lincoln/WestSide PS, NE	69 (7.2)	●
Japan	68 (1.9)	●
Michigan Invitational Group, MI	68 (4.6)	●
Connecticut	67 (3.0)	●
Pennsylvania	67 (3.1)	●
Project SMART Consortium, OH	65 (4.5)	●
Idaho	65 (3.3)	●
England †	65 (2.6)	●
Maryland	65 (2.6)	●
Oregon	65 (3.2)	●
United States	64 (1.7)	●
Guilford County, NC [2]	64 (3.6)	●
South Carolina	64 (2.5)	●
Texas	64 (4.3)	●
North Carolina	64 (3.2)	●
Delaware Science Coalition, DE	61 (3.7)	●
Canada	60 (2.2)	●
Jersey City Public Schools, NJ	58 (4.1)	●
Miami-Dade County PS, FL	57 (1.9)	▼
Rochester City Sch. Dist., NY	57 (4.9)	●
Italy	56 (2.3)	▼
Chicago Public Schools, IL	55 (4.8)	●
International Avg. (All Countries)	64 (0.4)	

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.18

Median TIMSS International Benchmark – Example Item 15

An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Chemistry

Description: Recognizes that painting iron prevents exposure to oxygen and moisture.

Paint applied to an iron surface prevents the iron from rusting. Which ONE of the following provides the best reason?

A. It prevents nitrogen from coming in contact with the iron.

B. It reacts chemically with the iron.

C. It prevents carbon dioxide from coming in contact with the iron.

D. It makes the surface of the iron smoother.

[✓ E.] It prevents oxygen and moisture from coming in contact with the iron.

	Overall Percent Correct	
Chinese Taipei	91 (0.7)	▲
Russian Federation	81 (1.3)	▲
Singapore	81 (1.8)	▲
Netherlands †	80 (2.2)	▲
Hong Kong, SAR †	79 (1.4)	▲
England †	76 (1.6)	▲
Michigan Invitational Group, MI	74 (2.4)	●
Korea, Rep. of	73 (1.1)	▲
Connecticut	72 (2.6)	●
Naperville Sch. Dist. #203, IL	72 (2.0)	●
Canada	72 (1.6)	●
Michigan	72 (2.7)	●
SW Math/Sci. Collaborative, PA	72 (2.9)	●
Czech Republic	72 (1.8)	●
Massachusetts	71 (2.4)	●
Academy School Dist. #20, CO	71 (2.2)	●
Project SMART Consortium, OH	70 (1.9)	●
Oregon	70 (2.0)	●
Japan	70 (1.3)	●
Belgium (Flemish) †	70 (1.6)	●
Idaho	69 (2.1)	●
Pennsylvania	69 (2.0)	●
First in the World Consort., IL	68 (2.8)	●
Guilford County, NC [2]	68 (2.3)	●
Texas	68 (2.6)	●
Indiana †	67 (1.9)	●
Missouri	67 (2.3)	●
Illinois	66 (2.6)	●
United States	66 (1.4)	●
Italy	65 (1.6)	●
Montgomery County, MD [2]	64 (2.3)	●
North Carolina	64 (2.1)	●
South Carolina	63 (3.1)	●
Maryland	63 (2.7)	●
Fremont/Lincoln/WestSide PS, NE	62 (3.1)	●
Delaware Science Coalition, DE	60 (3.1)	●
Jersey City Public Schools, NJ	53 (2.6)	▼
Rochester City Sch. Dist., NY	50 (3.4)	▼
Chicago Public Schools, IL	49 (3.1)	▼
Miami-Dade County PS, FL	45 (3.3)	▼
International Avg. (All Countries)	67 (0.2)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.19

Median TIMSS International Benchmark – Example Item 16

An Item That Students Reaching the Median International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Environmental and Resource Issues

Description: Recognizes that soil erosion is more likely in barren sloping areas.

Rain and running water can wash away soil. From which area is soil most likely to be washed away?

A. A sloping area with bushes

B. A flat area with grasses

C. A flat area that is barren

[✓ D.] A sloping area that is barren

	Overall Percent Correct	
Chinese Taipei	92 (0.7)	▲
Singapore	88 (1.2)	▲
Academy School Dist. #20, CO	85 (1.7)	▲
Hong Kong, SAR †	85 (1.1)	▲
Netherlands †	83 (2.9)	▲
Korea, Rep. of	83 (0.9)	▲
Project SMART Consortium, OH	82 (3.3)	▲
Naperville Sch. Dist. #203, IL	81 (1.6)	▲
Michigan Invitational Group, MI	80 (1.6)	▲
Russian Federation	80 (1.3)	▲
Japan	79 (1.0)	▲
SW Math/Sci. Collaborative, PA	79 (2.0)	▲
England †	78 (1.4)	▲
Michigan	78 (2.0)	▲
Missouri	78 (2.0)	▲
Idaho	78 (2.2)	▲
Massachusetts	76 (2.2)	▲
Canada	76 (1.3)	▲
Indiana †	76 (2.6)	●
Oregon	75 (2.3)	▲
Guilford County, NC [2]	75 (2.2)	▲
Fremont/Lincoln/WestSide PS, NE	75 (2.9)	●
Montgomery County, MD [2]	74 (2.1)	▲
North Carolina	74 (2.2)	●
First in the World Consort., IL	74 (3.5)	●
Pennsylvania	74 (2.0)	●
Czech Republic	73 (1.8)	●
South Carolina	73 (1.5)	▲
Connecticut	73 (2.7)	●
United States	73 (1.6)	●
Maryland	72 (2.5)	●
Illinois	70 (1.5)	●
Delaware Science Coalition, DE	70 (4.0)	●
Texas	69 (3.1)	●
Belgium (Flemish) †	68 (1.3)	●
Italy	59 (1.8)	▼
Jersey City Public Schools, NJ	55 (3.1)	▼
Rochester City Sch. Dist., NY	50 (3.1)	▼
Chicago Public Schools, IL	49 (3.3)	▼
Miami-Dade County PS, FL	44 (4.9)	▼
International Avg. (All Countries)	68 (0.2)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in italics did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Achievement at the Lower Quarter Benchmark

Exhibit 2.20 describes performance at the Lower Quarter Benchmark. At this level of performance, students typically could demonstrate knowledge of some basic facts about the earth's physical features and could use information presented in simple diagrams. In Example Item 17 (see Exhibit 2.21), 82 percent of students internationally were able to interpret the pictorial diagram of the earth's layers and identify the center as the hottest layer. Among Benchmarking participants, almost all students (85 percent or more) gave the correct answer.

In the life sciences, students at the Lower Quarter Benchmark showed some basic knowledge of human biology. A full 87 percent of students internationally recognized that exercise causes an increase in their breathing and pulse rates (see Example Item 18 in Exhibit 2.22). Performance on this item was even higher in the United States and most Benchmarking jurisdictions. Student performance exceeded the international average in the United States overall and in 19 of the Benchmarking entities, and was not significantly below the international average in any entity. However, typically only students scoring at higher benchmarks could relate the link between exercise and pulse and breathing rate to the function of the circulatory or respiratory system.

At the Lower Quarter Benchmark, students could recognize some facts about familiar physical phenomena. In Example Item 19 in Exhibit 2.23, they demonstrated basic knowledge of light reflection by recognizing that white surfaces reflect more light than colored surfaces. Internationally and in the United States, more than 80 percent of students answered this item correctly. Among Benchmarking participants, only in Naperville, Michigan, and Montgomery County was the percentage of students choosing the correct answer significantly greater than the international average.

Students at the Lower Quarter Benchmark could also recognize that there is greater evaporation from a larger surface area, as shown in Example Item 20 in Exhibit 2.24. Internationally on average, 84 percent of students could interpret the pictorial diagrams showing liquid in containers of different shapes and identify the container with the largest surface area as the one from which the liquid would evaporate first. Performance was at about the international average on this question in the United States and in many of the Benchmarking jurisdictions. However, performance in First in the World, the Academy School District, Project SMART, Naperville, and Michigan was significantly above the international average. In each of these entities, the item was answered correctly by more than 90 percent of the eighth-grade students.

Exhibit 2.20 Description of Lower Quarter TIMSS International Benchmark of Science Achievement

8th Grade Science

• Lower Quarter Benchmark

Summary

Students recognize some basic facts from the earth, life, and physical sciences presented using non-technical language. They can identify some of the earth's physical features, have some knowledge of the human body, and demonstrate familiarity with everyday physical phenomena. They can interpret and use information presented in simple diagrams.

Students know a few basic facts about the earth's physical features and solar system. For example, they can select the hottest of earth's layers, recognize that there is less oxygen at higher altitudes and know that the moon reflects sunlight.

Students demonstrate some basic knowledge of human biology and plant features. They recognize that nerves carry sensory messages to the brain, that traits are inherited from both parents and transferred through sperm and egg, that exercise leads to increased breathing and pulse rates, and that vitamins are necessary for human nutrition. They also recognize that seeds develop from flowers of a plant and can state one role of trees in a rainforest.

Students recognize some facts about familiar physical phenomena. They can recognize the correct arrangement of flashlight batteries, the container where evaporation would be greatest, and that fanning a fire makes it burn faster by supplying more oxygen. Students also know some basic facts about light reflection. They can identify the path of light reflected from a mirror, recognize that objects are visible because of reflected light and that white surfaces reflect more light than colored surfaces. They also recognize that a powder made up of both black and white specks is likely to be a mixture.

Students can interpret uncomplicated pictorial diagrams.

25th Percentile: 410

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 2.21

Lower Quarter TIMSS International Benchmark – Example Item 17

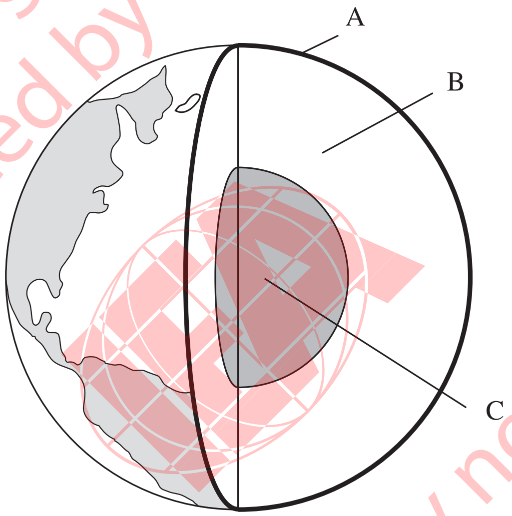
An Item That Students Reaching the Lower Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Earth Science

Description: Interprets a diagram of the Earth's layers and identifies the center as the hottest.

The picture shows the three main layers of the Earth.



Where is it the hottest?

A. Layer A

B. Layer B

[✓ C.] Layer C

D. All three layers are the same temperature.

	Overall Percent Correct	
Naperville Sch. Dist. #203, IL	97 (0.8)	▲
Michigan Invitational Group, MI	96 (0.6)	▲
Academy School Dist. #20, CO	95 (1.0)	▲
Oregon	95 (0.6)	▲
First in the World Consort., IL	95 (1.6)	▲
Montgomery County, MD [2]	95 (1.2)	▲
SW Math/Sci. Collaborative, PA	95 (0.8)	▲
Michigan	95 (0.9)	▲
Project SMART Consortium, OH	94 (1.2)	▲
Fremont/Lincoln/WestSide PS, NE	94 (0.9)	▲
Massachusetts	94 (0.8)	▲
Canada	94 (0.5)	▲
South Carolina	94 (1.0)	▲
Guilford County, NC [2]	94 (1.5)	▲
Netherlands †	93 (2.3)	▲
Pennsylvania	93 (1.0)	▲
Connecticut	93 (1.3)	▲
North Carolina	93 (1.0)	▲
England †	93 (0.9)	▲
Maryland	93 (0.8)	▲
Texas	93 (1.1)	▲
Delaware Science Coalition, DE	92 (1.2)	▲
United States	92 (0.7)	▲
Idaho	92 (1.0)	▲
Missouri	92 (1.2)	▲
Illinois	92 (0.8)	▲
Indiana †	91 (0.9)	▲
Italy	91 (0.9)	▲
Rochester City Sch. Dist., NY	91 (1.5)	▲
Czech Republic	91 (1.3)	▲
Russian Federation	90 (1.1)	▲
Japan	89 (0.7)	▲
Belgium (Flemish) †	89 (1.6)	▲
Hong Kong, SAR †	88 (0.8)	▲
Chicago Public Schools, IL	87 (2.0)	●
Jersey City Public Schools, NJ	86 (1.7)	●
Miami-Dade County PS, FL	85 (1.6)	●
Korea, Rep. of	85 (0.8)	▲
Chinese Taipei	84 (0.8)	●
Singapore	84 (1.2)	●
International Avg. (All Countries)	82 (0.2)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.22

Lower Quarter TIMSS International Benchmark – Example Item 18

An Item That Students Reaching the Lower Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Life Science

Description: Recognizes that exercise causes an increase in breathing and pulse rates.

Immediately before and after running a 50 meter race, your pulse and breathing rates are taken. What changes would you expect to find?

A. no change in pulse but a decrease in breathing rate

B. an increase in pulse but no change in breathing rate

[✓ C.] an increase in pulse and breathing rate

D. a decrease in pulse and breathing rate

E. no change in either

	Overall Percent Correct	
Japan	98 (0.3)	▲
First in the World Consort., IL	97 (0.8)	▲
Naperville Sch. Dist. #203, IL	96 (0.8)	▲
Singapore	96 (0.6)	▲
Netherlands [†]	95 (1.2)	▲
Belgium (Flemish) [†]	95 (1.4)	▲
England [†]	95 (1.0)	▲
Korea, Rep. of	95 (0.4)	▲
SW Math/Sci. Collaborative, PA	95 (0.8)	▲
Indiana [†]	94 (0.9)	▲
Michigan Invitational Group, MI	94 (1.2)	▲
Guilford County, NC [2]	94 (1.3)	▲
Canada	94 (0.6)	▲
Oregon	94 (0.9)	▲
Chinese Taipei	94 (0.5)	▲
Project SMART Consortium, OH	94 (1.2)	▲
Academy School Dist. #20, CO	94 (1.1)	▲
Czech Republic	94 (1.1)	▲
Missouri	94 (0.9)	▲
Connecticut	94 (1.2)	▲
Michigan	94 (1.1)	▲
Pennsylvania	93 (1.0)	▲
Montgomery County, MD [2]	93 (0.9)	▲
Massachusetts	93 (1.0)	▲
Idaho	93 (1.3)	▲
Hong Kong, SAR [†]	93 (0.6)	▲
Illinois	93 (1.1)	▲
North Carolina	92 (1.1)	▲
Maryland	92 (1.0)	▲
United States	91 (0.5)	▲
Fremont/Lincoln/WestSide PS, NE	91 (2.0)	●
Texas	90 (2.0)	●
South Carolina	90 (1.5)	●
Delaware Science Coalition, DE	90 (1.7)	●
Russian Federation	89 (1.0)	●
Italy	89 (0.9)	●
Chicago Public Schools, IL	87 (1.3)	●
Rochester City Sch. Dist., NY	86 (2.3)	●
Jersey City Public Schools, NJ	84 (2.3)	●
Miami-Dade County PS, FL	81 (2.2)	●
International Avg. (All Countries)	87 (0.2)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.23

Lower Quarter TIMSS International Benchmark – Example Item 19

An Item That Students Reaching the Lower Quarter International Benchmark Are Likely to Answer Correctly*

8th Grade Science

Content Area: Physics

Description: Recognizes that white surfaces reflect more light than colored surfaces.

The walls of a building are to be painted to reflect as much light as possible. What color should they be painted?

[✓ A.] White

B. Red

C. Black

D. Pink

	Overall Percent Correct	
Belgium (Flemish) †	94 (0.8)	▲
Netherlands †	92 (1.3)	▲
Singapore	91 (0.9)	▲
Czech Republic	90 (1.0)	▲
Russian Federation	90 (1.1)	▲
Naperville Sch. Dist. #203, IL	89 (1.1)	▲
England †	89 (1.1)	▲
Chinese Taipei	89 (0.7)	▲
Michigan	87 (1.3)	▲
Montgomery County, MD [2]	87 (1.5)	▲
Japan	87 (0.9)	▲
Academy School Dist. #20, CO	87 (1.5)	●
Michigan Invitational Group, MI	87 (1.5)	●
Oregon	86 (1.5)	●
Guilford County, NC [2]	86 (1.9)	●
Missouri	86 (1.3)	●
Project SMART Consortium, OH	85 (2.1)	●
Hong Kong, SAR †	85 (0.8)	▲
SW Math/Sci. Collaborative, PA	85 (1.4)	●
First in the World Consort., IL	85 (2.1)	●
Idaho	85 (1.5)	●
Illinois	85 (1.3)	●
Indiana †	84 (1.3)	●
Connecticut	84 (1.7)	●
Massachusetts	83 (1.6)	●
Pennsylvania	83 (1.6)	●
Canada	83 (1.2)	●
United States	83 (0.8)	●
Texas	83 (2.0)	●
Fremont/Lincoln/WestSide PS, NE	82 (2.4)	●
Italy	82 (1.3)	●
North Carolina	82 (1.4)	●
Delaware Science Coalition, DE	81 (2.0)	●
Maryland	81 (1.7)	●
South Carolina	80 (1.7)	●
Korea, Rep. of	78 (0.9)	▼
Chicago Public Schools, IL	77 (2.5)	●
Rochester City Sch. Dist., NY	76 (1.9)	▼
Miami-Dade County PS, FL	74 (2.6)	▼
Jersey City Public Schools, NJ	71 (2.9)	▼
International Avg. (All Countries)	82 (0.2)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 2.24 Lower Quarter TIMSS International Benchmark – Example Item 20

An Item That Students Reaching the Lower Quarter International Benchmark Are Likely to Answer Correctly*

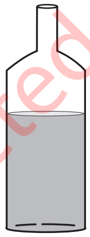
8th Grade Science

Content Area: Physics

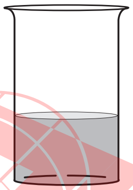
Description: Recognizes the relationship between surface area and evaporation rate.

A student put 100 mL of water in each of the open containers and let them stand in the sun for one day. Which container would probably lose the most water due to evaporation?

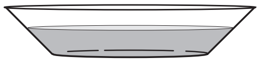
A.



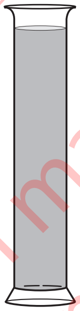
B.



C.



D.



	Overall Percent Correct	
Singapore	98 (0.8)	▲
First in the World Consort., IL	95 (2.0)	▲
Korea, Rep. of	95 (0.8)	▲
Russian Federation	95 (1.4)	▲
Czech Republic	94 (1.6)	▲
Japan	94 (1.2)	▲
Academy School Dist. #20, CO	94 (1.9)	▲
Hong Kong, SAR †	93 (1.2)	▲
Chinese Taipei	93 (0.9)	▲
Project SMART Consortium, OH	92 (2.3)	▲
Naperville Sch. Dist. #203, IL	92 (2.0)	▲
England †	92 (1.7)	▲
Canada	91 (1.2)	▲
Massachusetts	91 (2.2)	●
Michigan	91 (1.7)	▲
SW Math/Sci. Collaborative, PA	90 (2.2)	●
Guilford County, NC ²	90 (2.6)	●
Netherlands †	89 (4.7)	●
Michigan Invitational Group, MI	89 (2.5)	●
Connecticut	88 (3.3)	●
Missouri	87 (2.2)	●
South Carolina	87 (2.1)	●
Montgomery County, MD ²	87 (4.6)	●
North Carolina	87 (2.1)	●
Illinois	87 (2.5)	●
Idaho	86 (2.0)	●
Rochester City Sch. Dist., NY	86 (3.6)	●
Pennsylvania	86 (2.1)	●
Belgium (Flemish) †	84 (3.1)	●
United States	84 (1.3)	●
Delaware Science Coalition, DE	84 (3.5)	●
Maryland	83 (2.1)	●
Oregon	82 (3.1)	●
Texas	82 (3.7)	●
Indiana †	81 (2.3)	●
Jersey City Public Schools, NJ	79 (3.0)	●
Fremont/Lincoln/WestSide PS, NE	73 (3.4)	▼
Miami-Dade County PS, FL	72 (2.7)	▼
Chicago Public Schools, IL	71 (4.0)	▼
Italy	70 (2.3)	▼
International Avg. (All Countries)	84 (0.3)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Participant average significantly higher than international average	▲
No statistically significant difference between participant average and international average	●
Participant average significantly lower than international average	▼

Significance tests adjusted for multiple comparisons

---

* The item was answered correctly by a majority of students reaching this benchmark.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

² National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

What Issues Emerge from the Benchmark Descriptions?

The benchmark descriptions and example items reveal a gradation in achievement, from the top-performing students' ability to grasp complex and abstract science concepts, apply knowledge to solve problems, and understand the fundamentals of scientific investigation to the lower-performing students' recognition of basic facts and familiarity with everyday physical phenomena. The fact that even at the Median Benchmark students had only a very limited knowledge of chemical concepts suggests a need to reevaluate the attention paid to chemistry in eighth-grade science curricula. In addition, knowledge of systems and cycles in the life and physical sciences was demonstrated mainly by students scoring at the upper benchmarks, indicating that more emphasis in these areas may be needed. Basic scientific inquiry skills also were more in evidence among students scoring at the upper benchmarks, indicating that science curricula in many countries may not be stressing scientific investigation by grade 8.

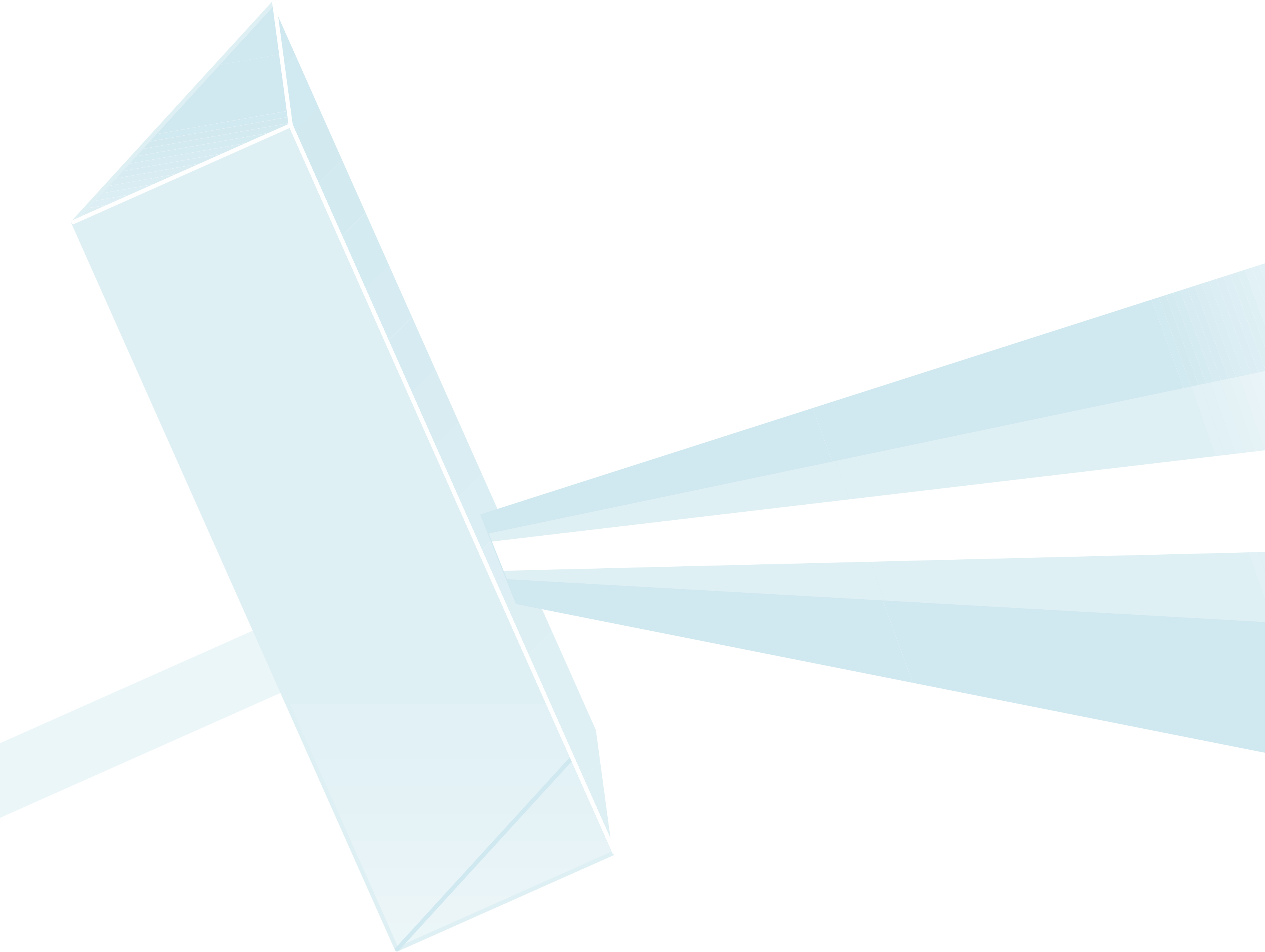
In reviewing the item-level results, it is also important to note the variation in performance across the topics covered. On the 20 items presented in this chapter, there was a substantial range in performance for many Benchmarking participants. In some cases, differences in performance may reflect intended differences in emphasis in the curriculum. It is likely, however, that such results may be unintended, and the findings will provide important information about strengths and weaknesses in the intended or implemented curricula. At the very least, an in-depth examination of the TIMSS 1999 results may reveal aspects of curricula that merit further investigation.

CHAPTER 3

Average Achievement in the Science Content Areas

Chapter 3 presents results by the major content areas in science to provide information about the possible effects of curricular variation on average achievement. Average performance is provided for six content areas: earth science; life science; physics; chemistry; environmental and resource issues; scientific inquiry and the nature of science.

3



As delineated by the curriculum of the countries around the world and in the Benchmarking entities, science contains a range of content areas (see Chapter 5 on curriculum). For example, almost all TIMSS 1999 countries and Benchmarking participants reported some elements of earth science, life science, physics, and chemistry in the eighth-grade science curriculum. Since these content areas can differ in complexity, enter the curriculum at different times, receive varying degrees of emphasis, or even be taught as separate courses, Chapter 3 presents results by the major content areas in science. For each Benchmarking entity, average achievement is shown for each content area and compared with the international average for that content area, and average achievement in the content areas is profiled in relation to overall science achievement. Results are also provided by gender. These different perspectives are provided to identify the relative strengths and weaknesses of students in the different science content areas as well as the possible effects of curricular variation on average achievement.

The TIMSS 1999 science test for the eighth grade was designed to enable reporting by six content areas in accordance with the TIMSS science framework. These areas, with their main topics, are:

- Earth science

  Includes earth features, earth processes, and earth in the universe

- Life science

  Includes diversity, organization and structure of living things; life processes and systems enabling life functions; life spirals, genetic continuity and diversity; interactions of living things; and human biology and health

- Physics

  Includes physical properties and transformations; energy and physical processes; and forces and motion

- Chemistry

  Includes classification and structure of matter; chemical properties; and chemical transformations

- Environmental and resource issues

  Includes pollution; conservation of land, water, and sea resources; conservation of material and energy resources; world population; food supply and production; and effects of natural disasters

- Scientific inquiry and the nature of science

  Includes the nature of scientific knowledge; the scientific enterprise; interactions of science, technology, mathematics, and society; and the tools, procedures, and processes used in conducting scientific investigations.

How Does Achievement Differ Across Science Content Areas?

Exhibit 3.1 presents average achievement in each of the six science content areas for the Benchmarking states, districts, and consortia. The Benchmarking jurisdictions as well as selected reference countries are displayed in decreasing order of achievement for each content area, and symbols indicate whether performance is statistically significantly above or below the international average. To allow comparison of the relative performance of each country in each content area, the international average for each content area was scaled to be 488, the same as the overall international average.

The countries scoring highest in the overall science assessment – Chinese Taipei, Singapore, Japan, Korea, and the Netherlands – were generally also the highest scorers in each content area, although with some exceptions and not necessarily in that order. Similarly, the Benchmarking jurisdictions with the highest overall performance – the Naperville School District, the First in the World Consortium, the Michigan Invitational Group, and the Academy School District – were also the highest-scoring jurisdictions in five of the six science content areas (all except scientific inquiry and the nature of science). In all content areas, these Benchmarking participants had average achievement comparable to that of the highest-scoring countries. The four participants with the lowest overall performance – the Rochester City School District, the Chicago Public Schools, the Jersey City Public Schools, and the Miami-Dade County Public Schools – also had the lowest performance in each content area.

In contrast to the consistent performance across content areas displayed by the highest- and lowest-performing entities, performance varied more for entities in the middle of the overall performance distribution. The United States, which performed significantly above the international average in the overall assessment, also had above-average performance in each of the content areas except physics. Performance in Connecticut, Idaho, and Guilford County followed the U.S. pattern. In life science and in scientific inquiry and the nature of science, the two areas in which the United States performed best, some of the lowest-performing Benchmarking participants had more success than in the other content areas. Rochester and Chicago performed at about the international average in both content areas, and Jersey City and Miami-Dade in scientific inquiry and the nature of science.

Exhibits B.1 through B.6 in Appendix B compare average achievement among individual entities for each of the content areas. The exhibits show whether or not the differences in average achievement between pairs of participating entities are statistically significant.

Exhibit 3.1 Average Achievement in Science Content Areas

Earth Science
Average Scale Score
(22 items)

Naperville Sch. Dist. #203, IL	▲	554 (5.6)
Michigan Invitational Group, MI	▲	546 (6.5)
First in the World Consort., IL	▲	539 (3.8)
Chinese Taipei	▲	538 (3.0)
Academy School Dist. #20, CO	▲	535 (3.9)
Netherlands †	▲	534 (7.2)
Japan	▲	533 (6.2)
Belgium (Flemish) †	▲	533 (3.5)
Czech Republic	▲	533 (6.9)
Korea, Rep. of	▲	532 (2.7)
Project SMART Consortium, OH	▲	531 (7.8)
Russian Federation	▲	529 (5.1)
SW Math/Sci. Collaborative, PA	▲	528 (6.6)
Oregon	▲	528 (6.7)
Michigan	▲	526 (7.9)
England †	▲	525 (3.9)
Singapore	▲	521 (7.3)
Guilford County, NC [2]	▲	519 (8.0)
Canada	▲	519 (3.7)
Montgomery County, MD [2]	▲	518 (5.9)
Massachusetts	▲	516 (7.6)
Indiana †	▲	515 (6.3)
Pennsylvania	▲	515 (6.6)
South Carolina	▲	514 (6.5)
Idaho	▲	513 (6.6)
Missouri	▲	511 (5.8)
Connecticut	▲	508 (6.5)
Hong Kong, SAR †	▲	506 (4.3)
Illinois	○	505 (7.2)
United States	▲	504 (4.2)
Texas	○	503 (9.4)
Italy	○	502 (5.9)
North Carolina	○	500 (7.0)
Delaware Science Coalition, DE	○	500 (7.2)
Fremont/Lincoln/WestSide PS, NE	○	497 (4.6)
Maryland	○	495 (6.1)
Rochester City Sch. Dist., NY	▽	461 (5.1)
Chicago Public Schools, IL	▽	456 (4.1)
Jersey City Public Schools, NJ	▽	447 (9.3)
Miami-Dade County PS, FL	▽	446 (9.0)

200 500 800

International Avg. (All Countries) 488 (0.9)

Life Science
Average Scale Score
(40 items)

Naperville Sch. Dist. #203, IL	▲	573 (3.4)
First in the World Consort., IL	▲	567 (4.5)
Academy School Dist. #20, CO	▲	559 (4.6)
Michigan Invitational Group, MI	▲	558 (7.5)
Chinese Taipei	▲	550 (3.3)
SW Math/Sci. Collaborative, PA	▲	544 (8.6)
Czech Republic	▲	544 (4.1)
Michigan	▲	541 (7.6)
Singapore	▲	541 (7.2)
Oregon	▲	541 (5.6)
Project SMART Consortium, OH	▲	540 (8.3)
Indiana †	▲	539 (8.4)
Netherlands †	▲	536 (7.2)
Belgium (Flemish) †	▲	535 (4.6)
Japan	▲	534 (5.4)
Connecticut	▲	533 (9.6)
England †	▲	533 (6.2)
Guilford County, NC [2]	▲	532 (7.6)
Massachusetts	▲	531 (6.4)
Idaho	▲	531 (5.7)
Montgomery County, MD [2]	▲	530 (5.0)
Pennsylvania	▲	530 (7.6)
Korea, Rep. of	▲	528 (3.6)
Missouri	▲	525 (6.1)
Illinois	▲	525 (6.8)
Fremont/Lincoln/WestSide PS, NE	▲	524 (5.7)
Canada	▲	523 (3.8)
United States	▲	520 (4.1)
South Carolina	▲	518 (5.7)
Russian Federation	▲	517 (6.5)
Hong Kong, SAR †	▲	516 (5.5)
Texas	○	513 (9.4)
North Carolina	▲	513 (5.7)
Maryland	▲	510 (6.8)
Delaware Science Coalition, DE	○	507 (7.5)
Italy	○	488 (4.6)
Rochester City Sch. Dist., NY	○	476 (8.7)
Chicago Public Schools, IL	○	471 (10.8)
Jersey City Public Schools, NJ	▽	457 (8.6)
Miami-Dade County PS, FL	▽	445 (12.7)

200 500 800

International Avg. (All Countries) 488 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

- ▲ Participant average significantly higher than international average
- ○ Participant average not significantly different from international average
- ▽ Participant average significantly lower than international average

Significance tests adjusted for multiple comparisons

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90% of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 3.1
(Continued 1)

Average Achievement in Science Content Areas

Physics Average Scale Score (39 items)		
Singapore	▲	570 (6.7)
Naperville Sch. Dist. #203, IL	▲	557 (4.5)
Chinese Taipei	▲	552 (3.9)
Japan	▲	544 (2.9)
Korea, Rep. of	▲	544 (5.1)
First in the World Consort., IL	▲	538 (5.7)
Netherlands †	▲	537 (6.5)
Michigan Invitational Group, MI	▲	536 (7.1)
Academy School Dist. #20, CO	▲	533 (5.8)
Belgium (Flemish) †	▲	530 (3.5)
Russian Federation	▲	529 (6.3)
England †	▲	528 (4.5)
Czech Republic	▲	526 (4.2)
Michigan	▲	524 (6.8)
Hong Kong, SAR †	▲	523 (4.9)
Canada	▲	521 (3.8)
Project SMART Consortium, OH	▲	516 (7.0)
SW Math/Sci. Collaborative, PA	▲	516 (7.2)
Montgomery County, MD [2]	▲	514 (4.0)
Oregon	▲	513 (6.9)
Guilford County, NC [2]	○	510 (7.5)
Massachusetts	▲	510 (5.8)
Indiana †	▲	509 (6.4)
Connecticut	○	508 (8.0)
Idaho	○	507 (7.3)
Missouri	▲	506 (5.6)
Illinois	○	506 (6.4)
Pennsylvania	○	503 (6.5)
United States	○	498 (5.5)
Texas	○	492 (7.9)
Fremont/Lincoln/WestSide PS, NE	○	490 (5.2)
South Carolina	○	488 (6.8)
Maryland	○	487 (7.3)
North Carolina	○	487 (6.7)
Delaware Science Coalition, DE	○	484 (7.5)
Italy	○	480 (4.1)
Chicago Public Schools, IL	▽	453 (7.6)
Rochester City Sch. Dist., NY	▽	452 (6.5)
Jersey City Public Schools, NJ	▽	451 (8.2)
Miami-Dade County PS, FL	▽	440 (9.5)
	200 500 800	
International Avg. (All Countries)		488 (0.9)

Chemistry Average Scale Score (20 items)		
Chinese Taipei	▲	563 (4.3)
Naperville Sch. Dist. #203, IL	▲	558 (4.5)
Michigan Invitational Group, MI	▲	554 (9.4)
Academy School Dist. #20, CO	▲	551 (5.8)
First in the World Consort., IL	▲	548 (6.6)
Singapore	▲	545 (8.3)
SW Math/Sci. Collaborative, PA	▲	537 (7.8)
Michigan	▲	537 (7.2)
Project SMART Consortium, OH	▲	534 (8.6)
Japan	▲	530 (3.1)
Oregon	▲	527 (7.0)
Indiana †	▲	524 (7.4)
England †	▲	524 (5.5)
Korea, Rep. of	▲	523 (3.7)
Russian Federation	▲	523 (8.0)
Massachusetts	▲	522 (7.8)
Connecticut	▲	521 (9.1)
Canada	▲	521 (5.4)
Montgomery County, MD [2]	▲	519 (4.2)
Guilford County, NC [2]	▲	518 (8.6)
Idaho	▲	518 (8.0)
Pennsylvania	○	516 (8.8)
Hong Kong, SAR †	▲	515 (5.2)
Netherlands †	▲	515 (6.4)
Missouri	▲	513 (7.1)
Fremont/Lincoln/WestSide PS, NE	▲	513 (6.2)
Czech Republic	▲	512 (5.2)
Illinois	○	508 (7.1)
United States	▲	508 (4.8)
Belgium (Flemish) †	▲	508 (3.3)
South Carolina	○	502 (8.1)
North Carolina	○	498 (7.8)
Maryland	○	498 (6.9)
Texas	○	497 (10.5)
Delaware Science Coalition, DE	○	495 (8.4)
Italy	○	493 (4.8)
Rochester City Sch. Dist., NY	▽	453 (7.3)
Chicago Public Schools, IL	▽	441 (10.4)
Miami-Dade County PS, FL	▽	436 (10.5)
Jersey City Public Schools, NJ	▽	428 (8.4)
	200 500 800	
International Avg. (All Countries)		488 (0.8)

- ▲ Participant average significantly higher than international average
- ○ Participant average not significantly different from international average
- ▽ Participant average significantly lower than international average

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 3.1
(Continued 2)

Average Achievement in Science Content Areas

Environmental and Resource Issues

Average Scale Score

(13 items)

Singapore	▲	577 (8.3)
Chinese Taipei	▲	567 (4.0)
Naperville Sch. Dist. #203, IL	▲	566 (6.9)
Michigan Invitational Group, MI	▲	550 (8.0)
First in the World Consort., IL	▲	549 (5.9)
Academy School Dist. #20, CO	▲	540 (5.7)
Guilford County, NC 2	▲	531 (9.3)
Michigan	▲	529 (7.5)
SW Math/Sci. Collaborative, PA	▲	528 (6.8)
Indiana †	▲	527 (7.1)
Netherlands †	▲	526 (8.5)
Project SMART Consortium, OH	▲	525 (7.8)
Korea, Rep. of	▲	523 (4.5)
Idaho	▲	522 (7.1)
Pennsylvania	▲	522 (8.3)
Massachusetts	▲	522 (8.1)
Canada	▲	521 (3.5)
Oregon	▲	520 (6.5)
Hong Kong, SAR †	▲	518 (4.9)
England †	▲	518 (5.8)
Montgomery County, MD 2	▲	517 (6.4)
Czech Republic	▲	516 (5.7)
Connecticut	▲	515 (7.5)
Missouri	▲	514 (7.2)
Belgium (Flemish) †	▲	513 (3.5)
Illinois	▲	513 (6.8)
United States	▲	509 (6.4)
Fremont/Lincoln/WestSide PS, NE	▲	508 (5.2)
Japan	▲	506 (5.5)
South Carolina	○	505 (9.1)
North Carolina	○	505 (7.2)
Maryland	○	505 (6.4)
Texas	○	502 (9.6)
Russian Federation	○	495 (6.6)
Delaware Science Coalition, DE	○	494 (7.3)
Italy	○	491 (5.4)
Jersey City Public Schools, NJ	▽	451 (10.1)
Chicago Public Schools, IL	▽	442 (9.8)
Rochester City Sch. Dist., NY	▽	438 (9.6)
Miami-Dade County PS, FL	▽	426 (11.9)

200 500 800

International Avg. (All Countries) 488 (0.7)

Scientific Inquiry and the Nature of Science

Average Scale Score

(12 items)

Naperville Sch. Dist. #203, IL	▲	581 (3.8)
First in the World Consort., IL	▲	574 (8.8)
Singapore	▲	550 (5.9)
Korea, Rep. of	▲	545 (7.3)
Michigan Invitational Group, MI	▲	545 (5.1)
Japan	▲	543 (2.8)
Massachusetts	▲	542 (4.7)
Montgomery County, MD 2	▲	542 (4.4)
SW Math/Sci. Collaborative, PA	▲	541 (5.9)
Academy School Dist. #20, CO	▲	541 (5.1)
Chinese Taipei	▲	540 (4.9)
Michigan	▲	538 (6.8)
England †	▲	538 (5.1)
Netherlands †	▲	534 (6.5)
Connecticut	▲	533 (7.3)
Guilford County, NC 2	▲	533 (6.8)
Canada	▲	532 (5.1)
Illinois	▲	532 (8.3)
Pennsylvania	▲	531 (5.4)
Hong Kong, SAR †	▲	531 (2.8)
Indiana †	▲	527 (5.0)
Project SMART Consortium, OH	▲	527 (8.7)
Belgium (Flemish) †	▲	526 (4.9)
Oregon	▲	525 (6.0)
Maryland	▲	524 (5.4)
United States	▲	522 (4.3)
Czech Republic	▲	522 (5.7)
South Carolina	▲	521 (6.7)
North Carolina	▲	516 (5.1)
Missouri	▲	515 (4.1)
Texas	▲	514 (7.6)
Idaho	▲	513 (7.1)
Fremont/Lincoln/WestSide PS, NE	○	511 (8.4)
Delaware Science Coalition, DE	○	501 (7.3)
Jersey City Public Schools, NJ	○	492 (9.8)
Chicago Public Schools, IL	○	491 (8.1)
Russian Federation	○	491 (4.9)
Italy	○	489 (4.6)
Rochester City Sch. Dist., NY	○	476 (7.9)
Miami-Dade County PS, FL	○	462 (9.4)

200 500 800

International Avg. (All Countries) 488 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲	Participant average significantly higher than international average
○	Participant average not significantly different from international average
▽	Participant average significantly lower than international average

Significance tests adjusted for multiple comparisons

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

2 National Defined Population covers less than 90% of National Desired Population (see Exhibit A.3).

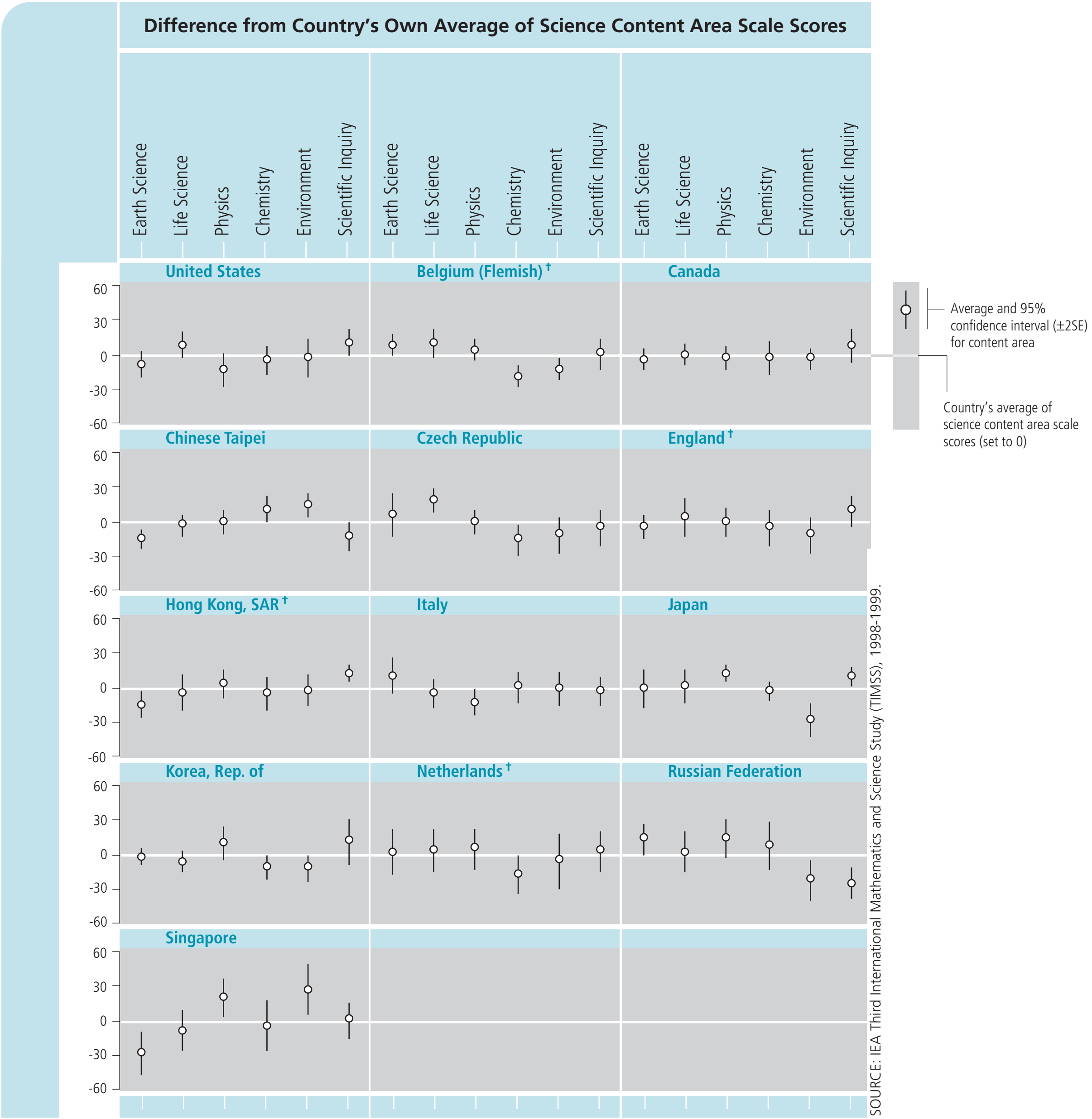
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

In Which Content Areas Are Countries Relatively Strong or Weak?

For purposes of comparison, Exhibit 3.2 profiles the relative performance in science content areas within the comparison countries, while Exhibit 3.3 provides the corresponding information for the Benchmarking states and Exhibit 3.4 for the districts and consortia. These exhibits display the difference between average performance in each content area and average science performance overall, highlighting any variation. The profiles reveal that as in the participating countries, students in many of the Benchmarking jurisdictions performed relatively better or worse in several content areas than they did overall. For example, the Benchmarking entities generally approximated the U.S. pattern of performing better in life science and in scientific inquiry and the nature of science than they did overall.

In particular, a number of jurisdictions had relatively high performance in scientific inquiry and the nature of science, including Maryland, Massachusetts, Chicago, Jersey City, Montgomery County, and Naperville. Although the difference was not large, physics was the content area in which the performance of students in the United States was weakest relative to overall science performance. Several of the Benchmarking participants also had relatively low physics performance, although only in South Carolina and the Fremont/Lincoln/Westside Public Schools was the difference statistically significant.

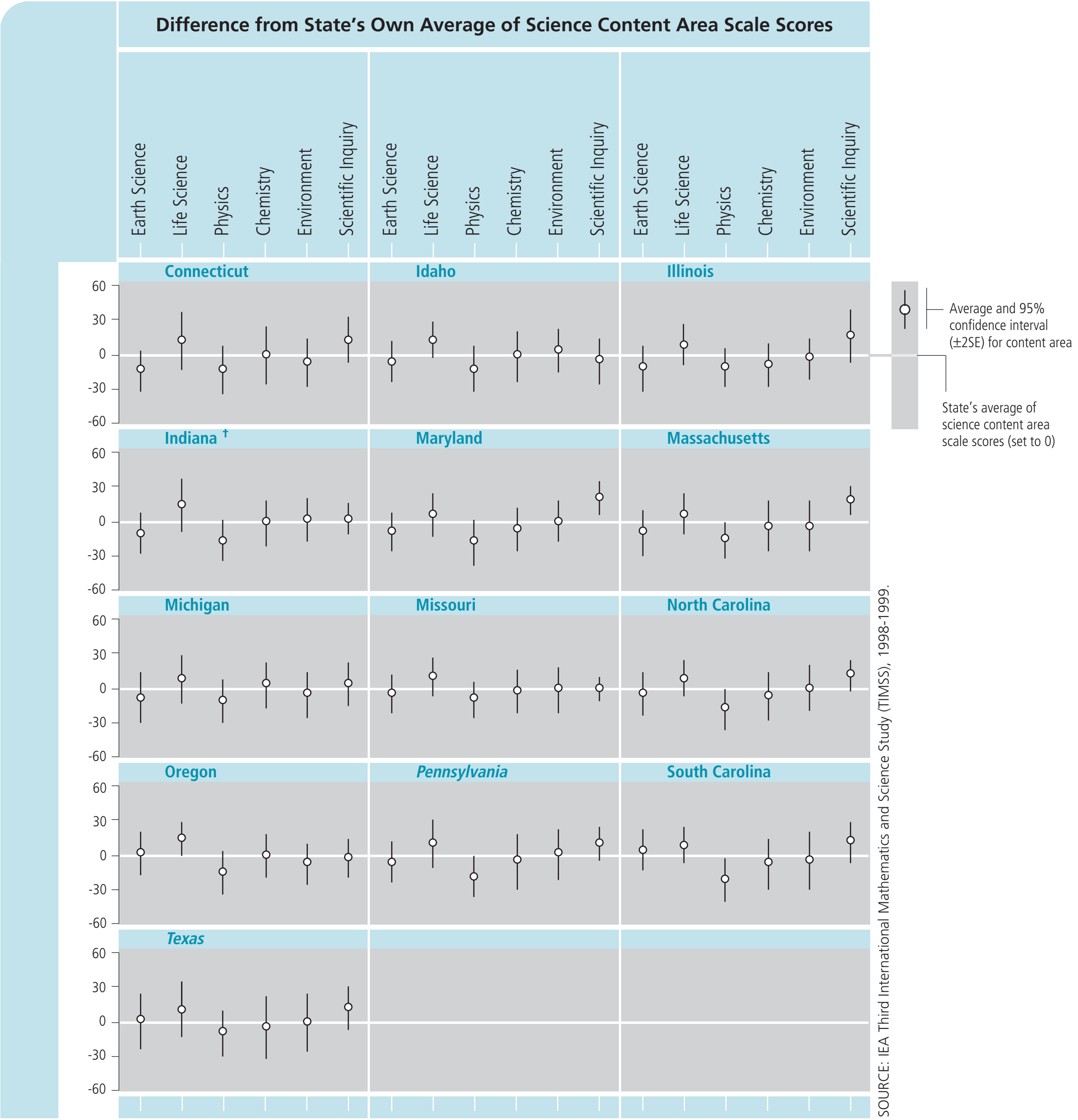
Differences in relative performance may be related to one or more of a number of factors, such as emphases in intended curricula or widely used textbooks, strengths or weaknesses in curriculum implementation, and the grade level at which topics are introduced. For the Benchmarking entities, the patterns of relative strengths and weaknesses profiled in Exhibits 3.3 and 3.4 are sometimes reflected in strengths and weaknesses relative to other countries and the United States (shown in Exhibit 3.1).



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

States' Profiles of Relative Performance in Science Content Areas

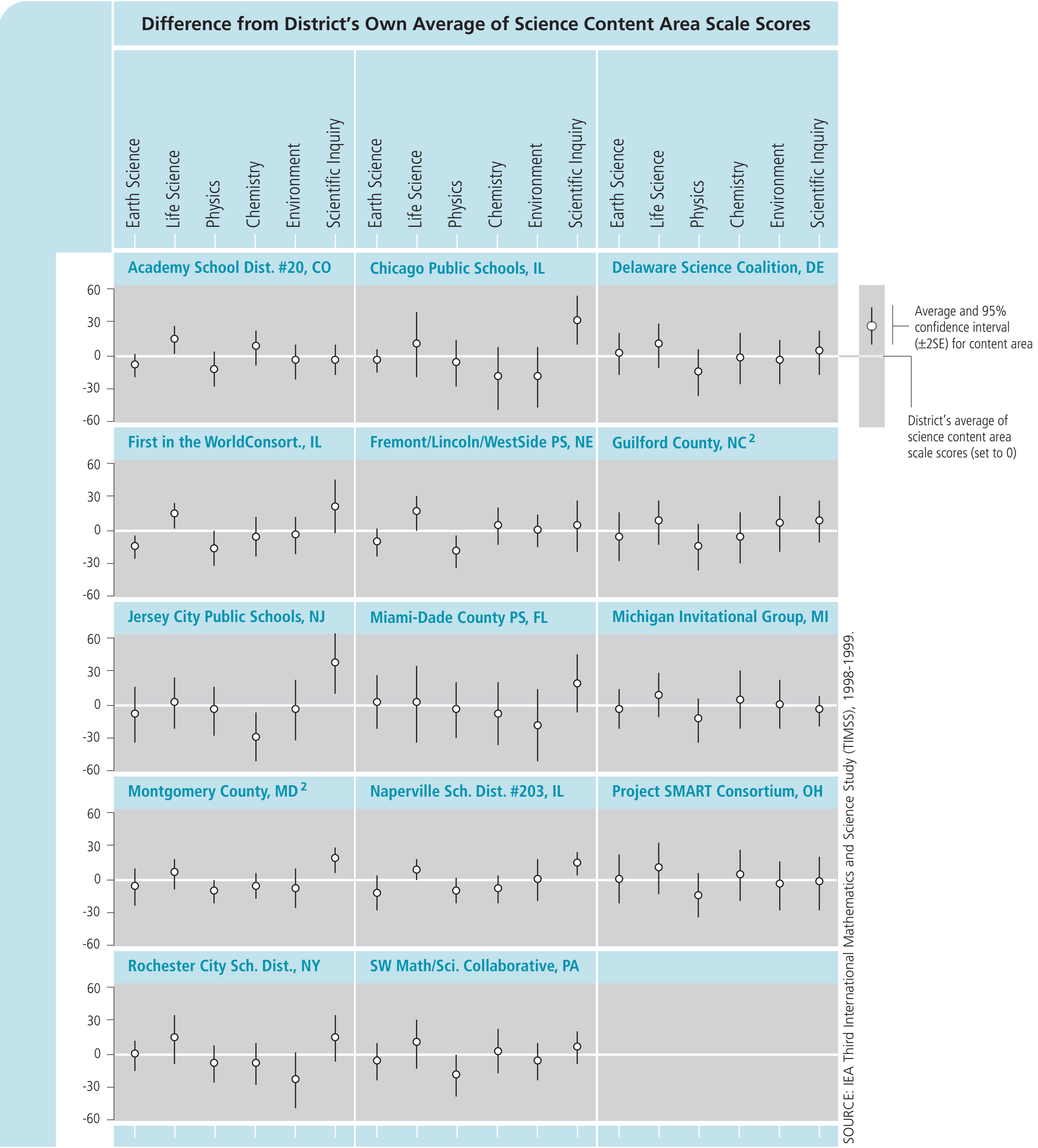


SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

Exhibit 3.4 Districts' and Consortia's Profiles of Relative Performance in Science Content Areas



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

2 National Defined Population covers less than 90% of National Desired Population (see Exhibit A.3).

What Are the Gender Differences in Achievement for the Content Areas?

Exhibit 3.5 displays average achievement in science content areas by gender for the Benchmarking entities as well as for the comparison countries. On average across all the TIMSS 1999 countries, boys outperformed girls in earth science, physics, chemistry, and environmental and resource issues. In the United States this gender difference was evident only in earth science. There were no gender differences in any country or Benchmarking participant in scientific inquiry and the nature of science; in life science, only the First in the World Consortium had a significant difference, in favor of boys. Among Benchmarking participants, gender differences were relatively rare, and were found mostly in physics, chemistry, and earth science. In physics, boys significantly outperformed girls in Connecticut, Illinois, North Carolina, Oregon, Texas, First in the World, Guilford County, Naperville, and the Southwest Pennsylvania Math and Science Collaborative. In chemistry, boys performed better in Indiana, Massachusetts, Oregon, Pennsylvania, Chicago, the Delaware Science Coalition, Guilford County, and the Southwest Pennsylvania Math and Science Collaborative. Boys scored better in earth science in Idaho, Indiana, Maryland, Michigan, and the Southwest Pennsylvania Math and Science Collaborative. Gender differences favoring boys in environmental and resource issues were found in Connecticut, Massachusetts, and Jersey City.

The patterns in the performance of girls and boys found in TIMSS 1999 are consistent with previous IEA science assessments. Girls tended to perform about the same as boys in life science in both TIMSS 1995 and the Second International Science Study (SISS),[1] while boys were markedly stronger in earth science, physics, and chemistry.

---

[1] Postlethwaite T.N. and Wiley, D.E. (1992), *The IEA Study of Science II: Science Achievement in Twenty-Three Countries*, New York, NY: Pergamon Press; Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996a), *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS)*, Chestnut Hill, MA: Boston College.

Exhibit 3.5 Average Achievement in Science Content Areas by Gender

8th Grade Science

	Average Scale Scores for Science Content Areas					
	Earth Science		Life Science		Physics	
	Girls	Boys	Girls	Boys	Girls	Boys
Countries						
United States	490 (5.2)	518 (5.5) ▲	518 (4.4)	522 (5.0)	488 (6.7)	509 (6.8)
Belgium (Flemish) †	521 (5.7)	544 (8.1)	530 (5.9)	539 (8.1)	521 (4.1)	539 (7.3)
Canada	510 (8.6)	528 (3.0)	523 (5.0)	523 (4.6)	512 (4.3)	530 (4.9) ▲
Chinese Taipei	529 (7.4)	546 (7.0)	543 (3.8)	557 (6.5)	542 (6.6)	563 (6.8)
Czech Republic	513 (8.2)	554 (9.2) ▲	537 (4.8)	552 (5.7)	510 (6.2)	544 (6.8) ▲
England †	514 (6.2)	536 (6.4)	525 (6.9)	540 (7.2)	513 (5.8)	543 (5.3) ▲
Hong Kong, SAR †	499 (6.1)	513 (6.2)	512 (8.6)	520 (7.4)	514 (5.8)	532 (6.0)
Italy	493 (6.5)	512 (6.8)	482 (6.5)	494 (5.1)	469 (5.5)	490 (7.1)
Japan	527 (7.9)	539 (8.0)	532 (6.4)	536 (5.7)	537 (4.6)	552 (2.7)
Korea, Rep. of	525 (4.0)	539 (4.2)	520 (5.6)	536 (3.3)	534 (6.5)	553 (5.7)
Netherlands †	525 (8.5)	544 (10.2)	535 (9.6)	537 (7.8)	524 (6.6)	550 (7.7) ▲
Russian Federation	518 (7.4)	541 (6.3)	513 (8.6)	522 (7.6)	518 (7.3)	542 (7.5)
Singapore	510 (7.0)	532 (9.9)	536 (7.9)	546 (9.8)	557 (6.9)	581 (8.4)
States						
Connecticut	500 (8.5)	517 (6.8)	530 (10.3)	536 (10.2)	494 (8.6)	523 (8.5) ▲
Idaho	500 (6.1)	526 (8.6) ▲	526 (5.5)	535 (7.4)	494 (8.4)	519 (8.4)
Illinois	496 (7.1)	514 (12.4)	518 (7.9)	532 (8.1)	492 (7.0)	519 (7.0) ▲
Indiana †	503 (7.4)	528 (6.9) ▲	537 (9.6)	542 (8.4)	498 (7.3)	521 (7.5)
Maryland	486 (7.2)	506 (5.8) ▲	509 (7.8)	510 (8.0)	476 (8.3)	500 (9.8)
Massachusetts	508 (10.4)	524 (7.1)	531 (6.1)	532 (7.5)	503 (6.2)	517 (7.5)
Michigan	514 (8.5)	539 (8.4) ▲	538 (8.7)	544 (9.2)	512 (8.0)	536 (8.5)
Missouri	502 (6.8)	520 (6.1)	519 (7.8)	531 (5.8)	493 (8.6)	519 (6.6)
North Carolina	493 (8.6)	508 (7.7)	510 (5.5)	516 (7.2)	475 (8.4)	501 (7.3) ▲
Oregon	520 (6.7)	537 (8.6)	536 (6.9)	545 (8.1)	498 (7.4)	529 (7.9) ▲
Pennsylvania	508 (8.6)	524 (11.1)	526 (8.7)	535 (8.1)	490 (7.7)	516 (9.1)
South Carolina	507 (7.5)	521 (9.5)	518 (6.7)	518 (6.8)	481 (7.8)	496 (7.2)
Texas	494 (10.6)	511 (10.7)	509 (8.6)	516 (11.2)	477 (8.0)	507 (9.9) ▲
Districts and Consortia						
Academy School Dist. #20, CO	524 (5.3)	545 (5.3)	562 (4.2)	556 (7.6)	522 (6.7)	543 (7.3)
Chicago Public Schools, IL	451 (8.0)	462 (6.1)	470 (12.5)	473 (12.8)	445 (7.7)	463 (9.4)
Delaware Science Coalition, DE	493 (10.0)	506 (9.3)	508 (8.4)	507 (9.2)	474 (9.8)	494 (8.4)
First in the World Consort., IL	531 (6.4)	546 (6.8)	556 (5.9)	578 (5.1) ▲	522 (6.4)	553 (7.2) ▲
Fremont/Lincoln/WestSide PS, NE	487 (7.2)	507 (6.7)	528 (6.3)	520 (9.0)	479 (7.6)	501 (7.8)
Guilford County, NC [2]	514 (12.4)	526 (8.7)	525 (8.5)	540 (9.0)	493 (8.3)	530 (9.8) ▲
Jersey City Public Schools, NJ	441 (10.2)	455 (10.0)	457 (8.4)	457 (10.8)	440 (10.3)	463 (9.7)
Miami-Dade County PS, FL	436 (9.5)	455 (9.5)	439 (10.0)	449 (16.2)	432 (9.3)	447 (11.8)
Michigan Invitational Group, MI	539 (7.1)	554 (8.2)	557 (8.1)	559 (9.6)	524 (6.7)	549 (10.2)
Montgomery County, MD [2]	505 (8.8)	533 (6.7)	528 (5.4)	532 (9.2)	502 (7.9)	526 (4.5)
Naperville Sch. Dist. #203, IL	551 (8.2)	558 (7.4)	568 (5.3)	579 (4.3)	542 (6.9)	571 (5.4) ▲
Project SMART Consortium, OH	525 (9.6)	537 (8.7)	544 (10.4)	535 (8.9)	509 (8.3)	524 (9.5)
Rochester City Sch. Dist., NY	453 (7.2)	470 (6.3)	473 (9.4)	478 (9.8)	443 (6.6)	462 (8.6)
SW Math/Sci. Collaborative, PA	516 (6.7)	542 (7.7) ▲	535 (10.0)	554 (10.9)	500 (8.4)	532 (9.0) ▲
International Avg. (All Countries)	479 (1.1)	496 (1.1) ▲	487 (1.0)	488 (1.1)	477 (1.0)	498 (1.1) ▲

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.6).

[2] National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.3).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 3.5
(Continued)

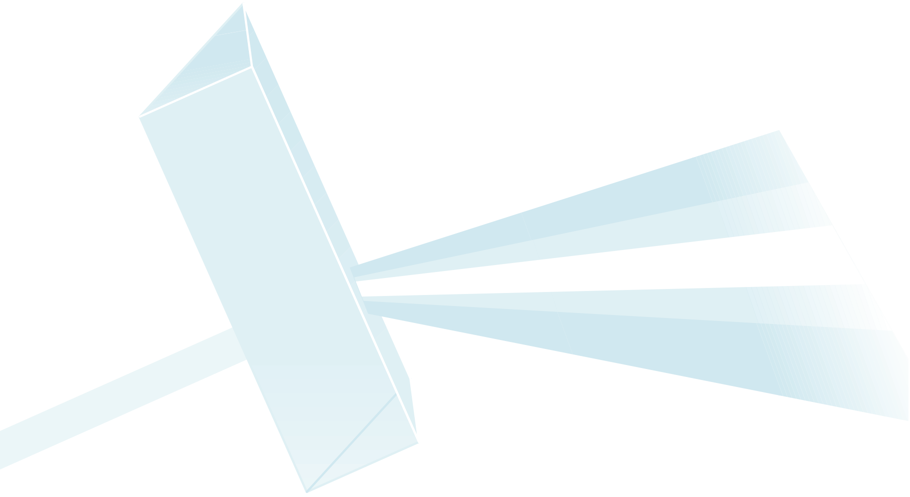
Average Achievement in Science Content Areas by Gender

	Average Scale Scores for Science Content Areas					
	Chemistry		Enviromental and Resource Issues		Scientific Inquiry and the Nature of Science	
	Girls	Boys	Girls	Boys	Girls	Boys
Countries						
United States	495 (6.1)	520 (7.0)	500 (7.0)	519 (9.6)	521 (5.4)	523 (6.2)
Belgium (Flemish) †	500 (6.6)	515 (6.4)	503 (5.3)	523 (8.1)	528 (5.7)	524 (7.2)
Canada	512 (6.3)	531 (7.4)	514 (4.8)	529 (6.0)	535 (5.4)	530 (5.3)
Chinese Taipei	555 (4.1)	571 (8.3)	555 (6.7)	579 (4.9)	544 (5.3)	537 (5.4)
Czech Republic	492 (6.7)	532 (8.8) ▲	502 (5.8)	530 (7.1) ▲	524 (4.9)	519 (8.9)
England †	503 (6.8)	543 (6.6) ▲	503 (7.5)	532 (5.6) ▲	536 (5.7)	540 (8.3)
Hong Kong, SAR †	508 (8.3)	522 (4.5)	510 (5.4)	526 (6.2)	535 (3.2)	527 (4.0)
Italy	485 (7.0)	501 (5.1)	482 (6.4)	499 (4.9) ▲	486 (5.4)	492 (5.8)
Japan	522 (5.0)	537 (2.7)	500 (8.6)	511 (5.9)	546 (6.3)	540 (5.9)
Korea, Rep. of	515 (9.1)	532 (5.5)	516 (3.0)	529 (7.5)	547 (10.1)	544 (6.5)
Netherlands †	505 (7.3)	526 (7.5)	517 (10.4)	536 (9.0)	539 (8.8)	530 (9.1)
Russian Federation	516 (9.9)	531 (7.6)	490 (7.5)	499 (9.5)	491 (4.3)	491 (9.5)
Singapore	535 (9.8)	554 (11.3)	570 (10.1)	584 (11.5)	552 (6.5)	548 (6.6)
States						
Connecticut	510 (9.8)	534 (10.8)	500 (8.5)	531 (8.9) ▲	532 (7.9)	534 (8.6)
Idaho	509 (9.7)	526 (8.5)	513 (7.2)	530 (8.7)	515 (7.0)	513 (9.9)
Illinois	494 (8.4)	522 (9.1)	503 (8.8)	523 (7.5)	534 (10.7)	531 (7.6)
Indiana †	510 (6.8)	539 (9.2) ▲	516 (8.2)	538 (9.2)	526 (5.6)	529 (7.3)
Maryland	486 (9.6)	510 (6.3)	493 (8.5)	518 (6.6)	526 (6.2)	521 (7.6)
Massachusetts	512 (9.2)	532 (7.4) ▲	512 (9.2)	531 (8.2) ▲	545 (6.4)	540 (5.5)
Michigan	526 (9.1)	548 (8.9)	519 (8.7)	538 (7.6)	539 (7.2)	537 (7.4)
Missouri	504 (9.4)	522 (6.5)	505 (9.4)	524 (7.4)	516 (5.0)	514 (6.3)
North Carolina	489 (9.4)	510 (8.9)	503 (6.5)	508 (11.2)	518 (5.8)	514 (6.4)
Oregon	513 (6.9)	540 (9.0) ▲	511 (8.4)	528 (7.7)	527 (6.1)	523 (8.6)
Pennsylvania	503 (8.4)	530 (10.1) ▲	512 (10.6)	532 (9.5)	536 (6.9)	527 (5.9)
South Carolina	498 (9.9)	507 (9.0)	496 (8.0)	516 (11.9)	521 (9.1)	521 (6.4)
Texas	481 (11.5)	512 (12.7)	491 (10.1)	512 (12.1)	522 (7.1)	507 (9.1)
Districts and Consortia						
Academy School Dist. #20, CO	544 (9.5)	559 (6.1)	533 (10.2)	545 (7.0)	550 (8.9)	531 (5.3)
Chicago Public Schools, IL	423 (11.3)	461 (11.7) ▲	433 (11.5)	453 (10.7)	497 (8.9)	485 (9.4)
Delaware Science Coalition, DE	478 (8.2)	513 (11.3) ▲	484 (9.3)	504 (9.1)	502 (7.4)	500 (9.5)
First in the World Consort., IL	532 (9.2)	564 (8.1)	535 (9.9)	563 (6.2)	585 (10.3)	562 (12.6)
Fremont/Lincoln/WestSide PS, NE	500 (9.3)	524 (9.0)	499 (8.0)	516 (6.7)	513 (8.4)	510 (13.3)
Guilford County, NC [2]	505 (9.6)	534 (9.7) ▲	523 (10.6)	540 (9.6)	531 (8.1)	534 (12.1)
Jersey City Public Schools, NJ	413 (9.8)	444 (10.0)	435 (10.1)	469 (12.6) ▲	494 (10.1)	490 (10.6)
Miami-Dade County PS, FL	422 (11.1)	450 (11.5)	418 (12.6)	433 (13.6)	467 (9.1)	457 (12.2)
Michigan Invitational Group, MI	543 (10.4)	565 (10.2)	536 (8.9)	564 (13.7)	552 (6.3)	538 (6.9)
Montgomery County, MD [2]	513 (6.2)	524 (5.4)	509 (7.4)	525 (7.4)	543 (6.1)	540 (5.9)
Naperville Sch. Dist. #203, IL	553 (6.2)	564 (5.0)	558 (6.9)	575 (11.0)	580 (5.4)	582 (5.4)
Project SMART Consortium, OH	528 (8.5)	539 (12.3)	516 (9.1)	534 (8.9)	535 (8.9)	519 (9.8)
Rochester City Sch. Dist., NY	442 (8.8)	465 (9.8)	427 (12.5)	450 (10.7)	474 (9.5)	478 (11.1)
SW Math/Sci. Collaborative, PA	526 (7.9)	548 (8.8) ▲	517 (9.1)	540 (6.8)	537 (5.8)	544 (7.1)
International Avg. (All Countries)	480 (1.1)	495 (1.1) ▲	481 (1.1)	494 (1.2) ▲	489 (1.0)	486 (1.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

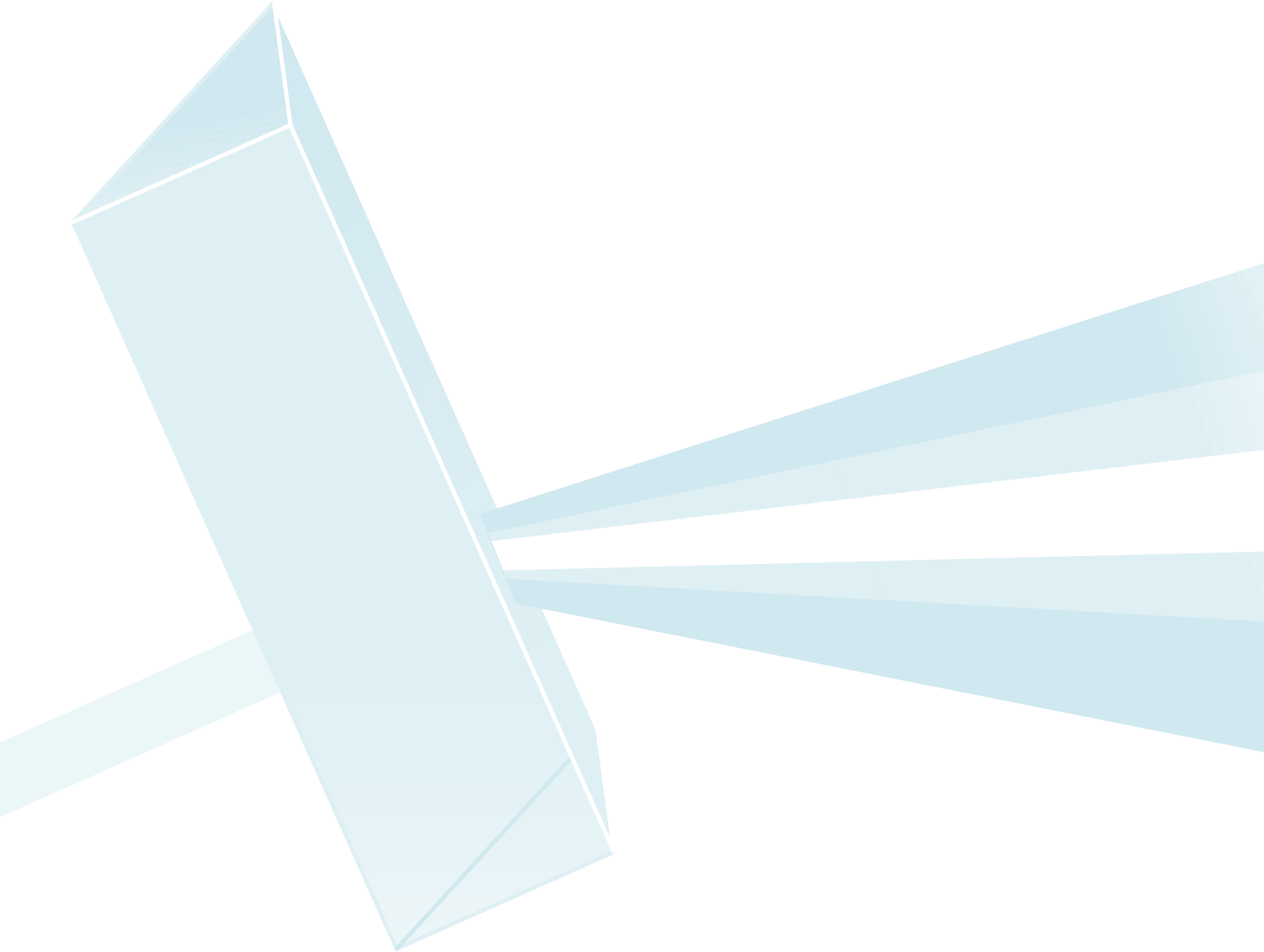


CHAPTER 4

Students' Backgrounds and Attitudes Towards Science

There is abundant evidence that student achievement is related to home background factors, and to students' activities and attitudes. To help interpret the achievement results, Chapter 4 provides detailed information about students' home backgrounds, how they spend their time out of school, their self-concept in science, and their attitudes towards science.

4



To provide an educational context for interpreting the achievement results of the Benchmarking participants, TIMSS collected detailed information from students about their home backgrounds, how they spend their time, and their attitudes towards science. This chapter presents eighth-grade students' responses to a subset of these questions. One set addresses home resources and support for academic achievement. Another examines how much out-of-school time students spend on their schoolwork. A third addresses students' self-concept in science and their feelings towards science.

In an effort to summarize this information concisely and focus attention on educationally relevant support and practice, TIMSS sometimes has combined information from individual questions to form an index that was more global and reliable than the component questions (e.g., home educational resources). According to their responses, students were placed in a "high," "medium," or "low" category. Cutoff points were established so that the high level of an index corresponds to conditions or activities generally associated with good educational practice and high academic achievement. For each index, the percentages of students in each category are presented in relation to their science achievement. The data from the component questions and more detail about some areas are provided in the reference section of this report (see reference section R1).

What Educational Resources Do Students Have in Their Homes?

There is no shortage of evidence that students from homes with extensive educational resources have higher achievement in science and other subjects than those from less advantaged backgrounds. TIMSS in 1995 showed that this was true of students from homes with large numbers of books, with a range of educational study aids, or with parents with university-level education.[1] The TIMSS 1999 international report presented combined student responses to these three variables in an index of home educational resources (HER) that was clearly related to achievement in science.[2]

Exhibit 4.1 summarizes the home educational resources index in a two-page display. The index is described on the first page. Students at the high level of this index reported coming from homes with more than 100 books, with all three study aids (a computer, a study desk or table for the student's own use, and a dictionary), and where at least one

---

[1] Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996), *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*, Chestnut Hill, MA: Boston College.

[2] Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Gregory, K.D., Smith, T.A., Chrostowski, S.J., Garden, R.A., and O'Connor, K.M. (2000), *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College.

parent finished university. Students at the low level had 25 or fewer books in the home, not all three study aids, and parents that had not completed secondary education. The remaining students were assigned to the medium level.

The first page of the display also presents the percentage of students at each level of the index for each Benchmarking participant and for selected reference countries, together with the average science achievement for those students. Standard errors are also shown. Entities are ordered by the percentage of students at the high index level. The international average across all TIMSS 1999 countries is shown at the bottom. The second page of the display graphically shows the percentage of students at the high index level for each entity. There was a substantial difference in the average science achievement of students at the index levels in every entity for which data were available. This is reflected in the international average for the TIMSS 1999 countries, where the achievement difference between students at the high level (558) and the low level (431) amounted to 127 score points.

Relative to other countries, the United States had a large percentage of students at the high level of the home educational resources index (22 percent). Of the TIMSS 1999 countries included in Exhibit 4.1, only Canada had a comparable percentage of students at the high level (27 percent). The relatively high standing of the United States on this index was reflected in the results for the Benchmarking jurisdictions, most of which had larger percentages of students in the high category of home educational resources than did most of the comparison countries.

The Benchmarking participants with the greatest percentages of students at the high level included the Naperville School District (56 percent), the First in the World Consortium (45 percent), the Academy School District (44 percent), and Montgomery County (39 percent). With the exception of Montgomery County, these were also among the top-performing jurisdictions in science. The four urban Benchmarking school districts that had the lowest student achievement in science – the Rochester City School District, the Chicago Public Schools, the Jersey City Public Schools, and the Miami-Dade County Public Schools – also had the lowest percentages of students at the high level of the home educational resources index (only 7 to 10 percent).

Since the association between home educational resources and science achievement is well documented in TIMSS and in extensive educational research, low average student achievement in the less wealthy areas most likely reflects the low level of educational resources in students' homes. However, since there is far from a one-to-one correspondence between high performance and home resources, clearly other influences are also at work. For example, Chinese Taipei had about the same percentage of students (eight percent) at the high index level as Rochester, Chicago, Jersey City, and Miami-Dade, but the average science achievement of its students at that level was considerably higher. In fact, the international average for all 38 TIMSS 1999 countries was just nine percent. There is also evidence that financial resources alone will not result in high academic achievement. According to OECD analyses for 1994, U.S. schools ranked third highest among 22 countries in per-student expenditures on primary schools and third highest among 23 countries on secondary schools.[3]

Exhibits R1.1 through R1.3 in the reference section present more detailed information on the student responses that were combined in the home educational resources index. Exhibit R1.1 shows the percentage of eighth-grade students in each of the Benchmarking jurisdictions and comparison countries who had a dictionary, study desk or table, or computer, and shows that students reporting having all three had higher average science achievement than those without all three.

Exhibit R1.2 shows for each entity the percentage of students at each of five ranges of numbers of books in the home in relation to average science achievement. In most jurisdictions, the more books students reported in the home, the higher their science achievement.

The percentages of students in each of five categories of parents' educational level are shown in Exhibit R1.3, together with their average science achievement. Although countries did their best to use educational categories that were comparable across all countries, the range of educational provision made this difficult. About half of the participating countries had to modify the response options presented to students in the questionnaire in order to conform to their national education system. Exhibit R1.4 provides details of how these modifications were aligned with the categories of parents' education used in this report. Despite the different educational approaches, structures, and organizations across the TIMSS 1999 countries, it is clear that parents' education is positively related to students' science achievement. The pattern across countries was that eighth-grade students whose parents had more education were also those who had higher achievement in science. The same was true for nearly all Benchmarking jurisdictions.

As information technology and the Internet become more and more important as an educational resource, those who do not have access to this technology will be increasingly at a disadvantage. To provide information about this "digital divide," Exhibit 4.2 presents the percentage of students in each entity that reported having a computer at home,

text continued on page 116

---

[3] *Education at a Glance: OECD Indicators* (1997), Paris, France: Organization for Economic Cooperation and Development. The OECD adjusted the expenditure estimates for the purchasing power of each country's currency.

Exhibit 4.1 Index of Home Educational Resources (HER)

8th Grade Science

Index of Home Educational Resources

Index based on students' responses to three questions about home educational resources: number of books in the home; educational aids in the home (computer, study desk/table for own use, dictionary); parents' education (see reference exhibits R1.1-R1.3). High level indicates more than 100 books in the home; all three educational aids; and either parent's highest level of education is finished university. Low level indicates 25 or fewer books in the home; not all three educational aids; and both parents' highest level of education is some secondary or less or is not known. Medium level includes all other possible combinations of responses. See reference exhibit R1.4 for national definitions of educational levels; response categories were defined by each country to conform to their own educational system and may not be strictly comparable across countries.

	High HER		**Medium** HER		**Low** HER	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Naperville Sch. Dist. #203, IL	56 (1.3)	599 (5.2)	43 (1.3)	565 (4.5)	0 (0.2)	~ ~
First in the World Consort., IL	45 (2.5)	587 (7.2)	53 (2.5)	552 (5.5)	2 (0.3)	~ ~
Academy School Dist. #20, CO	44 (1.6)	581 (3.0)	55 (1.6)	544 (3.1)	1 (0.3)	~ ~
Montgomery County, MD	39 (2.5)	575 (6.5)	59 (2.4)	509 (3.9)	2 (0.8)	~ ~
Michigan Invitational Group, MI	29 (2.6)	591 (11.8)	70 (2.6)	555 (5.7)	1 (0.3)	~ ~
Connecticut	29 (2.8)	573 (11.7)	68 (2.5)	516 (8.9)	3 (0.8)	426 (15.8)
Oregon	28 (2.6)	586 (6.7)	68 (2.6)	523 (5.1)	3 (0.6)	413 (26.6)
Canada	27 (1.0)	559 (3.8)	71 (1.0)	526 (2.1)	2 (0.2)	~ ~
Michigan	27 (2.9)	592 (7.8)	71 (2.7)	531 (8.3)	2 (0.5)	~ ~
Guilford County, NC	26 (2.0)	586 (5.6)	72 (1.7)	517 (7.8)	3 (0.4)	486 (17.4)
Maryland	26 (2.0)	559 (6.3)	71 (1.8)	492 (7.4)	3 (0.5)	417 (13.7)
Massachusetts	25 (2.1)	579 (8.3)	72 (1.8)	521 (6.9)	3 (0.6)	442 (14.0)
SW Math/Sci. Collaborative, PA	25 (2.8)	585 (7.6)	72 (2.9)	532 (6.6)	3 (0.8)	474 (18.3)
Fremont/Lincoln/WestSide PS, NE	24 (1.7)	560 (7.1)	72 (1.7)	499 (6.5)	3 (0.4)	433 (22.1)
Indiana	23 (2.6)	578 (8.0)	74 (2.4)	524 (6.1)	3 (0.5)	456 (14.1)
Pennsylvania	22 (2.7)	569 (6.9)	75 (2.6)	519 (5.6)	2 (0.4)	~ ~
Delaware Science Coalition, DE	22 (2.6)	562 (9.3)	75 (2.4)	488 (6.9)	3 (0.9)	426 (17.6)
United States	22 (1.5)	573 (3.8)	73 (1.4)	506 (4.2)	4 (0.5)	420 (7.3)
Illinois	22 (2.7)	577 (8.2)	74 (2.6)	509 (6.1)	4 (0.7)	438 (10.0)
Project SMART Consortium, OH	22 (2.3)	577 (10.0)	76 (2.1)	532 (7.7)	2 (0.5)	~ ~
Texas	21 (2.8)	581 (5.5)	70 (2.1)	504 (10.0)	9 (1.6)	408 (15.3)
Idaho	21 (1.8)	566 (7.0)	74 (1.6)	523 (5.5)	5 (1.1)	423 (13.1)
Missouri	17 (1.4)	567 (10.1)	79 (1.4)	517 (6.1)	4 (0.5)	453 (15.1)
South Carolina	17 (1.6)	570 (7.5)	79 (1.6)	503 (6.8)	4 (0.6)	433 (10.3)
North Carolina	16 (1.9)	559 (8.0)	81 (1.6)	502 (6.0)	4 (0.6)	430 (15.6)
Korea, Rep. of	14 (0.8)	600 (4.0)	80 (0.8)	544 (2.6)	5 (0.3)	475 (6.4)
Czech Republic	13 (0.8)	587 (5.6)	83 (0.8)	535 (4.2)	4 (0.5)	479 (10.5)
Chicago Public Schools, IL	10 (2.4)	493 (19.4)	81 (1.8)	449 (8.5)	9 (1.4)	408 (13.5)
Miami-Dade County PS, FL	10 (2.2)	511 (19.7)	80 (2.3)	426 (9.1)	11 (1.4)	361 (11.3)
Netherlands	9 (1.1)	581 (8.7)	89 (1.1)	543 (6.7)	2 (0.8)	~ ~
Russian Federation	9 (0.8)	564 (8.4)	86 (0.7)	530 (6.3)	6 (0.5)	475 (14.8)
Rochester City Sch. Dist., NY	8 (1.5)	504 (24.3)	82 (1.4)	452 (6.5)	10 (0.9)	422 (10.7)
Belgium (Flemish)	8 (0.7)	571 (7.0)	86 (1.3)	536 (3.3)	6 (1.3)	483 (9.1)
Chinese Taipei	8 (0.7)	639 (5.8)	84 (0.7)	569 (4.2)	8 (0.6)	505 (7.1)
Jersey City Public Schools, NJ	7 (1.2)	488 (21.7)	82 (1.3)	444 (9.3)	11 (1.0)	389 (8.1)
Italy	6 (0.6)	546 (9.4)	81 (0.8)	498 (3.7)	14 (0.8)	446 (6.4)
Singapore	5 (0.7)	650 (10.2)	87 (0.6)	569 (7.6)	8 (0.7)	494 (10.5)
Hong Kong, SAR	3 (0.3)	558 (9.6)	78 (0.8)	533 (3.7)	19 (0.9)	515 (4.5)
England	– –	– –	– –	– –	– –	– –
Japan	– –	– –	– –	– –	– –	– –
International Avg. (All Countries)	9 (0.1)	558 (2.0)	72 (0.2)	487 (0.8)	19 (0.2)	431 (1.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

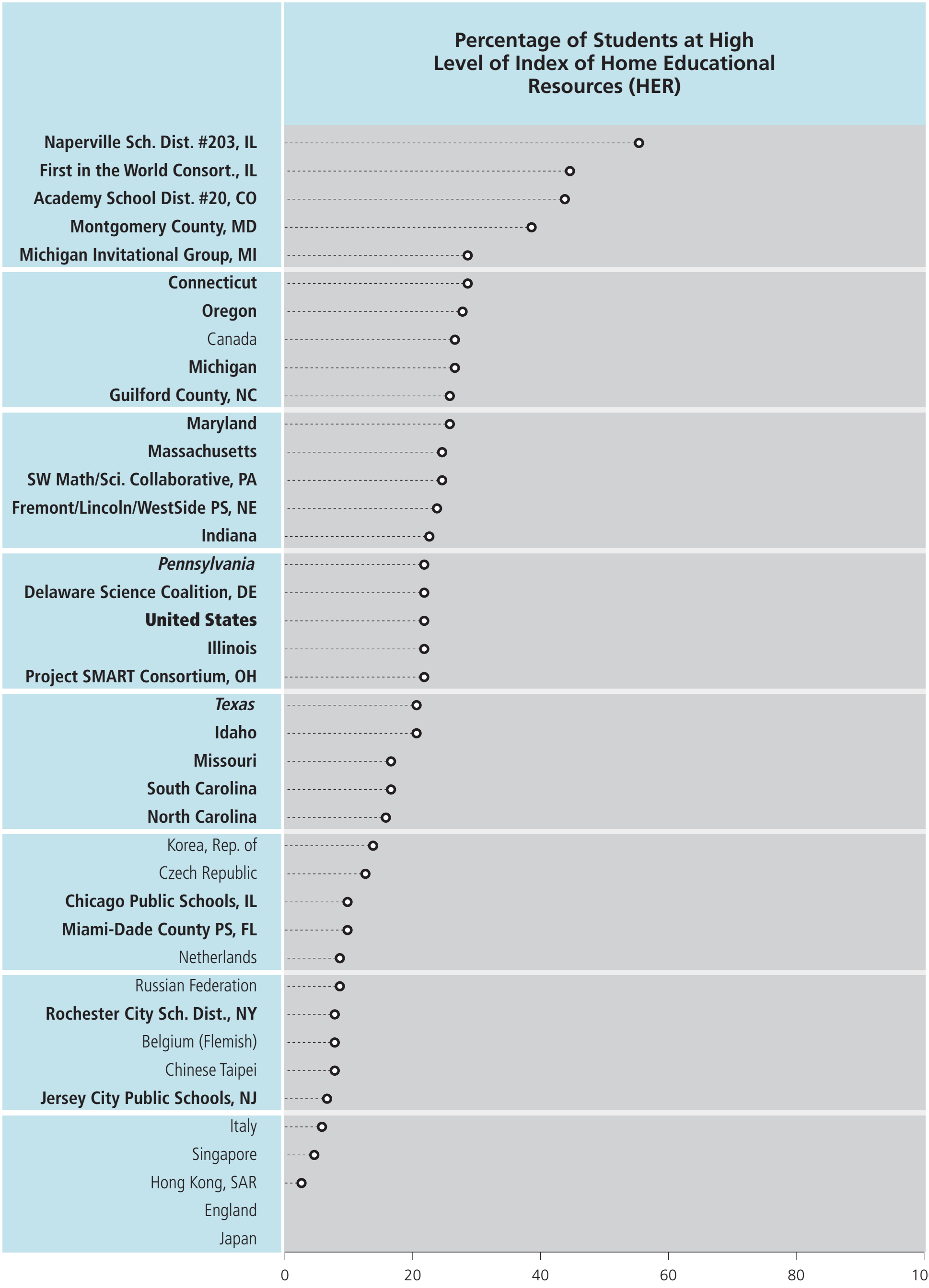
States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.1
(Continued)

Index of Home Educational Resources (HER)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

text continued from page 113

together with their average science achievement. Compared with some of the reference countries as well as the international average (45 percent), students in the Benchmarking jurisdictions reported relatively high levels of computer ownership; more than 70 percent of students in each state reported having a computer at home. In the wealthier districts and consortia such as the Academy School District, the First in the World Consortium, Montgomery County, and the Naperville School District, more than 90 percent of students so reported. Even in the less advantaged public school districts, more than half the students reported having a computer at home. In almost every entity, students with a computer at home had higher average science achievement than those without.

Students who speak a language (or languages) in the home that is different from the language spoken in school sometimes benefit from being multilingual. However, when they are still developing proficiency in the language of instruction they can be at a disadvantage in learning situations. Exhibit 4.3 contains students' reports of how frequently they speak the language of the TIMSS test at home in relation to their average science achievement. Students from homes where the language of the test is always or almost always spoken had higher average achievement than those who spoke it less frequently. In all of the Benchmarking states except Massachusetts and Texas, 90 percent or more of the students reported always or almost always speaking the language of the test at home. The percentage of students speaking the language of the test at home was lower in a number of school districts, however, particularly the public school systems in Chicago, Jersey City, and Miami-Dade.

Exhibit 4.4 presents students' reports of their race/ethnicity. Across the United States as a whole, 63 percent reported that they were white, 15 percent black, 12 percent Hispanic, five percent Asian or Pacific Islander, one percent American Indian or Alaskan Native, and four percent other. There was a pronounced relationship between race/ethnicity and science achievement, with white students having the highest average achievement, followed by Asian/Pacific Islander, Hispanic, and black students. This pattern was found even in the higher-performing and more affluent Benchmarking districts and consortia. Because minority students are often concentrated in urban schools, the resource disparities between urban and non-urban schools summarized in the introduction to this report are particularly troubling in light of the persistent achievement gaps between many minority and non-minority students.

Among Benchmarking states, Maryland, North Carolina, and South Carolina had more than 30 percent black students, and Texas more than 30 percent Hispanic. Racial composition varied even more among the Benchmarking districts and consortia. Predominantly white jurisdictions included the Academy School District, the Fremont/Lincoln/Westside Public Schools, the Michigan Invitational Group, Naperville, and the

Southwest Pennsylvania Math and Science Collaborative, with more than 80 percent white students. Ethnically more diverse jurisdictions included Chicago (47 percent black, 37 percent Hispanic), Jersey City (35 percent black, 35 percent Hispanic, 16 percent Asian/Pacific Islander), Miami-Dade (31 percent black, 55 percent Hispanic), Montgomery County (16 percent black, 12 percent Hispanic, 15 percent Asian/Pacific Islander), and Rochester (56 percent black, 16 percent Hispanic).

By the end of the eighth grade, students in most countries can say what their expectations are for further education. Although one-quarter or more of the students in some countries did not know, Exhibit 4.5 shows that, on average across countries, more than half the students reported that they expected to finish university (a four-year degree program or equivalent). The United States was among the countries that had the highest percentage, with almost 80 percent expecting to finish university. In almost every country, also, there was a positive association between educational expectations and science achievement. Among Benchmarking participants, the percentage of students expecting to finish university was also high, even in areas with low student achievement, as more than 70 percent of students in all Benchmarking entities reported that they expected to finish university.

Exhibits R1.5 to R1.7 in the reference section present eighth-grade students' reports about how they, their mothers, and their friends feel about the importance of doing well in various academic and non-academic activities. On average across the TIMSS 1999 countries, more than 90 percent of students reported that they and their mothers agreed that it was important to do well in science, mathematics, and language. Somewhat fewer reported that their friends agreed (77 to 86 percent). As might be anticipated, slightly more students reported that they and their friends felt it was important to have fun (92 percent) than reported that their mothers found this important (85 percent). More moderate agreement was reported for the importance of doing well in sports (from 81 to 87 percent). In general, the reports of students in the Benchmarking jurisdictions resembled those in the United States overall. It is noteworthy, however, that students in the U.S. and in many Benchmarking jurisdictions were less likely than their counterparts internationally, on average, to report that their friends think it is important to do well in science, mathematics, and language, and were more likely to report that they, their mothers, and their friends think it is important to have fun.

Students were also asked why they needed to do well in science (see Exhibit R1.8). In most entities, getting into their desired secondary school or university was a stronger motivating factor than was pleasing their parents or getting their desired job.

Exhibit 4.2 Students Having a Computer at Home

	Have Computer at Home		Do Not Have Computer at Home	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries				
United States	80 (1.2)	531 (3.9)	20 (1.2)	464 (6.5)
Belgium (Flemish)	86 (1.0)	540 (2.9)	14 (1.0)	507 (6.6)
Canada	85 (0.8)	538 (2.1)	15 (0.8)	506 (4.7)
Chinese Taipei	63 (1.0)	585 (4.2)	37 (1.0)	542 (5.6)
Czech Republic	47 (1.2)	558 (4.6)	53 (1.2)	523 (4.7)
England	85 (0.8)	545 (4.8)	15 (0.8)	509 (8.0)
Hong Kong, SAR	72 (1.3)	536 (3.6)	28 (1.3)	515 (4.9)
Italy	63 (1.0)	502 (4.5)	37 (1.0)	479 (4.4)
Japan	52 (0.9)	563 (2.8)	48 (0.9)	536 (2.7)
Korea, Rep. of	67 (0.9)	562 (2.9)	33 (0.9)	523 (3.1)
Netherlands	96 (1.0)	547 (6.8)	4 (1.0)	498 (21.2)
Russian Federation	22 (1.2)	534 (7.2)	78 (1.2)	528 (6.9)
Singapore	80 (1.3)	581 (7.6)	20 (1.3)	515 (10.1)
States				
Connecticut	88 (1.7)	539 (9.7)	12 (1.7)	461 (11.5)
Idaho	82 (2.1)	537 (5.5)	18 (2.1)	481 (9.6)
Illinois	80 (2.1)	533 (6.5)	20 (2.1)	470 (6.2)
Indiana	81 (1.5)	544 (6.8)	19 (1.5)	493 (8.7)
Maryland	86 (1.4)	515 (6.9)	14 (1.4)	453 (11.1)
Massachusetts	87 (1.6)	542 (7.2)	13 (1.6)	478 (6.5)
Michigan	85 (1.7)	555 (7.3)	15 (1.7)	486 (12.6)
Missouri	76 (1.8)	535 (6.5)	24 (1.8)	486 (7.7)
North Carolina	74 (1.8)	521 (6.0)	26 (1.8)	471 (7.8)
Oregon	86 (1.7)	547 (5.1)	14 (1.7)	474 (10.4)
Pennsylvania	83 (2.0)	538 (5.6)	17 (2.0)	483 (10.4)
South Carolina	75 (2.2)	524 (6.5)	25 (2.2)	473 (8.4)
Texas	73 (3.3)	536 (8.3)	27 (3.3)	447 (11.6)
Districts and Consortia				
Academy School Dist. #20, CO	96 (0.5)	561 (2.2)	4 (0.5)	509 (11.9)
Chicago Public Schools, IL	61 (1.7)	462 (10.0)	39 (1.7)	432 (9.7)
Delaware Science Coalition, DE	82 (1.6)	512 (8.5)	18 (1.6)	454 (10.0)
First in the World Consort., IL	96 (0.6)	569 (4.9)	4 (0.6)	491 (20.0)
Fremont/Lincoln/WestSide PS, NE	81 (1.6)	525 (6.0)	19 (1.6)	456 (10.1)
Guilford County, NC	81 (1.6)	546 (6.9)	19 (1.6)	482 (9.8)
Jersey City Public Schools, NJ	58 (2.3)	458 (12.7)	42 (2.3)	417 (6.7)
Miami-Dade County PS, FL	66 (2.8)	442 (11.4)	34 (2.8)	397 (9.4)
Michigan Invitational Group, MI	89 (1.6)	570 (5.9)	11 (1.6)	522 (11.4)
Montgomery County, MD	91 (1.4)	540 (4.2)	9 (1.4)	450 (11.8)
Naperville Sch. Dist. #203, IL	98 (0.4)	585 (4.1)	2 (0.4)	~ ~
Project SMART Consortium, OH	83 (1.2)	547 (8.9)	17 (1.2)	501 (8.9)
Rochester City Sch. Dist., NY	61 (2.3)	455 (9.0)	39 (2.3)	452 (8.2)
SW Math/Sci. Collaborative, PA	82 (1.9)	553 (6.6)	18 (1.9)	498 (11.0)
International Avg. (All Countries)	45 (0.2)	509 (1.1)	55 (0.2)	470 (1.0)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Exhibit 4.3 Frequency with Which Students Speak Language of the Test at Home

8th Grade Science

	Always or Almost Always		Sometimes		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries						
United States	90 (1.0)	524 (4.3)	9 (1.0)	456 (7.4)	1 (0.1)	~ ~
Belgium (Flemish)	86 (1.3)	542 (2.8)	8 (0.7)	504 (10.7)	6 (0.9)	496 (18.1)
Canada	91 (0.6)	537 (2.3)	8 (0.5)	494 (7.4)	2 (0.2)	~ ~
Chinese Taipei	67 (1.4)	587 (4.8)	31 (1.3)	535 (5.5)	2 (0.2)	~ ~
Czech Republic	98 (0.5)	541 (4.4)	1 (0.3)	~ ~	1 (0.2)	~ ~
England	95 (0.9)	544 (4.8)	5 (0.8)	487 (13.6)	0 (0.1)	~ ~
Hong Kong, SAR r	80 (2.4)	523 (4.2)	17 (1.9)	536 (8.8)	3 (0.5)	551 (11.5)
Italy	77 (1.1)	506 (3.9)	20 (1.0)	448 (6.1)	4 (0.5)	468 (12.9)
Japan	97 (0.3)	552 (2.2)	3 (0.3)	511 (13.5)	0 (0.1)	~ ~
Korea, Rep. of	96 (0.3)	551 (2.6)	4 (0.3)	504 (8.6)	0 (0.0)	~ ~
Netherlands	86 (2.4)	550 (6.9)	8 (1.2)	509 (14.8)	6 (1.8)	536 (11.7)
Russian Federation	94 (2.3)	530 (6.2)	5 (2.3)	541 (47.0)	1 (0.2)	~ ~
Singapore	27 (1.8)	612 (8.4)	63 (1.6)	553 (8.2)	10 (0.5)	548 (11.2)
States						
Connecticut	90 (1.4)	537 (9.4)	8 (1.4)	464 (19.0)	2 (0.3)	~ ~
Idaho	92 (1.4)	534 (5.9)	7 (1.3)	444 (15.4)	1 (0.3)	~ ~
Illinois	91 (1.3)	528 (6.7)	8 (1.2)	465 (7.1)	1 (0.2)	~ ~
Indiana	96 (0.6)	538 (6.8)	3 (0.5)	473 (18.1)	1 (0.3)	~ ~
Maryland	91 (0.8)	510 (7.5)	8 (0.7)	485 (12.8)	1 (0.3)	~ ~
Massachusetts	88 (1.6)	541 (7.0)	10 (1.4)	484 (14.6)	2 (0.3)	~ ~
Michigan	96 (0.6)	549 (8.1)	3 (0.4)	481 (19.9)	1 (0.2)	~ ~
Missouri	95 (0.6)	527 (7.0)	4 (0.5)	472 (15.6)	1 (0.2)	~ ~
North Carolina	96 (0.5)	510 (6.5)	3 (0.4)	485 (14.6)	1 (0.2)	~ ~
Oregon	92 (1.1)	544 (5.4)	7 (0.9)	464 (17.0)	1 (0.4)	~ ~
Pennsylvania	95 (1.1)	532 (6.4)	5 (0.9)	491 (16.6)	1 (0.3)	~ ~
South Carolina	97 (0.4)	514 (6.9)	2 (0.4)	~ ~	0 (0.2)	~ ~
Texas	82 (2.9)	527 (9.8)	17 (2.8)	442 (12.2)	1 (0.4)	~ ~
Districts and Consortia						
Academy School Dist. #20, CO	93 (0.8)	562 (2.2)	6 (0.7)	539 (13.7)	1 (0.3)	~ ~
Chicago Public Schools, IL	77 (4.7)	453 (10.7)	21 (4.6)	444 (13.1)	2 (0.7)	~ ~
Delaware Science Coalition, DE	91 (0.9)	507 (8.4)	6 (0.9)	466 (12.4)	3 (0.5)	454 (17.7)
First in the World Consort., IL	85 (1.3)	571 (5.2)	14 (1.3)	533 (8.7)	1 (0.3)	~ ~
Fremont/Lincoln/WestSide PS, NE	92 (1.1)	518 (6.3)	7 (0.9)	454 (11.1)	1 (0.3)	~ ~
Guilford County, NC	95 (0.7)	537 (6.8)	4 (0.7)	495 (19.1)	1 (0.5)	~ ~
Jersey City Public Schools, NJ	74 (1.5)	442 (10.1)	26 (1.4)	444 (13.5)	1 (0.3)	~ ~
Miami-Dade County PS, FL	59 (4.1)	436 (11.0)	36 (3.6)	418 (13.1)	5 (0.8)	424 (12.8)
Michigan Invitational Group, MI	96 (0.6)	567 (6.4)	3 (0.5)	533 (14.2)	1 (0.3)	~ ~
Montgomery County, MD	83 (1.9)	541 (4.8)	15 (2.0)	494 (10.0)	2 (0.6)	~ ~
Naperville Sch. Dist. #203, IL	93 (0.5)	585 (4.2)	6 (0.6)	581 (10.6)	1 (0.2)	~ ~
Project SMART Consortium, OH	95 (0.9)	543 (8.3)	4 (0.7)	480 (15.9)	1 (0.3)	~ ~
Rochester City Sch. Dist., NY	86 (1.3)	457 (7.9)	13 (1.1)	444 (11.4)	2 (0.6)	~ ~
SW Math/Sci. Collaborative, PA	98 (0.4)	545 (7.2)	1 (0.3)	~ ~	1 (0.2)	~ ~
International Avg. (All Countries)	79 (0.3)	496 (0.8)	17 (0.2)	459 (3.0)	5 (0.1)	445 (3.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates a 70-84% student response rate.

Exhibit 4.4 Students' Race/Ethnicity

8th Grade Science

	White		Black		Hispanic	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
States						
Connecticut	74 (4.5)	553 (7.7)	10 (3.0)	444 (9.4)	9 (2.2)	453 (17.5)
Idaho	83 (2.0)	537 (5.3)	1 (0.3)	~ ~	10 (1.7)	451 (11.0)
Illinois	65 (3.4)	550 (6.3)	17 (2.9)	448 (8.2)	12 (2.3)	457 (9.5)
Indiana	83 (2.3)	548 (6.5)	10 (2.2)	438 (9.7)	3 (0.6)	507 (16.7)
Maryland	55 (4.2)	540 (5.0)	30 (3.9)	443 (9.1)	4 (0.6)	485 (14.2)
Massachusetts	74 (3.4)	550 (6.6)	7 (1.6)	461 (16.0)	8 (1.4)	464 (10.5)
Michigan	82 (3.4)	564 (5.5)	10 (3.4)	413 (10.5)	3 (0.6)	507 (18.5)
Missouri	78 (3.2)	543 (4.8)	15 (3.1)	438 (13.9)	2 (0.4)	~ ~
North Carolina	62 (3.5)	539 (5.6)	31 (3.2)	450 (8.7)	3 (0.5)	463 (18.1)
Oregon	80 (1.9)	549 (4.8)	1 (0.5)	~ ~	8 (1.1)	451 (15.9)
Pennsylvania	78 (4.5)	545 (5.0)	12 (3.7)	448 (13.6)	3 (1.3)	500 (9.7)
South Carolina	63 (4.0)	549 (5.5)	32 (4.0)	443 (6.8)	1 (0.4)	~ ~
Texas	47 (5.2)	563 (4.8)	13 (2.5)	444 (18.4)	32 (4.7)	461 (9.5)
Districts and Consortia						
Academy School Dist. #20, CO	82 (1.0)	565 (2.6)	3 (0.5)	508 (15.8)	7 (0.6)	528 (10.1)
Chicago Public Schools, IL	11 (3.2)	475 (14.8)	47 (10.6)	433 (12.3)	37 (8.9)	460 (13.4)
Delaware Science Coalition, DE	63 (2.3)	527 (8.8)	24 (2.0)	450 (7.6)	5 (0.7)	465 (12.1)
First in the World Consort., IL	74 (1.8)	573 (5.7)	1 (0.3)	~ ~	7 (0.8)	484 (10.3)
Fremont/Lincoln/WestSide PS, NE	83 (1.6)	524 (6.3)	3 (0.8)	461 (27.3)	4 (0.7)	440 (17.7)
Guilford County, NC	57 (2.1)	568 (5.4)	35 (2.3)	479 (8.5)	2 (0.5)	~ ~
Jersey City Public Schools, NJ	7 (0.9)	482 (21.4)	35 (1.7)	410 (10.1)	35 (1.1)	451 (7.6)
Miami-Dade County PS, FL	7 (2.5)	522 (21.7)	31 (5.6)	388 (11.8)	55 (6.8)	445 (7.8)
Michigan Invitational Group, MI	88 (1.2)	567 (5.9)	4 (1.0)	497 (16.6)	1 (0.5)	~ ~
Montgomery County, MD	50 (2.7)	568 (7.3)	16 (1.3)	470 (7.9)	12 (1.8)	475 (15.1)
Naperville Sch. Dist. #203, IL	82 (1.0)	585 (4.2)	1 (0.4)	~ ~	2 (0.5)	~ ~
Project SMART Consortium, OH	79 (1.9)	552 (8.7)	10 (1.5)	478 (15.5)	4 (0.7)	462 (23.1)
Rochester City Sch. Dist., NY	16 (2.2)	521 (14.0)	56 (2.6)	430 (5.5)	16 (1.7)	452 (9.9)
SW Math/Sci. Collaborative, PA	87 (2.9)	555 (6.3)	10 (2.6)	448 (11.1)	1 (0.3)	~ ~
United States	63 (2.4)	547 (4.2)	15 (1.9)	438 (6.0)	12 (1.6)	462 (7.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Exhibit 4.4
(Continued)

Students' Race/Ethnicity

8th Grade Science

	Asian/ Pacific Islander		American Indian/ Alaskan Native		Other	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
States						
Connecticut	2 (0.4)	~ ~	0 (0.2)	~ ~	4 (0.6)	514 (16.1)
Idaho	2 (0.5)	~ ~	2 (0.5)	~ ~	2 (0.3)	~ ~
Illinois	4 (0.9)	539 (10.2)	0 (0.2)	~ ~	2 (0.4)	~ ~
Indiana	2 (0.4)	~ ~	1 (0.3)	~ ~	2 (0.4)	~ ~
Maryland	5 (0.6)	539 (12.3)	1 (0.2)	~ ~	5 (0.6)	517 (11.1)
Massachusetts	5 (0.8)	552 (26.5)	1 (0.2)	~ ~	5 (0.8)	503 (14.5)
Michigan	2 (0.3)	~ ~	1 (0.2)	~ ~	3 (0.3)	509 (16.5)
Missouri	1 (0.3)	~ ~	1 (0.4)	~ ~	3 (0.4)	475 (14.4)
North Carolina	1 (0.3)	~ ~	1 (0.4)	~ ~	2 (0.4)	~ ~
Oregon	4 (0.7)	530 (11.7)	3 (0.5)	498 (17.8)	4 (0.5)	548 (15.3)
Pennsylvania	3 (1.4)	524 (24.8)	1 (0.2)	~ ~	3 (0.5)	517 (17.8)
South Carolina	1 (0.2)	~ ~	1 (0.2)	~ ~	2 (0.3)	~ ~
Texas	4 (1.4)	548 (18.5)	1 (0.1)	~ ~	3 (0.4)	513 (18.4)
Districts and Consortia						
Academy School Dist. #20, CO	4 (0.6)	559 (9.6)	1 (0.3)	~ ~	4 (0.5)	543 (16.0)
Chicago Public Schools, IL	2 (1.0)	~ ~	1 (0.2)	~ ~	2 (0.5)	~ ~
Delaware Science Coalition, DE	2 (0.6)	~ ~	1 (0.2)	~ ~	5 (0.9)	490 (17.1)
First in the World Consort., IL	15 (1.7)	580 (6.5)	1 (0.4)	~ ~	2 (0.8)	~ ~
Fremont/Lincoln/WestSide PS, NE	3 (0.5)	470 (20.7)	2 (0.4)	~ ~	5 (0.9)	481 (13.3)
Guilford County, NC	4 (0.4)	505 (10.2)	1 (0.2)	~ ~	2 (0.5)	~ ~
Jersey City Public Schools, NJ	16 (1.7)	471 (21.8)	0 (0.2)	~ ~	7 (0.8)	457 (20.2)
Miami-Dade County PS, FL	2 (0.6)	~ ~	1 (0.1)	~ ~	5 (1.1)	438 (28.5)
Michigan Invitational Group, MI	3 (0.5)	587 (26.1)	0 (0.2)	~ ~	3 (0.3)	580 (19.2)
Montgomery County, MD	15 (1.4)	538 (7.8)	1 (0.2)	~ ~	6 (0.8)	524 (11.5)
Naperville Sch. Dist. #203, IL	12 (0.8)	593 (7.8)	0 (0.1)	~ ~	3 (0.5)	592 (17.0)
Project SMART Consortium, OH	3 (0.5)	541 (24.5)	1 (0.2)	~ ~	3 (0.7)	550 (25.3)
Rochester City Sch. Dist., NY	3 (0.5)	497 (19.2)	2 (0.5)	~ ~	7 (1.0)	478 (13.8)
SW Math/Sci. Collaborative, PA	1 (0.4)	~ ~	0 (0.1)	~ ~	2 (0.4)	~ ~
United States	5 (1.3)	527 (8.7)	1 (0.2)	~ ~	4 (0.3)	502 (12.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.5 Students' Expectations for Finishing School*

8th Grade Science

	Finish University¹		Some Vocational/ Technical Education or University Only²		Finish Secondary School Only³		Some Secondary School Only		Don't Know	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries										
United States	78 (1.2)	530 (4.2)	9 (0.6)	484 (6.5)	5 (0.4)	447 (7.3)	1 (0.1)	~ ~	7 (0.5)	484 (7.1)
Belgium (Flemish)	26 (1.1)	569 (4.1)	30 (0.9)	542 (4.1)	16 (0.9)	501 (4.5)	0 (0.0)	~ ~	29 (1.0)	520 (3.5)
Canada	76 (0.9)	541 (2.0)	13 (0.6)	521 (5.7)	4 (0.3)	493 (10.8)	1 (0.1)	~ ~	7 (0.6)	498 (7.1)
Chinese Taipei	62 (1.4)	601 (3.9)	24 (1.0)	523 (4.2)	2 (0.3)	~ ~	0 (0.1)	~ ~	11 (0.6)	528 (6.8)
Czech Republic	38 (1.8)	580 (4.2)	5 (0.6)	557 (10.0)	39 (1.5)	517 (4.8)	8 (1.0)	475 (9.0)	10 (0.8)	518 (6.7)
England	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	63 (1.7)	547 (3.3)	20 (0.9)	512 (6.1)	10 (0.8)	479 (8.1)	1 (0.2)	~ ~	6 (0.4)	511 (9.3)
Italy	33 (1.3)	531 (6.1)	19 (0.9)	504 (8.0)	31 (1.1)	477 (4.5)	7 (0.6)	403 (8.6)	9 (0.7)	472 (9.5)
Japan	38 (0.9)	579 (3.6)	18 (0.6)	540 (2.8)	18 (0.7)	512 (5.2)	1 (0.1)	~ ~	25 (0.7)	544 (3.6)
Korea, Rep. of	77 (0.7)	565 (2.7)	8 (0.4)	486 (4.1)	4 (0.3)	472 (9.2)	0 (0.1)	~ ~	11 (0.5)	510 (6.6)
Netherlands	22 (2.8)	583 (9.2)	30 (1.8)	557 (5.3)	29 (2.6)	511 (9.3)	1 (0.2)	~ ~	18 (0.9)	537 (7.6)
Russian Federation	61 (1.5)	547 (6.0)	19 (1.0)	518 (6.7)	7 (0.5)	493 (11.3)	2 (0.5)	~ ~	11 (0.7)	496 (9.2)
Singapore	57 (2.1)	597 (7.3)	26 (1.6)	529 (7.7)	2 (0.3)	~ ~	0 (0.0)	~ ~	15 (0.7)	544 (11.1)
States										
Connecticut	80 (1.6)	540 (11.0)	8 (1.0)	491 (15.9)	4 (0.5)	464 (13.4)	1 (0.2)	~ ~	7 (0.8)	501 (10.2)
Idaho	72 (2.0)	541 (5.7)	11 (0.9)	521 (7.7)	7 (0.9)	459 (11.5)	1 (0.2)	~ ~	9 (0.9)	486 (9.6)
Illinois	81 (1.2)	531 (7.0)	9 (0.8)	487 (8.5)	4 (0.7)	441 (12.7)	0 (0.1)	~ ~	6 (0.6)	496 (14.4)
Indiana	79 (1.6)	547 (6.7)	9 (0.9)	490 (9.3)	4 (0.6)	472 (12.0)	1 (0.2)	~ ~	7 (0.7)	502 (13.4)
Maryland	80 (1.2)	516 (7.3)	9 (0.7)	483 (13.0)	4 (0.5)	431 (21.1)	1 (0.2)	~ ~	6 (0.6)	487 (9.4)
Massachusetts	78 (1.5)	545 (7.2)	10 (0.6)	493 (10.4)	5 (0.7)	457 (14.8)	1 (0.1)	~ ~	6 (0.7)	518 (9.2)
Michigan	83 (1.1)	554 (8.4)	7 (0.7)	501 (11.1)	3 (0.4)	486 (15.7)	1 (0.1)	~ ~	6 (0.5)	512 (16.7)
Missouri	72 (1.5)	536 (7.5)	12 (0.9)	504 (9.1)	8 (0.8)	463 (9.4)	1 (0.2)	~ ~	7 (0.6)	507 (12.0)
North Carolina	79 (1.5)	519 (6.7)	9 (0.7)	480 (9.2)	6 (0.7)	439 (10.8)	1 (0.1)	~ ~	4 (0.4)	483 (11.5)
Oregon	76 (1.9)	549 (5.3)	10 (0.9)	516 (8.1)	5 (0.8)	458 (15.4)	1 (0.2)	~ ~	9 (0.9)	510 (11.9)
Pennsylvania	77 (1.4)	538 (6.5)	9 (0.7)	514 (13.1)	5 (0.6)	471 (12.4)	1 (0.1)	~ ~	7 (0.6)	505 (9.5)
South Carolina	80 (1.3)	526 (7.0)	9 (0.8)	452 (11.5)	6 (0.6)	436 (11.5)	0 (0.1)	~ ~	5 (0.5)	474 (10.0)
Texas	80 (2.0)	528 (8.9)	7 (0.8)	456 (14.8)	6 (1.3)	404 (25.6)	1 (0.3)	~ ~	6 (0.7)	476 (20.9)
Districts and Consortia										
Academy School Dist. #20, CO	83 (1.1)	568 (2.4)	5 (0.6)	500 (11.0)	3 (0.4)	489 (19.1)	1 (0.3)	~ ~	8 (0.9)	539 (9.2)
Chicago Public Schools, IL	74 (1.8)	460 (10.1)	11 (0.8)	432 (12.5)	8 (1.2)	399 (14.5)	1 (0.3)	~ ~	6 (0.9)	436 (16.7)
Delaware Science Coalition, DE	74 (2.2)	519 (8.4)	11 (0.8)	461 (9.1)	7 (1.1)	432 (13.4)	1 (0.4)	~ ~	7 (1.0)	470 (10.3)
First in the World Consort., IL	92 (1.1)	570 (5.1)	3 (0.8)	507 (17.5)	1 (0.5)	~ ~	0 (0.2)	~ ~	4 (0.8)	536 (19.2)
Fremont/Lincoln/WestSide PS, NE	74 (2.3)	529 (5.8)	7 (1.1)	472 (14.1)	5 (1.3)	432 (14.7)	1 (0.2)	~ ~	12 (1.4)	483 (15.5)
Guilford County, NC	89 (1.5)	541 (6.9)	5 (0.9)	485 (14.8)	3 (0.8)	436 (18.0)	0 (0.3)	~ ~	3 (0.6)	518 (19.4)
Jersey City Public Schools, NJ	80 (1.6)	450 (11.2)	8 (0.9)	415 (10.3)	6 (0.8)	405 (16.9)	0 (0.0)	~ ~	6 (0.8)	401 (16.0)
Miami-Dade County PS, FL	76 (2.4)	445 (9.8)	10 (1.3)	376 (17.0)	6 (0.7)	364 (17.4)	1 (0.2)	~ ~	7 (1.0)	381 (18.4)
Michigan Invitational Group, MI	80 (2.1)	574 (6.5)	9 (1.6)	550 (8.3)	5 (0.7)	503 (18.2)	1 (0.3)	~ ~	5 (0.8)	519 (15.8)
Montgomery County, MD	85 (1.0)	541 (4.2)	6 (0.9)	477 (18.2)	2 (0.3)	~ ~	1 (0.3)	~ ~	7 (0.6)	516 (9.3)
Naperville Sch. Dist. #203, IL	94 (0.8)	586 (4.0)	3 (0.5)	538 (14.3)	1 (0.3)	~ ~	0 (0.1)	~ ~	3 (0.5)	548 (24.6)
Project SMART Consortium, OH	81 (2.1)	550 (9.0)	8 (1.1)	501 (8.2)	4 (0.8)	499 (15.7)	1 (0.3)	~ ~	7 (0.8)	493 (11.8)
Rochester City Sch. Dist., NY	76 (1.6)	464 (7.5)	9 (1.1)	427 (15.9)	7 (0.9)	393 (15.9)	1 (0.3)	~ ~	8 (1.0)	440 (14.6)
SW Math/Sci. Collaborative, PA	80 (2.1)	552 (6.8)	8 (0.8)	519 (11.6)	5 (0.5)	471 (17.6)	0 (0.1)	~ ~	7 (1.2)	516 (10.7)
International Avg (All Countries)	52 (0.3)	515 (0.9)	17 (0.1)	470 (1.2)	15 (0.2)	445 (1.4)	3 (0.1)	397 (3.8)	14 (0.1)	461 (1.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Response categories were defined by each country to conform to their own educational system and may not be strictly comparable across countries. See Reference Exhibit R1.4 for country definitions of educational levels.

[1] In most countries, finish university is defined as completion of at least a 4-year degree program at a university or an equivalent institute of higher education. For the United States, includes community college, college, or university.

[2] In some countries, may include higher post-secondary education levels.

[3] In most countries, finish secondary school corresponds to completion of an upper-secondary track terminating after 11 to 13 years of schooling (ISCED level 3 vocational, apprenticeship or academic tracks).

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

How Much of Their Out-of-School Time Do Students Spend on Homework During the School Week?

One of the main ways for students to consolidate and extend classroom learning is to spend time out of school studying or doing homework. Well-chosen homework assignments can reinforce classroom learning, and by providing a challenge can encourage students to extend their understanding of the subject matter. Homework also allows students who are having trouble keeping up with their classmates to review material taught in class.

To summarize the amount of time typically devoted to homework in each country and Benchmarking jurisdiction, TIMSS constructed an index of out-of-school study time (OST) that assigns students to a high, medium, or low level based on the amount of time they reported studying science, mathematics, and other subjects. Students at the high level reported spending more than three hours each day out of school studying all subjects combined. Students at the medium level reported spending more than one hour but not more than three, while those at the low level reported one hour or less per day.

Exhibit 4.6 shows the percentages of students at each level of this index, and their average science achievement, for Benchmarking participants and comparison countries. On average across all the TIMSS 1999 countries, 38 percent of eighth-grade students were at the high level of the out-of-school study time index, and a further 48 percent were at the medium level. Only 14 percent, on average, were at the low level, with just one hour of homework or less each day. The United States was one of the countries with relatively little emphasis on homework, with just 22 percent of students at the high level and 23 percent at the low level. Among Benchmarking participants, the jurisdictions that reported the greatest amount of out-of-school study time included the Jersey City and Chicago Public Schools, and the Academy School District, which each had more than one-third of their students at the high level of the index.

On average internationally, and in many of the Benchmarking entities, students at the low index level had lower average science achievement than their classmates who reported more out-of-school study time. However, spending a lot of time studying was not necessarily associated with higher achievement. In many of the Benchmarking entities, students at the medium level of the study index had average achievement that was as high as or higher than that of students at the high level. This pattern suggests that, compared with their higher-achieving counterparts, the lower-performing students may do less homework, either because they simply do not do it or because their teachers do not assign it, or more homework, perhaps in an effort to keep up academically.

More detailed information on the amount of time students reported spending on science homework is presented in Exhibit 4.7. The results reveal that while students on average across all the TIMSS 1999 countries spent one hour per day doing science homework, students in the Benchmarking jurisdictions and the United States spent less. The exhibit also shows the percentages of students that reported spending one hour or more, less than one hour, and no time at all studying science or doing science homework on a normal school day, together with their average science achievement. On average across all countries, 36 percent of students reported spending one hour or more per day doing science homework. None of the Benchmarking entities reported this much homework. The highest levels of science homework were reported in Massachusetts, the Academy School District, and the public school systems in Chicago, Jersey City, Miami-Dade, and Rochester, where more than 20 percent of students reported spending one hour or more. The lowest levels were reported in Idaho, Indiana, Missouri, Oregon, Texas, the Delaware Science Coalition, the Fremont/Lincoln/Westside Public Schools, and the Project SMART Consortium, where at least one-fourth of the students reported spending no time at all doing science homework on a normal school day.

Further detail on the student data that underlie the out-of-school study time index appears in Exhibit R1.9 in the reference section. In comparison with the one hour each day spent on science homework, the TIMSS 1999 countries on average reported 2.8 hours of homework in total. None of the Benchmarking jurisdictions reached this level, the highest being 2.7 hours in Chicago and Jersey City, and the lowest 1.8 hours in Texas, the Fremont/Lincoln/Westside Public Schools, and Project SMART. To provide a fuller picture of how students spend their out-of-school time on a school day, Exhibit R1.10, also in the reference section, gives students' reports on how they spend their daily leisure time. The two most popular activities internationally were watching television or videos and playing or talking with friends (each about two hours per day). Among Benchmarking participants, students generally reported spending a little more time on these activities and on sports, and less time reading for enjoyment. For example, in the four jurisdictions with the lowest average science achievement – the public school systems of Rochester, Chicago, Jersey City, and Miami-Dade – students reported watching television or videos for about three to three and one-half hours (as well as playing computer games for about one hour).

Exhibit 4.6 Index of Out-of-School Study Time (OST)

Index of Out-of-School Study Time

Index based on students' responses to three questions about out-of-school study time: time spent after school studying science or doing science homework; time spent after school studying mathematics or doing mathematics homework; time spent after school studying or doing homework in school subjects other than science and mathematics (see reference exhibit R1.9). Number of hours based on: no time = 0, less than 1 hour = 0.5, 1-2 hours = 1.5, 3-5 hours = 4, more than 5 hours = 7. High level indicates more than three hours studying all subjects combined. Medium level indicates more than one hour to three hours studying all subjects combined. Low level indicates one hour or less studying all subjects combined.

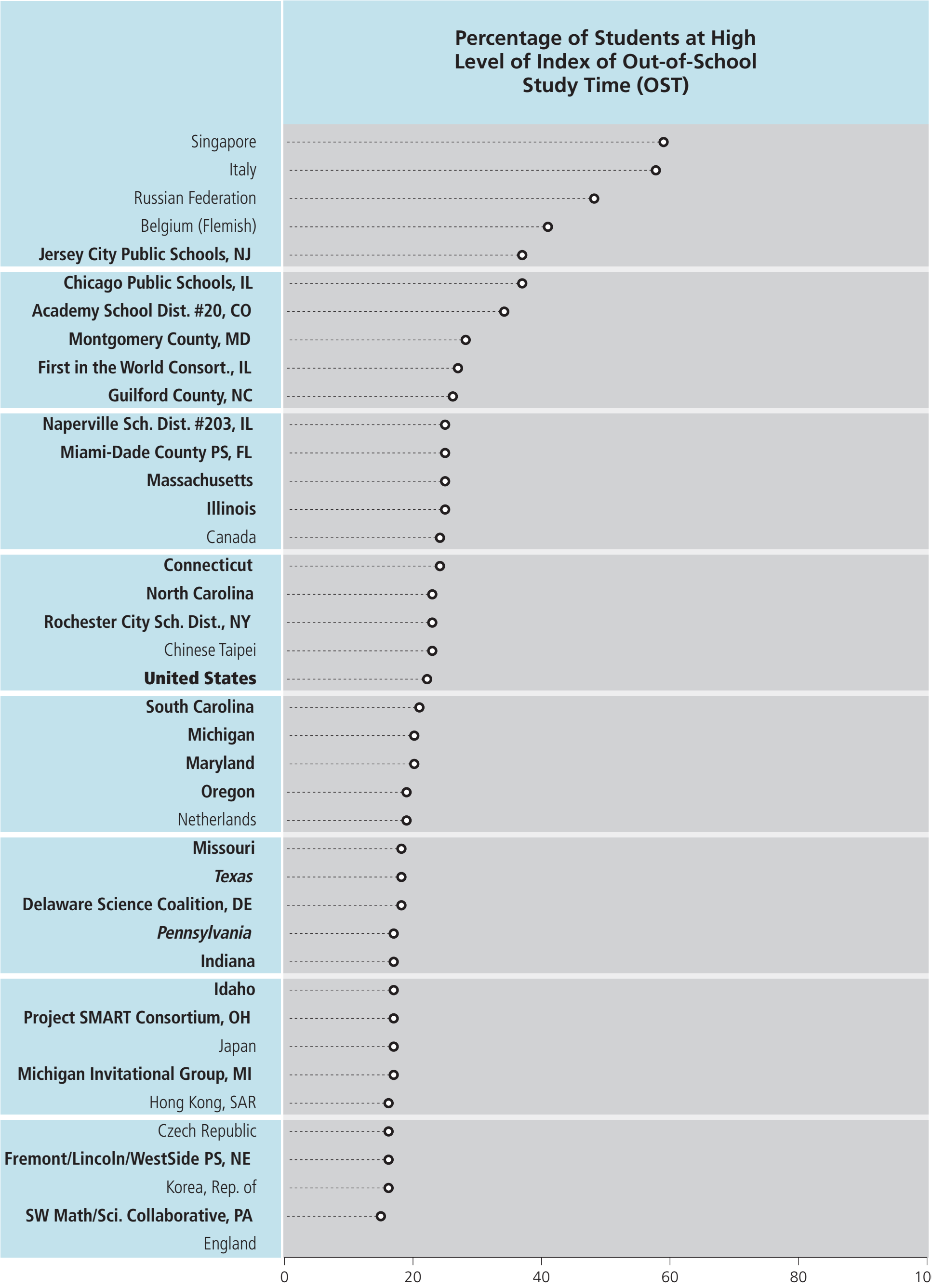
	High OST		Medium OST		Low OST	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore	59 (1.2)	573 (7.2)	35 (0.9)	571 (9.8)	7 (0.6)	514 (13.3)
Italy	58 (1.3)	504 (4.4)	36 (1.2)	497 (5.0)	6 (0.6)	419 (8.6)
Russian Federation	48 (1.3)	541 (6.3)	46 (1.2)	536 (7.0)	6 (0.6)	493 (9.7)
Belgium (Flemish)	41 (1.3)	529 (3.0)	52 (1.1)	545 (3.6)	7 (1.0)	514 (14.4)
Jersey City Public Schools, NJ	37 (2.4)	451 (12.3)	47 (1.8)	449 (9.2)	16 (1.7)	418 (9.0)
Chicago Public Schools, IL	37 (2.1)	458 (10.4)	51 (1.6)	452 (9.6)	12 (1.2)	445 (13.2)
Academy School Dist. #20, CO	34 (1.3)	567 (3.4)	55 (1.4)	565 (3.4)	11 (0.9)	526 (9.9)
Montgomery County, MD	28 (1.4)	547 (7.1)	57 (2.3)	541 (5.0)	15 (1.5)	491 (10.4)
First in the World Consort., IL	27 (2.4)	565 (7.2)	61 (2.2)	567 (6.7)	12 (1.1)	557 (11.2)
Guilford County, NC	26 (1.6)	527 (6.1)	62 (1.9)	540 (8.6)	12 (1.0)	526 (11.3)
Naperville Sch. Dist. #203, IL	25 (1.4)	584 (6.2)	63 (1.7)	588 (4.8)	12 (0.9)	571 (10.4)
Miami-Dade County PS, FL	25 (1.5)	435 (15.5)	51 (1.3)	439 (9.7)	24 (2.4)	416 (11.3)
Massachusetts	25 (1.7)	535 (8.3)	62 (1.6)	546 (7.5)	13 (1.2)	487 (9.1)
Illinois	25 (1.6)	509 (7.7)	58 (1.2)	530 (7.2)	17 (1.4)	517 (6.5)
Canada	24 (0.8)	519 (3.3)	59 (1.0)	542 (2.3)	18 (0.8)	531 (4.6)
Connecticut	24 (1.1)	524 (12.5)	62 (1.7)	543 (10.0)	15 (1.5)	494 (11.1)
North Carolina	23 (1.2)	507 (8.6)	57 (1.3)	521 (5.8)	19 (1.6)	483 (7.5)
Rochester City Sch. Dist., NY	23 (1.8)	455 (9.9)	56 (2.3)	468 (8.4)	21 (2.2)	429 (8.8)
Chinese Taipei	23 (1.0)	604 (4.0)	42 (0.8)	581 (4.5)	35 (1.3)	533 (5.7)
United States	22 (0.8)	520 (5.1)	56 (0.9)	531 (4.2)	23 (1.3)	492 (6.5)
South Carolina	21 (1.3)	502 (9.2)	57 (1.1)	526 (6.6)	22 (1.4)	499 (8.6)
Michigan	20 (1.1)	549 (9.5)	59 (1.0)	553 (8.0)	20 (1.3)	528 (10.4)
Maryland	20 (1.0)	511 (9.6)	60 (1.3)	522 (6.5)	20 (1.3)	472 (11.4)
Oregon	19 (1.1)	548 (7.6)	55 (1.5)	545 (5.6)	25 (1.7)	522 (8.7)
Netherlands	19 (1.4)	519 (12.8)	74 (1.3)	553 (6.9)	7 (1.0)	543 (11.4)
Missouri	18 (1.5)	516 (7.5)	54 (1.5)	533 (6.7)	28 (1.6)	514 (8.4)
Texas	18 (1.4)	521 (11.2)	49 (2.2)	524 (9.4)	33 (2.6)	502 (11.9)
Delaware Science Coalition, DE	18 (1.0)	490 (10.8)	58 (2.1)	524 (9.0)	24 (1.9)	472 (8.9)
Pennsylvania	17 (1.9)	520 (8.1)	59 (2.0)	540 (5.8)	24 (1.9)	516 (9.0)
Indiana	17 (1.3)	530 (8.1)	58 (1.5)	544 (6.8)	25 (2.0)	524 (8.5)
Idaho	17 (1.3)	527 (9.0)	55 (1.9)	536 (5.8)	28 (2.1)	514 (9.2)
Project SMART Consortium, OH	17 (1.0)	534 (11.1)	58 (1.2)	550 (8.6)	26 (1.6)	522 (9.9)
Japan	17 (0.9)	558 (5.9)	49 (0.9)	558 (2.7)	35 (1.3)	535 (3.7)
Michigan Invitational Group, MI	17 (1.1)	570 (14.3)	63 (1.8)	571 (4.6)	20 (1.9)	543 (9.1)
Hong Kong, SAR	16 (0.8)	545 (6.0)	42 (0.9)	541 (3.5)	42 (1.4)	513 (4.5)
Czech Republic	16 (1.1)	522 (5.3)	62 (1.4)	547 (4.6)	22 (1.3)	537 (6.3)
Fremont/Lincoln/WestSide PS, NE	16 (1.8)	509 (7.1)	54 (1.6)	533 (5.6)	30 (2.2)	486 (8.6)
Korea, Rep. of	16 (0.7)	574 (4.6)	43 (0.7)	561 (3.7)	41 (1.0)	527 (2.9)
SW Math/Sci. Collaborative, PA	15 (1.1)	531 (8.3)	61 (1.6)	555 (7.2)	24 (1.9)	525 (10.0)
England	– –	– –	– –	– –	– –	– –
International Avg. (All Countries)	38 (0.2)	491 (1.0)	48 (0.2)	496 (0.9)	14 (0.1)	464 (1.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

A dash (–) indicates data are not available.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.7 Total Amount of Out-of-School Time Students Spend Studying Science or Doing Science Homework on a Normal School Day

8th Grade Science

	One Hour or More		Less Than One Hour		No Time		Average Hours[1]
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Countries							
United States	16 (0.8)	502 (5.9)	60 (1.3)	532 (4.6)	24 (1.4)	495 (6.4)	0.6 (0.01)
Belgium (Flemish)	31 (1.4)	520 (3.7)	55 (1.2)	543 (3.9)	14 (1.1)	538 (8.8)	0.8 (0.03)
Canada	18 (0.7)	515 (4.4)	62 (0.9)	541 (2.3)	20 (1.0)	525 (4.1)	0.6 (0.01)
Chinese Taipei	20 (0.9)	607 (4.7)	42 (0.9)	588 (4.4)	38 (1.3)	530 (5.7)	0.6 (0.02)
Czech Republic	20 (1.1)	530 (5.0)	62 (1.2)	546 (4.5)	18 (1.1)	529 (7.0)	0.6 (0.02)
England	– –	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	13 (0.6)	539 (6.6)	48 (1.0)	543 (4.0)	39 (1.3)	513 (4.2)	0.5 (0.01)
Italy	45 (1.4)	498 (4.3)	48 (1.4)	501 (4.3)	7 (0.7)	435 (8.6)	1.0 (0.02)
Japan	12 (0.7)	555 (7.5)	50 (1.2)	560 (2.3)	39 (1.4)	535 (3.2)	0.4 (0.01)
Korea, Rep. of	13 (0.6)	578 (4.6)	42 (0.7)	564 (3.1)	45 (0.8)	527 (2.9)	0.4 (0.01)
Netherlands	15 (1.3)	507 (12.9)	80 (1.5)	555 (6.4)	6 (0.8)	530 (11.6)	0.6 (0.02)
Russian Federation	61 (1.3)	536 (6.4)	34 (1.3)	534 (7.1)	5 (0.4)	494 (8.4)	1.5 (0.03)
Singapore	55 (1.2)	573 (7.1)	38 (1.1)	573 (9.9)	7 (0.6)	507 (13.2)	1.2 (0.02)
States							
Connecticut	18 (1.0)	516 (12.2)	68 (1.8)	542 (10.3)	14 (1.5)	493 (11.5)	0.7 (0.02)
Idaho	14 (1.3)	521 (9.8)	57 (2.2)	536 (5.7)	29 (2.4)	514 (8.9)	0.6 (0.02)
Illinois	17 (1.1)	495 (8.3)	64 (1.5)	531 (7.5)	20 (1.6)	511 (6.0)	0.6 (0.02)
Indiana	12 (0.8)	519 (9.6)	61 (1.8)	543 (6.8)	26 (2.0)	526 (8.4)	0.5 (0.02)
Maryland	17 (1.1)	495 (9.7)	65 (1.3)	519 (6.8)	18 (1.1)	480 (11.8)	0.6 (0.02)
Massachusetts	21 (1.4)	521 (9.9)	67 (1.5)	546 (7.0)	12 (1.0)	490 (9.8)	0.7 (0.02)
Michigan	13 (1.0)	530 (11.7)	65 (1.4)	552 (7.6)	21 (1.6)	536 (11.5)	0.6 (0.02)
Missouri	16 (1.2)	507 (6.2)	54 (1.9)	537 (6.7)	30 (2.0)	509 (9.6)	0.5 (0.02)
North Carolina	18 (1.1)	489 (6.1)	60 (1.8)	522 (6.3)	22 (1.9)	488 (10.1)	0.6 (0.02)
Oregon	13 (1.4)	536 (7.6)	59 (2.2)	547 (5.8)	28 (2.2)	523 (8.7)	0.5 (0.03)
Pennsylvania	14 (2.1)	506 (7.1)	62 (2.6)	540 (5.6)	24 (1.8)	518 (10.5)	0.6 (0.02)
South Carolina	16 (1.5)	487 (8.9)	61 (1.6)	526 (6.5)	23 (1.6)	495 (10.9)	0.6 (0.02)
Texas	13 (1.0)	489 (13.5)	51 (1.9)	525 (8.9)	36 (2.1)	507 (13.4)	0.5 (0.03)
Districts and Consortia							
Academy School Dist. #20, CO	24 (1.4)	550 (4.8)	64 (1.4)	570 (3.1)	12 (0.8)	526 (9.4)	0.8 (0.03)
Chicago Public Schools, IL	27 (1.8)	461 (12.4)	55 (1.6)	452 (9.7)	17 (1.8)	434 (10.3)	0.8 (0.03)
Delaware Science Coalition, DE	15 (1.3)	476 (10.0)	60 (2.1)	522 (8.9)	25 (2.2)	475 (8.3)	0.6 (0.03)
First in the World Consort., IL	16 (2.1)	556 (11.1)	69 (2.7)	570 (6.3)	15 (1.8)	557 (10.8)	0.6 (0.03)
Fremont/Lincoln/WestSide PS, NE	10 (1.2)	488 (10.8)	57 (1.6)	531 (5.0)	33 (1.4)	490 (7.1)	0.5 (0.03)
Guilford County, NC	17 (1.6)	518 (9.0)	68 (2.1)	542 (8.2)	15 (1.7)	520 (10.6)	0.6 (0.02)
Jersey City Public Schools, NJ	29 (1.9)	447 (13.0)	53 (1.9)	450 (8.9)	18 (2.0)	413 (10.0)	0.8 (0.03)
Miami-Dade County PS, FL	24 (2.1)	427 (12.0)	55 (1.5)	439 (10.6)	21 (2.3)	411 (14.5)	0.7 (0.04)
Michigan Invitational Group, MI	14 (0.8)	555 (10.7)	67 (1.2)	573 (5.8)	19 (1.3)	545 (10.2)	0.6 (0.01)
Montgomery County, MD	18 (1.5)	526 (8.6)	67 (2.1)	541 (4.7)	15 (1.3)	504 (8.4)	0.7 (0.03)
Naperville Sch. Dist. #203, IL	17 (1.4)	570 (6.4)	69 (1.8)	592 (4.5)	14 (1.4)	564 (10.6)	0.6 (0.02)
Project SMART Consortium, OH	13 (0.9)	516 (12.8)	62 (1.5)	551 (8.9)	25 (1.7)	523 (10.5)	0.5 (0.02)
Rochester City Sch. Dist., NY	23 (2.0)	449 (10.8)	57 (2.5)	468 (8.1)	20 (2.4)	425 (8.5)	0.7 (0.04)
SW Math/Sci. Collaborative, PA	10 (1.1)	513 (12.1)	66 (1.9)	554 (6.9)	24 (1.8)	527 (9.8)	0.5 (0.02)
International Avg. (All Countries)	36 (0.2)	486 (1.0)	49 (0.2)	495 (1.0)	14 (0.2)	462 (1.2)	1.0 (0.00)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

[1] Average hours based on: No time=0; less than 1 hour=.5; 1-2 hours=1.5; 3-5 hours=4; more than 5 hours=7.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

How Do Students Perceive Their Ability in the Sciences?

To investigate how students think of their abilities in science, TIMSS created an index of students' self-concept in the sciences (SCS). It is based on student's responses to four statements about their science ability:

- I would like science much more if it were not so difficult
- Although I do my best, science is more difficult for me than for many of my classmates
- Nobody can be good in every subject, and I am just not talented in science
- Science is not one of my strengths.

In countries where the sciences are taught as separate subjects, students were asked about each subject separately.

Students who disagreed or strongly disagreed with all four statements were assigned to the high level of the index, while students who agreed or strongly agreed with all four were assigned to the low level. The medium level includes all other combinations of responses. (As an example of one of the components of the index, Exhibit R1.11 in the reference section shows the percentages of agreement for the statement "science is not one of my strengths.")

The percentages of eighth-grade students at each index level, and their average science achievement, are presented in Exhibit 4.8. This four-page display summarizes the data in one panel for the countries that teach science as a single subject (including all the Benchmarking participants), and in separate panels for earth science, biology, physics, and chemistry for countries that teach the sciences separately. Among all the single-science countries, the United States had the greatest percentage of students at the high level of the self-concept index: 45 percent compared with 26 percent on average across all countries. Several of the Benchmarking participants had even greater percentages at the high level, notably the First in the World Consortium and North Carolina, with more than 50 percent of students at this level.

Although there was a clear positive association between self-concept and science achievement within every country and within every Benchmarking jurisdiction, the relationship across entities was more complex. Several countries with high average science achievement, including Singapore, Japan, Hong Kong, Chinese Taipei, and Korea, had relatively low percentages of students (21 percent or less) in the high self-concept category. Since all of these are Asian Pacific countries, they may share cultural traditions that encourage a modest self-concept.

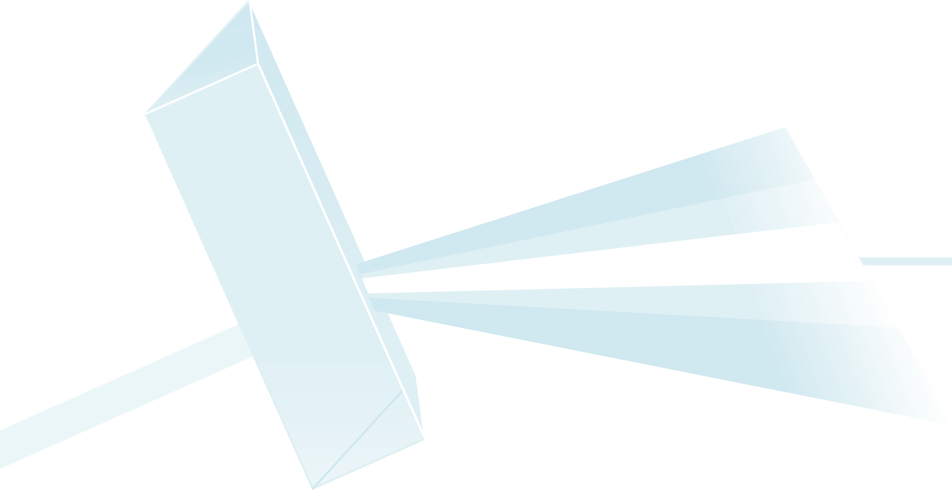
In countries teaching the sciences as separate subjects, the percentage of students at the high level of the science self-concept index was greatest for biology and earth science, with more than 40 percent of students in the high category on average. The percentage was lower for physics (32 percent on average) and chemistry (28 percent). Generally, countries with high percentages of students in the high category for one subject had high percentages in the other subjects also. The largest percentages of students in the high category were in the Russian Federation and the Netherlands[4] in all subjects. The positive association between science self-concept and science achievement that was found for science as a single subject was also evident in each of the science subject areas.

Results of analyses of the TIMSS 1995 data by gender[5] reveal not only that boys outperformed girls in science at the eighth grade in many countries, but that they attached more importance to doing well in science and mathematics than in language, and to doing well in science in order to get a good job. Not surprisingly, therefore, many countries, including the United States, showed differences in science self-concept between girls and boys. Exhibit 4.9 presents the percentages of girls and boys in the Benchmarking entities and in the reference countries at the high, medium, and low levels of the science self-concept index. Despite the gender differences in the United States as a whole, there were few significant differences among Benchmarking participants. There were greater percentages of boys at the high index level in Massachusetts, Missouri, Naperville, and the Southwest Pennsylvania Math and Science Collaborative. Naperville had a greater percentage of girls at the low level. Greater percentages of girls at the medium level were found in Massachusetts, Oregon, and Rochester.

---

[4] Physics and chemistry are taught as one subject in the Netherlands. Student responses are reported in the physics panel of Exhibit 4.8.

[5] Mullis, I.V.S., Martin, M.O., Fierros, E.G., Goldberg, A.L., and Stemler, S.E. (2000), *Gender Differences in Achievement: IEA's Third International Mathematics and Science Study*, Chestnut Hill, MA: Boston College.



Exhibits 4.8-4.9

Exhibit 4.8 Index of Students' Self-Concept in the Sciences (SCS)

8th Grade Science

Index of Students' Self-Concept in the Sciences

Index based on students' responses to four statements about their science ability: 1) I would like science much more if it were not so difficult; 2) although I do my best, science is more difficult for me than for many of my classmates; 3) nobody can be good in every subject, and I am just not talented in science; 4) science is not one of my strengths. In countries where science is taught as separate subjects, students were asked about each subject area separately. High level indicates student disagrees or strongly disagrees with all four statements. Low level indicates student agrees or strongly agrees with all four statements. Medium level includes all other possible combinations of responses.

	High SCS		Medium SCS		Low SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
General/Integrated Science (SCS-G)						
First in the World Consort., IL	51 (1.8)	587 (6.3)	36 (1.8)	553 (5.6)	13 (1.3)	515 (8.7)
North Carolina	51 (2.2)	533 (6.8)	37 (1.5)	494 (7.3)	13 (1.1)	457 (8.5)
Montgomery County, MD	49 (2.1)	565 (4.8)	35 (1.2)	517 (7.0)	15 (1.8)	462 (9.0)
Guilford County, NC	49 (2.2)	566 (5.9)	40 (1.6)	515 (8.7)	11 (1.6)	469 (8.0)
Michigan	49 (1.7)	572 (8.9)	37 (1.3)	531 (8.6)	13 (1.0)	498 (9.7)
Michigan Invitational Group, MI	48 (2.9)	587 (7.1)	40 (2.2)	556 (5.2)	11 (1.2)	508 (9.8)
SW Math/Sci. Collaborative, PA	48 (2.3)	568 (8.9)	37 (1.3)	532 (8.1)	15 (1.9)	500 (10.5)
Delaware Science Coalition, DE	48 (2.6)	533 (7.7)	37 (1.6)	491 (8.6)	15 (1.6)	455 (8.3)
Chicago Public Schools, IL	48 (2.7)	470 (10.0)	41 (1.9)	440 (9.6)	11 (1.7)	407 (11.6)
Connecticut	47 (2.3)	557 (10.4)	38 (1.7)	519 (10.4)	15 (1.3)	477 (10.8)
Naperville Sch. Dist. #203, IL	46 (2.2)	613 (5.9)	40 (1.9)	572 (4.5)	14 (1.2)	523 (7.1)
Illinois	46 (1.6)	551 (7.0)	40 (1.0)	502 (7.6)	14 (0.9)	473 (6.0)
Indiana	46 (2.2)	564 (6.2)	41 (1.7)	523 (7.7)	14 (1.4)	479 (8.0)
Project SMART Consortium, OH	46 (2.9)	571 (8.9)	39 (1.8)	524 (7.6)	15 (1.9)	486 (7.8)
Oregon	45 (1.9)	567 (6.5)	39 (1.6)	527 (6.8)	16 (1.3)	486 (10.5)
United States	45 (1.2)	550 (4.5)	40 (0.8)	505 (4.4)	15 (0.7)	459 (6.2)
Massachusetts	45 (2.0)	565 (7.3)	40 (1.3)	522 (6.4)	16 (1.3)	475 (9.1)
South Carolina	45 (2.4)	542 (8.8)	41 (1.9)	496 (7.2)	14 (1.0)	467 (8.2)
Maryland	45 (1.7)	541 (6.9)	39 (1.1)	492 (8.2)	16 (1.2)	460 (7.7)
Academy School Dist. #20, CO	44 (1.2)	584 (4.0)	40 (1.4)	552 (3.1)	16 (1.0)	509 (6.7)
Texas	44 (2.7)	554 (7.8)	41 (1.8)	497 (11.7)	16 (1.5)	442 (12.0)
England	42 (1.3)	573 (5.8)	45 (1.2)	528 (4.6)	13 (0.8)	486 (8.6)
Missouri	42 (1.5)	553 (7.7)	39 (1.0)	514 (6.5)	19 (1.5)	479 (8.3)
Pennsylvania	42 (1.2)	556 (6.5)	42 (0.8)	521 (6.5)	16 (1.2)	489 (10.6)
Idaho	41 (1.7)	559 (6.5)	40 (1.1)	516 (7.0)	19 (1.3)	486 (6.3)
Rochester City Sch. Dist., NY	40 (2.2)	473 (7.8)	39 (1.8)	460 (9.2)	21 (1.6)	427 (10.5)
Jersey City Public Schools, NJ	40 (1.7)	461 (11.2)	45 (1.8)	440 (11.4)	16 (1.6)	399 (9.7)
Fremont/Lincoln/WestSide PS, NE	39 (2.9)	551 (4.8)	40 (2.3)	503 (7.3)	21 (2.2)	461 (11.4)
Miami-Dade County PS, FL	39 (2.1)	469 (10.5)	41 (1.3)	414 (8.6)	20 (2.1)	381 (13.6)
Italy	38 (1.3)	523 (3.6)	49 (1.1)	487 (4.4)	12 (0.7)	441 (6.3)
Canada	38 (0.8)	562 (2.5)	45 (0.7)	526 (2.9)	17 (0.6)	490 (4.7)
Singapore	21 (1.1)	616 (8.9)	59 (0.8)	562 (7.8)	19 (0.9)	533 (8.7)
Japan	21 (0.6)	592 (4.1)	63 (0.6)	543 (2.3)	16 (0.6)	521 (4.4)
Hong Kong, SAR	20 (0.8)	556 (4.2)	58 (0.7)	532 (3.4)	22 (0.8)	504 (5.9)
Chinese Taipei [a]	14 (0.6)	617 (5.1)	61 (0.8)	572 (4.9)	25 (0.8)	538 (4.0)
Korea, Rep. of	12 (0.5)	601 (5.0)	80 (0.6)	547 (2.6)	8 (0.4)	490 (4.5)
International Avg. (All General Science Countries)	26 (0.2)	521 (1.4)	56 (0.2)	475 (1.0)	18 (0.2)	439 (1.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

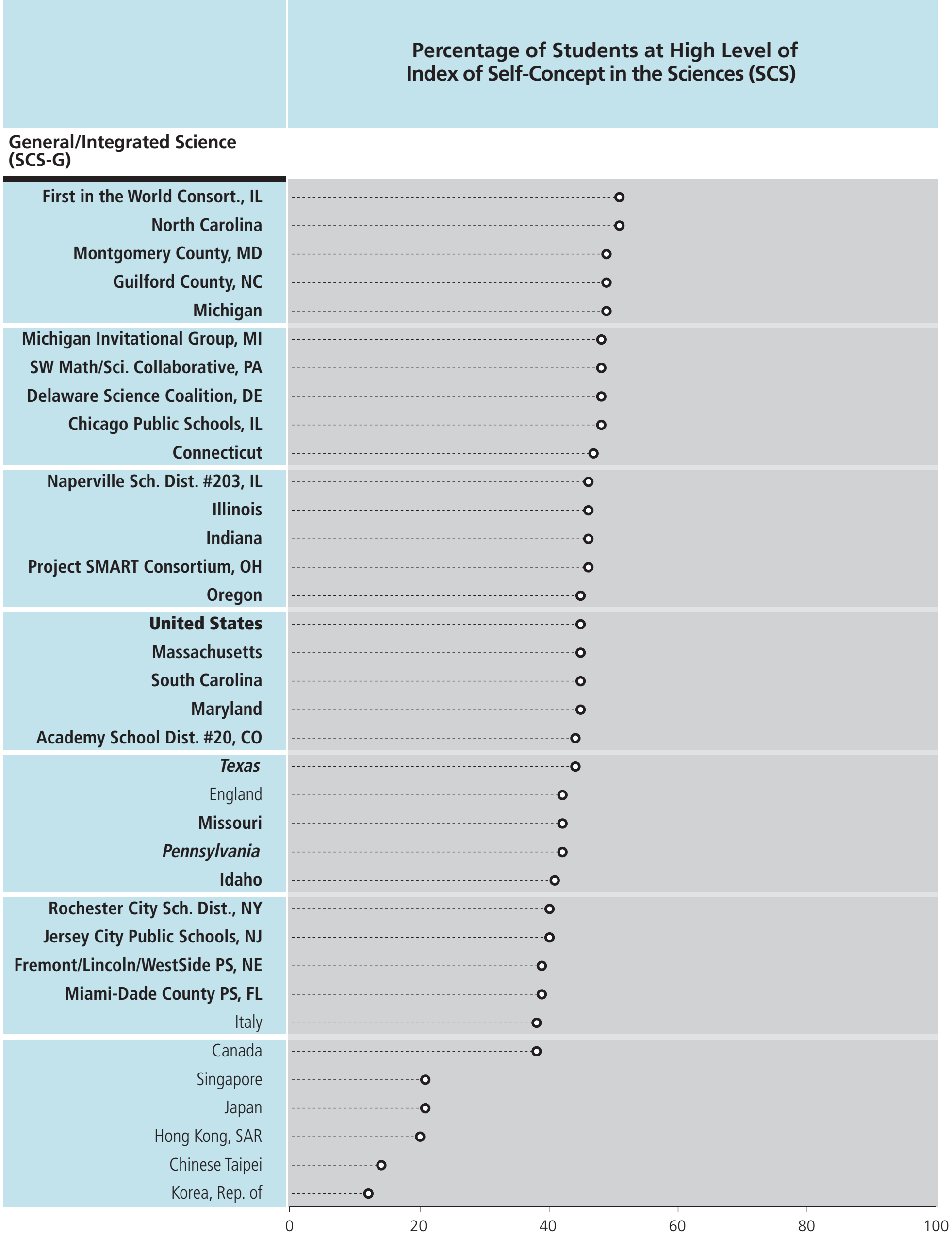
[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

Exhibit 4.8
(Continued 1)

Index of Students' Self-Concept in the Sciences (SCS)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.8
(Continued 2)

Index of Students' Self-Concept in the Sciences (SCS)

	High SCS		**Medium** SCS		**Low** SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Earth Science (SCS-E)						
Russian Federation	68 (1.2)	545 (6.4)	22 (0.9)	519 (7.2)	10 (0.6)	488 (8.1)
Netherlands	50 (1.7)	555 (7.3)	43 (1.4)	538 (8.3)	7 (0.6)	527 (9.8)
Czech Republic	48 (1.5)	552 (4.8)	43 (1.2)	533 (4.6)	9 (0.7)	506 (8.2)
Belgium (Flemish)	36 (1.1)	555 (4.5)	49 (1.3)	535 (3.5)	15 (0.9)	511 (5.3)
International Avg. (All Separate Science Countries)	42 (0.4)	522 (1.5)	43 (0.3)	496 (1.5)	15 (0.3)	467 (2.0)
Biology (SCS-B)						
Russian Federation	78 (1.2)	542 (6.3)	17 (0.9)	510 (7.6)	5 (0.5)	481 (11.7)
Netherlands	54 (1.4)	556 (8.1)	39 (1.3)	535 (7.3)	7 (0.6)	514 (9.8)
Czech Republic	52 (1.5)	551 (4.8)	40 (1.2)	532 (4.8)	8 (0.8)	506 (7.3)
Belgium (Flemish)	40 (1.2)	557 (3.9)	48 (1.2)	529 (2.9)	12 (0.8)	496 (6.3)
International Avg. (All Separate Science Countries)	45 (0.4)	524 (1.4)	44 (0.3)	495 (1.2)	12 (0.2)	461 (2.1)
Physics (SCS-P)						
Russian Federation	63 (1.1)	548 (6.5)	24 (0.8)	520 (7.0)	13 (0.8)	490 (10.0)
Netherlands[b]	44 (2.4)	563 (8.2)	45 (1.8)	533 (6.9)	11 (1.2)	526 (8.4)
Belgium (Flemish)	33 (1.8)	561 (6.9)	49 (1.5)	539 (5.9)	18 (1.1)	530 (7.5)
Czech Republic	33 (1.6)	564 (5.2)	47 (1.1)	534 (4.6)	20 (1.3)	512 (5.6)
International Avg. (All Separate Science Countries)	32 (0.4)	530 (1.6)	46 (0.3)	501 (1.4)	22 (0.3)	475 (2.0)
Chemistry (SCS-C)						
Russian Federation	53 (1.6)	551 (6.2)	28 (0.8)	524 (7.8)	19 (1.2)	499 (9.2)
Czech Republic	32 (1.7)	561 (5.6)	48 (1.3)	537 (3.8)	20 (1.4)	511 (5.9)
Belgium (Flemish)	– –	– –	– –	– –	– –	– –
Netherlands	– –	– –	– –	– –	– –	– –
International Avg. (All Separate Science Countries)	28 (0.4)	523 (1.5)	47 (0.3)	497 (1.5)	24 (0.3)	471 (1.8)

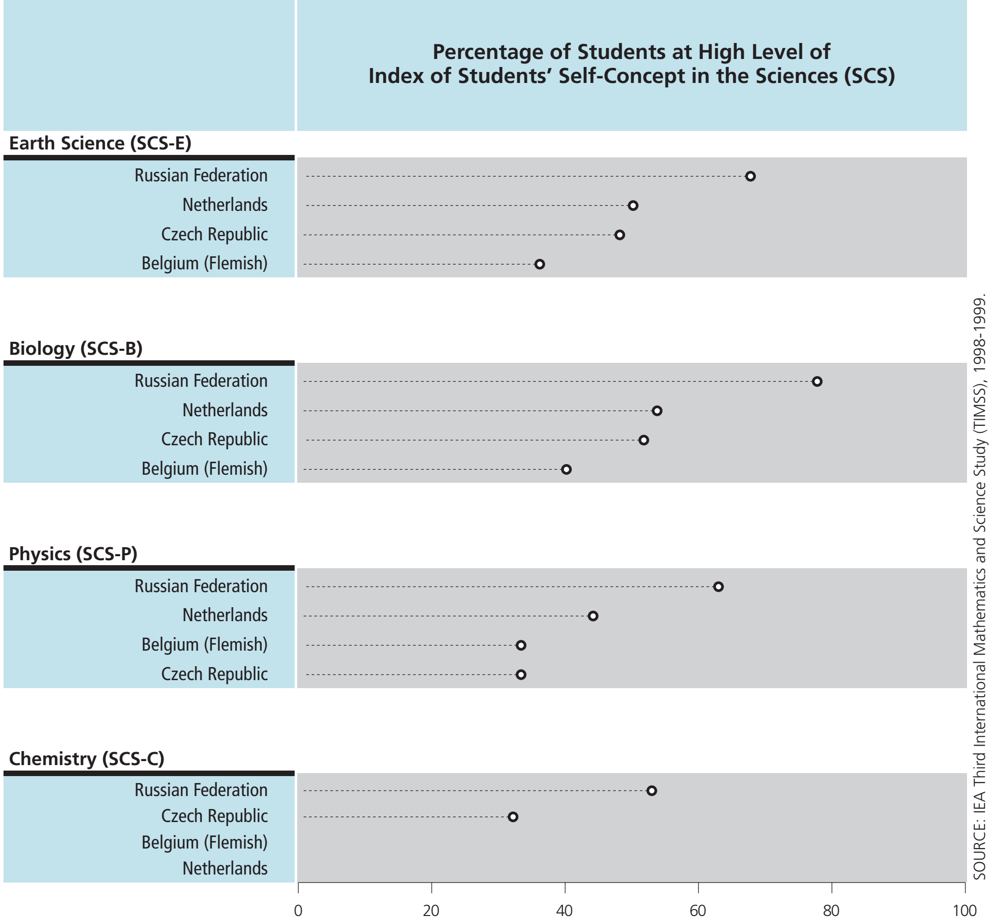
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

Index of Students' Self-Concept in the Sciences (SCS)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.9 Index of Students' Self-Concept in the Sciences (SCS) by Gender*

8th Grade Science

General/Integrated Science (SCS-G)		High SCS Percent of Students		Medium SCS Percent of Students		Low SCS Percent of Students	
		Girls	Boys	Girls	Boys	Girls	Boys
Countries	United States	42 (1.2)	48 (1.6) ▲	42 (1.0) ▲	38 (1.1)	16 (0.7)	14 (0.9)
	Canada	35 (1.3)	41 (1.3)	49 (1.4) ▲	42 (1.1)	16 (0.7)	17 (0.8)
	Chinese Taipei [a]	10 (0.6)	18 (0.9) ▲	60 (0.9)	62 (1.1)	30 (1.0) ▲	20 (1.1)
	England	36 (1.9)	48 (1.6) ▲	49 (1.6) ▲	42 (1.4)	15 (1.2) ▲	10 (1.0)
	Hong Kong, SAR	16 (1.0)	24 (1.0) ▲	61 (1.0) ▲	56 (0.9)	23 (1.1)	20 (1.0)
	Italy	40 (1.7)	36 (1.4)	49 (1.4)	50 (1.3)	11 (0.8)	14 (1.0)
	Japan	15 (0.9)	27 (1.0) ▲	65 (1.0)	62 (0.9)	20 (0.9) ▲	11 (0.7)
	Korea, Rep. of	8 (0.5)	15 (0.8) ▲	83 (0.7) ▲	78 (0.9)	9 (0.6)	7 (0.5)
	Singapore	17 (1.0)	26 (1.5) ▲	61 (1.0)	58 (1.2)	23 (1.1) ▲	16 (1.0)
States	Connecticut	44 (2.9)	51 (2.4)	40 (2.1)	37 (2.1)	17 (1.6)	13 (1.5)
	Idaho	40 (2.0)	42 (2.2)	41 (1.3)	39 (1.7)	20 (1.6)	18 (1.6)
	Illinois	42 (1.8)	50 (2.4)	42 (1.7)	37 (1.7)	15 (1.2)	12 (1.2)
	Indiana	44 (2.5)	47 (2.6)	41 (1.7)	40 (2.7)	15 (1.8)	12 (1.6)
	Maryland	43 (2.1)	47 (1.8)	42 (1.3)	37 (1.5)	16 (1.2)	16 (1.3)
	Massachusetts	42 (1.9)	48 (2.6) ▲	43 (1.3) ▲	36 (2.0)	16 (1.7)	16 (1.4)
	Michigan	47 (2.3)	52 (2.0)	38 (2.2)	37 (1.6)	15 (1.6)	11 (1.1)
	Missouri	38 (1.7)	46 (2.3) ▲	42 (1.7)	35 (1.6)	19 (1.5)	19 (1.8)
	North Carolina	51 (2.3)	50 (2.6)	35 (1.6)	38 (2.0)	13 (1.6)	12 (1.1)
	Oregon	41 (2.4)	48 (2.1)	44 (2.1) ▲	35 (1.8)	15 (1.8)	17 (2.0)
	Pennsylvania	40 (1.6)	43 (1.9)	43 (1.4)	41 (1.0)	17 (1.5)	16 (1.4)
	South Carolina	42 (3.3)	48 (2.3)	44 (2.7)	38 (1.9)	15 (1.6)	15 (1.1)
	Texas	41 (3.0)	47 (2.8)	42 (2.2)	39 (1.8)	17 (1.7)	14 (1.8)
Districts	Academy School Dist. #20, CO	40 (2.2)	48 (1.7)	44 (2.5)	36 (1.9)	16 (1.5)	16 (1.2)
	Chicago Public Schools, IL	45 (3.1)	51 (3.6)	42 (2.2)	40 (3.2)	13 (2.5)	10 (1.2)
	Delaware Science Coalition, DE	46 (2.8)	49 (3.5)	38 (2.3)	36 (2.1)	15 (1.6)	15 (2.1)
	First in the World Consort., IL	46 (3.0)	56 (2.1)	39 (2.9)	32 (2.0)	14 (1.7)	12 (1.6)
	Fremont/Lincoln/WestSide PS, NE	35 (3.3)	44 (3.4)	43 (3.4)	38 (3.3)	23 (3.3)	19 (2.0)
	Guilford County, NC	47 (3.0)	52 (2.3)	40 (2.4)	39 (2.2)	12 (1.5)	10 (2.3)
	Jersey City Public Schools, NJ	38 (2.4)	42 (2.5)	46 (2.3)	43 (2.6)	16 (1.8)	16 (2.6)
	Miami-Dade County PS, FL	40 (3.1)	39 (1.9)	42 (2.0)	40 (1.8)	19 (2.5)	21 (2.7)
	Michigan Invitational Group, MI	48 (5.1)	48 (3.1)	41 (4.1)	40 (2.4)	11 (1.6)	12 (1.7)
	Montgomery County, MD	47 (2.7)	52 (2.4)	36 (2.1)	34 (2.0)	17 (1.8)	14 (2.3)
	Naperville Sch. Dist. #203, IL	40 (2.1)	53 (3.0) ▲	42 (1.9)	37 (2.9)	17 (1.8) ▲	10 (1.4)
	Project SMART Consortium, OH	43 (3.3)	48 (3.4)	40 (2.5)	38 (2.2)	17 (2.2)	14 (2.3)
	Rochester City Sch. Dist., NY	36 (2.3)	45 (3.0)	43 (1.8) ▲	34 (2.2)	21 (1.6)	21 (2.3)
	SW Math/Sci. Collaborative, PA	43 (2.8)	53 (2.5) ▲	39 (1.4)	34 (1.8)	18 (2.7)	12 (1.6)
	International Avg. (All General Science Countries)	25 (0.3)	28 (0.3) ▲	57 (0.3) ▲	55 (0.2)	19 (0.2) ▲	18 (0.2)

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

Exhibit 4.9
(Continued)

Index of Students' Self-Concept in the Sciences (SCS) by Gender*

8th Grade Science

	High SCS Percent of Students		**Medium** SCS Percent of Students		**Low** SCS Percent of Students	
	Girls	Boys	Girls	Boys	Girls	Boys
Earth Science (SCS-E)						
Belgium (Flemish)	33 (1.6)	38 (1.8)	50 (1.2)	48 (1.8)	17 (1.5)	14 (0.7)
Czech Republic	48 (2.1)	48 (1.9)	43 (1.8)	43 (1.4)	9 (0.8)	9 (1.1)
Netherlands	43 (2.3)	57 (2.3) ▲	48 (2.0) ▲	37 (1.8)	9 (0.9)	6 (1.0)
Russian Federation	70 (1.7)	66 (1.1)	21 (1.3)	23 (0.9)	9 (0.8)	11 (0.8)
International Avg. (All Separate Science Countries)	42 (0.5)	43 (0.5) ▲	43 (0.5) ▲	42 (0.4)	15 (0.3)	16 (0.3) ▲
Biology (SCS-B)						
Belgium (Flemish)	42 (2.1)	39 (1.6)	47 (2.3)	49 (1.6)	10 (1.4)	13 (1.3)
Czech Republic	57 (1.9) ▲	47 (1.5)	38 (1.7)	43 (1.3)	6 (0.9)	10 (1.1) ▲
Netherlands	56 (1.7)	52 (1.9)	39 (1.5)	40 (1.9)	5 (0.8)	8 (1.1)
Russian Federation	82 (1.3) ▲	73 (1.5)	16 (1.0)	19 (1.1)	2 (0.4)	8 (0.8) ▲
International Avg. (All Separate Science Countries)	48 (0.5) ▲	41 (0.5)	42 (0.4)	46 (0.4) ▲	10 (0.3)	14 (0.3) ▲
Physics (SCS-P)						
Belgium (Flemish)	30 (2.5)	36 (2.2)	50 (2.0)	47 (1.9)	20 (1.9)	17 (1.0)
Czech Republic	26 (1.8)	40 (1.8) ▲	51 (1.7) ▲	43 (1.4)	23 (1.4)	17 (1.8)
Netherlands[b]	35 (3.4)	53 (3.1) ▲	52 (2.4) ▲	38 (2.6)	13 (1.6)	9 (1.6)
Russian Federation	62 (1.2)	64 (1.3)	25 (1.0)	24 (1.0)	14 (0.9)	13 (0.9)
International Avg. (All Separate Science Countries)	27 (0.5)	36 (0.5) ▲	48 (0.4) ▲	44 (0.4)	25 (0.4) ▲	19 (0.3)
Chemistry (SCS-C)						
Belgium (Flemish)	– –	– –	– –	– –	– –	– –
Czech Republic	31 (2.1)	32 (1.8)	49 (1.6)	47 (1.7)	20 (1.5)	21 (1.7)
Netherlands	– –	– –	– –	– –	– –	– –
Russian Federation	53 (1.7)	52 (2.0)	29 (1.1)	28 (1.1)	18 (1.3)	20 (1.4)
International Avg. (All Separate Science Countries)	27 (0.4)	29 (0.4) ▲	48 (0.4) ▲	47 (0.4)	25 (0.4) ▲	24 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

What Are Students' Attitudes Towards the Sciences?

Generating positive attitudes towards science among students is an important goal of science education in many jurisdictions. To gain some understanding of eighth-graders' views about the utility of science and their enjoyment of it as a school subject, TIMSS created an index of positive attitudes towards the sciences (PATS). Students were asked to state their agreement with the following five statements:

- I like science
- I enjoy learning science
- Science is boring[6]
- Science is important to everyone's life
- I would like a job that involved using science.

In countries where the sciences are taught as separate subjects students were asked about each subject area separately.

For each statement, students responded on a four-point scale indicating whether their feelings about science were strongly positive, positive, negative, or strongly negative. The responses were averaged, with students being placed in the high category if their average indicated a positive or strongly positive attitude. Students with a negative or strongly negative attitude on average were placed in the low category. The students between these extremes were placed in the medium category. The results are presented in Exhibit 4.10 in a four-page display, in a single panel for the countries that teach science as a single subject (this panel includes the Benchmarking participants) and in separate panels for earth science, biology, physics, and chemistry for countries that teach the sciences separately. (Additional information on students' liking science, one of the components of the index, is provided in Exhibit R1.12 in the reference section.)

In countries where science is taught as a single subject, students generally had positive attitudes towards the sciences, with 40 percent on average across all TIMSS 1999 countries in the high category and a further 49 percent in the medium category. Only 10 percent of students were in the low category. Percentages for the United States did not vary much from the international averages. Benchmarking jurisdictions with large percentages of students at the high level included the Rochester City School District and North Carolina (40 percent). Jurisdictions with somewhat less favorable attitudes included Idaho, the Delaware Science Coalition,

---

[6] The response categories for this statement were reversed in constructing the index.

Massachusetts, the Fremont/Lincoln/Westside Public Schools, Pennsylvania, Oregon, and the Chicago Public Schools, where less than 30 percent of the students were at the high level. The comparison countries with the least positive attitudes were Chinese Taipei, Hong Kong, Japan, and Korea. Since these are all countries with high average science achievement, it may be that the students follow a demanding science curriculum that leads to high achievement but little enthusiasm for the subject matter. However, there was a clear positive association between attitudes towards the sciences and science achievement on average across all the TIMSS 1999 countries and in many of the Benchmarking entities.

Attitudes towards the science subject areas were somewhat less positive among the separate-science countries. The most positive were towards biology (32 percent in the high category, on average) and earth science (27 percent), and the least positive towards physics and chemistry (19 and 23 percent, respectively). Among the four separate-science comparison countries, the Russian Federation and the Czech Republic had the greatest percentage of students at the high level in all of the subject areas. The relationship between positive attitudes and science achievement was not as clear for the separate-science subject areas as it was for science as a single subject. In physics and chemistry, students at the high level of the index had substantially higher average achievement than students at the medium and low levels on average across all the TIMSS 1999 countries, but this was not the case for earth science and biology.

Exhibit 4.11 shows the percentages of girls and boys in each of the comparison countries and Benchmarking jurisdictions at each level of the index of positive attitudes towards the sciences. Although the United States, like many of the other countries, had significantly different percentages of girls and boys at the index levels, there were few significant differences among the Benchmarking participants. North Carolina was the only state to show a difference, with a greater percentage of boys at the high level and of girls at the medium level. The Delaware Science Coalition and Naperville had greater percentages of boys at the high level. For the separate-science countries on average, there were significantly greater percentages of boys than girls at the high level of the index in earth science, physics, and chemistry, but a larger percentage of girls in biology.

Exhibit 4.10 Index of Students' Positive Attitudes Towards the Sciences (PATS)

8th Grade Science

Index of Students' Positive Attitudes Towards the Sciences

Index based on students' responses to five statements about science: 1) I like science; 2) I enjoy learning science; 3) science is boring (reversed scale); 4) science is important to everyone's life; 5) I would like a job that involved using science. Average is computed across the five items based on a 4-point scale: 1 = strongly negative; 2 = negative; 3 = positive; 4 = strongly positive. In countries where science is taught as separate subjects, students were asked about each subject area separately. High level indicates average is greater than 3. Medium level indicates average is greater than 2 and less than or equal to 3. Low level indicates average is less than or equal to 2.

G

General/Integrated Science (PATS-G)

		High PATS		**Medium** PATS		**Low** PATS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore		46 (1.4)	594 (8.1)	49 (1.2)	549 (7.8)	5 (0.6)	509 (12.3)
Rochester City Sch. Dist., NY	s	40 (2.0)	475 (10.8)	50 (2.3)	469 (8.8)	10 (1.6)	454 (14.7)
North Carolina		40 (1.4)	526 (6.8)	50 (1.4)	501 (6.8)	10 (0.8)	486 (12.8)
England		39 (1.1)	559 (5.5)	53 (1.1)	532 (5.6)	8 (0.6)	514 (10.2)
Miami-Dade County PS, FL		38 (3.4)	443 (13.5)	53 (2.5)	428 (9.7)	10 (1.5)	420 (12.2)
Jersey City Public Schools, NJ		35 (2.2)	461 (13.8)	51 (1.9)	437 (8.3)	13 (1.0)	432 (11.9)
First in the World Consort., IL		34 (2.0)	584 (7.5)	50 (2.1)	561 (5.9)	15 (1.5)	539 (12.7)
South Carolina		33 (1.9)	539 (9.0)	50 (1.1)	503 (7.4)	17 (1.5)	490 (7.2)
Guilford County, NC		33 (1.7)	556 (7.0)	54 (1.7)	530 (8.8)	12 (1.5)	513 (8.7)
Maryland		33 (1.6)	534 (7.6)	49 (1.2)	507 (7.9)	18 (1.4)	487 (8.7)
United States		32 (0.9)	543 (5.9)	51 (0.8)	515 (4.5)	16 (0.6)	489 (4.3)
Indiana		32 (2.1)	561 (7.8)	52 (1.3)	531 (6.8)	16 (1.4)	508 (7.8)
Academy School Dist. #20, CO		32 (1.4)	592 (4.2)	51 (1.4)	550 (3.0)	17 (1.2)	530 (6.6)
Texas		32 (1.2)	536 (11.2)	54 (1.2)	507 (10.6)	15 (0.9)	497 (13.6)
Connecticut		31 (1.6)	554 (12.8)	51 (1.3)	530 (10.4)	18 (1.6)	505 (6.0)
Montgomery County, MD		31 (2.0)	562 (5.1)	51 (1.4)	529 (6.4)	18 (2.1)	495 (8.1)
SW Math/Sci. Collaborative, PA		31 (2.1)	572 (9.3)	52 (1.4)	536 (6.4)	18 (1.5)	520 (10.3)
Missouri		31 (1.6)	548 (8.4)	50 (0.9)	519 (7.0)	19 (1.5)	498 (6.5)
Michigan Invitational Group, MI		30 (1.7)	589 (9.1)	54 (2.0)	557 (6.4)	16 (1.4)	550 (10.0)
Michigan		30 (1.4)	570 (7.9)	54 (1.3)	545 (8.4)	16 (1.0)	517 (8.8)
Illinois		30 (1.5)	544 (9.6)	53 (1.6)	515 (6.7)	17 (1.1)	503 (6.0)
Naperville Sch. Dist. #203, IL		30 (1.8)	618 (7.3)	52 (2.0)	578 (3.9)	18 (1.2)	546 (7.0)
Canada		30 (0.8)	556 (2.8)	52 (0.8)	530 (2.6)	18 (0.8)	511 (4.0)
Project SMART Consortium, OH		30 (1.5)	557 (9.5)	54 (1.3)	540 (9.5)	16 (1.4)	508 (7.7)
Italy		29 (1.2)	514 (4.9)	58 (1.1)	489 (4.2)	13 (0.9)	475 (6.1)
Idaho		29 (2.1)	563 (6.4)	51 (1.4)	523 (7.0)	20 (1.6)	490 (7.8)
Delaware Science Coalition, DE		29 (1.9)	538 (10.1)	53 (1.4)	504 (8.4)	18 (2.1)	477 (10.7)
Massachusetts		29 (1.6)	565 (9.6)	55 (1.0)	530 (5.7)	17 (1.4)	496 (10.0)
Fremont/Lincoln/WestSide PS, NE		28 (2.2)	541 (6.8)	53 (2.2)	513 (5.3)	18 (1.7)	479 (12.5)
Pennsylvania		28 (1.7)	555 (7.3)	53 (1.6)	529 (6.8)	18 (1.1)	501 (8.0)
Oregon		28 (2.1)	562 (8.1)	52 (1.1)	537 (6.2)	20 (1.8)	516 (9.8)
Chinese Taipei	a	27 (0.8)	607 (4.7)	64 (0.7)	561 (4.4)	10 (0.6)	528 (6.7)
Chicago Public Schools, IL		26 (2.6)	482 (10.0)	60 (2.1)	442 (9.2)	14 (1.9)	443 (13.3)
Hong Kong, SAR		25 (1.0)	555 (5.1)	65 (0.8)	526 (3.7)	9 (0.6)	497 (4.8)
Korea, Rep. of		10 (0.5)	613 (4.3)	66 (0.7)	550 (2.6)	24 (0.8)	519 (3.4)
Japan		10 (0.5)	599 (6.3)	60 (0.9)	554 (2.6)	30 (1.0)	527 (3.0)
International Avg. (All General Science Countries)		40 (0.2)	499 (1.1)	49 (0.2)	473 (1.0)	10 (0.1)	467 (2.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

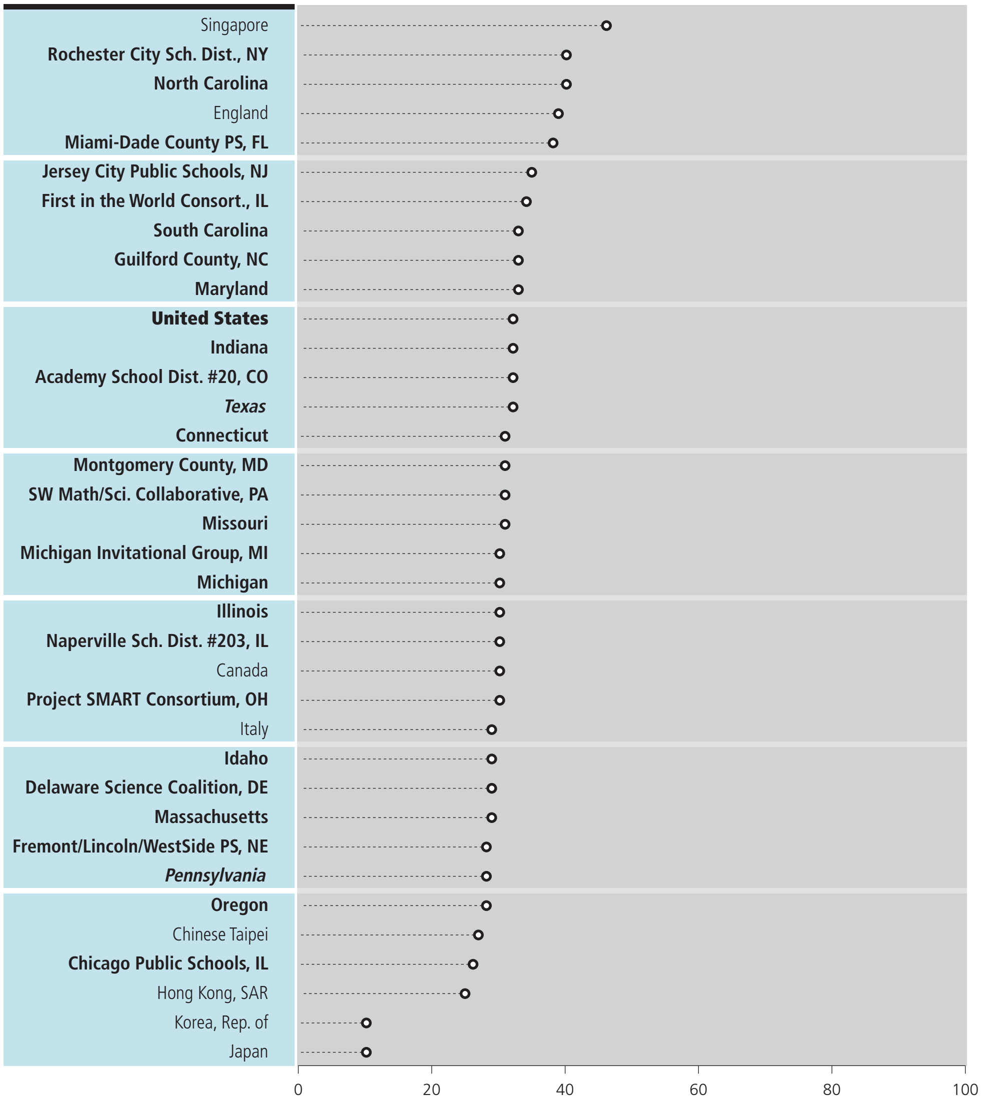
An "s" indicates a 50-69% student response rate.

Exhibit 4.10
(Continued 1)

Index of Students' Positive Attitudes Towards the Sciences (PATS)

Percentage of Students at High Level of Index of Positive Attitudes Towards the Sciences (PATS)

General/Integrated Science (PATS-G)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.10
(Continued 2)

Index of Students' Positive Attitudes Towards the Sciences (PATS)

8th Grade Science

	High PATS		**Medium** PATS		**Low** PATS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Earth Science (PATS-E)						
Russian Federation	28 (1.8)	542 (10.2)	65 (1.6)	529 (6.2)	7 (0.6)	526 (8.7)
Czech Republic	23 (1.4)	544 (6.1)	64 (1.2)	538 (4.4)	13 (1.0)	547 (7.6)
Netherlands	11 (1.3)	544 (12.0)	65 (1.5)	548 (7.2)	23 (1.7)	540 (9.6)
Belgium (Flemish)	9 (0.7)	546 (7.4)	56 (1.2)	545 (3.8)	35 (1.5)	539 (3.4)
International Avg. (All Separate Science Countries)	27 (0.4)	524 (2.1)	60 (0.4)	517 (1.4)	13 (0.4)	525 (3.3)
Biology (PATS-B)						
Russian Federation	41 (1.6)	536 (7.6)	55 (1.5)	529 (6.6)	4 (0.3)	530 (11.9)
Czech Republic	27 (1.5)	546 (5.1)	60 (1.1)	537 (4.5)	12 (1.2)	541 (7.3)
Netherlands	21 (1.8)	543 (11.7)	63 (1.4)	541 (9.1)	16 (1.3)	550 (8.3)
Belgium (Flemish)	17 (0.9)	555 (3.4)	61 (1.2)	541 (3.6)	23 (1.1)	518 (4.5)
International Avg. (All Separate Science Countries)	32 (0.3)	509 (1.7)	58 (0.3)	502 (1.2)	10 (0.2)	505 (3.0)
Physics (PATS-P)						
Russian Federation	31 (1.4)	551 (8.0)	63 (1.3)	526 (6.7)	6 (0.6)	516 (9.3)
Czech Republic	15 (1.3)	565 (9.2)	59 (1.5)	539 (4.6)	26 (1.8)	533 (4.5)
Belgium (Flemish)	11 (0.9)	564 (7.9)	58 (1.5)	548 (5.1)	31 (1.9)	533 (6.8)
Netherlands [b]	11 (0.8)	564 (12.8)	59 (1.7)	550 (7.9)	30 (2.0)	532 (7.2)
International Avg. (All Separate Science Countries)	19 (0.3)	532 (2.2)	61 (0.3)	516 (1.3)	20 (0.4)	512 (2.3)
Chemistry (PATS-C)						
Russian Federation	28 (1.2)	546 (8.4)	62 (1.0)	528 (6.5)	10 (0.9)	522 (8.2)
Czech Republic	14 (1.0)	560 (8.5)	60 (1.5)	538 (4.2)	25 (1.7)	533 (5.1)
Belgium (Flemish)	– –	– –	– –	– –	– –	– –
Netherlands	– –	– –	– –	– –	– –	– –
International Avg. (All Separate Science Countries)	23 (0.3)	510 (2.1)	60 (0.3)	495 (1.7)	17 (0.3)	497 (3.0)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

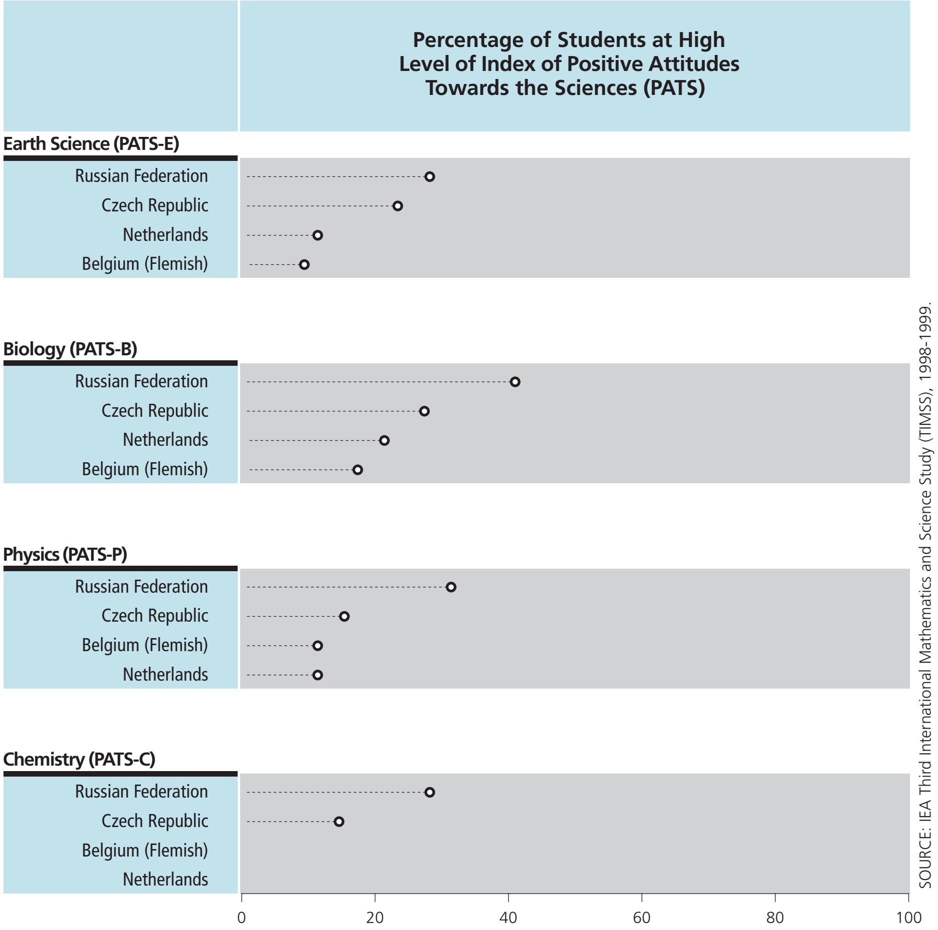
[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

Exhibit 4.10
(Continued 3)

Index of Students' Positive Attitudes Towards the Sciences (PATS)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 4.11 Index of Students' Positive Attitudes Towards the Sciences (PATS) by Gender*

8th Grade Science

General/Integrated Science (PATS-G)		High PATS Percent of Students		Medium PATS Percent of Students		Low PATS Percent of Students	
		Girls	Boys	Girls	Boys	Girls	Boys
Countries	United States	29 (1.1)	35 (1.2) ▲	54 (0.9) ▲	49 (1.0)	17 (0.8)	15 (0.9)
	Canada	28 (1.1)	32 (1.1)	55 (1.3) ▲	49 (0.9)	17 (0.9)	19 (1.2)
	Chinese Taipei [a]	19 (0.9)	34 (1.2) ▲	69 (0.8) ▲	59 (1.1)	12 (0.8) ▲	7 (0.6)
	England	33 (1.7)	46 (1.4) ▲	58 (1.8) ▲	48 (1.4)	9 (0.9)	6 (0.8)
	Hong Kong, SAR	20 (1.2)	31 (1.3) ▲	69 (1.1) ▲	61 (1.2)	11 (1.0) ▲	7 (0.6)
	Italy	28 (1.6)	31 (1.2)	59 (1.4)	56 (1.2)	12 (1.2)	13 (1.0)
	Japan	6 (0.6)	13 (0.8) ▲	57 (1.2)	64 (1.2) ▲	37 (1.4) ▲	23 (1.3)
	Korea, Rep. of	7 (0.6)	14 (0.7) ▲	65 (1.0)	67 (0.9)	28 (1.1) ▲	19 (0.9)
	Singapore	39 (1.7)	52 (1.5) ▲	55 (1.4) ▲	44 (1.3)	6 (0.7)	4 (0.6)
States	Connecticut	30 (1.7)	34 (2.0)	53 (1.5)	48 (2.3)	17 (1.7)	19 (2.5)
	Idaho	26 (2.3)	32 (2.5)	52 (2.0)	49 (1.8)	21 (2.0)	19 (1.9)
	Illinois	28 (1.6)	31 (1.9)	54 (1.9)	53 (1.9)	18 (1.4)	16 (1.6)
	Indiana	30 (2.9)	34 (2.4)	54 (2.2)	50 (1.7)	15 (2.1)	16 (1.9)
	Maryland	30 (1.8)	35 (2.0)	51 (1.6)	48 (1.5)	19 (1.7)	17 (1.6)
	Massachusetts	27 (1.8)	31 (2.1)	56 (1.4)	54 (1.7)	18 (2.0)	16 (1.6)
	Michigan	28 (2.0)	33 (1.5)	56 (1.6)	52 (1.8)	16 (1.4)	15 (1.2)
	Missouri	28 (1.8)	34 (2.4)	53 (1.4)	47 (1.5)	20 (1.6)	19 (2.1)
	North Carolina	37 (1.8)	42 (2.3)	53 (1.9)	47 (1.9)	10 (1.0)	11 (1.2)
	Oregon	25 (2.3)	31 (2.9)	56 (2.1)	48 (2.3)	20 (1.8)	20 (2.7)
	Pennsylvania	28 (2.0)	29 (2.0)	54 (1.9)	54 (1.7)	19 (1.5)	18 (1.0)
	South Carolina	31 (2.3)	35 (2.2)	52 (1.4)	48 (1.9)	17 (1.7)	16 (1.9)
	Texas	30 (2.0)	33 (1.5)	54 (2.0)	53 (1.7)	16 (1.3)	14 (1.2)
Districts	Academy School Dist. #20, CO	29 (1.8)	35 (2.1)	53 (2.1)	48 (1.8)	18 (1.6)	17 (1.7)
	Chicago Public Schools, IL	23 (3.0)	30 (2.8)	61 (2.6)	58 (2.4)	16 (2.8)	12 (1.6)
	Delaware Science Coalition, DE	23 (2.0)	36 (2.6) ▲	57 (2.0)	49 (1.9)	20 (2.6)	15 (1.9)
	First in the World Consort., IL	32 (4.0)	37 (1.9)	50 (3.9)	50 (2.1)	17 (1.9)	13 (1.4)
	Fremont/Lincoln/WestSide PS, NE	26 (3.3)	31 (2.4)	54 (3.0)	53 (2.1)	21 (2.6)	16 (2.4)
	Guilford County, NC	31 (2.3)	36 (1.8)	57 (2.0)	52 (1.8)	13 (1.6)	12 (2.1)
	Jersey City Public Schools, NJ	35 (2.5)	36 (3.1)	52 (2.1)	51 (3.4)	13 (1.7)	13 (1.5)
	Miami-Dade County PS, FL	37 (3.7)	38 (4.0)	53 (3.0)	53 (2.8)	10 (1.9)	9 (1.5)
	Michigan Invitational Group, MI	29 (2.4)	31 (2.7)	57 (3.1)	51 (2.3)	14 (1.8)	18 (2.0)
	Montgomery County, MD	28 (2.3)	34 (3.1)	52 (2.3)	49 (1.9)	20 (2.5)	17 (1.9)
	Naperville Sch. Dist. #203, IL	24 (1.7)	35 (2.6) ▲	55 (2.3)	50 (2.7)	20 (1.7)	15 (1.6)
	Project SMART Consortium, OH	27 (2.1)	33 (1.8)	55 (2.0)	54 (1.8)	18 (1.6)	14 (2.0)
	Rochester City Sch. Dist., NY s	39 (2.5)	42 (3.5)	49 (2.9)	51 (3.8)	12 (2.3)	8 (1.5)
	SW Math/Sci. Collaborative, PA	26 (2.6)	36 (3.1)	56 (2.1)	47 (2.5)	18 (1.8)	17 (1.9)
	International Avg. (All General Science Countries)	38 (0.3)	42 (0.3) ▲	50 (0.3) ▲	48 (0.3)	11 (0.2) ▲	9 (0.2)

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Index of Students' Positive Attitudes Towards the Sciences (PATS) by Gender*

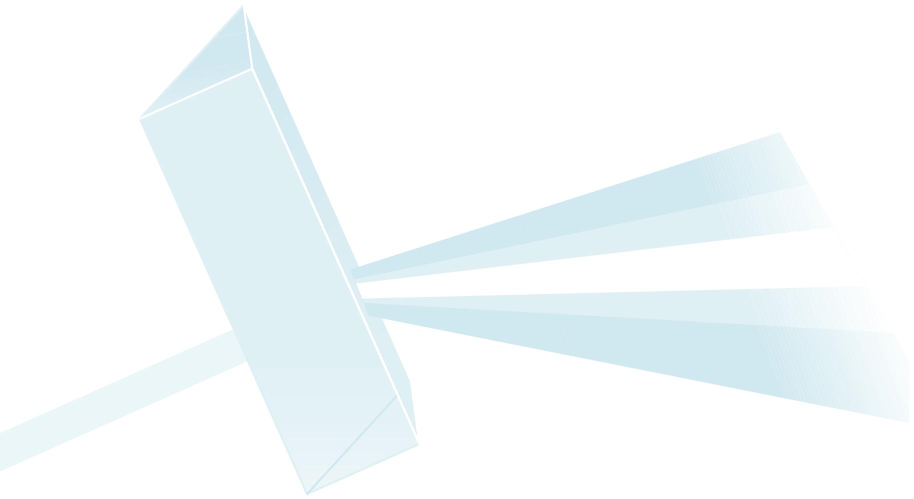
8th Grade Science

	High PATS Percent of Students		**Medium** PATS Percent of Students		**Low** PATS Percent of Students	
	Girls	Boys	Girls	Boys	Girls	Boys
Earth Science (PATS-E)						
Belgium (Flemish)	7 (0.7)	11 (0.9) ▲	53 (1.7)	59 (1.4)	40 (2.0) ▲	30 (1.6)
Czech Republic	21 (1.9)	26 (2.0)	64 (1.5)	63 (2.0)	14 (1.3)	12 (1.1)
Netherlands	8 (1.0)	15 (1.8) ▲	64 (2.0)	66 (1.9)	28 (2.3) ▲	18 (1.8)
Russian Federation	24 (1.9)	33 (2.0) ▲	69 (1.8) ▲	61 (1.9)	7 (0.8)	7 (0.8)
International Avg. (All Separate Science Countries)	24 (0.5)	30 (0.5) ▲	62 (0.5) ▲	59 (0.5)	14 (0.4) ▲	12 (0.4)
Biology (PATS-B)						
Belgium (Flemish)	19 (1.4) ▲	14 (0.9)	61 (1.3)	60 (1.6)	20 (1.3)	25 (1.6)
Czech Republic	34 (2.0) ▲	20 (1.8)	57 (1.6)	64 (1.5)	9 (1.3)	16 (1.4) ▲
Netherlands	27 (2.6) ▲	14 (1.6)	61 (2.0)	66 (1.7)	12 (1.5)	20 (1.8) ▲
Russian Federation	44 (1.9)	39 (1.7)	53 (1.9)	57 (1.5)	3 (0.4)	4 (0.5)
International Avg. (All Separate Science Countries)	35 (0.4) ▲	28 (0.4)	57 (0.4)	60 (0.4) ▲	8 (0.3)	12 (0.3) ▲
Physics (PATS-P)						
Belgium (Flemish)	9 (1.2)	13 (1.4)	57 (2.1)	59 (1.8)	34 (2.3)	28 (2.6)
Czech Republic	8 (1.4)	22 (1.6) ▲	58 (1.8)	60 (1.9)	34 (2.2) ▲	18 (1.8)
Netherlands [b]	5 (1.1)	17 (1.4) ▲	56 (2.4)	62 (1.7)	38 (2.6) ▲	21 (2.0)
Russian Federation	24 (1.7)	39 (1.6) ▲	68 (1.5) ▲	57 (1.6)	8 (0.9) ▲	4 (0.5)
International Avg. (All Separate Science Countries)	14 (0.3)	29 (0.4) ▲	61 (0.5) ▲	58 (0.4)	25 (0.5) ▲	14 (0.4)
Chemistry (PATS-C)						
Belgium (Flemish)	– –	– –	– –	– –	– –	– –
Czech Republic	15 (1.4)	14 (1.3)	61 (2.2)	60 (1.9)	24 (2.2)	27 (1.8)
Netherlands	– –	– –	– –	– –	– –	– –
Russian Federation	28 (1.5)	28 (1.3)	63 (1.3)	61 (1.2)	9 (1.2)	10 (0.9)
International Avg. (All Separate Science Countries)	19 (0.4)	24 (0.4) ▲	62 (0.5) ▲	59 (0.4)	19 (0.4) ▲	17 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

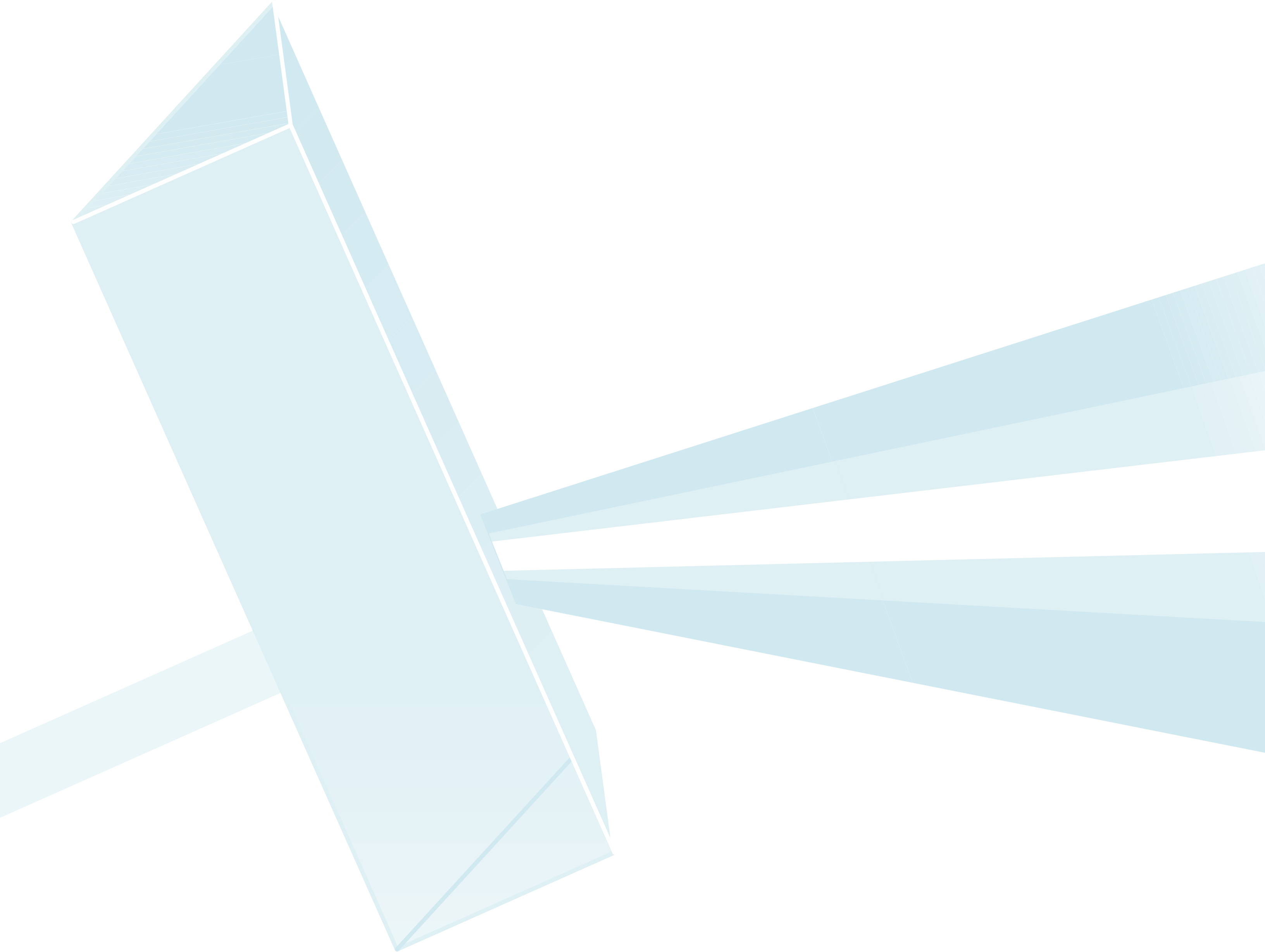


CHAPTER 5

The Science Curriculum

The first part of Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries and Benchmarking states, districts, and consortia. The ways in which the curriculum is supported and monitored within each entity, and the relationship between the curriculum and system-wide testing, are examined. The second part of the chapter contains teachers' reports about the science topics actually studied in their classrooms.

5



In comparing achievement across systems, it is important to consider differences in students' curricular experiences and how they may affect the science they have studied. At the most fundamental level, students' opportunity to learn the content, skills, and processes tested in the TIMSS 1999 assessment depends to a great extent on the curricular goals and intentions inherent in each system's policies for science education. Just as important as what students are expected to learn, however, is what their teachers choose to teach them, which ultimately determines the science students are taught.

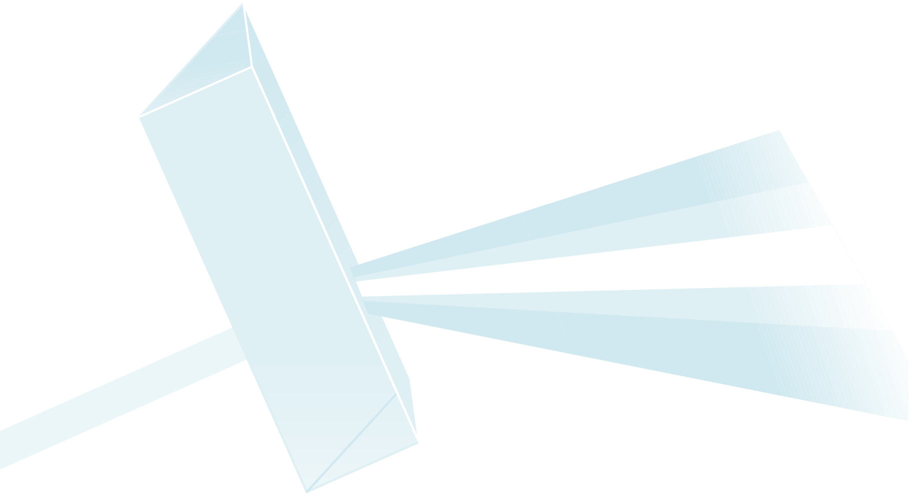
Teacher's instructional programs are usually guided by an "official curriculum" that describes the science education that should be provided. The official curriculum can be communicated by documents or statements of various sorts (often called guides, guidelines, standards, or frameworks) prepared by the education ministry or by national or regional education departments. These documents, together with supporting material such as instructional guides or mandated textbooks, are referred to as the *intended curriculum*.

To collect information about the intended science curriculum at the eighth grade, the coordinators in each participating country and Benchmarking jurisdiction responsible for implementing the study completed questionnaires and participated in interviews. Information was gathered about factors related to supporting and monitoring the implementation of the official curriculum, including instructional materials, audits, and assessments aligned with the curriculum.

In many cases, teachers need to interpret and modify the intended curriculum according to their perceptions of the needs and abilities of their classes, and this evolves into the *implemented curriculum*. Research has shown that, even in highly regulated education systems, this is not identical to the intended curriculum. Furthermore, what is actually implemented is often inconsistent across an education system. Studies, including the Second International Mathematics Study, suggest that the implemented curriculum in the United States varies considerably from classroom to classroom – calling for more research into not only what is intended to be taught but what content is covered.[1] To collect data about the implemented curriculum, the science teachers of the students tested in TIMSS 1999 completed questionnaires about whether students had been taught the various science topics covered in the test.

---

[1] Mayer, D.P., Mullens, J.E., and Moore, M.T. (2000), *Monitoring School Quality: An Indicators Report*, NCES 2001-030, Washington, DC: National Center for Education Statistics.



Science Subjects Offered Up To and Including Eighth Grade

The most striking difference among science curricula of the TIMSS 1999 countries in the eighth and earlier grades is that the sciences are taught as separate subjects in some countries and integrated to form a general science course in others. Exhibit 5.1 shows how science instruction is organized in these grades in the TIMSS 1999 countries and Benchmarking jurisdictions. By the eighth grade, Chinese Taipei, Indonesia, and most of the European countries were teaching some or all of earth science, biology, physics and chemistry as separate subjects, not necessarily contemporaneously. Three of the Benchmarking states (Connecticut, Missouri, and Oregon) and four of the districts and consortia (the Academy School District, the Jersey City Public Schools, the Miami-Dade County Public Schools, and the Rochester City School District) reported teaching science as separate subjects by the eighth grade, predominantly life science, earth science, and physical science. Among the others, the practice was to integrate the sciences into a general science curriculum. Of the countries that taught science as separate subjects, most taught chemistry and physics as separate subjects by the eighth grade, while in separate-science Benchmarking jurisdictions these were taught together as physical science.

Exhibit 5.1 Science Subjects Offered Up to and Including Eighth Grade

8th Grade Science

	Separate Science Courses Offered	Science Subjects and Grades Taught
United States	No	General/integrated science course
Australia [1]	No	General/integrated science course
Belgium (Flemish)	Yes	World orientation (3-6); biology and earth science (7-8); scientific work (7-8); technological education (7-8); physics (8); applied science (8); natural science (8)
Bulgaria	Yes	General/integrated science (3-5); biology (6-8); chemistry (7-8); physics (7-8); earth science (6-8)
Canada [2]	No	General sciences organized by strands (grades K-8)
Chile	No	General integrated science (4-8) with some earth science taught in history/geography/social studies
Chinese Taipei	Yes	Natural science (1-6); biology (7); integrated physics/chemistry (8); integrated physics/chemistry continues to be taught at grade 9 in addition to earth science
Cyprus	No	General/integrated science course taught at grade 8. This course may be taught by separate subject area teachers in some schools. General science includes a combination of physics, chemistry and biology topics
Czech Republic	Yes	Elementary science (1-3), General/integrated science (4-5); physics (6-8); chemistry (8); life science/biology (6-8); earth science (6-8)
England	No	General/integrated science course, though some schools (especially independent ones) may offer physics, chemistry, and biology, separately
Finland	Yes	Integrated course of biology, geography and environmental studies (1-6); physics (7-8); chemistry (7-8); biology (7-8); natural geography (7-8); physics, chemistry, biology and natural geography are also taught at grade 9
Hong Kong, SAR	No	General studies (1-6); science (7-8)
Hungary	Yes	Environment (5); biology, physics, geography (6-8); chemistry (7-8)
Indonesia	Yes	Biology, physics, and earth science taught separately, but one composite grade is given; chemistry is not taught until high school
Iran, Islamic Rep.	No	General/integrated science course (includes life sciences, physical sciences, earth sciences, and environmental and resource issues)
Israel	No	General/integrated science course
Italy	No	General/integrated science course
Japan	No	General/integrated science course
Jordan	No	General/integrated science course
Korea, Rep. of	No	Intelligent life (combined with social studies) (1-2); science (3-8)
Latvia (LSS)	Yes	Biology (5-8); chemistry (8); physics (8)
Lithuania [3]	Yes	Integrated science course 'cognition of the world' (1-4); integrated science course 'man and nature' (5); integrated science course 'man and nature'/geography (6); biology/geography (7); biology, physics, chemistry and geography (8); subjects taught at grade 8 continue through grade 10
Macedonia, Rep. of	Yes	Nature and some earth science (1-4); biology (5-8); geography (5-8); chemistry (7-8); physics (7-8)
Malaysia	No	General/integrated science course
Moldova	Yes	Separate science subjects are taught in grade 8: biology, chemistry, physics, and geography
Morocco	Yes	Biology and physics (7); physics/chemistry and biology/geology (8)
Netherlands	Yes	General/integrated science (primary school up to grade 6); physics/chemistry, biology, geography which includes earth science (7-8)
New Zealand	No	General/integrated science course
Philippines	No	General/integrated science course (1-7)
Romania	Yes	General/integrated science (3-4); biology (5-8); geography (5-8); physics (6-8); chemistry (7-8)
Russian Federation	Yes	Science integrated with social studies (2-4); integrated science (5); geography (6-8); physics (7-8); biology (6-8); chemistry (8)
Singapore	No	General/integrated science course
Slovak Republic	Yes	General/integrated science (1-4); physics, chemistry, geography/geology, and biology taught as separate subjects (5-8)
Slovenia [3]	Yes	Knowledge about nature and society (1-3); knowledge about nature (4-5); geography (6-8); biology (6-8); chemistry (7-8); physics (7-8)
South Africa	No	General/integrated science and geography
Thailand	No	General/integrated science course
Tunisia	No	General/integrated science course
Turkey	No	General/integrated science course (grades 4-8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by National Research Coordinators.

[1] Australia: Yes in 4 of 8 states/territories.

[2] Canada: Results shown are for the majority of provinces.

[3] Lithuania and Slovenia: Geography is considered to be an integrated social studies and natural science course at grade 8; geography teachers were not sampled in the TIMSS studies.

Exhibit 5.1
(Continued)

Science Subjects Offered Up to and Including Eighth Grade

	Separate Science Courses Offered	Science Subjects and Grades Taught
States		
Connecticut	Yes	Varies throughout the state
Idaho	No	General/integrated science course
Illinois	No	General/integrated science course
Indiana	No	General/integrated science course
Maryland	No	General/integrated science course
Massachusetts	No	General/integrated science course
Michigan	–	–
Missouri	Yes	Different schools teach earth science, life science, and physical science in middle school
North Carolina	No	There are not separate courses but each grade level has specific science areas that are emphasized
Oregon	Yes	Many districts offer science as separate subjects (e.g. life science, physical science, and earth science)
Pennsylvania	Varies	Districts have the ability to decide the structure of their science instruction
South Carolina	No	Integrated science course (K-8); science content in life science, earth science, and physical science will be integrated in grades 6-8 beginning 2000
Texas	No	General/integrated science course (K-8)
Districts and Consortia		
Academy School Dist. #20, CO	Yes	General/integrated science course (K-5), earth science or integrated science (6), life science (7), physical science (8)
Chicago Public Schools, IL	Varies	Schools have the ability to decide the structure of their science instruction as long as it meets the achievement standards set by the school district
Delaware Science Coalition, DE	Varies	Currently in grades K-5, curriculum units are available to cover required topics in physical science, earth science, life science, and ecology each year; at grades 6-8, a similar set of units is being piloted for eventual adoption
First in the World Consort., IL	No	General/integrated science course (K-8)
Fremont/Lincoln/WestSide PS, NE	No	General/integrated science course (K-8)
Guilford County, NC	No	There are not separate courses but each grade level has specific science areas that are emphasized
Jersey City Public Schools, NJ	Yes	Different science courses are offered in middle school: earth science (6); physical science (7); life science (8)
Miami-Dade County PS, FL	Yes	Comprehensive science, regular and advanced (6-8); earth/space science and biology honors courses (accelerator courses for 7-8)
Michigan Invitational Group, MI	No	General/integrated science course (K-8)
Montgomery County, MD	No	General/integrated science course (K-8)
Naperville Sch. Dist. #203, IL	No	General science course (K-8) with emphasis on earth science, life science, and physical science
Project SMART Consortium, OH	No	General/integrated science course (K-8)
Rochester City Sch. Dist., NY	Yes	Integrated physical science, life science, and earth science (K-6), life science (7), physical science (8)
SW Math/Sci. Collaborative, PA	Varies	Districts have the ability to decide the structure of their science instruction

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

A dash (–) indicates data are not available.

Does Decision Making About the Intended Curriculum Take Place at the National, Regional, or Local Level?

Depending on the education system, students' learning goals are set at different levels of authority. Some systems are highly centralized, with the ministry of education (or highest authority in the system) being exclusively responsible for the major decisions governing the direction of education. In others, such decisions are made regionally or locally. Each approach has its strengths and weaknesses. Centralized decision making can add coherence and uniformity in curriculum coverage, but may constrain a school or teacher's flexibility in tailoring instruction to the needs of students.

Exhibit 5.2 presents information for each TIMSS 1999 country about the highest level of authority responsible for making curricular decisions and gives the curriculum's current status. The data reveal that 35 of the 38 countries reported that the specifications for students' curricular goals were developed as national curricula. Australia determined curricula at the state level, with local input; the United States did so at both the state and local (district and school) levels, with variability across states; and Canada did so at the provincial level.

In recent decades, it has become common for intended curricula to be updated regularly. At the time of the TIMSS 1999 testing, the official science curricula in 31 countries had been in place for less than a decade, and more than three-quarters of them were in revision. Of the seven countries with a science curriculum of more than 10 years' standing, four were being revised. In Australia, Canada, and the United States, curriculum change is made at the state, provincial, or local level, and some science curricula were in revision at the time of testing. The curricula in these three countries were relatively recent, having been developed within the 10 years preceding the study.

The development and implementation of academic content standards and subject-specific curriculum frameworks has been a central focus of educational change in the United States at both the state and local level. In science, most states are in the process of implementing new content or curriculum standards or revising existing ones.[2] Much of this effort has been based on work done at the national level over the past decade to develop standards aimed at increasing the science literacy of all students. The two most prominent documents are the American Association for the Advancement of Science (AAAS) *Benchmarks for Science Literacy* and the National Research Council's *National Science Education*

---

[2] Glidden, H. (1999), *Making Standards Matter 1999*, Washington, DC: American Federation of Teachers.

Standards (NSES), both of which define standards for the teaching and learning of science that many state and local educational systems have used to fashion their own curricula.[3] All but four states now have standards in science.[4]

In all 13 states that participated in TIMSS 1999 Benchmarking, curriculum frameworks or content standards in science were published between 1996 and 2000 (see Exhibit 5.3). Four states detailed the standards for every grade including the eighth grade, seven states detailed them by a cluster or pair of grades that included the eighth grade, and two states reported the eighth grade as a benchmark grade at which certain standards should be met. Most states provided standards documents to guide districts and schools in developing their own curriculum, while some states, such as North Carolina, developed a statewide curriculum for all schools to use.

Exhibit 5.4 presents information about the curriculum of participating districts and consortia. Of the eight districts that participated, one reported that it used the statewide curriculum in all schools (Guilford County); five had a district-wide curriculum that supported the state-developed frameworks or standards (the Jersey City Public Schools, the Miami-Dade County Public Schools, Montgomery County, the Naperville School District, and the Rochester City School District); and two had a curriculum developed at the school level (the Academy School District and the Chicago Public Schools), with Chicago also offering an optional structured curriculum district-wide. Each participating consortium indicated that all or most of its districts developed their own curriculum at the district level.

---

[3] Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

[4] *Key State Education Policies on K-12 Education: 2000* (2000), Washington, DC: Council of Chief State School Officers.

Exhibit 5.2 Countries' Science Curriculum

8th Grade Science

	National or Regional Curriculum	Year Curriculum Introduced	Status of Curriculum
United States	Regional & Local	1990-1999	As of 1999, 47 out of 50 states have completed content standards
Australia	Regional & Local	1984-1999	In revision (in 4 states/territories); As introduced (in 4 states/territories)
Belgium (Flemish) [1]	National	1989-1999	As introduced
Bulgaria	National	1989 (biology and chemistry); 1996 (physics); 1995 (earth science)	In revision
Canada	Regional	1987-1998	In revision (5 provinces); As introduced (5 provinces)
Chile	National	1980	In revision
Chinese Taipei	National	1997	In revision
Cyprus	National	1978	As introduced
Czech Republic	National	1996	In revision
England	National	1995	In revision, same structure with minor revisions (to be implemented 2000/01)
Finland	National	1994	As introduced
Hong Kong, SAR	National	1986	In revision
Hungary	National	1995	As introduced
Indonesia	National	1994	In revision
Iran, Islamic Rep.	National	1996	In revision
Israel	National	1997-1998	In revision
Italy	National	1979	As introduced
Japan	National	1993	As introduced
Jordan	National	1993	Slight revisions annually
Korea, Rep. of	National	1995	As introduced
Latvia (LSS)	National	1992-1994	In revision
Lithuania	National	1997	In revision
Macedonia, Rep. of	National	1979 (adaptations in 1995)	As introduced
Malaysia	National	1990	In revision
Moldova	National	1991	In revision
Morocco	National	1991	In revision
Netherlands	National	1993 (slight adaptations in 1998)	As introduced
New Zealand	National	1995	As introduced
Philippines	National	1998	In revision
Romania	National	1993	In revision
Russian Federation	National	1998	In revision
Singapore	National	1993	In revision
Slovak Republic	National	–	–
Slovenia	National	1983	In revision
South Africa	National	1984	In revision
Thailand	National	1990	In revision
Tunisia	National	1997	In revision
Turkey	National	1992	In revision

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by National Research Coordinators.

A dash (–) indicates data are not available.

[1] Belgium (Flemish): Curricula were introduced as follows: 1997-98 (biology); 1997 (technological education), early 1990 (physics); 1997 (earth science); 1997-99 (applied sciences); 1989 (scientific work); 1989-97 (natural science).

Exhibit 5.3 States' Curriculum Frameworks/Content Standards

8th Grade Science

	Curriculum Framework/Content Standards and Year[1]	Grades Detailed in Framework/Standards
Connecticut	Connecticut's K-12 Science Curriculum Framework (1998)	Grade clusters: K-4, 5-8, 9-12
Idaho	Skills-Based Scope and Sequence Guides K-6 (1996); Achievement Standards K-8 (In draft); Achievement Standards 9-12 (1999)	Every grade: K-6 Grade clusters: 7-8, 9-12
Illinois	Illinois Learning Standards for Science (1997)	Grade clusters: Early Elementary School, Late Elementary School, Middle/Junior High School, Early High School, Late High School
Indiana	Indiana Science Proficiency Guide (1997); revised Indiana's Academic Standards for Science (2000)	Grade clusters: K-2, 3-5, 6-8, 9-12 (1997 version); Every grade: K-8, individual courses in high school (2000 version)
Maryland	Learning Outcomes (1990); Content Standards for Science (2000)	Grade clusters: K-3, 4-5, 6-8, 9-12
Massachusetts	Massachusetts Science & Technology Curriculum Frameworks (1996; under revision)	Grade clusters: pK-4, 5-8, 9-10, 11-12
Michigan	Michigan Essential Goals and Objectives for Science Education (1991); Michigan Curriculum Frameworks: Content Standards and Benchmarks (1996)	Grade clusters: Elementary School, Middle School, High School
Missouri	Frameworks for Curriculum Development in Science (1996)	Grade clusters: K-2, 3-4, 5-8, 9-12
North Carolina	North Carolina Standard Course of Study (1994; revised 2000-01)	Every grade: K-8, individual courses in high school
Oregon	Oregon Science Content Standards (1996, 1998)	Benchmark grades: 3, 5, 8, 10, 12
Pennsylvania	Academic Standards for Science and Technology (2000)	Benchmark grades: 4, 7, 10, 12
South Carolina	South Carolina Science Curriculum Standards (2000)	Every grade: K-8; Grade clusters: 9-12
Texas	Texas Essential Knowledge and Skills (1998)	Every grade: K-8, individual courses in high school

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Indicates year(s) in which curriculum frameworks/content standards were instituted.

Exhibit 5.4 Districts' and Consortia's Curriculum

8th Grade Science

	Level of Curriculum Development
Academy School Dist. #20, CO	Curriculum is developed at the school level. Curriculum is currently in revision to reflect state standards.
Chicago Public Schools, IL	Curriculum is developed at the school level. The district writes standards statements which are aligned with state standards; schools translate these into a curriculum. The district also offers an optional structured curriculum.
Delaware Science Coalition, DE	Districts share a common curriculum in grades K-5 based on NSF-funded modules. In middle school, schools use NSF-funded units (FOSS, BCSC, STC, etc.) or units developed through the local systemic change program. The high school curriculum is mainly textbook driven with some NSF-funded modules and units developed by teachers with university faculty.
First in the World Consort., IL	Most districts within the Consortium have district-wide objectives and/or a curriculum based on state standards.
Fremont/Lincoln/ WestSide PS, NE	Each district has locally-developed standards and a curriculum based on state standards.
Guilford County, NC	The district uses the state-developed curriculum, the North Carolina Standard Course of Study.
Jersey City Public Schools, NJ	The science curriculum (pK-12) is developed by the district and is aligned with the New Jersey Core Curriculum Content Standards.
Miami-Dade County PS, FL	The district has developed a science curriculum, Competency-Based Curriculum (CBC), which is correlated to the Florida Sunshine State Standards for Science and the National Science Education Standards. Most recently, the state has developed Grade Level Expectations (GLEs) that further define what a student should know and be able to do at specific grade levels. The district is currently making revisions to the CBC to reflect the GLEs.
Michigan Invitational Group, MI	Most districts have district-wide curriculum guides aligned to the state standards.
Montgomery County, MD	The district develops curriculum based on state standards.
Naperville Sch. Dist. #203, IL	The district develops curriculum based on state standards.
Project SMART Consortium, OH	Each district in the consortium has a separate curriculum.
Rochester City Sch. Dist., NY	The district develops curriculum based on state standards.
SW Math/Sci. Collaborative, PA	Each district in the collaborative has a separate curriculum. District-level curriculum is not necessarily based on the state standards.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

How Do Education Systems Support and Monitor Curriculum Implementation?

During the past decade, content-driven systemic school reform has emerged as a promising model for school improvement.[5] That is, curriculum frameworks establishing what students should know and be able to do provide a coherent direction for improving the quality of instruction. Teacher preparation, instructional materials, and other aspects of the system are then aligned to reflect the content of the frameworks in an integrated way to reinforce and sustain high-quality teaching and learning in schools and classrooms.

Education systems use different ways to achieve this desired connection between the intended and the implemented curriculum. The methods used by the TIMSS 1999 countries to monitor curriculum implementation are shown in Exhibit 5.5, and by states, districts, and consortia in Exhibits 5.6 through 5.8. For example, teachers can be trained in the content and pedagogical approaches specified in the curriculum guides. Another way to help ensure alignment is to develop instructional materials, including textbooks, instructional guides, and ministry notes, that are tailored to the curriculum. Systems can also monitor implementation of the intended curriculum by means of school inspection or audit.

Of the methods for supporting and monitoring curriculum implementation shown in Exhibit 5.5, 10 countries reported using all six, and a further 13 countries used five. Support for the national/regional science curriculum as part of pre-service education was reported by 24 of the 38 countries. Nearly all countries (33) used in-service teacher education, and most countries (31) used mandated or recommended textbooks. Ministry notes and directives were used in 29 countries, and a system of school inspection or audit was used in 31 countries.

States, districts, and consortia provided data on policies related to textbook selection, pedagogical guides, and accreditation. As shown in Exhibit 5.6, seven of the Benchmarking states reported that they do not select textbooks for use at the local level. The other six states issue a list of books from which districts can choose. Almost all districts and consortia reported that their state does not select textbooks, while three reported state involvement in textbook selection. Ten jurisdictions indicated that textbooks were chosen or recommended at the district level, and four that selection occurs at the school level or, in the consortia, at the school and district level depending on the district.

---

[5] O'Day, J.A. and Smith, M.S. (1993), "Systemic Reform and Educational Opportunity" in S.H. Fuhrman (ed.), *Designing Coherent Education Policy: Improving the System*, San Francisco, CA: Jossey-Bass, Inc.

As shown in Exhibit 5.7, eight of the 13 Benchmarking states developed materials that included pedagogical guidance for instruction and implementation of the curriculum frameworks and standards. Ten districts and consortia had at least state- or district-level guides to support curriculum implementation. Two states and one consortium reported having documents in draft. These materials, developed to support teachers in implementing the curriculum, span a variety of types including ideas for classroom activities, tool kits for planning instructional units, and sample lessons.

As shown in Exhibit 5.8, six of the participating states had accreditation systems, four of which included student performance on the state assessment in their accreditation review (Indiana, Michigan, Missouri, and Oregon). Two states without accreditation systems, Illinois and Texas, made periodic site visits to evaluate schools. Only one consortium, the Michigan Invitational Group, reported having an accreditation system at the state level. The Academy School District in Colorado reported that the state was in the process of implementing a system for 2001.

Exhibit 5.5

Countries’ Use of Methods to Support or Monitor Implementation of the Curriculum*

8th Grade Science

	Pre-Service Teacher Education	In-Service Teacher Education	Mandated or Recommended Textbook(s)	Instructional or Pedagogical Guide	Ministry Notes and Directives	System of School Inspection or Audit
United States [1]	+	+	+	+	+	+
Australia [2]	●	●		●	●	
Belgium (Flemish)	●	●		●	●	●
Bulgaria	●	●	●		●	●
Canada [3]	●	●	●	●	●	
Chile			●		●	
Chinese Taipei	●	●	●	●		●
Cyprus		●	●		●	●
Czech Republic	●		●		●	●
England	●	●				●
Finland	●	●	●	●		
Hong Kong, SAR			●	●		●
Hungary	●	●	●	●	●	
Indonesia		●	●	●	●	●
Iran, Islamic Rep.	●	●	●	●	●	●
Israel	●	●	●	●	●	●
Italy		●		●	●	●
Japan		●	●	●	●	●
Jordan		●	●	●	●	●
Korea, Rep. of	●	●	●	●	●	●
Latvia (LSS)	●	●	●	●	●	●
Lithuania		●	●		●	
Macedonia, Rep. of	●	●	●	●		●
Malaysia	●	●	●	●	●	●
Moldova		●	●		●	●
Morocco	●	●	●	●	●	●
Netherlands	●	●		●	●	●
New Zealand	●	●				●
Philippines		●	●	●	●	●
Romania	●	●	●	●	●	●
Russian Federation	●	●	●	●	●	●
Singapore	●	●	●	●	●	●
Slovak Republic	●		●		●	●
Slovenia	●	●	●	●		●
South Africa		●	●			●
Thailand	●	●	●	●	●	●
Tunisia		●	●	●	●	●
Turkey		●	●		●	●

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by National Research Coordinators.

---

* Other than system-wide assessments and public examinations described in Exhibits 5.9 and 5.10, respectively.

[1] United States: Methods are implemented by individual states and vary from state to state. As of 1998, 13 states have policies on textbook/materials selection; 8 states have policies recommending textbook/materials.

[2] Australia: Results shown are for the majority of states/territories.

[3] Canada: Results shown are for the majority of provinces.

Exhibit 5.6 States', Districts' and Consortia's Use of Textbooks and Instructional Materials to Support Implementation of the Curriculum

8th Grade Science

States	Policy on Textbooks and Instructional Materials
Connecticut	The state does not select textbooks.
Idaho	The state approves a list of textbooks and materials from which districts/schools must choose. The textbooks selection criteria include alignment with Idaho Skills-Based Scope and Sequence Guide and Achievement Standards, which specify skills that all students should know at different levels. Schools are required to select all their basic instructional materials from the Idaho Adoption Guide produced by the adoption committee. Schools not choosing from the adoption list can lose accreditation points.
Illinois	The state does not select textbooks.
Indiana	The state recommends a list of textbooks from which districts/schools must choose; however, waivers are granted. The state texts are not necessarily based on the state standards. The state intends to align textbook selections with Indiana's new Academic Standards (2000).
Maryland	The state does not select textbooks.
Massachusetts	The state does not select textbooks.
Michigan	The state does not select textbooks.
Missouri	The state does not select textbooks.
North Carolina	The state recommends textbooks and instructional materials; there is a fee arrangement between the state and the vendor that the districts are able to use.
Oregon	The state selects a list of textbooks and materials from which districts can choose. Districts may submit a waiver for an independent adoption to select textbooks and instructional materials of their own choice. These district-level adoptions must meet the state selection criteria.
Pennsylvania	The state does not select textbooks.
South Carolina	The state selects a list of textbooks and materials from which districts can choose. The state funds the instructional materials that are selected from the state approved list.
Texas	State Textbook Review Committee selects textbooks and instructional materials according to the state curriculum framework. Districts choose textbooks and/or instructional materials using local criteria. The state funds the purchase of textbooks and/or instructional materials that are on the selected list. Districts may waiver, at own expense, from selected textbooks or instructional materials.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

Exhibit 5.6 (Continued)

States', Districts' and Consortia's Use of Textbooks and Instructional Materials to Support Implementation of the Curriculum

8th Grade Science

	Policy on Textbooks and Instructional Materials
Districts and Consortia	
Academy School Dist. #20, CO	STATE: The state does not select textbooks. LOCAL: Schools can select materials based on guidelines with acceptance by the Board of Education.
Chicago Public Schools, IL	STATE: The state does not select textbooks. LOCAL: Schools in districts choose instructional materials.
Delaware Science Coalition, DE	STATE: The state does not select textbooks. LOCAL: Textbook selection is usually made at the school level.
First in the World Consort., IL	STATE: The state does not select textbooks. LOCAL: Textbooks and materials are selected and recommended at the district level. Consortium is reviewing materials to recommend as well. As of 1999/2000, the Consortium is looking to Project 2061/AAAS and NSF for guidance in textbook selection. Selection includes a committee reviewing materials against AAAS benchmarks, choosing materials, and submitting their recommendation for approval by the school board.
Fremont/Lincoln/ WestSide PS, NE	STATE: The state does not select textbooks. LOCAL: Districts select textbooks/textbook series and schools select supplemental materials.
Guilford County, NC	STATE: The state selects a list of textbooks and materials based on the state content standards from which districts can choose. LOCAL: One textbook used throughout county. A system-wide committee reviews the state selected list and one textbook per grade level is selected to be used system-wide.
Jersey City Public Schools, NJ	STATE: The state does not select textbooks. LOCAL: A committee is formed at the district level to facilitate the selection of science textbooks and materials. There is a "standard operating procedure" for the formulation of the committee so as to include all constituent groups. All selected textbooks and materials are aligned with the district's science curriculum and the NJ Core Curriculum Content Standards in Science.
Miami-Dade County PS, FL	STATE: The state recommends the texts and instructional materials. LOCAL: The district selection committee narrows the selection to two or three texts. The schools pick one of the selected textbooks. The new legislation makes waivers for using non-adopted texts more difficult, but schools are allotted some money to spend on non-state adopted materials with review at the district level.
Michigan Invitational Group, MI	STATE: The state does not select textbooks. LOCAL: Textbook selection is made at the school level. Selection of textbooks is based on curriculum.
Montgomery County, MD	STATE: The state does not select textbooks. LOCAL: The district recommends a few textbooks. Evaluation and approval of texts to support specific courses is done by a committee headed by the science supervisor.
Naperville Sch. Dist. #203, IL	STATE: The state does not select textbooks. LOCAL: District uses criteria based on the learning outcomes to select instructional materials. No one textbook selected.
Project SMART Consortium, OH	STATE: The state does not select textbooks, but approves a liberal textbook list from which districts can choose. LOCAL: A teacher review committee selects several texts and the teacher community involved usually votes or is given an opportunity to express their choice.
Rochester City Sch. Dist., NY	STATE: The state does not select textbooks. LOCAL: A committee conformed by parents, teachers, building administrators and staff from central office selects textbooks.
SW Math/Sci. Collaborative, PA	STATE: The state does not select textbooks. LOCAL: Each district selects instructional materials. Over forty districts are part of a local initiative which supports use of exemplary modules at the elementary level. At the middle school level, the Collaborative has engaged over 14 districts in selecting materials through a showcase-pilot adoption process.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 5.7

States', Districts' and Consortia's Use of Pedagogical Guides to Support Implementation of the Curriculum

8th Grade Science

States	Pedagogical Guides
Connecticut	Some pedagogical information is included with the state science framework.
Idaho	Pedagogical guides are not available at the state level.
Illinois	Performance descriptors have been completed (in draft form) to guide educators in implementing the standards. Classroom assessment tasks and student work exemplars will be available Summer 2001.
Indiana	The "Indiana Science Proficiency Guide" (1997) contains grade cluster ideas for activities. New Curriculum Frameworks are being written to support Indiana's new grade-specific Academic Standards (2000).
Maryland	Pedagogical guidance is not available at the state level.
Massachusetts	The curriculum frameworks provide appropriate teaching activities for each learning standard.
Michigan	Toolkits are designed to support the implementation of the curriculum frameworks including kits on planning subject area instructional units, curriculum integration, designing classroom assessments, and connecting with the learner. "The Science Education Guidebook" was developed specifically to assist in teaching the science frameworks.
Missouri	The Curriculum Frameworks provide appropriate teaching activities by discipline providing examples of how "Show-Me Standards" may be taught and assessed.
North Carolina	The development of a curriculum enhancement guide is in process.
Oregon	"Teaching and Learning to Standards" supports the Oregon content standards and provides best practices, example lessons, vignettes, scored student work, teaching resources, and common curriculum goals. A curriculum framework will be complete in January 2001.
Pennsylvania	Pedagogical guides are not available at the state level.
South Carolina	An implementation guide (2000) contains sample lesson plans, sample assessments, resources for teachers, and information for administrators on what to look for in exemplary science instruction. Content briefs are being developed to help teachers with implementation of the standards.
Texas	Under the direction of the Texas Education Agency, the Texas Science Center for Educator Development has produced different pedagogical guides: "TEXTEAMS" (modules for curriculum and instructional reform), "TEKSplorations Guides" for each grade and high school courses, "TEKS for Leaders" (materials and training for science reform), "Safety Handbook" (supports implementation of TEKS hands-on science in laboratory and field curriculum), "Curriculum Charts: K-12"; as well as a website and CD ROM: the "Science Teacher Toolkit" that includes support on many aspects of science teaching.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

	Pedagogical Guides
Districts and Consortia	
Academy School Dist. #20, CO	No specific "how-to" instructional manuals are provided. The state has provided grade-appropriate sample assessments as well as released items and samples of scored student work which the district has expanded upon.
Chicago Public Schools, IL	The optional structured curriculum provides daily lesson plans at all grade levels. For high schools, test blueprints of the "Chicago Academic Standards Exam" (CASE) are provided to teachers for instructional purposes.
Delaware Science Coalition, DE	The "Delaware Performance Indicators for Curriculum Planning and Development" is a pedagogical guide for teachers. It defines expected performance in science but does not specify performance levels. All Performance Indicators are specifically limited to content standards and are included in the guide. Some districts have developed their own Performance Indicators, but most have adopted state Performance Indicators.
First in the World Consort., IL	There is no specific guide developed by the consortium. AAAS/Project 2061 provides professional development on content and instruction and evaluating materials for alignment to the Project 2061 benchmarks of science literacy.
Fremont/Lincoln/ WestSide PS, NE	Districts have curriculum-based instructional activities and commercially-developed materials.
Guilford County, NC	There is a locally-written book, Strategies for Instruction, detailing best practices, lessons, assessments, and teaching methods based on the North Carolina Course of Study.
Jersey City Public Schools, NJ	The "New Jersey Framework for Teaching in Science" published in May 1996, discusses essential components of a quality K-12 science program. The framework is not a curriculum, but a comprehensive digest of activities, curriculum connections, and instructional strategies related to the NJ Core Curriculum Content Standards in Science. In addition to the state standards and the state frameworks, the district's curriculum guides provide content guidelines based on grade-level competencies. In the district curriculum materials, hands-on learning kits, resources, and learning activities are provided at each grade level.
Miami-Dade County PS, FL	The Florida Curriculum Frameworks include the content knowledge and process skills for science that students should acquire, strategies to address various learning needs and styles, guidelines for effective assessment, professional development information, and sample evaluation criteria for school and district programs. The state recently has developed a CD-ROM entitled "Science Best Practices". The district produced a "Middle School Science Guide for Teachers" and "Elementary Science Guide for Teachers" that give specific information about the content and effective strategies that should be implemented. Most recently, the "Science Department Chairperson Handbook" was distributed that includes important information about curriculum, science inquiry, and technology use in the classroom.
Michigan Invitational Group, MI	Toolkits are designed by the state to support the implementation of the curriculum frameworks including kits on planning subject area instructional units, curriculum integration, designing classroom assessments, and connecting with the learner. The "Science Education Guidebook" was developed specifically to assist in teaching the science frameworks.
Montgomery County, MD	"Better Science" (1991), produced at the state level, provides pedagogical information and the "Outcomes Clarification Document" (1996) provides concept and process information. A website has been developed to provide the latest in best practices and exemplars. Local-level guides are adopted from commercial vendors. In addition, high school guides are developed locally.
Naperville Sch. Dist. #203, IL	The state provides goals, standards, and sample test items. Locally, the district develops K-5 detailed lessons and outcomes; grades 6-8 outcomes are connected to resources.
Project SMART Consortium, OH	There are not pedagogical guides at the state level. As soon as the state "Draft Content Science Standards" are approved by the Ohio State Board of Education (early 2001) plans are underway to provide pedagogical guides to locals. Ohio is a local-control state and thus many locals have developed various types of science guides.
Rochester City Sch. Dist., NY	New York State provides core curriculum guides based on the standards at all grade levels. Locally, the district develops K-12 curriculum guides based on standards.
SW Math/Sci. Collaborative, PA	Informal support is available connecting districts to exemplary materials, research findings, and best practices.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 5.8 States', Districts' and Consortia's Use of Accreditation to Support Implementation of the Curriculum

8th Grade Science

States	Use of Accreditation
Connecticut	No accreditation system.
Idaho	Accreditation requires that curriculum developed at the local level be aligned with state standards. Schools must establish educational standards for all grade levels and develop high school exiting standards for graduation; these standards must be aligned with exiting standards established by the State Board of Education. It also requires that schools participate in state testing and adhere to text adoption policies.
Illinois	Quality Review Teams of the State Board of Education conduct periodic quality-assurance site visits to schools.
Indiana	The accreditation system requires K-8 schools to self-report alignment of curriculum with state standards (proficiencies); grade 9-12 schools submit a master schedule and course descriptions to verify compliance with state standards. Performance on the ISTEP+ is also considered in accreditation. Technical assistance is available to schools that do not meet the accreditation standards.
Maryland	No accreditation system.
Massachusetts	No accreditation system.
Michigan	Accreditation is based in part on student performance on state assessments. The system is being revised to include successful achievement as well as continuous improvement.
Missouri	The Missouri School Improvement Program, designed to accredit districts, assesses districts progress on the Show-Me Standards as measured by the Missouri Assessment Program. There are "success teams" that help districts improve student achievement in all subject areas.
North Carolina	No accreditation system.
Oregon	All schools are state accredited through a system of "standard" assurances, Consolidated District and School Improvement Plans, Annual Performance Reports and Schools Reviews. State accreditation is based on the Oregon Performance Accountability System (OPAS), that assesses school science performance. Any school falling in the low or unacceptable category receives targeted assistance including alignment with standards, instructional improvement and professional development.
Pennsylvania	No accreditation system.
South Carolina	The accreditation system is in revision. Schools must meet a battery of standards in the current accreditation system, but student academic performance is not included. The new accreditation system will include student academic performance and will go into effect in 2001.
Texas	Although not considered an accreditation system, there is an accountability system in place. The state's accountability system includes a variety of on-site evaluations designed to provide feedback for improvement.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

Exhibit 5.8
(Continued)

States', Districts' and Consortia's Use of Accreditation to Support Implementation of the Curriculum

8th Grade Science

	Use of Accreditation
Districts and Consortia	
Academy School Dist. #20, CO	The state will be implementing an accreditation system beginning in Fall 2001 based primarily on the success and/or progress on the standards-referenced state assessment (CSAP).
Chicago Public Schools, IL	No accreditation system.
Delaware Science Coalition, DE	No accreditation system.
First in the World Consort., IL	No accreditation system.
Fremont/Lincoln/ WestSide PS, NE	No accreditation system.
Guilford County, NC	No accreditation system.
Jersey City Public Schools, NJ	No accreditation system.
Miami-Dade County PS, FL	No accreditation system.
Michigan Invitational Group, MI	State-level accreditation is based in part on student performance on state assessments. The system is being revised to include successful achievement as well as continuous improvement.
Montgomery County, MD	No accreditation system.
Naperville Sch. Dist. #203, IL	No accreditation system.
Project SMART Consortium, OH	No accreditation system.
Rochester City Sch. Dist., NY	No accreditation system.
SW Math/Sci. Collaborative, PA	No accreditation system.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

What TIMSS 1999 Countries Have Assessments And Exams in Science?

Assessments and exams that are aligned with the intended curriculum provide a means for evaluating system- and student-level achievement. System-wide assessments are designed primarily to inform policy makers about matters such as national standards of achievement of the intended curriculum objectives, strengths and weaknesses in the curriculum or how it is being implemented, and whether educational achievement is improving or deteriorating. The primary purpose of national public examinations, while providing information of interest to national and regional policy makers, is to provide information for making decisions about individual students.

Exhibit 5.9 shows that almost two-thirds of the participating countries had national assessments in science, with almost half of those assessing all students and just over half sampling students. The number of grades tested ranged from two in England and the Philippines to six in Korea. Generally, the purpose of system-wide assessments was to provide feedback to government policy makers and the public, although some countries provided feedback to individual schools. For example, in England and Hungary information about individual students was used for course placement or guidance.

Using public examinations as a way to select students for university or academic tracks in secondary school can be an important motivating factor for student achievement (see Exhibit 5.10). Thirty-six countries reported having public examinations or awards, at one or more grades, that included testing achievement in science. Most countries held their examinations in the final year of schooling for certification and selection to higher education (often, university education). In about one-third of the countries, public examinations were also used for selection or course assignment (tracking) within secondary schools.

Exhibit 5.9 Countries' System-Wide Assessments in Science

	System-Wide Assessments[1]	Grades		Purpose/Consequences
		Entire Grade Level	Sample from Grade Level	
United States	Yes		4, 8, 12	National and state-level feedback
Australia [2]	Yes	10 (1 state)	3, 7, 10 (1 state) 10 (1 state)	System-level feedback
Belgium (Flemish)	No			
Bulgaria	No			
Canada [3]	Yes	4, 7, 10 (1 province)	ages 13 and 16 nationally (most provinces)	System- and school-level feedback
Chile	Yes	4, 8, 10		System- and school-level feedback, usually one grade level assessed each year
Chinese Taipei	No			
Cyprus	No			
Czech Republic	No			
England	Yes	5, 8		System-, school- and student-level feedback
Finland	Yes		4, 8, 9	System-level feedback
Hong Kong, SAR	No			
Hungary	Yes		4, 6, 8, 10, 12	System-level, school-level, and individual-level feedback
Indonesia	Yes		various grades	System-level feedback, assessments given irregularly at different primary grades
Iran, Islamic Rep.	No			
Israel	Yes		6	System-level feedback
Italy	Yes		6, 8, 10, 13	System-level feedback; first administered in 1999 with a grade 4 assessment instituted in 2000.
Japan	Yes		5, 6, 7, 8, 9	System-level feedback
Jordan	Yes		4, 5, 8, 10	System-level feedback; monitoring reform impact; curricular revisions
Korea, Rep. of	Yes	4, 5, 6, 7, 8, 10		System-level feedback
Latvia (LSS)	No			
Lithuania	No			
Macedonia, Rep. of	Yes		5, 6, 7, 8	System-level feedback and research purposes (projects and curriculum development)
Malaysia	Yes	6, 9, 11, 13		System- and school-level feedback; "good schools" publicized
Moldova	No			
Morocco	Yes	6, 9, 10, 11, 12		System- and school-level feedback
Netherlands	Yes	10, 11, 12	6	System-level feedback
New Zealand	Yes		3, 7	System-level feedback
Philippines	Yes	6, 10		System- and school-level feedback (the assessment was sample-based up until 1999)
Romania	No			
Russian Federation	Yes		various grades	Irregularly for research purposes
Singapore	Yes	6, 10, 12		System- and school-level feedback; selection into courses, certification and entry to university
Slovak Republic	No			
Slovenia	No			
South Africa	No			
Thailand	No			
Tunisia	Yes	4, 6, 9, 13		System- and school-level feedback; may lead to redistribution of teachers in the regions; assessments at grades 4 and 6 developed regionally
Turkey	Yes		5, 8, 11	System- and school- level feedback

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by National Research Coordinators.

[1] Public examinations are also used for system-wide assessment purposes in these countries: Malaysia, Morocco, Netherlands, Philippines, Singapore, Tunisia, and Turkey.

[2] Australia: System-wide assessments are administered in 3 of 8 states/territories.

[3] Canada: System-wide assessments are administered in 5 of 10 provinces.

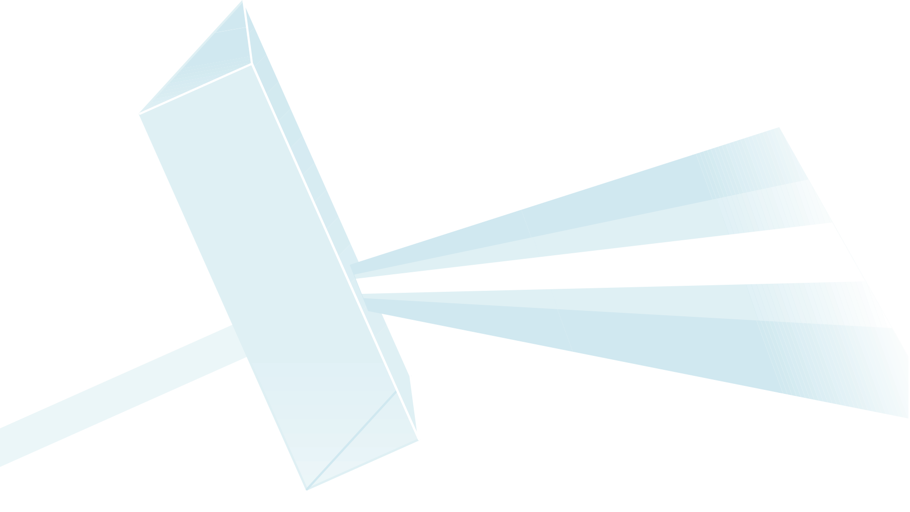


Exhibit 5.10 Countries' Public Examinations in Science

	Public Exams/ Awards	Grade(s)	Purpose/Consequences
United States [1]	Yes	varies	Primarily feedback to system and schools; in 8 states grade promotion is dependent on results; in 18 states graduation is dependent on results of grade 12 exams
Australia	Yes	12	Certification and selection for tertiary education
Belgium (Flemish)	No		
Bulgaria	Yes	7/8, 12	Candidates for profile schools (grade 7 or 8); certification and entrance to university–not taken by all students (grade 12)
Canada [2]	Yes	12 (2 provinces); 6, 9, 12 (1 province)	Certification (grade 12); feedback to system and schools
Chile	Yes	12	Entry to university
Chinese Taipei	No		
Cyprus	Yes	9, 12	Certification (grade 9); certification and entry to university (grade 12)
Czech Republic	Yes	13	Certification (science can be chosen as one of four subjects for leaving examination)
England	Yes	10, 12	Certification (grade 10); certification and entry to university (grade 12); feedback to system and schools
Finland	Yes	12	Certification and selection for tertiary education; in the matriculation exam, the General Studies Test section includes questions related to physics, chemistry, and biology in addition to seven other topic areas. Students can choose to take either the General Studies Test or the Mathematics Test
Hong Kong, SAR	Yes	6, 11, 13	School placement (grade 6); certification and placement for 12th grade (grade 11); placement in tertiary institutions (grade 13)
Hungary	Yes	12	Certification and entry to university (science is not a compulsory subject)
Indonesia	Yes	6, 9, 12	Leaving exam, selection for junior secondary school (grade 6); selection for senior secondary school (grade 9); leaving exam (grade 12); system-level feedback, in some cases school- and classroom-level feedback
Iran, Islamic Rep.	Yes	11, 12	Certification (grade 11); entry to tertiary education (grade 12); in addition, provincial exams are administered at grade 8
Israel	Yes	11 or 12	Matriculation certification for those choosing entry to specific areas in the university
Italy	Yes	13	Certification and entry to university
Japan	Yes	9, 12	Entry to prefectural and municipal upper secondary schools (grade 9); entry to national, prefectural and municipal universities (grade 12)
Jordan	Yes	12	Certification and entry to tertiary education
Korea, Rep. of	Yes	12	College entrance exam for selection of students
Latvia (LSS)	Yes	12	Certification
Lithuania	Yes	12	Leaving examination
Macedonia, Rep. of	Yes	12	Certification and entry to university; the exam constitutes 40% of the required points for entry to university with the remaining points based on university entry exams
Malaysia	Yes	6, 9, 11, 13	Feedback to system and schools, achievement test (grade 6); entry to course tracks (grade 9); certification and end of secondary (grade 11); certification and entry to university (grade 13)
Moldova	Yes	9, 11/12	Certification, selection for high school (grade 9); graduation (grade 11 or 12 depending on school)
Morocco	Yes	6, 9, 10, 11, 12	Remedial test for retention purposes (grade 6); certification, selection to secondary, and selection to courses (grade 9); certification and entry to tertiary (grade 12); feedback to system and schools
Netherlands	Yes	10, 11, 12	End-of-track examinations; exams recommended at grades 6 and 8
New Zealand	Yes	10, 12	Certification, course selection (grade 10); entry to tertiary education (grade 12); feedback to system and schools; informal between-school comparisons
Philippines	Yes	6, 10	Feedback to system and schools; entry to university set by each institution
Romania	Yes	12	Certification (science can be chosen as one of 7 subjects)
Russian Federation	Yes	9, 11	Certification (not state compulsory, may be administered at the regional or school level)
Singapore	Yes	6, 10, 12	Feedback to system and schools; selection into courses; certification and entry to university
Slovak Republic	Yes	12	Certification (science can be chosen as one of four subjects for leaving exam)
Slovenia	Yes	12	Certification and entry to tertiary education
South Africa	Yes	12	Certification and selection for tertiary education
Thailand	Yes	12	Entry to university
Tunisia	Yes	6, 9, 13	Feedback to system and schools; regional exam for promotion (grade 6); selection for schools/courses; promotion (grade 9)
Turkey	Yes	8, 11	Placement in specialized schools for some students (grade 8); entry to university (grade 11)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by National Research Coordinators.

[1] United States: As of 1997-1998, public examinations are administered in 36 of 50 states at grades 7-8 or 9-12.

[2] Canada: Public examinations are administered in 3 of 10 provinces.

What Benchmarking Jurisdictions Have Assessments in Science?

Across the United States, many states are conducting assessments based on their own content standards and are assessing whether students in their schools are meeting these standards for academic achievement. Twenty-nine states have some type of criterion-referenced science assessment aligned to state standards.[6]

While all Benchmarking states had developed or are developing state-level assessments aligned with their state curriculum in mathematics,[7] only 7 of the 13 states – Illinois, Maryland, Massachusetts, Michigan, Missouri, Oregon, and Texas – had such statewide assessments in science at the middle school grades (see Exhibits 5.11 and 5.12). Assessments of state science standards were reported to be in development in Indiana, Pennsylvania, and South Carolina, each of which developed science standards in 2000. Science assessments in Idaho were under discussion. Connecticut and North Carolina had no statewide science assessments at the middle school grades.

All the Benchmarking states except Pennsylvania have participated in recent state science assessments as part of the National Assessment of Educational Progress (NAEP). Eleven of the 13 states participated in both 1996 and 2000, and Idaho in 2000.

Although none of the Benchmarking states reported using student performance on a science assessment as a requirement for high-school graduation, Maryland and South Carolina reported developing assessments including science that students must pass in order to graduate from high school (see Exhibit 5.13). Benchmarking states reported a range of other consequences of their science assessments for students, apart from their use as a graduation requirement. For example, Connecticut, Illinois, and Oregon reported that they affix a certificate or seal to students' diplomas to show that they have met the performance goal on the state high school science assessment; Illinois and Oregon reported a policy of using assessment results to assist in making promotion decisions; and South Carolina planned to institute a promotion policy in 2002. As an incentive, students meeting the standards in Michigan and Missouri could receive state funds to support their academic careers through scholarship money and funds for advanced course work, respectively.

---

[6] Orlofsky, G.F. and Olson, L. (2001), "The State of the States" in *Quality Counts 2001, A Better Balance: Standards, Tests, and the Tools to Succeed*, Education Week, 20(17).

[7] Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., O'Connor, K.M., Chrostowski, S.J., Gregory, K.D., Garden, R.A., and Smith, T.A. (2001), *Mathematics Benchmarking Report, TIMSS 1999 – Eighth Grade: Achievement for U.S. States and Districts in an International Context*, Chestnut Hill, MA: Boston College.

Benchmarking states also reported a range of consequences at the district or school level. For example, Massachusetts reported that additional funding was made available to low-performing schools and districts to support remediation. In Oregon and South Carolina, districts were required to provide remediation to students with low scores on the state assessments. States had the right to take over schools or districts in Maryland and Massachusetts. While consequences of assessments for schools or districts usually involved remediation activities or sanctions, Maryland also provided monetary rewards to schools that showed improvement. In Massachusetts, schools receiving recognition were eligible for an Exemplary Schools Program.

As shown in Exhibit 5.14, 10 of the 14 Benchmarking districts and consortia participated in the science assessments administered by their state. Of these, the Michigan Invitational Group and Montgomery County were in states that were revising their science assessments to align more closely with their current standards. Ohio's Project SMART Consortium was in a state administering proficiency tests that were not standards-based assessments. Miami-Dade, Rochester, and the Southwest Pennsylvania Math and Science Collaborative were developing science assessments for 2003, 2001, and 2001, respectively. The Fremont/Lincoln/Westside Public Schools and Guilford County reported having no statewide science assessments at the eighth grade.

Exhibit 5.11 States' Science Assessments

8th Grade Science

	State-Developed Criterion-Referenced Science Assessment[1]	Other Science Assessments	Participated in NAEP	
			1996	2000
Connecticut	Connecticut Academic Performance Test (CAPT): In revision - Grade 10	None	Yes	Yes
Idaho	In discussion	ITBS: Grades 3-8 TAP: Grades 9-11	No	Yes
Illinois	Illinois Goal Assessment Program (IGAP): Grades 4, 7, 11 (1988-99) Illinois Standard Achievement Test (ISAT): Grades 4, 7 (2000) Prairie State Achievement Examination (PSAE): Grade 11 (2001)	None	Yes[2]	Yes
Indiana	In development for 2002	None	Yes	Yes
Maryland	Maryland School Performance Assessment Program (MSPAP): Designed to assess the 1990 Learning Outcomes - Grades 3, 5, 8	None	Yes	Yes
Massachusetts	Massachusetts Comprehensive Assessment System (MCAS): Grades 4, 8, 10	None	Yes	Yes
Michigan	Michigan Educational Assessment Program (MEAP): Grades 5, 8, 11	None	Yes	Yes
Missouri	Missouri Assessment Program (MAP): In revision - Grades 3, 7, 10	MAP includes the Terra Nova	Yes	Yes
North Carolina	No state assessment for grades K-8; End-of-course tests: physical science, biology, chemistry, physics - Grades 9-12	None	Yes	Yes
Oregon	Oregon Statewide Assessment System: Grades 5, 8, 10; Grade 6 (Fall 2001).	None	Yes	Yes
Pennsylvania	In development - Grades 4, 7, 10	None	No	No
South Carolina	Palmetto Achievement Challenge Test (PACT): In development Grades 3-8 (2002) and 10 (2004)	None	Yes	Yes
Texas	Texas Assessment of Academic Skills (TAAS): Grade 8	None	Yes	Yes

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

[1] Specifically developed to be aligned with the curriculum framework/content standards indicated in Exhibit 5.3.

[2] Illinois participated in NAEP in 1996 but results were not reported due to low participation rates.

	Status of State-Developed Science Assessment
Connecticut	The Connecticut Academic Performance Test (CAPT), first administered in 1995, was developed to be aligned with the 1987 Common Core of Learning. It is now being revised for 2000-01 based on Connecticut's 1998 K-12 Science Curriculum Framework.
Idaho	The development of state-wide science assessments is in discussion.
Illinois	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the 1997 Illinois Learning Standards.
Indiana	A state science assessment is in development for implementation in 2002. Currently, there is no mandatory state science assessment. Voluntary state science assessments of high schools courses (Core 40 assessments) are available.
Maryland	The Maryland School Performance Assessment Program (MSPAP) assesses students at grades 3, 5, and 8. Currently, the MSPAP is based on the 1990 Learning Outcomes. By 2003, the MSPAP will be revised to assess the 2000 standards. The High School Assessment, in development, is proposed as an end-of-course test which will be part of the graduation requirement. Unlike the Maryland Functional Assessment that is currently required for high school graduation, the new High School Assessment will have a science component.
Massachusetts	Massachusetts Comprehensive Assessment System (MCAS) was first administered in 1998 to grades 4, 8, and 10. Integrated science assessments for grades 5 and 8 and discipline-specific assessments for secondary grades are in development and will be included from 2002. The Science & Technology MCAS was developed to assess the 1996 Curriculum Frameworks which are currently in revision.
Michigan	The Michigan Educational Assessment Program (MEAP) will introduce revised science tests at grades 5, 8, and 11 in 2002. Each of these tests are based on the Michigan Curriculum Frameworks science standards.
Missouri	The Missouri Assessment Program (MAP) has been developed for science in grades 3, 7, and 10. This assessment is currently in revision. Each test includes multiple-choice, short constructed-response, and performance-event items. The test consist of three sessions. The first two sessions include items designed to assess the Show-Me Standards (1996) which are directly related to the curriculum frameworks. Items that match the Show-Me Standards from the norm-referenced Terra Nova are administered in the third session.
North Carolina	There are no state-level science assessments in grades K-8. The four end-of-course science assessments (physical science, biology, chemistry and physics) are being revised in accordance with the new curriculum for the 2001-2002 administration.
Oregon	The Oregon Statewide Assessment System includes a multiple-choice state test in science at grades 5, 8, and 10. Classroom work samples are required as local assessment in science for grades 3-12. All assessments are based on the content standards and are revised annually.
Pennsylvania	Science assessments are in development with field testing scheduled for Spring 2001.
South Carolina	The Palmetto Achievement Challenge Test (PACT) is being developed to be aligned with the 2000 science standards. The grades 3-8 assessments will be implemented in 2002 and the grade 10 exit-level assessment will be implemented in 2004. The PACT will replace the Basic Skills Assessment Program (BSAP) given at grades 3, 6, and 8. Additionally, a biology end-of-course assessment will be implemented in 2004.
Texas	The Texas Assessment of Academic Skills (TAAS) was recently revised to more specifically assess the current standards for the 2000 administration. TAAS is administered in science at grade 8 and the TAAS end-of-course biology exam is administered in high school. As a prerequisite to receiving a high school diploma, students must demonstrate satisfactory performance on either the biology or the U.S. History end-of-course examination. Beginning in 2003, science will be tested at grades 5, 10, and 11. Students will be required to pass the grade 11 examination for graduation.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

Exhibit 5.13 States' Use of Science Assessments with Consequences

	Assessment	Graduation Requirement	Other Consequences
Connecticut	Connecticut Academic Performance Test (CAPT)	No	STUDENT: Students meeting the state performance goal on the 10th grade CAPT assessment receive a certificate of mastery. This certificate is affixed to students' official transcripts. Students who do not meet the state goal may retake the test in grades 11 and 12. Results are reported publicly (e.g., newspapers) but there are no direct consequences.
Idaho	In discussion	–	–
Illinois	Illinois Standards Achievement Tests (ISAT) Prairie State Achievement Examination (PSAE)	No	STUDENT: Test results may be used, in conjunction with other data, to make decisions about students' promotion/retention, summer school requirements, and remediation. Students receiving high scores on the PSAE will receive honors designations. DISTRICT/SCHOOL: Test results are considered at both the district and school levels as part of the state accountability system.
Indiana	In development	No	–
Maryland	Maryland School Performance Assessment Program (MSPAP); High School Assessment (HSA)	The HSA is being developed as a graduation requirement.	STUDENT: There are no student-level consequences based on the MSPAP since each student is given only a portion of the assessment. DISTRICT/SCHOOL: The MSPAP is a school accountability assessment. Part of schools' performance rating is based on MSPAP assessment scores. Schools that improve significantly over a two-year period receive monetary rewards. Schools are required to develop school improvement plans for areas in which standards were not met. The State Board of Education has the right to reconstitute schools based on low MSPAP test scores and lack of improvement. Thus far, three schools in Maryland have been reconstituted.
Massachusetts	Massachusetts Comprehensive Assessment System (MCAS)	No	STUDENT: There are no student-level consequences. DISTRICT/SCHOOL: Results are being used as a high-stakes accountability measure to evaluate performance and improvement for schools and districts. Schools will be rated based on performance and progress. Recognized schools may be eligible for an Exemplary Schools Program. Low performance and inadequate progress may result in the removal of principals and/or state-takeover of districts. Targeted resources and funding will be provided to low-performing schools and districts.
Michigan	Michigan Educational Assessment Program (MEAP)	No	STUDENT: Students who meet the standards on the MEAP High School Tests are eligible for graduation certificate endorsement and scholarship awards.
Missouri	Missouri Assessment Program (MAP)	No	STUDENT: Students scoring at the lowest performance level must retake a shortened version of the exam the following year. Students performing at proficient or above on the 10th grade test receive state funds for college-level courses or Advanced Placement exams. DISTRICT/SCHOOL: Test results will be a part of district-level accreditation.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

A dash (–) indicates data are not available.

States' Use of Science Assessments with Consequences

	Assessment	Graduation Requirement	Other Consequences
North Carolina	NC Testing Program	No	STUDENT: For biology, the student's score on the biology test must be included as 25% of student's final grade for the course.
Oregon	Oregon State-wide Assessment System	No	STUDENT: Students who meet the performance standard on the state-level and local standards-based assessments receive Certificates of Initial Mastery in each area in which the standard is met. Students who do not meet the 10th grade science performance standard have an opportunity to take the test again. Low-performing students receive additional support and individual instruction to help them meet the standards. These students can change schools if instruction at one school is not meeting their needs. Districts may use the results of the tests to determine student promotion. DISTRICT/SCHOOL: Test results are part of the accountability system. Districts must meet set goals for the assessments to avoid possible sanctions.
Pennsylvania	In development	–	–
South Carolina	Palmetto Achievement Challenge Tests (PACT)	Beginning in 2004, students will have to pass a standards-based exam to graduate.	STUDENT: Promotion policy considers students' performances on the state assessments as of 2002. DISTRICT/SCHOOL: Schools will be rated based on student performance and improvement. Accreditation of schools will take into account student performance. Districts are required to provide remediation to low-performing students.
Texas	Texas Assessment of Academic Skills (TAAS)	No	STUDENT: No consequences. DISTRICT/SCHOOL: No consequences.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 5.14 Districts' and Consortia's State and Local Science Assessments

8th Grade Science

	Science Assessments	
	State	Local
Academy School Dist. #20, CO	Colorado State Assessment Program (CSAP) administered in science at grade 8.	In addition to the CSAP, students take ITBS (grade 7), and ITED (grade 10). District-developed performance assessment units are optional.
Chicago Public Schools, IL	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the Illinois Learning Standards.	Chicago Academic Standards Exam was developed to assess the district framework and is being piloted 1999-2000. Students are assessed in science in grades 9 and 10 with end-of-course exams (Biology, Physics, Chemistry, Earth and Space Science, Environmental Science). Chicago uses the norm-referenced TAP (9-11). Also, ACT's PLAN nationally-normed tests are administered at grade 11.
Delaware Science Coalition, DE	The Delaware Student Testing Program (DSTP) first administered in science at grades 8 and 11 (Spring 2000) and at grades 4 and 6 (Fall 2000).	There are no district-wide assessments based on the standards. Some districts administer the SAT-9 or the Terra Nova. The Delaware Science Coalition has developed some curriculum-based summative performance-based assessments complete with rubrics, anchor papers and instructions for administering in Grades 1-5. Middle School Assessments are planned. There are also plans to develop annual assessments and formative assessments based on the curriculum.
First in the World Consort., IL	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the Illinois Learning Standards. Consortium schools receive a measure of improvement based on the percentage of students in each performance level.	The consortium administered TIMSS in 1996 and is developing assessments for districts' use. There are no assessments at this time but will begin review of the curriculum against Project 2061 Benchmarks (2000-2001). Consortium districts administer the Terra Nova CTBS Battery which includes science. School-improvement goals/plans include professional development and instructional initiatives based on students' performance on the CTBS Battery.
Fremont/Lincoln/ WestSide PS, NE	There are no assessments at the state level. Assessing students is local responsibility.	Districts administer the ITBS.
Guilford County, NC	There are no state-level science assessments in grades K-8. The North Carolina Testing Program includes high school end-of-course exams in biology, physical science, chemistry, and physics. These end-of-course exams are used to rate individual schools. State assistance teams may be sent to low-performing schools.	Assessments were created by the state and given as a local option in grades 3, 5, 6, 7, and 8 through 1998-99. They were continued in grades 5 and 7 in 1999-2000. There are no plans for K-8 science assessments after 1999-2000.
Jersey City Public Schools, NJ	Starting in May 1999, the New Jersey Elementary School Proficiency Assessment (ESPA) was administered at grade 4. The ESPA contains a science component. Similarly, beginning in March 1999, the NJ Grade Eight Proficiency Assessment (GEPA) was administered at grade 8. This test replaced the Early Warning Test which had been previously administered to eighth graders. The science component of the GEPA was administered for the first time in March 2000. Both the ESPA and the GEPA are tests of excellence and measure student performance in relation to the NJ Core Content Curriculum Standards in Science. The High School Proficiency Assessment (HSPA) is presently in development at the state level and will be used beginning in the spring 2001 for first time juniors (Class of 2002) as the mandated test for graduation. Presently, the High School Proficiency Test (HSPT) has been administered statewide since the early 1990s as the mandated test for high school graduation. The HSPT does not contain a science component.	In addition to the state assessments, at the elementary level, the district has developed district-wide midterms in science in grades 3-8.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

Exhibit 5.14
(Continued)

Districts' and Consortia's State and Local Science Assessments

	Science Assessments	
	State	Local
Miami-Dade County PS, FL	The state criterion-referenced science assessment is in development (2003 administration).	The SAT-9 Science test is administered to students in grades 5, 7, and 9. The EXPLORE, which has mathematics and science assessments, is administered to all grade 8 students. District-level curriculum-based science assessments will be developed and implemented by 2001-02.
Michigan Invitational Group, MI	The Michigan Educational Assessment Program (MEAP) will introduce revised science tests at grades 5, 8, and 11 in 2002. Each of these tests are based on the Michigan Curriculum Frameworks science standards.	A variety of tests are used by local districts.
Montgomery County, MD	The Maryland School Performance Assessment Program (MSPAP) assesses students at grades 3, 5, and 8. Currently, the MSPAP is based on the 1990 Learning Outcomes. By 2003, the MSPAP will be revised to assess the 2000 standards. The High School Assessment is in development. It is proposed as an end-of-course test which will be part of the graduation requirement.	No formal local-level assessments for elementary or middle school in science. There are county-wide high school exams required for each high school science course.
Naperville Sch. Dist. #203, IL	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the Illinois Learning Standards. Schools could be placed on academic warning based on state test results. State NAEP is also administered at the 4th grade.	There are force choice and performance local science assessments at grades 2, 5, 6, 7, and 8. The science assessments are currently under revision.
Project SMART Consortium, OH	Proficiency assessments in science are administered at grades 4, 6, 9, and 12. As of 2000/01, students must pass the 9th grade assessment to graduate. A high school graduation exam is in development and will be required for the Class of 2005.	Districts have their own assessments in addition to state assessments. District assessments are given at grades 1-3, 5, and 7 to assess student progress. These are both standardized and district-developed assessments.
Rochester City Sch. Dist., NY	The state science test for grade 4 has been in place since 1989. The state science test for grade 8 starts in Spring 2001. The class entering grade 9 in 2001 will be the first class required to pass Regents exams (with a grade of 65% or higher) in all subject areas, including science. Beginning in June 2001, New York will assess students using new state-developed final exams for biology and earth science. Chemistry and physics will follow in later years. Exams are based on new state standards. New York is currently phasing out high school competency exams; instead, students will be required to pass at least one Regents exam. New York State has developed a school accountability system that will be phased in by 2003. School districts must provide academic intervention services to students who score below the state designated performance level on state assessments and/or students at risk of not achieving the state learning standards.	There are district-wide mid-terms and final exams for courses not ending in a Regents exam for grades 6 through 12.
SW Math/Sci. Collaborative, PA	The science assessment is in development with field testing scheduled for Spring 2001.	Each of the 118 districts has its own assessment system in addition to the state assessments. Forty of the districts have worked together to develop classroom-based assessment tools for the STC modules at the elementary level.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

How Do Education Systems Deal with Individual Differences?

The challenge of maximizing opportunity to learn for students with widely differing abilities and interests is met differently in different education systems. Exhibit 5.15 summarizes questionnaire and interview data on how selected comparison countries, as well as states, districts, and consortia, organized their curricula to deal with this issue.

Some participants indicated using more than one method of dealing with individual differences among students, and in these cases the category describing the main method was reported. In the United States, and in Canada, Chinese Taipei, the Czech Republic, Hong Kong, and the Russian Federation among the comparison countries, the same curriculum was intended for all students, but it was recommended that teachers adapt the level and scope of their teaching to the abilities and interests of their students. In the Czech Republic and England, the science curriculum was taught at different levels to different groups, two in the Czech Republic and nine in England – so many because in England the levels are defined in terms of progressively more complex performance to be demonstrated. Another approach to differentiated provision was followed in Belgium (Flemish), the Netherlands, and Singapore, which assign different curricula to students of different levels of ability and interest. Three of the comparison countries, Italy, Japan, and Korea, reported that their official science curricula did not address the issue of differentiating instruction for eighth-grade students with different abilities or interests.

All of the Benchmarking states and most of the districts and consortia generally resembled the United States in that they provided the same curriculum for all, but expected teachers to adapt the level and scope of their teaching to their students' needs. The First in the World Consortium, Miami-Dade, and Montgomery County provided the same curriculum to all, but at different levels for different groups – three levels in First in the World and two levels in each of the other two.

Schools' reports on how they organize to accommodate students with different abilities or interests are shown in Exhibit R2.1 in the reference section. Substantial percentages of students in many countries were in schools that offered remedial science (53 percent, on average internationally) and enrichment science (50 percent). While high-performing Singapore and Chinese Taipei reported that 97 and 78 percent of their students, respectively, were in schools that offered remedial science, all Benchmarking jurisdictions reported that less than 30 percent of their students were in such schools. Six Benchmarking jurisdictions reported higher percentages of students in schools that offer enrichment science than internationally, with Miami-Dade and Rochester reporting that 100 percent of their students were in such schools.

Exhibit 5.15 Differentiation of Curriculum for Students with Different Abilities or Interests

8th Grade Science

	Curriculum Addresses Differentiation	Approaches to Addressing Students with Different Abilities or Interests at Grade 8			
		Same Curriculum for All Students, and Teachers Adapt to Students' Needs	Same Curriculum with Different Levels for Different Groups	Different Curricula for Different Groups	Number of Curriculum Levels
Countries					
United States [1]	Yes	Yes	No	No	1
Belgium (Flemish)	Yes	No	No	Yes	2
Canada	Yes	Yes	No	No	1
Chinese Taipei	Yes	Yes	No	No	1
Czech Republic [2]	Yes	Yes	Yes	No	2
England [3]	Yes	No	Yes	No	9
Hong Kong, SAR	Yes	Yes	No	No	1
Italy	No				
Japan	No				
Korea, Rep. of	No				
Netherlands	Yes	No	No	Yes	4
Russian Federation	Yes	Yes	No	No	1
Singapore	Yes	No	No	Yes	3
States					
Connecticut	Yes	Yes	No	No	1
Idaho	Yes	Yes	No	No	1
Illinois	Yes	Yes	No	No	1
Indiana	Yes	Yes	No	No	1
Maryland	Yes	Yes	No	No	1
Massachusetts	Yes	Yes	No	No	1
Michigan	Yes	Yes	No	No	1
Missouri	Yes	Yes	No	No	1
North Carolina	Yes	Yes	No	No	1
Oregon	Yes	Yes	No	No	1
Pennsylvania [4]	–	–	–	–	–
South Carolina	Yes	Yes	No	No	1
Texas	Yes	Yes	No	No	1
Districts and Consortia					
Academy School Dist. #20, CO	Yes	Yes	No	No	1
Chicago Public Schools, IL	Yes	Yes	No	No	1
Delaware Science Coalition, DE	Yes	Yes	No	No	1
First in the World Consort., IL	Yes	No	Yes	No	3
Fremont/Lincoln/WestSide PS, NE	Yes	Yes	No	No	1
Guilford County, NC	Yes	Yes	No	No	1
Jersey City Public Schools, NJ	Yes	Yes	No	No	1
Miami-Dade County PS, FL	Yes	No	Yes	No	2
Michigan Invitational Group, MI	Yes	Yes	No	No	1
Montgomery County, MD	Yes	No	Yes	No	2
Naperville Sch. Dist. #203, IL	Yes	Yes	No	No	1
Project SMART Consortium, OH	Yes	Yes	No	No	1
Rochester City Sch. Dist., NY	Yes	Yes	No	No	1
SW Math/Sci. Collaborative, PA [4]	–	–	–	–	–

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

[1] United States: Most state standards are designed for all students.

[2] Czech Republic: There is the same curriculum with different levels for different groups in physics and chemistry (2 levels); there is one curriculum for all students, and teachers adapt to students' needs, in life science and earth science.

[3] England: While there is one "programme of study" for grades 6-8, the document identifies nine performance-levels describing the types and range of performance that pupils working at a particular level should demonstrate.

[4] Due to the variation across the state/collaborative, a representative response cannot be provided for these questions.

A dash (–) indicates data are not available.

What Are the Major Characteristics of the Intended Curriculum?

Exhibit 5.16 indicates the relative emphasis given to various aspects of science instruction in the intended curriculum. Knowing basic science facts and understanding science concepts received major emphasis in the curriculum of most participating countries, and at least moderate emphasis was placed on application of science concepts in almost all national curricula. In addition to these three areas, the United States reported placing major emphasis on using laboratory equipment, performing experiments, and designing and conducting scientific experiments, as did top-performing Singapore, Korea, and Japan. The Czech Republic's intended curriculum had minor or no emphasis on any aspect of practical work.

The Benchmarking jurisdictions were similar to the United States overall in the curricular areas that they reported placing major emphasis on. All Benchmarking jurisdictions reported placing major emphasis on understanding science concepts and on applying science concepts, and all jurisdictions except Pennsylvania and the Fremont/Lincoln/Westside Public Schools on designing and conducting scientific experiments. There were also areas of different emphasis. Although the pattern varied quite a lot, relatively less emphasis was reported by Benchmarking states on knowing basic science facts (particularly in Massachusetts and Michigan), on using laboratory equipment, and on performing experiments, and relatively more emphasis on assessment. The Benchmarking districts and consortia resembled the United States overall rather more closely, although again there was relatively more emphasis on assessment, as well as on communicating scientific procedures and explanations, reported in almost all of these jurisdictions.

It is possible that in some entities some of the approaches and processes reported as being given minor or no emphasis in the intended curriculum may receive more emphasis in the implemented curriculum. Conversely, it is also possible that some of the approaches and processes reported as being given major or moderate emphasis in the intended curriculum may receive less emphasis in the implemented curriculum.

Exhibit 5.16 Emphasis on Approaches and Processes

	Knowing Basic Science Facts	Understanding Science Concepts	Applying Science Concepts to Solve Problems and Develop Explanations	Using Laboratory Equipment	Performing Experiments	Designing and Conducting Scientific Investigations	Communicating Scientific Procedures and Explanations in Written and Oral Form	Integration of Science with Mathematics	Science, Technology and Society	Cross-Disciplinary Approach (Integration of the Sciences and Other School Subjects)	Thematic Approach	Multicultural Approach	Assessing Student Learning
Countries													
United States	●	●	●	●	●	●	◉	○	○	○	◉	○	◉
Belgium (Flemish) [1]	◉	◉	◉	◉	◉	◉	◉	○	◉	◉	◉	○	◉
Canada [2]	●	●	●	◉	◉	◉	●	○	●	○	◉	○	◉
Chinese Taipei	●	●	●	◉	◉	●	○	○	◉	○	○	○	◉
Czech Republic	●	●	◉	○	○	○	●	◉	◉	○	●	○	●
England	●	●	●	◉	◉	●	●	○	◉	○	○	○	●
Hong Kong, SAR	●	●	◉	●	●	○	○	○	◉	○	◉	○	●
Italy	●	●	●	◉	●	●	◉	●	●	●	●	◉	◉
Japan	●	●	●	●	●	●	◉	○	◉	○	○	○	●
Korea, Rep. of	●	●	●	●	●	●	◉	○	●	○	◉	○	●
Netherlands	◉	◉	●	◉	◉	◉	◉	◉	●	◉	●	◉	◉
Russian Federation [1]	●	●	●	◉	◉	○	◉	◉	◉	◉	●	○	●
Singapore	●	●	●	●	●	●	◉	◉	●	○	●	◉	●
States													
Connecticut	◉	●	●	◉	●	●	◉	○	◉	○	○	◉	◉
Idaho	●	●	●	●	●	●	◉	●	◉	◉	◉	○	○
Illinois	◉	●	●	◉	◉	●	◉	○	●	○	◉	○	○
Indiana	●	●	●	◉	●	●	●	●	●	●	●	●	◉
Maryland	◉	●	●	◉	●	●	●	●	●	●	◉	◉	●
Massachusetts	○	●	●	◉	◉	●	●	◉	◉	◉	◉	○	●
Michigan	○	●	●	◉	●	●	◉	○	●	○	◉	●	●
Missouri	◉	●	●	●	●	●	●	◉	●	◉	○	○	●
North Carolina	◉	●	●	●	●	●	●	◉	◉	○	◉	◉	◉
Oregon	●	●	●	◉	◉	●	●	○	○	○	○	○	●
Pennsylvania	●	●	●	◉	◉	◉	○	◉	●	◉	●	○	○
South Carolina	◉	●	●	●	●	●	●	●	◉	◉	◉	○	●
Texas	◉	●	●	●	●	●	●	○	●	○	●	◉	●
Districts and Consortia													
Academy School Dist. #20, CO	–	–	–	–	–	–	–	–	–	–	–	–	–
Chicago Public Schools, IL	●	●	●	●	●	●	◉	◉	◉	○	◉	◉	●
Delaware Science Coalition, DE	◉	●	●	●	●	●	●	○	●	◉	●	◉	●
First in the World Consort., IL	●	●	●	◉	●	●	●	●	●	◉	◉	○	◉
Fremont/Lincoln/WestSide PS, NE	◉	●	●	●	●	◉	●	◉	●	●	●	●	◉
Guilford County, NC	◉	●	●	●	●	●	●	◉	◉	◉	◉	◉	●
Jersey City Public Schools, NJ	●	●	●	◉	●	●	●	◉	●	●	●	◉	●
Miami-Dade County PS, FL	◉	●	●	●	●	●	●	●	●	◉	◉	◉	●
Michigan Invitational Group, MI	●	●	●	●	●	●	●	◉	◉	◉	○	◉	●
Montgomery County, MD	◉	●	●	●	●	●	●	●	●	◉	◉	◉	●
Naperville Sch. Dist. #203, IL	●	●	●	●	●	●	●	◉	◉	◉	◉	○	●
Project SMART Consortium, OH	◉	●	●	●	●	●	●	◉	●	○	●	●	●
Rochester City Sch. Dist., NY	◉	●	●	●	●	●	●	●	●	◉	◉	◉	●
SW Math/Sci. Collaborative, PA [3]	–	–	–	–	–	–	–	–	–	–	–	–	–

● Major Emphasis
◉ Moderate Emphasis
○ Minor/No Emphasis
– Not Available

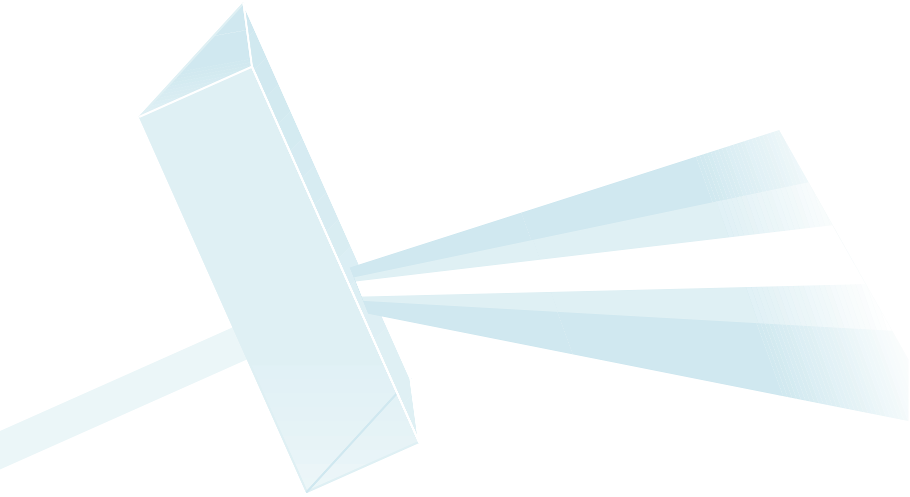
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

[1] Belgium (Flemish) and Russian Federation: The single codes are derived from a combination of codes for individual sciences.

[2] Canada: Results shown are for the majority of provinces.

[3] SW Math/Sci. Collaborative: Covering a workforce region of 118 autonomous districts, the Collaborative cannot provide a representative response for these questions.



What Science Content Do Teachers Emphasize at the Eighth Grade?

Teachers from the Benchmarking jurisdictions and the countries where eighth-grade science was taught as a general or integrated course were asked what subject matter they emphasized most in their classes (general science, earth science, biology, etc.). Their responses, shown in Exhibit 5.17, reveal that on average across all the TIMSS 1999 single-science countries, more than half the eighth-grade students (58 percent) were in classes where the emphasis was on general or integrated science. Next most common was biology with 14 percent, and physical science (physics and chemistry combined) with 11 percent.

In the United States, 41 percent of students were in classes emphasizing general science, 28 percent earth science, and 21 percent physical science. Just five percent of U.S. students were in science classes emphasizing biology, three percent chemistry, and two percent physics. The United States was unusual in its emphasis on earth science. Among the 21 single-science countries in TIMSS, only Canada, Italy, and the U.S. had more than 10 percent of their students in classes emphasizing earth science. It was more common for single-science countries to place emphasis on physical science.

There was considerable variation across the Benchmarking jurisdictions in the reported subject matter emphasis in science classes. Among states, the percentage of students in classes emphasizing general science ranged from four percent in Idaho to 72 percent in North Carolina. The only Benchmarking states besides Idaho with percentages lower than the U.S. average were Connecticut, Missouri, Oregon, Pennsylvania, and Texas. Earth science received least emphasis in Michigan (nine percent of students) and greatest in Texas (52 percent). Benchmarking states with more than one-fifth of the students in classes emphasizing earth science, in addition to Texas, were Connecticut, Idaho, Missouri, Oregon, Pennsylvania, and South Carolina. Physical science received least emphasis in Texas and North Carolina (five and six percent, respectively), and most in Idaho (50 percent). Eight of the states had more than one-fifth of their students in classes emphasizing physical science.

Among the districts and consortia, the greatest emphasis on general science was reported in Chicago, the Fremont/Lincoln/Westside Public Schools, Guilford County, Miami-Dade, and Naperville, all of which had two-thirds or more of their students in classes emphasizing general science. In contrast, the First in the World Consortium, Jersey City, the

Project SMART Consortium, and Rochester each had less than one-quarter of their students in such classes. There was less variation among districts and consortia in the emphasis given earth science. While 68 percent of the students in the Delaware Science Coalition were in classes emphasizing earth science, nine of the districts and consortia had less than 10 percent of their students in such classes, and seven of them had one percent or less. There was substantial variation among districts and consortia in the emphasis given physical science. The Academy School District, Jersey City and Rochester each had more than half their students in classes emphasizing physical science, while Chicago, the Delaware Science Coalition, the Fremont/Lincoln/Westside Public Schools, Guilford County, the Michigan Invitational Group, and Naperville had less than one-fifth of the students in such classes.

Exhibit 5.17 Subject Matter Emphasized Most in General/Integrated Science Class

8th Grade Science

	Percentage of Students Whose Teachers Report the Subject Matter Emphasized Most in Their Grade 8 Science Class						
	General/ Integrated Science	Earth Science	Biology	Physics	Chemistry	Physical Science (chemistry/ physics)	Other
Countries							
United States r	41 (4.7)	28 (4.8)	5 (1.5)	2 (0.8)	3 (1.0)	21 (3.1)	1 (0.4)
Canada r	55 (3.5)	14 (2.3)	6 (1.7)	1 (0.7)	1 (0.6)	19 (2.7)	3 (1.2)
England	– –	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	92 (2.6)	0 (0.0)	3 (1.5)	0 (0.0)	1 (0.0)	4 (1.9)	0 (0.0)
Italy	0 (0.0)	20 (3.2)	49 (3.9)	13 (2.6)	3 (1.2)	11 (2.6)	3 (1.4)
Japan	64 (4.6)	1 (1.0)	7 (2.4)	6 (2.1)	11 (2.7)	6 (2.1)	5 (1.9)
Korea, Rep. of	49 (4.0)	2 (1.0)	10 (2.0)	5 (1.6)	5 (1.7)	26 (3.2)	4 (1.6)
Singapore	69 (4.1)	0 (0.0)	5 (2.0)	4 (1.8)	7 (2.3)	11 (2.5)	4 (1.6)
States							
Connecticut s	30 (7.8)	22 (6.2)	5 (4.1)	4 (2.4)	5 (2.4)	32 (7.7)	3 (2.1)
Idaho r	4 (2.8)	32 (6.6)	8 (4.6)	3 (1.2)	0 (0.0)	50 (7.3)	3 (2.7)
Illinois r	46 (7.1)	14 (4.7)	8 (3.4)	0 (0.0)	6 (2.0)	24 (6.7)	1 (0.6)
Indiana r	52 (8.1)	16 (4.8)	3 (1.5)	0 (0.0)	3 (2.2)	23 (8.0)	4 (1.7)
Maryland s	41 (6.9)	18 (4.7)	1 (1.4)	0 (0.0)	5 (2.3)	32 (6.7)	2 (2.0)
Massachusetts r	42 (5.9)	17 (5.3)	0 (0.1)	0 (0.0)	0 (0.0)	41 (7.0)	1 (0.0)
Michigan r	54 (5.7)	9 (3.9)	3 (2.5)	2 (2.1)	0 (0.3)	32 (5.0)	0 (0.4)
Missouri r	38 (7.2)	37 (7.2)	6 (3.8)	0 (0.0)	0 (0.1)	16 (4.6)	2 (0.2)
North Carolina	72 (5.7)	10 (3.4)	1 (1.3)	1 (0.1)	8 (4.0)	6 (2.7)	2 (0.1)
Oregon r	36 (6.2)	41 (7.7)	5 (2.6)	0 (0.0)	4 (2.7)	12 (5.1)	2 (1.0)
Pennsylvania r	16 (3.2)	40 (5.5)	6 (2.5)	0 (0.0)	2 (0.9)	35 (6.1)	1 (0.9)
South Carolina	41 (6.6)	48 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	11 (4.1)	1 (0.3)
Texas s	40 (5.6)	52 (6.7)	1 (0.7)	0 (0.0)	1 (1.0)	5 (3.2)	0 (0.0)
Districts and Consortia							
Academy School Dist. #20, CO	28 (0.4)	0 (0.0)	0 (0.0)	15 (0.4)	0 (0.0)	57 (0.6)	0 (0.0)
Chicago Public Schools, IL r	66 (8.5)	6 (4.0)	7 (4.7)	0 (0.0)	0 (0.0)	19 (8.1)	3 (0.3)
Delaware Science Coalition, DE r	31 (4.1)	68 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)
First in the World Consort., IL	20 (9.3)	0 (0.0)	15 (1.5)	0 (0.0)	7 (1.0)	47 (8.1)	11 (4.7)
Fremont/Lincoln/WestSide PS, NE	87 (3.9)	0 (0.3)	1 (0.1)	4 (2.6)	0 (0.0)	8 (2.9)	1 (0.5)
Guilford County, NC	86 (4.5)	8 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	6 (3.9)	0 (0.0)
Jersey City Public Schools, NJ r	0 (0.0)	0 (0.0)	8 (4.1)	14 (1.4)	0 (0.0)	68 (4.1)	9 (0.9)
Miami-Dade County PS, FL s	70 (5.9)	1 (0.8)	1 (0.5)	0 (0.0)	6 (3.5)	20 (6.2)	3 (2.7)
Michigan Invitational Group, MI	47 (4.3)	32 (3.3)	4 (0.2)	0 (0.0)	3 (0.7)	14 (2.6)	0 (0.0)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	68 (3.4)	0 (0.0)	0 (0.0)	13 (0.7)	0 (0.0)	18 (3.5)	0 (0.0)
Project SMART Consortium, OH r	22 (4.2)	33 (3.3)	11 (3.0)	0 (0.0)	7 (3.1)	22 (3.4)	4 (1.7)
Rochester City Sch. Dist., NY	17 (5.3)	0 (0.0)	22 (6.2)	0 (0.0)	0 (0.0)	61 (6.5)	0 (0.0)
SW Math/Sci. Collaborative, PA	31 (7.8)	18 (6.6)	10 (5.8)	2 (2.1)	7 (3.8)	31 (5.9)	0 (0.0)
International Average (All General Science Countries)	58 (0.8)	5 (0.4)	14 (0.5)	6 (0.4)	4 (0.4)	11 (0.6)	2 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An “r” indicates teacher response data available for 70-84% of students. An “s” indicates teacher response data available for 50-69% of students. An “x” indicates teacher response data available for <50% of students.

What Science Topics Are Included in the Intended Curriculum?

In the course of their meetings on planning and implementation of TIMSS 1999, the National Research Coordinators developed a list of science topics that they agreed covered most of the content in the intended science curriculum in their respective countries. These topics, presented in Exhibit 5.18, built on the topics covered in the TIMSS 1995 science test and included in the teacher questionnaire. They represent all topics likely to have been included in the curricula of the 38 participating countries up to and including eighth grade. From the following choices, the coordinators from the participating entities indicated the percentages of students in their own countries or jurisdictions expected to have been taught each topic up to and including eighth grade:

- All or almost all students (at least 90 percent)
- About half of the students
- Only the more able students (top track – about 25 percent)
- Only the most advanced students (10 percent or less).

Exhibit 5.19 summarizes the data according to the percentage of topics intended to be taught to all or almost all students (at least 90 percent) in each entity, across the entire list of topics and for each content area. Information on specific topics in the intended curricula for each content area is presented in Exhibits R2.2 through R2.7 in the reference section of this report.

Internationally on average, curricular guidelines up to and including eighth grade called for nearly all students to have been taught about two-thirds of the topics overall. There was, however, marked variation between countries and between content areas in intended curricular coverage. The greatest percentages of topics intended to be taught to 90 percent or more of the students were in biology (77 percent, on average across countries), earth science (72 percent), and environmental and resource issues (69 percent). Next came physics (64 percent) and scientific inquiry and the nature of science (60 percent), with chemistry having the lowest percentage (52 percent). In six of the comparison countries, it was intended that all or nearly all students be taught all of the earth science topics. All environmental and resource issues topics were intended to be taught to practically all students in seven comparison countries, while in Hong Kong, Japan, and Korea, none of these topics were in the intended curriculum for most students.

In the United States overall, 86 percent of the science topics – compared with the international average of 63 percent – were intended to be taught to 90 percent or more of the students. This relatively high level of coverage resulted from the inclusion of 100 percent of the topics in each of the content areas except chemistry.

Benchmarking participants generally resembled the United States in topic coverage in the intended curriculum, although there were differences, particularly among the districts and consortia. Earth science, biology, environmental and resource issues, and scientific inquiry and the nature of science were included in the curriculum for almost all students in almost all Benchmarking jurisdictions, but the coverage of physics and particularly chemistry was more variable. Among states the percentage of physics topics intended for almost all students ranged from 60 percent in Idaho and Oregon to 100 percent in Illinois, Massachusetts, and North Carolina, and among districts and consortia from 50 percent in the Delaware Science Coalition to 100 percent in the First in the World Consortium, Guilford County, Jersey City, and Montgomery County. The percentage of chemistry topics ranged from just eight percent in Oregon to 100 percent in Texas, and from zero in the Michigan Invitational Group to 100 percent in First in the World, Jersey City, and Montgomery County.

It should be noted that some countries reported having different curricula or different levels of curriculum for different groups of students, as detailed in Exhibit 5.15. Not surprisingly, then, these countries often reported that about half, only the more able (25 percent), or the top 10 percent of students were expected to have been taught substantial percentages of the topics. Surprisingly, the Benchmarking jurisdictions that reported having different levels of curriculum for different groups, First in the World, Miami-Dade, and Montgomery County, indicated that at least 90 percent of the topics in each content area were intended to be taught to 90 percent or more of the students. It should also be noted that if content within a topic area required different responses, coordinators from participating entities chose the response that best represented the entire topic area and noted the discrepancy (see Exhibits A.8 and A.9 in the appendix for details).

Exhibit 5.18 Science Topics Included in the TIMSS Questionnaires

Earth Science

- ■ Earth's physical features (layers, landforms, bodies of water, rocks, soil)
- ■ Earth's atmosphere (layers, composition, temperature, pressure)
- ■ Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)
- ■ Earth in the solar system and the universe (interactions between Earth, sun, and moon; relationship to planets and stars)

Biology

- ■ Human body – structure and function of organs and systems
- ■ Human bodily processes (metabolism, respiration, digestion)
- ■ Human nutrition, health, and disease
- ■ Biology of plant and animal life (diversity, structure, life processes, life cycles)
- ◆ Photosynthesis
- ■ Interactions of living things (biomes and ecosystems, interdependence)
- ■ Reproduction, genetics, evolution, and speciation

Physics

- ■ Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)
- ■ Subatomic particles (protons, electrons, neutrons)
- ■ Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)
- ■ Heat and temperature
- ◆ Gas laws (relationship between temperature/pressure/volume)
- ■ Wave phenomena, sound, and vibration
- ■ Light (reflection, refraction, light and color)
- ■ Electricity and magnetism (circuits, conductivity, magnets)
- ■ Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)
- ◆ Buoyancy

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Exhibit 5.18
(Continued)

Science Topics Included in the TIMSS Questionnaires

Chemistry

■ Classification of matter (elements, compounds, solutions, mixtures)
■ Structure of matter (atoms, ions, molecules, crystals)
◆ Formation of solutions (solvents, solutes, soluble/insoluble substances)
◆ Acids, bases, and salts
■ Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)
■ Energy and chemical change (exothermic and endothermic reactions, reaction rates)
◆ Chemical bonding and compound formation (ionic, covalent)
◆ Chemical equations
◆ Atomic structure
◆ Atomic number and atomic mass
◆ Periodic table
◆ Valency

Environmental and Resource Issues

■ Pollution (acid rain, global warming, ozone layer, water pollution)
■ Conservation of natural resources (land, water, forests, energy resources)
■ Food supply and production, population, and environmental effects of natural and man-made events

Scientific Inquiry and the Nature of Science

■ Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)
■ Experimental design (experimental control, materials, and procedures)
■ Scientific measurements (reliability, replication, experimental error, accuracy, scales)
■ Using scientific apparatus and conducting routine experimental operations
■ Gathering, organizing, and representing data (units, tables, charts, graphs)
■ Describing and interpreting data

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Exhibit 5.19

Science Topics in the Intended Curriculum for At Least 90% of Students, Up to and Including Eighth Grade

	Percentage of Topics Intended to Be Taught to All or Almost All (at least 90%) Students						
	Overall	Earth Science	Biology	Physics	Chemistry	Environmental and Resource Issues	Scientific Inquiry and the Nature of Science
Countries							
United States	86	100	100	100	50	100	100
Belgium (Flemish)	38	0	71	40	0	67	83
Canada	48	75	86	20	17	100	67
Chinese Taipei	69	25	86	80	58	67	83
Czech Republic	79	100	86	90	83	33	50
England	71	75	71	80	42	100	100
Hong Kong, SAR	50	25	100	60	42	0	33
Italy	67	75	100	70	25	100	83
Japan	62	100	57	70	50	0	83
Korea, Rep. of	60	100	71	70	50	0	50
Netherlands	24	0	43	20	0	100	33
Russian Federation	71	100	29	70	100	100	33
Singapore	79	100	100	70	58	100	83
States							
Connecticut	86	100	100	80	67	100	100
Idaho	74	100	100	60	42	100	100
Illinois	95	100	100	100	83	100	100
Indiana	79	75	100	80	50	100	100
Maryland	71	100	100	80	17	100	100
Massachusetts	76	100	57	100	42	100	100
Michigan	71	100	100	70	25	100	100
Missouri	62	100	57	80	25	100	67
North Carolina	93	100	100	100	75	100	100
Oregon	52	75	71	60	8	33	100
Pennsylvania [1]	–	–	–	–	–	–	–
South Carolina	76	100	71	90	50	100	83
Texas	98	100	100	90	100	100	100
Districts and Consortia							
Academy School Dist. #20, CO [2]	–	–	–	–	–	–	–
Chicago Public Schools, IL	64	100	100	60	42	67	50
Delaware Science Coalition, DE	60	100	86	50	17	67	100
First in the World Consort., IL	100	100	100	100	100	100	100
Fremont/Lincoln/WestSide PS, NE	74	100	100	80	33	100	83
Guilford County, NC	95	100	100	100	83	100	100
Jersey City Public Schools, NJ	100	100	100	100	100	100	100
Miami-Dade County PS, FL	95	100	100	90	92	100	100
Michigan Invitational Group, MI	62	100	100	70	0	100	83
Montgomery County, MD	100	100	100	100	100	100	100
Naperville Sch. Dist. #203, IL	95	100	100	90	92	100	100
Project SMART Consortium, OH	79	100	100	80	42	100	100
Rochester City Sch. Dist., NY	67	100	71	80	42	33	83
SW Math/Sci. Collaborative, PA [1]	–	–	–	–	–	–	–
International Avg. (All Countries)	63	72	77	64	52	69	60

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions according to the official curriculum. Coordinators indicated the percentage of students who should have been taught each of the topics listed in Exhibit 5.18. The response categories were: all or almost all of the students (at least 90%); about half of the students; only the more able students (top track – about 25%); only the most advanced students (10% or less); not included in curriculum through grade 8. (See Reference Exhibits R2.2-R2.7 for detail by topic.)

[1] Due to the variation across the state/collaborative, a representative response cannot be provided for these questions.

[2] Academy School Dist. #20: As a district that has site-based curriculum development, the district cannot provide a representative response for these questions.

A dash (–) indicates data are not available.

Have Students Been Taught the Topics Tested by TIMSS?

In interpreting the achievement results, it is important to consider how extensively the topics tested are taught in the participating entities. As shown in Exhibits 5.20 through 5.25, the six major science content areas assessed in TIMSS 1999 were represented by 31 topic areas. For each area, teachers indicated whether their students had been taught the topics before this year (i.e., the eighth grade), one to five periods this year, more than five periods this year; whether the topics had not yet been taught; or whether the teacher did not know. Exhibits 5.20 through 5.25 show the percentages of students in each entity reported to have been taught each topic before or during the year of testing.

According to their teachers, more than two-thirds of students on average across all TIMSS 1999 countries had been taught the topics in earth science, as shown in Exhibit 5.20. The international average for each topic exceeded 70 percent of students. Nearly all students in the Czech Republic were taught each of the earth science topics, while less than half the students in Belgium (Flemish), Hong Kong, and Japan were taught two or more of the four topics in this content area. Teachers in the United States overall as well as in the Benchmarking jurisdictions reported greater percentages than did teachers internationally, with more than 80 percent of students in most jurisdictions being taught each topic. The major exceptions were Idaho, where about half the students were taught the earth science topics, and Rochester, where one-third or less of the students had been taught these topics. In contrast, all students in Jersey City and Naperville were taught three or more of the topics.

Exhibit R2.8 in the reference section indicates that many students in the U.S. as a whole and in the Benchmarking jurisdictions had instruction in the earth science topics both before and during the eighth grade. While 31 percent of students on average across countries had not yet been taught half or more of these topics, only 11 percent of the students in the United States overall had not been taught them. Thirty-two percent of U.S. students were taught more than half the earth science topics before the eighth grade and not again during the eighth grade, and a further 46 percent were taught more than half these topics during the eighth grade. Although many students in most Benchmarking jurisdictions were taught the earth science topics before and during the eighth grade, the percentage of students who had not yet been taught them ranged from three percent in South Carolina to 50 percent in Idaho among states, and from zero in Jersey City and Naperville to 87 percent in Rochester among districts and consortia.

With the exception of “reproduction, genetics, evolution, and speciation” (61 percent of students), instructional coverage was high for the biology topics presented in Exhibit 5.21. At least 77 percent of students, on average internationally, were taught each of the other six topics. Teachers in Belgium (Flemish), England, Italy, the Netherlands, as well as the United States reported that 80 percent or more of their students were taught all of the biology topics. Like the United States overall, the Benchmarking participants reported percentages above the international average for almost all of the topics, although there was some variation. More than 90 percent of the students in Massachusetts, Oregon, the Academy School District, the First in the World Consortium, and Jersey City were taught each of the biology topics, while less than 80 percent of the students in the Michigan Invitational Group were taught five of the six topics in this content area.

As indicated by Exhibit R2.9 in the reference section, biology topics received considerable emphasis before the eighth grade in the United States, more than in any of the comparison countries except Italy, and in the Benchmarking jurisdictions. Fifty-five percent of U.S. students received instruction in more than half the biology topics before the eighth grade only, compared with 16 percent on average across countries. In contrast, 44 percent of students internationally were taught more than half these topics during the eighth grade, compared with 26 percent in the U.S., and 21 percent of students internationally had not yet been taught half or more of the topics, compared with only 10 percent in the U.S. With some exceptions, results for the Benchmarking jurisdictions generally were similar to those of the United States.

Of the physics topics (see Exhibit 5.22), “physical properties and the physical changes of matter” had the greatest coverage internationally, with 91 percent of students, on average, having been taught this topic. “Energy types, sources, and conversions” and “subatomic particles” received less emphasis, with 75 and 71 percent of students, respectively, having been taught them. “Light,” “electricity and magnetism,” and “forces and motion” also had lower percentages of students, between 65 and 68 percent, compared with other physics topics. Least emphasis was given to “wave phenomena, sound, and vibration,” with an international average of 52 percent. All students in the Netherlands were taught each of the physics topics. The United States overall and the Benchmarking jurisdictions reported percentages of students taught the physics topics that were generally greater than the international averages.

However, as indicated by Exhibit R2.10 in the reference section, physics topics received very little emphasis before the eighth grade in the United States and in the Benchmarking jurisdictions. This was true internationally as well. Only 12 percent of the students in the U.S., and nine percent on average across countries, were taught more than half the physics topics before the eighth grade and not again during the eighth grade. Fifty-eight percent of U.S. students, compared with 44 percent internationally, were taught more than half these topics during the eighth grade. More than half the topics were taught before or during the eighth grade to three-fourths or more of the students in Michigan, South Carolina, Texas, the Academy School District, Jersey City, and Miami-Dade. However, half or more of the topics had not yet been taught to one-third or more of the students in Connecticut, Idaho, Pennsylvania, and Rochester.

Instructional coverage was high for three of the four chemistry topics, “classification of matter” (90 percent of students taught), “structure of matter” (84 percent), and “chemical reactivity and transformations” (76 percent), but less for “energy and chemical change,” which just 58 percent of students, internationally on average, had been taught (see Exhibit 5.23). As with physics, nearly all students (99 percent) in the Netherlands were taught each of the chemistry topics. The United States as a whole and the Benchmarking participants had similar or even higher percentages of students taught these topics than internationally. Highest percentages across all topics were reported in Naperville and the First in the World Consortium.

Exhibit R2.11 in the reference section shows that, like physics, topics in chemistry received very little emphasis before the eighth grade internationally, in the United States, and in the Benchmarking jurisdictions. Only 13 percent of the students on average across countries, and 10 percent in the U.S., had been taught the chemistry topics before the eighth grade only. Sixty-three percent of U.S. students, compared with 54 percent of students internationally, were taught more than half these topics during the eighth grade. Results for the Benchmarking jurisdictions generally resembled those of the United States.

Most students in most countries, with the notable exception of Japan among the comparison countries, were taught the topics in environmental and resource issues (see Exhibit 5.24), especially those dealing with “pollution” and “conservation of natural resources.” Four-fifths or more of the students in the United States had been taught each of the topics in this content area, which was above the international average in each case. Among Benchmarking entities the lowest percentages were in

Idaho, Chicago, and Rochester, where two-thirds of the students or less were taught these topics. Ninety-five percent or more of the students in the Academy School District and the First in the World Consortium were taught all three topics in this content area.

As may be seen in Exhibit R2.12 in the reference section, topics in environmental and resource issues received considerable emphasis before the eighth grade in the United States and in most Benchmarking jurisdictions, more than in most of the comparison countries. More than half the students were taught more than half the topics in this content area before the eighth grade only in Connecticut, Massachusetts, the Academy School District, the First in the World Consortium, and the Michigan Invitational Group. However, 43 percent or more of the students in Idaho, Chicago, and Rochester had not yet been taught half or more of these topics.

Instructional coverage of the six scientific inquiry and the nature of science topics was high in most countries, with between 75 and 88 percent of students, on average internationally, having been taught these topics (see Exhibit 5.25). Coverage was particularly high in the United States overall and in all of the Benchmarking jurisdictions. In 20 Benchmarking jurisdictions, ninety percent or more of the students were taught all six topics. Teachers in all jurisdictions and comparison countries except Belgium (Flemish) reported that each topic had been taught to more than 60 percent of their students.

Exhibit R2.13 reveals that while relatively little emphasis was placed on scientific inquiry and the nature of science topics before the eighth grade, considerable attention was paid to them during that year. Ninety-two percent of students in the United States, and two-thirds of the students internationally, were taught more than half these topics during the eighth grade. Benchmarking participants reported percentages similar to those of the U.S., as 90 percent or more of the students in all Benchmarking entities except Missouri, North Carolina, and Pennsylvania were taught more than half the topics during the eighth grade.

Exhibit 5.20 Percentages of Students Taught Earth Science Topics*

8th Grade Science

	Earth's physical features (layers, landforms, bodies of water, rocks, soil)	Earth's atmosphere (layers, composition, temperature, pressure)	Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	Earth in the solar system and the universe (interactions between earth, sun, and moon; relationship to planets and stars)
Countries				
United States	r 87 (2.5)	r 84 (2.7)	r 92 (2.0)	r 84 (2.3)
Belgium (Flemish)	r 93 (3.0)	r 45 (4.3)	r 64 (5.2)	r 16 (3.4)
Canada	s 91 (1.9)	s 83 (2.1)	s 86 (2.3)	s 80 (3.1)
Chinese Taipei [1]	– –	– –	– –	– –
Czech Republic	99 (0.4)	98 (1.2)	97 (1.7)	98 (1.2)
England	s 86 (4.0)	s 64 (3.9)	s 71 (3.5)	s 90 (3.6)
Hong Kong, SAR	s 17 (3.2)	r 61 (5.0)	s 17 (4.0)	s 15 (3.8)
Italy	82 (2.9)	95 (1.5)	81 (3.2)	70 (3.6)
Japan	6 (2.2)	74 (3.7)	39 (4.1)	99 (0.7)
Korea, Rep. of	91 (2.4)	98 (1.2)	95 (1.5)	52 (4.0)
Netherlands	76 (5.6)	91 (2.7)	92 (4.1)	r 82 (4.8)
Russian Federation	– –	– –	– –	– –
Singapore	x x	x x	x x	x x
States				
Connecticut	s 84 (6.0)	s 83 (5.9)	s 81 (5.7)	s 85 (5.8)
Idaho	s 53 (6.8)	s 50 (7.3)	s 52 (7.2)	s 48 (6.6)
Illinois	r 84 (6.6)	r 83 (7.0)	r 81 (6.9)	r 75 (7.3)
Indiana	r 93 (3.0)	r 92 (3.7)	r 89 (3.8)	r 91 (4.0)
Maryland	s 83 (4.3)	s 81 (5.1)	s 82 (4.1)	s 79 (6.4)
Massachusetts	r 83 (4.6)	r 80 (4.5)	r 84 (4.6)	r 79 (4.5)
Michigan	r 89 (4.3)	r 86 (4.9)	r 93 (3.0)	r 88 (4.1)
Missouri	r 93 (3.1)	r 95 (1.6)	r 93 (3.8)	r 77 (4.4)
North Carolina	93 (1.5)	91 (2.2)	r 90 (3.0)	88 (3.6)
Oregon	94 (3.2)	83 (4.6)	90 (4.0)	85 (5.0)
Pennsylvania	r 83 (4.2)	r 80 (4.8)	r 83 (4.0)	r 75 (4.4)
South Carolina	r 98 (1.5)	r 91 (3.6)	98 (1.0)	90 (3.6)
Texas	r 94 (3.3)	r 89 (3.8)	r 93 (3.6)	r 85 (4.2)
Districts and Consortia				
Academy School Dist. #20, CO	91 (0.2)	90 (0.2)	90 (0.2)	90 (0.2)
Chicago Public Schools, IL	r 92 (4.9)	r 94 (4.2)	r 82 (4.9)	r 80 (7.9)
Delaware Science Coalition, DE	s 85 (5.4)	s 83 (4.6)	s 84 (5.4)	s 83 (4.8)
First in the World Consort., IL	86 (7.8)	86 (7.8)	100 (0.0)	82 (7.5)
Fremont/Lincoln/WestSide PS, NE	r 97 (2.4)	r 96 (2.5)	r 97 (2.4)	68 (6.6)
Guilford County, NC	95 (2.8)	96 (2.5)	92 (2.7)	88 (3.6)
Jersey City Public Schools, NJ	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	s 100 (0.0)
Miami-Dade County PS, FL	s 98 (1.2)	s 93 (5.1)	s 97 (2.6)	s 82 (6.6)
Michigan Invitational Group, MI	r 83 (2.3)	r 94 (1.8)	r 90 (1.4)	r 96 (1.5)
Montgomery County, MD	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	90 (2.9)	100 (0.0)	100 (0.0)
Project SMART Consortium, OH	r 84 (1.8)	r 81 (3.7)	r 94 (0.9)	r 85 (3.3)
Rochester City Sch. Dist., NY	s 22 (3.5)	s 25 (4.0)	s 22 (3.5)	s 35 (5.9)
SW Math/Sci. Collaborative, PA	79 (5.0)	79 (4.9)	80 (6.4)	r 72 (7.4)
International Avg. (All Countries)	77 (0.6)	73 (0.6)	71 (0.6)	71 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

[1] Chinese Taipei: Data for grade 9 earth science teachers not available.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.21 Percentages of Students Taught Biology Topics*

8th Grade Science

	Human body – structure and function of organs and systems	Human bodily processes (metabolism, respiration, digestion)	Human nutrition, health, and disease	Biology of plant and animal life (diversity, structure, life processes, life cycles)	Interactions of living things (biomes, ecosystems, and interdependence)	Reproduction, genetics, evolution, and speciation
Countries						
United States	r 90 (2.6)	r 90 (2.1)	r 91 (2.2)	r 92 (1.9)	r 90 (2.0)	r 83 (2.8)
Belgium (Flemish)	98 (1.0)	100 (0.0)	100 (0.0)	r 91 (2.6)	r 85 (3.7)	94 (2.2)
Canada	s 54 (3.0)	s 49 (3.6)	s 54 (3.8)	s 70 (3.2)	s 77 (2.7)	s 45 (3.7)
Chinese Taipei [1]	– –	– –	– –	– –	– –	– –
Czech Republic	99 (0.4)	99 (0.5)	98 (1.1)	96 (2.1)	73 (4.4)	57 (5.4)
England	s 96 (1.9)	s 99 (0.8)	s 95 (2.5)	s 91 (3.2)	s 84 (4.2)	s 80 (3.6)
Hong Kong, SAR	79 (3.8)	76 (3.6)	r 30 (4.7)	r 69 (4.6)	r 57 (4.9)	r 61 (4.6)
Italy	99 (0.9)	99 (0.9)	97 (0.9)	100 (0.0)	89 (2.4)	87 (2.9)
Japan	97 (1.7)	96 (1.8)	82 (3.3)	86 (3.0)	15 (3.2)	8 (2.5)
Korea, Rep. of	91 (2.2)	92 (2.2)	87 (2.8)	76 (3.7)	57 (4.3)	54 (4.3)
Netherlands	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 99 (0.9)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	97 (1.5)	97 (1.6)	97 (1.8)	r 86 (3.8)	r 69 (4.4)	92 (2.7)
States						
Connecticut	s 91 (4.7)	s 95 (2.2)	s 97 (1.2)	s 93 (2.8)	s 96 (2.6)	s 78 (5.9)
Idaho	s 76 (7.7)	s 77 (7.7)	s 80 (7.0)	s 87 (4.4)	s 83 (5.6)	s 76 (5.8)
Illinois	r 84 (5.3)	r 89 (4.6)	r 88 (3.6)	r 95 (2.5)	r 91 (3.3)	r 84 (4.0)
Indiana	r 91 (3.5)	r 91 (3.6)	r 94 (2.7)	r 93 (3.1)	r 93 (2.9)	r 84 (5.5)
Maryland	s 99 (1.0)	s 99 (1.0)	s 97 (1.9)	s 96 (2.5)	s 89 (4.3)	s 83 (5.8)
Massachusetts	r 96 (2.8)	r 93 (3.3)	s 97 (2.2)	r 96 (1.9)	r 92 (1.8)	r 91 (3.3)
Michigan	r 87 (4.1)	r 85 (4.7)	r 86 (4.5)	r 98 (1.2)	r 97 (1.4)	r 81 (5.1)
Missouri	r 83 (4.1)	r 86 (4.9)	r 83 (5.6)	r 89 (4.4)	r 89 (4.1)	r 83 (5.7)
North Carolina	r 92 (3.4)	r 89 (4.1)	r 91 (3.6)	r 90 (3.0)	r 84 (3.9)	r 85 (4.5)
Oregon	r 92 (3.6)	r 92 (3.2)	r 93 (3.4)	r 93 (3.2)	r 94 (3.4)	r 92 (3.7)
Pennsylvania	r 78 (3.5)	r 77 (3.7)	r 86 (3.2)	r 91 (3.3)	r 90 (3.6)	r 74 (3.6)
South Carolina	96 (2.6)	r 97 (2.0)	r 96 (2.2)	r 89 (4.3)	r 90 (3.6)	r 95 (2.8)
Texas	r 94 (2.8)	r 91 (4.1)	r 91 (3.5)	r 94 (3.0)	r 95 (2.8)	s 89 (4.6)
Districts and Consortia						
Academy School Dist. #20, CO	100 (0.0)	100 (0.0)	100 (0.0)	r 100 (0.0)	r 100 (0.0)	100 (0.0)
Chicago Public Schools, IL	r 75 (12.5)	r 75 (12.5)	r 86 (8.3)	r 89 (7.7)	r 79 (8.0)	r 77 (10.6)
Delaware Science Coalition, DE	s 81 (6.9)	s 82 (6.3)	s 86 (5.7)	s 89 (5.3)	s 85 (6.3)	s 86 (6.0)
First in the World Consort., IL	95 (1.7)	95 (1.7)	100 (0.0)	96 (1.5)	96 (1.5)	96 (1.5)
Fremont/Lincoln/WestSide PS, NE	s 96 (1.4)	x x	s 96 (3.2)	r 87 (0.8)	90 (3.3)	r 82 (7.5)
Guilford County, NC	r 94 (2.8)	r 94 (2.9)	r 94 (2.9)	94 (2.7)	r 79 (4.5)	r 87 (3.0)
Jersey City Public Schools, NJ	r 93 (4.2)	r 91 (4.3)	r 92 (4.0)	r 98 (0.2)	r 96 (0.4)	r 96 (0.4)
Miami-Dade County PS, FL	s 98 (0.8)	s 94 (4.0)	s 86 (5.0)	s 96 (2.9)	s 91 (5.5)	s 83 (4.6)
Michigan Invitational Group, MI	r 76 (2.8)	r 74 (3.5)	r 79 (4.0)	r 73 (2.4)	r 85 (3.5)	r 65 (1.5)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	86 (4.2)	100 (0.0)	r 100 (0.0)	100 (0.0)	100 (0.0)	83 (1.7)
Project SMART Consortium, OH	r 87 (3.5)	r 84 (3.8)	r 97 (1.5)	r 94 (2.9)	r 87 (3.9)	r 86 (3.2)
Rochester City Sch. Dist., NY	r 86 (3.0)	r 90 (3.4)	r 88 (3.9)	r 90 (3.4)	r 81 (4.9)	r 83 (3.7)
SW Math/Sci. Collaborative, PA	r 76 (8.4)	r 74 (7.0)	r 82 (7.3)	82 (5.0)	r 85 (3.8)	r 64 (8.2)
International Avg. (All Countries)	84 (0.5)	83 (0.5)	79 (0.6)	87 (0.5)	77 (0.6)	61 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

[1] Chinese Taipei: Data for grade 7 biology teachers not available.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.22 Percentages of Students Taught Physics Topics*

	Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)	Subatomic particles (protons, electrons, neutrons)	Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	Heat and temperature	Wave phenomena, sound, and vibration	Light	Electricity and magnetism	Forces and motion (types of forces, balanced/ unbalanced forces, fluid behavior, speed, acceleration)
Countries								
United States	r 93 (1.7)	r 86 (2.6)	r 76 (3.4)	r 82 (3.0)	r 65 (3.8)	r 67 (3.3)	r 70 (3.2)	75 (3.4)
Belgium (Flemish)	s 58 (5.3)	s 8 (2.9)	s 35 (4.7)	s 54 (5.4)	s 5 (2.1)	s 31 (4.0)	s 38 (4.3)	33 (4.5)
Canada	r 97 (1.3)	s 44 (3.4)	r 82 (2.6)	r 91 (2.1)	s 35 (3.8)	s 50 (4.0)	s 48 (3.3)	56 (3.1)
Chinese Taipei	98 (1.0)	98 (1.0)	47 (4.3)	93 (2.3)	79 (3.1)	89 (2.6)	20 (3.2)	29 (3.5)
Czech Republic	96 (2.1)	96 (2.0)	94 (2.4)	98 (1.3)	10 (3.1)	81 (4.1)	71 (4.8)	100 (0.2)
England	s 97 (1.4)	s 66 (4.1)	s 96 (1.7)	s 92 (2.8)	s 82 (3.6)	s 98 (1.1)	s 97 (1.8)	98 (1.1)
Hong Kong, SAR	r 87 (3.4)	r 34 (4.9)	87 (3.4)	84 (3.2)	r 58 (4.6)	r 50 (5.2)	83 (3.5)	41 (4.9)
Italy	98 (1.2)	89 (2.6)	77 (3.1)	95 (1.5)	44 (4.0)	38 (4.0)	55 (3.9)	85 (2.9)
Japan	100 (0.0)	43 (4.1)	15 (3.5)	99 (0.9)	99 (1.3)	99 (1.3)	90 (2.6)	20 (3.1)
Korea, Rep. of	95 (1.9)	66 (4.1)	63 (4.3)	85 (3.1)	33 (3.9)	41 (4.0)	96 (1.7)	87 (2.6)
Netherlands	100 (0.0)	r 100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Russian Federation	– –	– –	– –	– –	– –	– –	– –	– –
Singapore	96 (1.8)	s 80 (4.5)	97 (1.6)	99 (0.9)	85 (3.4)	99 (0.8)	92 (2.6)	82 (4.2)
States								
Connecticut	s 92 (4.2)	s 79 (7.4)	s 74 (6.2)	s 87 (5.3)	s 58 (7.7)	s 67 (7.6)	s 68 (7.6)	65 (7.5)
Idaho	s 87 (6.4)	s 87 (6.6)	s 67 (6.6)	s 69 (7.1)	s 56 (7.9)	s 53 (7.3)	s 46 (7.6)	65 (7.1)
Illinois	91 (2.4)	89 (4.7)	r 79 (6.7)	r 70 (6.9)	s 50 (6.2)	r 54 (6.9)	r 70 (5.8)	87 (4.9)
Indiana	r 97 (1.7)	r 94 (3.0)	r 77 (7.8)	r 78 (8.0)	s 56 (9.1)	r 62 (9.2)	r 69 (9.0)	91 (3.6)
Maryland	s 98 (1.4)	s 88 (3.3)	s 85 (4.0)	s 79 (5.3)	s 69 (4.7)	s 71 (4.6)	s 80 (5.6)	89 (4.4)
Massachusetts	r 97 (2.0)	r 91 (3.8)	r 78 (5.6)	r 82 (5.7)	s 58 (7.5)	r 62 (7.6)	r 70 (7.1)	81 (5.5)
Michigan	r 97 (2.6)	r 91 (4.1)	r 95 (2.8)	r 94 (3.1)	r 79 (5.1)	r 77 (5.2)	r 74 (5.5)	87 (4.7)
Missouri	r 97 (1.6)	r 94 (3.3)	r 81 (5.6)	r 85 (5.5)	r 69 (5.1)	r 70 (6.7)	r 78 (4.9)	83 (4.4)
North Carolina	r 97 (3.2)	97 (3.1)	r 82 (6.1)	r 88 (5.5)	r 77 (6.8)	r 76 (6.7)	73 (6.1)	78 (6.4)
Oregon	98 (1.3)	96 (2.7)	r 81 (5.1)	r 86 (4.9)	r 57 (5.9)	r 63 (6.0)	r 74 (6.2)	80 (5.9)
Pennsylvania	r 85 (3.4)	r 85 (3.9)	r 74 (6.4)	r 73 (6.4)	s 49 (8.1)	s 56 (7.8)	s 67 (6.6)	61 (5.9)
South Carolina	97 (1.8)	98 (1.1)	r 87 (3.4)	r 93 (2.7)	r 79 (4.6)	r 82 (4.6)	r 85 (4.5)	76 (6.0)
Texas	r 96 (2.4)	r 98 (1.3)	s 82 (4.8)	s 87 (5.5)	s 78 (7.1)	s 77 (5.5)	s 77 (4.8)	79 (5.5)
Districts and Consortia								
Academy School Dist. #20, CO	100 (0.0)	86 (0.2)	100 (0.0)	91 (0.1)	41 (0.4)	38 (0.4)	r 47 (0.4)	69 (0.4)
Chicago Public Schools, IL	r 86 (7.3)	r 86 (7.3)	r 87 (7.4)	r 83 (8.5)	r 66 (10.8)	r 69 (10.4)	r 73 (10.0)	84 (8.1)
Delaware Science Coalition, DE	s 99 (0.4)	s 91 (4.8)	s 77 (7.3)	s 94 (3.2)	s 55 (7.2)	s 89 (5.0)	s 68 (6.7)	83 (2.6)
First in the World Consort., IL	100 (0.0)	98 (2.2)	94 (1.9)	86 (7.8)	69 (3.1)	69 (3.1)	92 (0.8)	87 (1.5)
Fremont/Lincoln/WestSide PS, NE	r 99 (0.6)	r 100 (0.3)	r 73 (3.2)	r 78 (8.1)	s 65 (10.1)	r 61 (6.0)	r 86 (3.7)	91 (1.4)
Guilford County, NC	r 97 (1.1)	95 (2.3)	r 94 (2.2)	r 97 (2.2)	s 89 (4.9)	r 95 (3.6)	95 (2.3)	87 (4.6)
Jersey City Public Schools, NJ	r 98 (0.3)	r 93 (0.7)	r 100 (0.0)	r 100 (0.0)	s 48 (5.0)	r 55 (4.5)	r 69 (4.2)	100 (0.0)
Miami-Dade County PS, FL	s 99 (1.2)	s 96 (2.5)	s 92 (2.6)	s 90 (4.0)	s 76 (6.4)	s 67 (7.9)	s 78 (6.7)	82 (4.3)
Michigan Invitational Group, MI	r 97 (0.4)	r 96 (0.4)	r 79 (1.6)	r 86 (3.4)	r 69 (2.4)	r 56 (6.6)	r 80 (2.6)	89 (1.9)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	100 (0.0)	100 (0.0)	89 (0.4)	36 (4.3)	19 (3.5)	44 (3.3)	90 (2.9)
Project SMART Consortium, OH	r 95 (2.6)	r 82 (3.7)	r 93 (1.5)	r 84 (2.3)	r 75 (3.5)	r 78 (3.1)	r 76 (3.0)	81 (2.8)
Rochester City Sch. Dist., NY	r 86 (4.7)	r 100 (0.4)	r 83 (5.4)	r 60 (4.8)	r 22 (3.8)	r 28 (5.6)	r 57 (6.8)	74 (7.4)
SW Math/Sci. Collaborative, PA	96 (2.6)	93 (3.0)	r 79 (7.3)	80 (6.9)	r 44 (8.7)	r 53 (6.9)	r 62 (6.3)	72 (9.0)
International Avg. (All Countries)	91 (0.4)	71 (0.6)	75 (0.5)	83 (0.5)	52 (0.6)	68 (0.6)	67 (0.6)	65 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An “r” indicates teacher response data available for 70-84% of students. An “s” indicates teacher response data available for 50-69% of students. An “x” indicates teacher response data available for <50% of students.

Exhibit 5.23 Percentages of Students Taught Chemistry Topics*

8th Grade Science

		Classification of matter (elements, compounds, solutions, mixtures)		Structure of matter (atoms, ions, molecules, crystals)		Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)		Energy and chemical change (exothermic and endothermic reactions, reaction rates)
Countries								
United States	r	88 (2.2)	r	88 (2.6)	r	76 (3.4)	r	66 (3.9)
Belgium (Flemish)	s	13 (2.9)	s	8 (2.6)	s	8 (3.0)	s	4 (1.9)
Canada	r	80 (2.3)	s	63 (3.1)	s	54 (4.2)	s	36 (3.6)
Chinese Taipei		100 (0.0)		97 (1.4)		100 (0.0)		84 (2.9)
Czech Republic		100 (0.0)		100 (0.0)		92 (3.0)		53 (5.3)
England	s	98 (1.7)	s	84 (4.1)	s	94 (2.1)	s	73 (4.7)
Hong Kong, SAR		90 (2.7)	r	66 (4.6)	r	57 (5.0)	r	71 (4.8)
Italy		95 (1.8)		91 (2.0)		78 (3.6)		58 (4.0)
Japan		99 (1.2)		75 (3.6)		96 (1.7)		46 (4.2)
Korea, Rep. of		99 (0.8)		97 (1.4)		91 (2.3)		51 (3.8)
Netherlands	r	99 (1.0)	r	99 (0.9)	r	99 (0.9)	r	99 (0.8)
Russian Federation		– –		– –		– –		– –
Singapore		98 (1.3)		93 (2.5)	r	89 (2.9)		x x
States								
Connecticut	s	80 (6.4)	s	81 (6.2)	s	70 (7.6)	s	67 (6.8)
Idaho	s	85 (6.7)	s	85 (6.7)	s	73 (6.9)	s	64 (7.5)
Illinois	r	90 (4.2)	r	91 (3.9)	r	78 (5.2)	r	71 (4.6)
Indiana	r	91 (4.2)	r	88 (4.7)	r	84 (5.1)	r	71 (6.6)
Maryland	r	92 (3.4)	r	91 (3.2)	s	85 (4.5)	s	73 (4.7)
Massachusetts	r	94 (2.7)	r	86 (3.4)	r	76 (5.4)	r	61 (6.8)
Michigan	r	90 (5.1)	r	89 (5.2)	r	78 (6.3)	r	78 (6.5)
Missouri	r	92 (3.0)	r	87 (4.8)	r	69 (7.0)	r	56 (7.6)
North Carolina	r	87 (4.6)		91 (4.1)		84 (5.0)	r	73 (5.3)
Oregon		95 (2.5)		92 (3.3)	r	88 (3.6)	r	81 (4.6)
Pennsylvania	r	91 (3.3)	r	91 (3.3)	s	69 (6.2)	r	58 (7.0)
South Carolina		97 (1.5)		96 (1.7)	r	83 (4.4)	r	70 (5.2)
Texas	r	92 (3.0)	r	93 (3.3)	s	81 (5.3)	s	72 (6.0)
Districts and Consortia								
Academy School Dist. #20, CO		86 (0.2)		86 (0.2)		86 (0.2)		86 (0.2)
Chicago Public Schools, IL	r	81 (9.3)	r	79 (9.7)	r	76 (9.4)	r	66 (11.4)
Delaware Science Coalition, DE		x x	s	97 (2.7)		x x		x x
First in the World Consort., IL		100 (0.0)		100 (0.0)		93 (0.7)		91 (1.8)
Fremont/Lincoln/WestSide PS, NE	r	86 (8.3)	r	94 (2.8)	s	61 (7.8)	s	46 (7.1)
Guilford County, NC		94 (2.8)		94 (2.8)		79 (4.7)		83 (5.1)
Jersey City Public Schools, NJ	r	98 (0.2)	r	97 (0.3)	r	75 (2.5)	s	57 (4.1)
Miami-Dade County PS, FL	s	97 (1.0)	s	97 (1.7)	s	93 (2.8)	s	95 (3.0)
Michigan Invitational Group, MI	r	95 (0.7)	r	95 (0.7)	r	83 (2.5)	r	73 (4.2)
Montgomery County, MD		x x		x x		x x		x x
Naperville Sch. Dist. #203, IL		100 (0.0)		100 (0.0)		100 (0.0)		79 (3.6)
Project SMART Consortium, OH	r	82 (3.5)	r	86 (3.5)	r	75 (4.2)	r	58 (4.5)
Rochester City Sch. Dist., NY	r	100 (0.4)	r	100 (0.4)	r	72 (6.1)	r	68 (6.6)
SW Math/Sci. Collaborative, PA	r	94 (3.5)		92 (3.8)	r	65 (7.0)	r	64 (5.5)
International Avg. (All Countries)		90 (0.3)		84 (0.4)		76 (0.6)		58 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.24 Percentages of Students Taught Environmental and Resource Issues Topics*

8th Grade Science

	Pollution (acid rain, global warming, ozone layer, water pollution)	Conservation of natural resources (land, water forests, energy sources)	Food supply and production, population, and environmental effects of natural and man-made events
Countries			
United States	r 83 (2.4)	r 79 (2.5)	s 81 (2.9)
Belgium (Flemish)	r 89 (3.3)	r 82 (3.7)	r 63 (4.3)
Canada	s 92 (1.4)	s 90 (2.2)	s 83 (2.9)
Chinese Taipei	r 73 (3.5)	r 48 (4.4)	r 41 (4.7)
Czech Republic	92 (2.6)	92 (2.5)	82 (4.1)
England	s 79 (4.5)	s 71 (5.1)	s 71 (4.6)
Hong Kong, SAR	74 (4.3)	r 54 (5.3)	r 30 (4.7)
Italy	84 (2.6)	80 (2.8)	70 (3.4)
Japan	26 (3.4)	7 (2.4)	7 (2.4)
Korea, Rep. of	75 (3.8)	58 (4.5)	49 (4.4)
Netherlands	99 (1.0)	98 (1.0)	r 98 (1.1)
Russian Federation	– –	– –	– –
Singapore	93 (2.4)	r 86 (3.5)	s 64 (5.0)
States			
Connecticut	s 91 (4.4)	s 87 (5.5)	x x
Idaho	s 65 (7.5)	s 64 (6.6)	s 55 (8.3)
Illinois	r 86 (3.7)	r 81 (4.7)	r 88 (3.6)
Indiana	s 87 (4.3)	s 82 (5.1)	s 76 (5.5)
Maryland	s 84 (5.7)	s 82 (4.8)	s 82 (5.4)
Massachusetts	r 93 (2.2)	r 88 (3.2)	s 87 (3.9)
Michigan	r 92 (3.2)	r 84 (4.8)	s 90 (4.2)
Missouri	r 90 (3.3)	r 91 (3.0)	r 90 (3.6)
North Carolina	r 76 (5.8)	r 78 (5.8)	r 77 (5.2)
Oregon	r 84 (5.7)	r 84 (5.3)	r 84 (5.9)
Pennsylvania	r 77 (5.9)	r 74 (6.3)	r 75 (6.1)
South Carolina	r 93 (2.7)	r 94 (2.1)	r 90 (3.4)
Texas	r 90 (2.9)	r 88 (3.2)	s 85 (4.7)
Districts and Consortia			
Academy School Dist. #20, CO	s 100 (0.0)	s 100 (0.0)	s 100 (0.0)
Chicago Public Schools, IL	r 65 (11.2)	r 53 (12.5)	r 63 (11.7)
Delaware Science Coalition, DE	s 79 (6.0)	s 66 (5.2)	s 56 (5.6)
First in the World Consort., IL	95 (2.5)	100 (0.0)	100 (0.0)
Fremont/Lincoln/WestSide PS, NE	s 81 (6.5)	s 76 (6.2)	r 73 (5.4)
Guilford County, NC	r 66 (4.1)	r 90 (2.7)	r 74 (4.5)
Jersey City Public Schools, NJ	r 100 (0.0)	r 98 (0.2)	r 90 (0.9)
Miami-Dade County PS, FL	s 82 (6.7)	s 83 (7.0)	s 81 (6.6)
Michigan Invitational Group, MI	s 80 (4.0)	s 84 (3.9)	r 83 (3.5)
Montgomery County, MD	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	89 (3.9)	r 77 (3.4)
Project SMART Consortium, OH	r 89 (2.1)	r 90 (1.7)	r 91 (1.6)
Rochester City Sch. Dist., NY	r 46 (4.5)	s 33 (6.3)	s 36 (7.1)
SW Math/Sci. Collaborative, PA	r 85 (6.8)	r 93 (4.3)	s 87 (5.4)
International Avg. (All Countries)	78 (0.6)	76 (0.6)	66 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 5.25 Percentages of Students Taught Scientific Inquiry and the Nature of Science Topics*

	Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	Experimental design (experimental control, materials, and procedures)	Scientific measurements (reliability, replication, experimental error, accuracy, scales)	Using scientific apparatus and conducting routine experimental operations	Gathering, organizing, and representing data (units, tables, charts, graphs)	Describing and interpreting data
Countries						
United States	r 99 (0.6)	r 97 (1.2)	r 89 (2.5)	r 95 (1.4)	r 97 (1.4)	r 98 (1.1)
Belgium (Flemish)	r 86 (3.8)	r 46 (4.6)	r 64 (4.6)	r 66 (4.9)	r 91 (2.8)	r 90 (3.2)
Canada	r 99 (0.5)	r 97 (1.7)	s 84 (2.8)	r 99 (0.8)	r 100 (0.2)	r 99 (0.7)
Chinese Taipei	85 (3.2)	71 (4.0)	83 (3.3)	90 (2.7)	68 (4.0)	69 (3.9)
Czech Republic	r 79 (4.4)	r 73 (4.9)	r 81 (4.4)	r 80 (4.8)	r 86 (3.7)	r 81 (4.8)
England	s 96 (1.6)	s 95 (1.9)	s 92 (2.2)	s 98 (0.9)	s 98 (0.8)	s 98 (0.9)
Hong Kong, SAR	85 (3.4)	68 (4.5)	63 (4.8)	88 (3.1)	81 (3.4)	r 80 (3.3)
Italy	100 (0.0)	94 (1.8)	84 (3.1)	84 (3.2)	95 (1.7)	94 (1.8)
Japan	90 (2.6)	96 (1.8)	77 (3.4)	99 (1.0)	97 (1.6)	95 (1.9)
Korea, Rep. of	93 (2.1)	89 (2.6)	84 (3.1)	99 (0.7)	92 (2.1)	86 (2.9)
Netherlands	92 (3.7)	96 (3.0)	99 (0.7)	100 (0.0)	100 (0.0)	100 (0.0)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	94 (2.2)	r 93 (2.6)	r 91 (3.0)	97 (1.7)	95 (2.1)	96 (1.9)
States						
Connecticut	s 99 (0.8)	s 100 (0.0)	s 89 (5.8)	s 100 (0.0)	s 100 (0.0)	s 100 (0.0)
Idaho	s 99 (0.6)	s 96 (2.3)	s 94 (3.2)	s 97 (1.6)	s 99 (0.6)	s 100 (0.2)
Illinois	98 (2.1)	r 98 (1.0)	r 92 (1.8)	94 (3.4)	97 (2.0)	98 (1.9)
Indiana	100 (0.0)	r 97 (1.5)	r 96 (2.6)	r 100 (0.0)	r 98 (2.0)	r 98 (2.0)
Maryland	r 100 (0.1)	r 100 (0.1)	r 98 (1.4)	r 98 (1.4)	r 99 (0.8)	r 100 (0.1)
Massachusetts	r 100 (0.2)	r 97 (1.7)	r 94 (2.6)	r 99 (0.6)	r 98 (1.7)	r 100 (0.0)
Michigan	r 100 (0.5)	r 99 (0.5)	r 94 (3.3)	r 94 (3.8)	r 100 (0.0)	r 100 (0.0)
Missouri	r 99 (0.8)	r 97 (2.7)	r 88 (4.2)	r 93 (3.7)	r 100 (0.1)	r 100 (0.1)
North Carolina	96 (3.2)	91 (3.7)	r 88 (4.3)	r 93 (3.3)	96 (3.2)	96 (3.2)
Oregon	100 (0.0)	97 (1.9)	93 (2.9)	100 (0.4)	98 (1.4)	99 (1.3)
Pennsylvania	100 (0.0)	97 (1.9)	r 91 (2.0)	r 94 (1.5)	100 (0.2)	100 (0.2)
South Carolina	99 (0.4)	r 98 (1.4)	r 93 (2.5)	97 (1.9)	r 100 (0.0)	100 (0.0)
Texas	r 100 (0.2)	r 97 (2.5)	r 96 (2.8)	r 100 (0.3)	r 100 (0.2)	r 100 (0.2)
Districts and Consortia						
Academy School Dist. #20, CO	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Chicago Public Schools, IL	r 100 (0.0)	r 94 (5.7)	r 89 (7.9)	r 94 (5.7)	r 96 (4.0)	r 100 (0.0)
Delaware Science Coalition, DE	s 100 (0.0)	s 100 (0.0)	s 91 (4.4)	s 98 (0.4)	r 100 (0.0)	r 100 (0.0)
First in the World Consort., IL	99 (0.8)	99 (0.8)	99 (0.8)	99 (0.8)	99 (0.8)	99 (0.8)
Fremont/Lincoln/WestSide PS, NE	r 100 (0.0)	r 99 (0.6)	r 94 (5.9)	r 98 (0.6)	100 (0.0)	100 (0.0)
Guilford County, NC	r 99 (0.0)	r 94 (0.9)	r 94 (0.9)	r 97 (2.7)	r 100 (0.0)	r 100 (0.0)
Jersey City Public Schools, NJ	r 100 (0.0)	r 100 (0.0)	r 80 (4.1)	r 96 (0.4)	r 100 (0.0)	r 100 (0.0)
Miami-Dade County PS, FL	s 100 (0.0)	s 99 (0.7)	s 100 (0.2)	s 99 (0.7)	s 100 (0.0)	s 100 (0.0)
Michigan Invitational Group, MI	r 100 (0.0)	r 98 (0.1)	r 97 (0.1)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
Project SMART Consortium, OH	r 100 (0.0)	r 95 (2.6)	r 99 (0.1)	r 98 (2.2)	r 100 (0.0)	r 100 (0.0)
Rochester City Sch. Dist., NY	r 100 (0.0)	r 100 (0.0)	r 72 (5.0)	s 100 (0.0)	r 98 (2.4)	r 98 (2.4)
SW Math/Sci. Collaborative, PA	100 (0.0)	95 (4.3)	r 92 (6.1)	99 (0.9)	100 (0.0)	100 (0.0)
International Avg. (All Countries)	88 (0.5)	84 (0.6)	75 (0.7)	87 (0.5)	87 (0.5)	87 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Taught before or during this school year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

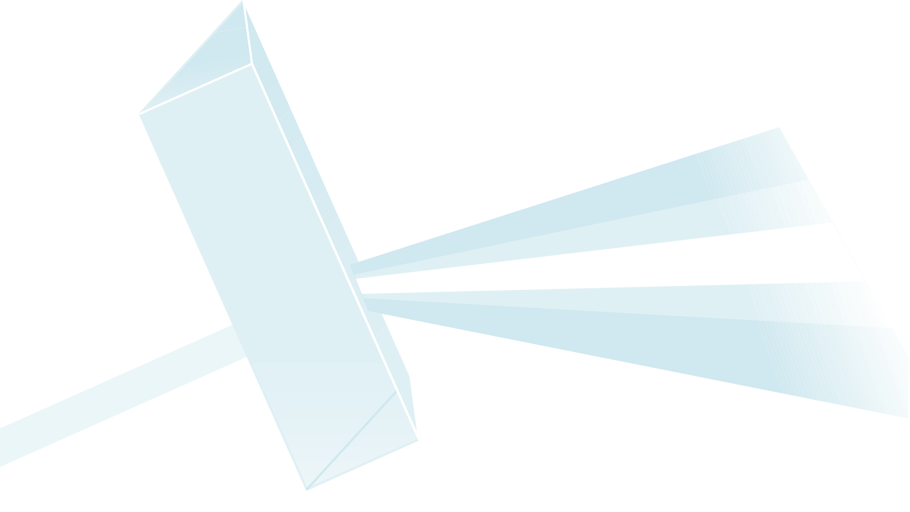
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

What Can Be Learned About the Science Curriculum?

In contrast to the United States, most countries around the world have well-established, centrally-mandated national curricula. Recently, however, states and districts in the U.S. have been making great strides in establishing content standards and curriculum frameworks to guide curriculum implementation in schools. Furthermore, many education systems in the U.S. have begun to assess whether the intended curriculum in science is being attained or learned by their students. Thoroughly examining the Benchmarking jurisdictions' results in an international context can provide insights into what students are expected to learn in science, what is taught in classrooms, and what policies and practices provide the best match between the intended and the implemented curriculum to improve student achievement.

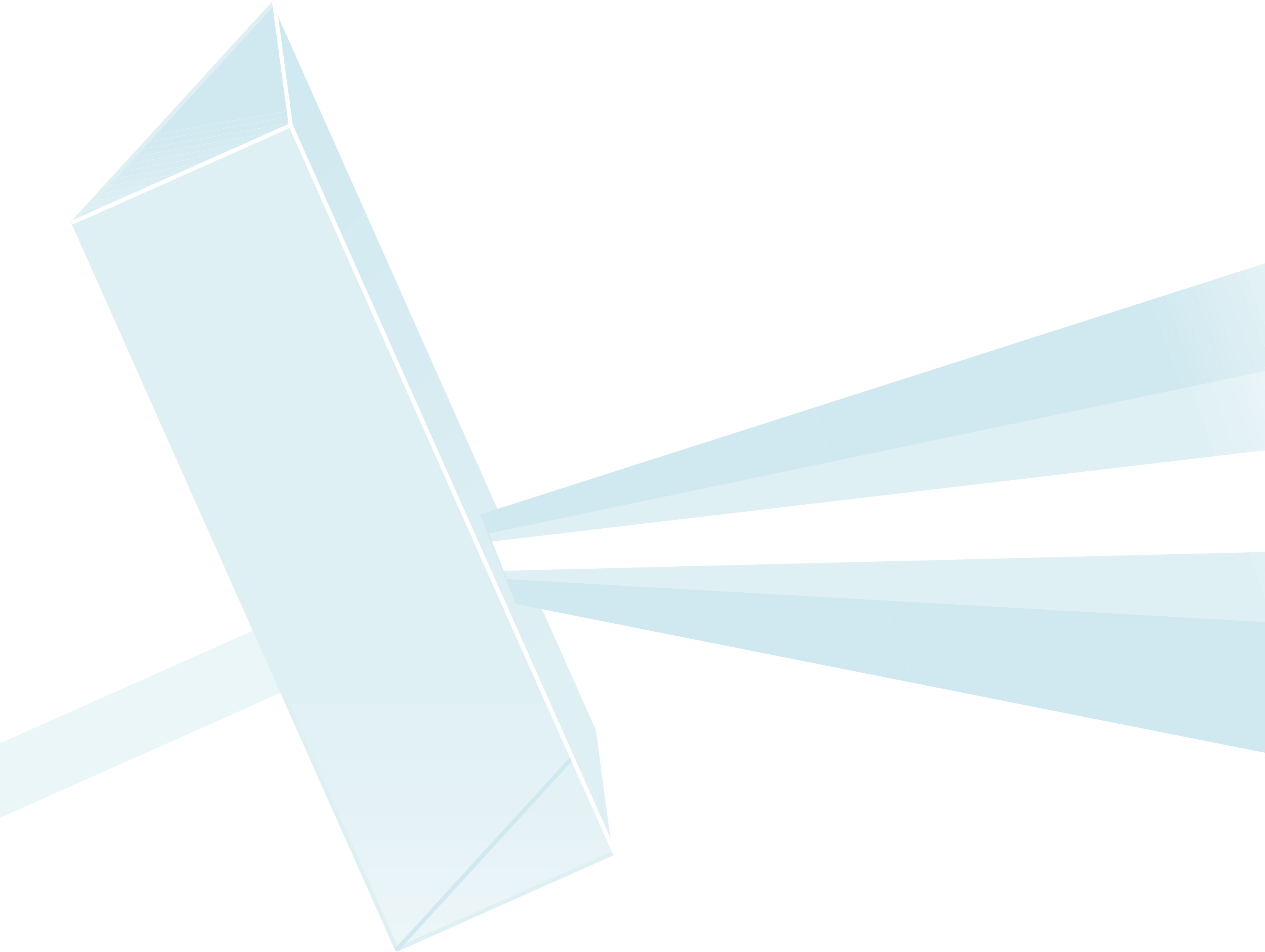


CHAPTER 6

Teachers and Instruction

Chapter 6 presents information about science teachers and instruction. Teachers' reports are given on their educational background, teaching preparation, and instructional practices. Information is also provided about how teachers spend their time related to teaching tasks, the materials used in instruction, the activities students do in class, the use of computers in science lessons, the role of homework, and the reliance on different types of assessment.

6



Teachers of science design and manage the learning environments that provide students with the opportunity needed to learn science. They structure the content and pace of lessons, introducing new material, selecting various instructional activities, and monitoring students' developing understanding of the concepts studied. Teachers may help students use technology and tools to investigate scientific ideas, analyze students' work for misconceptions, and promote positive attitudes towards science. They may also assign homework and conduct formal and informal assessments to evaluate achievement. To collect information about science instruction, TIMSS administered a questionnaire to teachers asking them about some of these issues.

Because the sampling for the teacher questionnaires was based on participating students, teachers' responses do not necessarily represent all eighth-grade science teachers in each participating entity. Rather, they represent teachers of the representative samples of students assessed. It is important to note that when information from the teacher questionnaire is reported, the student is always the unit of analysis. That is, the data shown are the percentages of *students* whose teachers reported on various characteristics or instructional strategies. Using the student as the unit of analysis makes it possible to describe the science instruction received by representative samples of students. Although this perspective may differ from that obtained by simply collecting information from teachers, it is consistent with the TIMSS goals of examining the educational contexts and performance of students.

The teachers who completed the questionnaires were the science teachers of the students who took the TIMSS 1999 test. The general sampling procedure was to sample a mathematics class from each participating school, administer the test to those students, and ask both their mathematics and science teachers to complete a background questionnaire. Thus, the information about instruction is tied directly to the students tested and the specific science classes in which they were taught. In countries where students had separate teachers for the science subjects, all science teachers of the students in the sampled mathematics classes were asked to complete questionnaires. Sometimes, however, teachers did not complete the questionnaire assigned to them, so most entities had some percentage of students for whom no teacher questionnaire information is available. The exhibits in this chapter have special notations on this point. For a TIMSS 1999 participating entity (country, state, district, or consortium) where teacher responses are available for 70 to 84 percent of the students, an "r" is included next to the data. Where teacher responses are available for 50 to 69 percent of students, an "s" is included; where they are available for less than 50 percent, an "x" replaces the data.

What Preparation Do Teachers Have for Teaching Science?

This section provides information about background characteristics of science teachers, including age and gender, major area of study, and certification. Teachers' confidence in teaching various science topics is also discussed.

As shown by the international average at the bottom of Exhibit 6.1, 61 percent of eighth-grade students internationally were taught by teachers between the ages of 30 and 49, 21 percent by teachers age 50 or older, and only 19 percent by teachers younger than age 30. In comparison, the United States had a relatively older teaching force, with 32 percent of students taught by teachers age 50 or older.

Most Benchmarking participants did not differ substantially from the international profile. However, Idaho, Oregon, the Chicago Public Schools, the First in the World Consortium, the Fremont/Lincoln/Westside Public Schools, and the Michigan Invitational Group had less than 10 percent of their students taught by teachers in their 20s. Similarly, Connecticut, Idaho, Massachusetts, Oregon, Chicago, the Fremont/Lincoln/Westside Public Schools, the Jersey City Public Schools, the Michigan Invitational Group, and the Southwest Pennsylvania Math and Science Collaborative had 65 percent or more of their students taught by teachers age 40 or older, compared with 51 percent internationally and 61 percent in the United States. On the other hand, the teachers in the Delaware Science Coalition were younger than the international average – 69 percent of the students had teachers under age 40 compared with 50 percent internationally.

Internationally on average, 58 percent of eighth-grade students had female science teachers, and 42 percent had male. However, in the United States and in Canada, Chinese Taipei, England, Hong Kong, Japan, and the Netherlands, the majority of students were taught science by male teachers. The Benchmarking participants varied quite considerably, with South Carolina, Chicago, and Jersey City having more than three-fourths of their students taught by female science teachers, and Oregon, the Fremont/Lincoln/Westside Public Schools, the Project SMART Consortium, and the Southwest Pennsylvania Math and Science Collaborative having more than 60 percent of their students taught by male science teachers.

Exhibit 6.2 presents teachers' reports about their major areas of study during their post-secondary teacher preparation programs. Teachers' undergraduate and graduate studies give some indication of their preparation to teach science. Also, research shows that higher achievement in science is associated with teachers having a bachelor's and/or master's degree in science.[1] According to their teachers, however, U.S. eighth-grade students were less likely than those in other countries to be taught science by teachers with a major area of study in science.

In countries such as the United States that offer eighth-grade science as a single general subject, 42 percent of students on average internationally were in a science class taught by a teacher whose major area of study was biology, 23 percent physics, 30 percent chemistry, 44 percent science education, 25 percent mathematics or mathematics education, and 30 percent general education. (Note that teachers can have dual majors, or different majors at the undergraduate and graduate level.) The United States was similar to the international profile, although with somewhat fewer students taught by physics and chemistry teachers and considerably more taught by teachers with a major in general education or some other area.

Among Benchmarking participants, in almost every jurisdiction the majority of students were in science classes in which the teacher's major area was science education or general education. In addition, in eight of the jurisdictions – Connecticut, Idaho, Illinois, Missouri, the Academy School District, the Delaware Science Coalition, the First in the World Consortium, the Miami-Dade County Public Schools, and the Michigan Invitational Group – the majority of students had science teachers with a major in some other non-science subject. More than half the students in Maryland, Massachusetts, Missouri, Oregon, Texas, the Academy School District, First in the World, the Fremont/Lincoln/Westside Public Schools, Naperville, and Rochester were taught science by teachers with a major in biology. Teachers with a major in physics or chemistry were rare; only in the Academy School District, Naperville, and Project SMART were more than 30 percent of students taught by such teachers.

In countries such as Belgium (Flemish), Chinese Taipei, the Czech Republic, the Netherlands, and the Russian Federation, where the science subjects are taught as separate courses, typically greater percentages of students were taught science by teachers with a major in the area they were teaching. On average across all the TIMSS 1999 separate-science countries, 85 percent of students were taught biology by teachers with a major in biology, 75 percent were taught physics by a physics major, and 87 percent were taught chemistry by a chemistry major.

---

[1] Goldhaber, D.D. and Brewer, D.J. (1997), "Evaluating the Effect of Teacher Degree Level on Educational Performance" in W. Fowler (ed.), *Developments in School Finance, 1996*, NCES 97-535, Washington DC: National Center for Education Statistics; Darling-Hammond, L. (2000), *Teacher Quality and Student Achievement: A Review of State Policy Evidence*, Education Policy Analysis Archives, 8(1).

To gauge teachers' confidence in their ability to teach science topics, TIMSS constructed an index of teachers' confidence in their preparation to teach science (CPTS), presented in Exhibit 6.3. Teachers were asked how well prepared they felt to teach each of 10 science topics (e.g., earth's features and physical processes, chemical reactivity and transformation). There were three possible responses: very well prepared was assigned a value of three, somewhat prepared two, and not well prepared one. Students were assigned to the high level of the index if their teachers reported feeling very well prepared, on average, across the 10 topics (2.75 or higher). The medium level indicates that teachers reported being somewhat to well prepared (averages from 2.25 to 2.75), and the low level that they felt only somewhat prepared or less (averages less than 2.25). Because in some countries teachers specialize in separate science subjects, they could answer that they did not teach some of the topics. In computing the index value, topics that a teacher did not teach were excluded from the average.

In general, teachers reported only moderate confidence in their preparation to teach science, with just 20 percent of students, on average internationally, taught by teachers who believed they were very well prepared and another 41 percent by teachers somewhat to well prepared. On average across countries, 39 percent of students had teachers with a low level of confidence, and in three of the highest-performing countries, Hong Kong, Japan, and Korea, more than half the students had teachers who felt only somewhat prepared or less. In the United States, science teachers generally reported greater confidence in their preparation than did their peers in other countries, with only the Czech Republic reporting greater confidence among the comparison countries. Despite this, however, teachers in the U.S. overall and in many Benchmarking entities generally expressed much less confidence in their preparation to teach eighth-grade science than mathematics. In the U.S. as a whole, 87 percent of the students had teachers who reported a high level of confidence in their preparation to teach mathematics,[2] compared with 27 percent for science. This figure for science ranged from 56 percent in the Academy School District to 14 percent in the Delaware Science Coalition across the Benchmarking entities, with half of them exceeding the national average. Teachers in a number of the lower-scoring jurisdictions reported relatively high levels of confidence in their preparation, possibly because they are teaching a science curriculum that is not very demanding.

Exhibit R3.1 in the reference section provides the detail for the 10 topics comprising the confidence in preparation index. Teachers were most confident in their preparation to teach biology topics, with more than 50 percent of students, on average internationally, having teachers who

[2] Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., O'Connor, K.M., Chrostowski, S.J., Gregory, K.D., Garden, R.A., and Smith, T.A. (2001), *Mathematics Benchmarking Report, TIMSS 1999 – Eighth Grade: Achievement for U.S. States and Districts in an International Context*, Chestnut Hill, MA: Boston College.

reported feeling very well prepared to teach these topics. Teachers had less confidence in their preparation to teach earth science topics, particularly the solar system and the universe. Between 45 and 51 percent of students across countries had teachers who reported feeling very well prepared to teach chemistry or physics topics, compared with 39 percent for environmental and resource issues and 34 percent for scientific methods and inquiry skills. Teachers in the United States overall expressed greater than average confidence in their preparation to teach topics in earth science, environmental and resource issues, and scientific methods and inquiry skills. The Benchmarking participants generally followed the pattern for the United States.

Exhibit R3.2 shows principals' opinions about the degree to which shortages of qualified science teachers affect the capacity to provide instruction. On average internationally, principals reported that such shortages affect the quality of instruction some or a lot for 35 percent of students in countries with general/integrated science, and for somewhat fewer in the separate-science countries. In the United States, and among Benchmarking participants generally, relatively few students were in schools where such shortages affected instructional capacity. In Idaho, Illinois, Massachusetts, Oregon, and Pennsylvania, less than 10 percent of students were in schools with science teacher shortages, and in the Academy School District, the First in the World Consortium, the Fremont/Lincoln/Westside Public Schools, and Naperville, no students at all were reported to be in such schools. In the Michigan Invitational Group, however, 40 percent of students were in schools with science teacher shortages.

Teachers' beliefs about science learning and instruction are to some degree related to their preparation. Exhibits R3.3 and R3.4 in the reference section show the percentages of eighth-grade students whose science teachers reported certain beliefs about science, the way science should be taught, and the importance of various abilities in achieving success in the discipline. In general, teachers revealed a fairly practical view of science. Across countries and Benchmarking entities, there was substantial agreement that science is primarily a practical and structured guide for addressing real situations, and that it is important for teachers to give students prescriptive and sequential directions for doing science experiments. Also across Benchmarking entities but less so across the comparison countries, there was substantial agreement that science is primarily a formal way of representing the real world. Benchmarking entities were less in agreement that some students have a natural talent for science and others do not. Teachers also generally agreed that all of the skills shown in Exhibit R3.4 (thinking in a sequential and procedural manner, being able to think creatively, understanding how science is used in the real world, and being able to provide reasons to support conclusions) are very important for students' success in science.

How teachers spend their time in school is determined mainly by school and district policies and practices, but the perspectives they gain during their teacher preparation can also have an effect. Across countries, students' science teachers spent only 58 percent of their formally scheduled school time teaching science, and 71 percent of their time teaching altogether (see Exhibit R3.5 in the reference section). Additionally, 10 percent was spent on curriculum planning, and about 20 percent on various administrative and other duties. The results for the United States as a whole and for most of the Benchmarking entities were very similar to the international profile.

Exhibit 6.1 Age and Gender of Teachers

8th Grade Science

	Percentage of Students by Age of Teachers				Percentage of Students by Gender of Teachers	
	29 Years or Under	30-39 Years	40-49 Years	50 Years or Older	Female	Male
Countries						
United States	r 20 (2.6)	19 (2.2)	29 (2.8)	32 (2.7)	r 48 (3.5)	52 (3.5)
Belgium (Flemish)	25 (2.8)	24 (3.1)	34 (3.5)	17 (2.5)	64 (3.9)	36 (3.9)
Canada	21 (3.1)	31 (2.6)	31 (2.9)	18 (2.6)	41 (3.3)	59 (3.3)
Chinese Taipei	17 (3.0)	40 (3.9)	32 (3.7)	11 (2.6)	40 (3.7)	60 (3.7)
Czech Republic	12 (1.8)	20 (2.0)	21 (2.2)	47 (3.1)	74 (2.4)	26 (2.4)
England	s 24 (4.0)	23 (3.6)	31 (4.0)	22 (3.4)	s 43 (4.3)	57 (4.3)
Hong Kong, SAR	34 (4.3)	38 (4.6)	19 (3.6)	9 (2.7)	39 (4.2)	61 (4.2)
Italy	0 (0.0)	8 (2.0)	58 (4.1)	34 (3.8)	76 (3.1)	24 (3.1)
Japan	15 (3.1)	43 (4.2)	28 (3.8)	15 (2.8)	21 (3.6)	79 (3.6)
Korea, Rep. of	17 (2.6)	49 (3.4)	22 (3.3)	12 (2.6)	59 (3.3)	41 (3.3)
Netherlands	19 (2.9)	23 (3.3)	34 (3.8)	25 (3.2)	20 (2.6)	80 (2.6)
Russian Federation	19 (1.7)	27 (1.6)	27 (1.7)	28 (2.0)	88 (1.2)	12 (1.2)
Singapore	25 (4.1)	22 (3.7)	26 (4.1)	26 (3.5)	68 (3.4)	32 (3.4)
States						
Connecticut	s 12 (4.1)	10 (2.9)	31 (7.7)	46 (7.7)	s 47 (7.5)	53 (7.5)
Idaho	r 9 (3.3)	14 (3.4)	44 (7.4)	33 (6.9)	r 44 (6.1)	56 (6.1)
Illinois	15 (5.7)	29 (7.1)	29 (4.8)	28 (6.3)	58 (6.5)	42 (6.5)
Indiana	22 (7.4)	18 (5.0)	35 (7.0)	25 (5.1)	53 (5.7)	47 (5.7)
Maryland	r 21 (4.5)	23 (6.1)	32 (6.8)	24 (5.1)	r 63 (5.7)	37 (5.7)
Massachusetts	13 (3.8)	16 (4.0)	36 (5.2)	36 (5.7)	50 (5.6)	50 (5.6)
Michigan	26 (5.9)	18 (4.2)	22 (4.9)	34 (6.0)	50 (5.4)	50 (5.4)
Missouri	28 (6.5)	21 (5.8)	31 (5.8)	21 (5.6)	67 (5.6)	33 (5.6)
North Carolina	33 (5.0)	22 (4.0)	31 (6.7)	14 (4.8)	60 (6.6)	40 (6.6)
Oregon	5 (2.2)	25 (5.0)	50 (6.4)	20 (3.6)	37 (6.9)	63 (6.9)
Pennsylvania	19 (5.2)	18 (6.7)	32 (5.8)	31 (5.3)	47 (5.6)	53 (5.6)
South Carolina	20 (3.3)	24 (5.7)	30 (5.7)	26 (5.2)	78 (5.8)	22 (5.8)
Texas	r 32 (6.9)	20 (5.6)	24 (6.0)	24 (5.2)	r 70 (6.0)	30 (6.0)
Districts and Consortia						
Academy School Dist. #20, CO	39 (0.4)	12 (0.4)	24 (0.3)	25 (0.3)	53 (0.4)	47 (0.4)
Chicago Public Schools, IL	4 (3.5)	23 (7.2)	49 (9.0)	24 (7.1)	78 (8.7)	22 (8.7)
Delaware Science Coalition, DE	r 38 (6.8)	31 (7.2)	9 (4.0)	22 (5.9)	r 63 (3.4)	37 (3.4)
First in the World Consort., IL	7 (4.8)	26 (8.9)	12 (4.1)	55 (6.7)	42 (5.5)	58 (5.5)
Fremont/Lincoln/WestSide PS, NE	5 (2.7)	26 (6.8)	40 (9.4)	30 (6.6)	39 (7.3)	61 (7.3)
Guilford County, NC	35 (6.7)	16 (3.8)	19 (5.7)	30 (3.6)	67 (4.9)	33 (4.9)
Jersey City Public Schools, NJ	r 28 (3.1)	6 (0.4)	35 (2.0)	32 (2.7)	r 78 (3.3)	22 (3.3)
Miami-Dade County PS, FL	s 18 (5.5)	19 (7.8)	25 (8.8)	37 (8.8)	s 60 (5.8)	40 (5.8)
Michigan Invitational Group, MI	r 9 (5.3)	21 (2.3)	31 (6.4)	40 (3.5)	r 46 (3.0)	54 (3.0)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	10 (3.4)	44 (5.3)	25 (3.7)	21 (1.8)	53 (2.5)	47 (2.5)
Project SMART Consortium, OH	33 (2.6)	19 (4.0)	31 (3.9)	18 (5.3)	29 (3.6)	71 (3.6)
Rochester City Sch. Dist., NY	23 (4.7)	25 (4.3)	43 (6.1)	10 (3.1)	55 (4.4)	45 (4.4)
SW Math/Sci. Collaborative, PA	13 (4.4)	22 (6.1)	22 (6.1)	43 (8.1)	33 (6.2)	67 (6.2)
International Avg. (All Countries)	19 (0.5)	31 (0.5)	30 (0.5)	21 (0.4)	58 (0.6)	42 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 6.2 Teachers' Major Area of Study in Their BA, MA, or Teacher Training Certification Program*

8th Grade Science

General/Integrated Science

G

		Percentage of Students Whose Teachers Reported Having the Major Area of Study						
		Biology	Physics	Chemistry	Science Education	Mathematics or Mathematics Education	Education	Other
Countries	United States	47 (3.5)	13 (2.2)	21 (3.0)	43 (3.7)	14 (2.5)	56 (3.6)	r 45 (3.7)
	Canada	36 (2.8)	8 (1.9)	17 (2.3)	28 (2.9)	11 (1.8)	51 (3.0)	67 (2.8)
	England	s 49 (4.6)	s 47 (3.8)	s 54 (3.8)	s 54 (3.7)	s 25 (3.9)	s 44 (3.6)	s 35 (4.4)
	Hong Kong, SAR	26 (3.9)	15 (3.4)	29 (4.2)	47 (4.4)	33 (4.5)	38 (4.5)	30 (4.1)
	Italy	61 (3.5)	3 (1.4)	5 (1.5)	– –	23 (3.5)	0 (0.0)	16 (3.1)
	Japan	r 31 (4.7)	r 30 (4.5)	r 37 (4.7)	r 44 (5.0)	r 4 (1.8)	r 18 (3.2)	r 22 (4.0)
	Korea, Rep. of	27 (3.5)	24 (3.5)	28 (3.6)	38 (3.9)	1 (0.8)	10 (2.3)	10 (2.2)
	Singapore	48 (4.7)	20 (3.4)	53 (4.5)	46 (4.3)	49 (4.4)	40 (4.3)	r 29 (4.5)
States	Connecticut	s 41 (7.9)	s 5 (2.7)	s 8 (3.0)	s 45 (7.7)	s 5 (2.6)	s 44 (6.9)	s 59 (6.9)
	Idaho	r 42 (6.4)	r 8 (1.8)	r 18 (4.5)	r 50 (8.0)	r 7 (3.2)	r 68 (8.3)	s 58 (8.7)
	Illinois	44 (6.6)	6 (3.0)	11 (3.2)	46 (7.5)	12 (3.4)	65 (7.4)	r 54 (6.0)
	Indiana	47 (7.1)	23 (7.8)	26 (7.5)	65 (7.4)	21 (7.4)	77 (4.9)	42 (6.4)
	Maryland	r 59 (5.7)	r 12 (4.4)	r 18 (5.1)	r 45 (5.6)	r 9 (3.3)	r 65 (4.5)	r 41 (5.9)
	Massachusetts	55 (5.4)	12 (3.9)	23 (5.6)	51 (6.6)	12 (3.0)	50 (6.2)	44 (5.8)
	Michigan	r 43 (6.0)	r 11 (4.3)	r 19 (5.3)	r 51 (6.2)	r 23 (6.1)	r 72 (4.7)	r 46 (5.6)
	Missouri	56 (7.3)	14 (4.8)	24 (5.7)	72 (5.0)	11 (4.6)	72 (5.1)	r 56 (5.4)
	North Carolina	33 (5.7)	7 (3.4)	14 (3.8)	56 (6.6)	23 (4.7)	53 (6.8)	r 43 (6.1)
	Oregon	51 (7.1)	14 (4.5)	28 (6.4)	74 (6.0)	13 (4.4)	58 (6.4)	46 (6.4)
	Pennsylvania	40 (4.4)	9 (2.9)	20 (5.0)	52 (4.5)	5 (2.1)	64 (4.6)	r 41 (7.6)
	South Carolina	38 (4.2)	11 (3.6)	16 (4.0)	56 (5.7)	12 (4.1)	56 (6.3)	36 (5.6)
	Texas	r 59 (7.7)	r 16 (5.1)	r 20 (5.0)	r 35 (5.2)	r 7 (3.1)	r 45 (6.7)	r 44 (7.5)
Districts	Academy School Dist. #20, CO	61 (0.4)	35 (0.4)	39 (0.4)	46 (0.4)	18 (0.2)	69 (0.4)	61 (0.4)
	Chicago Public Schools, IL	21 (9.4)	6 (4.0)	5 (3.5)	19 (9.4)	23 (10.3)	70 (10.8)	r 45 (10.3)
	Delaware Science Coalition, DE	r 29 (4.8)	r 5 (3.4)	r 7 (3.6)	r 56 (7.0)	r 0 (0.0)	r 47 (7.9)	r 57 (8.5)
	First in the World Consort., IL	60 (7.0)	8 (6.0)	24 (4.6)	44 (4.1)	13 (3.8)	70 (7.2)	56 (4.9)
	Fremont/Lincoln/WestSide PS, NE	71 (4.3)	23 (9.2)	23 (7.3)	79 (7.8)	3 (0.1)	54 (7.9)	r 18 (3.9)
	Guilford County, NC	33 (6.6)	13 (4.3)	20 (6.2)	53 (6.6)	25 (5.4)	60 (6.6)	44 (5.4)
	Jersey City Public Schools, NJ	r 34 (2.9)	r 4 (0.4)	r 7 (0.5)	r 26 (3.8)	r 4 (0.4)	r 49 (2.8)	r 47 (3.0)
	Miami-Dade County PS, FL	s 40 (7.4)	s 10 (5.1)	s 28 (8.9)	s 38 (6.8)	s 5 (3.2)	s 35 (7.2)	s 51 (8.0)
	Michigan Invitational Group, MI	43 (6.6)	16 (2.0)	24 (3.5)	63 (5.3)	8 (2.8)	60 (6.3)	r 57 (4.8)
	Montgomery County, MD	s 40 (7.7)	s 7 (5.1)	s 15 (4.9)	s 60 (5.2)	s 14 (4.5)	s 51 (7.7)	s 46 (8.4)
	Naperville Sch. Dist. #203, IL	58 (3.9)	31 (2.4)	39 (4.0)	36 (2.3)	24 (2.0)	61 (3.8)	41 (5.2)
	Project SMART Consortium, OH	39 (2.2)	22 (3.7)	35 (3.5)	73 (4.4)	12 (3.9)	58 (3.3)	39 (5.7)
	Rochester City Sch. Dist., NY	65 (5.6)	3 (1.3)	22 (4.2)	46 (5.8)	3 (1.4)	61 (6.4)	r 33 (6.1)
	SW Math/Sci. Collaborative, PA	36 (5.5)	9 (4.5)	15 (4.2)	50 (7.0)	11 (4.4)	65 (7.3)	r 39 (6.9)
	International Avg. (All General Science Countries)	42 (0.8)	23 (0.7)	30 (0.8)	44 (0.9)	25 (0.7)	30 (0.7)	29 (0.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Countries are classified as having either general/integrated science or separate subject area classes at grade 8. Teachers who responded that they majored in more than one subject are reflected in all categories that apply.

[a] Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Teachers' Major Area of Study in Their BA, MA, or Teacher Training Certification Program*

	Percentage of Students Whose Teachers Reported Having the Major Area of Study						
	Biology	Physics	Chemistry	Science Education	Mathematics or Mathematics Education	Education	Other
Earth Science							
Belgium (Flemish)	66 (5.5)	38 (4.4)	57 (5.6)	45 (4.1)	10 (2.8)	41 (4.2)	85 (3.3)
Chinese Taipei	– –	– –	– –	– –	– –	– –	– –
Czech Republic	25 (5.3)	2 (1.5)	4 (2.0)	33 (5.1)	25 (4.0)	35 (5.6)	90 (3.3)
Netherlands	3 (1.6)	2 (1.2)	1 (0.1)	1 (0.7)	1 (0.1)	4 (1.8)	85 (4.5)
Russian Federation	42 (4.1)	4 (1.8)	15 (2.8)	71 (4.1)	7 (2.7)	74 (4.0)	84 (3.2)
International Avg. (All Separate Science Countries)	28 (1.3)	7 (0.7)	13 (0.9)	39 (1.5)	8 (0.8)	37 (1.5)	79 (1.4)
Biology							
Belgium (Flemish)	78 (4.3)	44 (4.9)	56 (4.7)	45 (4.6)	18 (3.7)	41 (4.9)	74 (4.6)
Chinese Taipei [a]	– –	– –	– –	– –	– –	– –	– –
Czech Republic	94 (2.5)	0 (0.0)	32 (4.5)	53 (5.3)	6 (2.3)	50 (4.8)	63 (5.4)
Netherlands	84 (4.1)	3 (1.3)	7 (3.0)	9 (3.6)	4 (2.2)	3 (2.1)	20 (5.9)
Russian Federation	88 (3.0)	10 (2.3)	53 (3.8)	75 (3.2)	8 (1.9)	77 (3.2)	65 (3.6)
International Avg. (All Separate Science Countries)	85 (0.9)	13 (0.8)	36 (1.0)	43 (1.2)	10 (0.7)	39 (1.0)	45 (1.2)
Physics							
Belgium (Flemish)	49 (6.0)	66 (5.6)	62 (6.2)	51 (6.1)	50 (5.7)	45 (6.1)	63 (6.2)
Chinese Taipei [a]	8 (2.4)	60 (4.3)	64 (4.2)	32 (4.1)	7 (2.2)	36 (4.0)	9 (2.5)
Czech Republic	1 (1.1)	88 (3.6)	14 (3.5)	46 (5.0)	61 (5.6)	41 (4.3)	35 (5.0)
Netherlands [b]	14 (4.7)	39 (5.4)	28 (6.7)	15 (4.7)	32 (5.7)	13 (4.5)	23 (5.4)
Russian Federation	1 (0.8)	88 (3.0)	5 (2.1)	73 (3.9)	53 (4.1)	74 (4.2)	64 (3.4)
International Avg. (All Separate Science Countries)	11 (0.8)	75 (1.0)	34 (1.2)	41 (1.2)	44 (1.1)	41 (1.0)	33 (1.1)
Chemistry							
Belgium (Flemish)	– –	– –	– –	– –	– –	– –	– –
Chinese Taipei	– –	– –	– –	– –	– –	– –	– –
Czech Republic	39 (5.2)	9 (3.0)	91 (3.2)	44 (5.2)	22 (4.2)	40 (5.3)	46 (5.4)
Netherlands	– –	– –	– –	– –	– –	– –	– –
Russian Federation	62 (5.9)	14 (3.1)	81 (4.3)	69 (5.9)	14 (3.1)	71 (5.3)	63 (3.7)
International Avg. (All Separate Science Countries)	45 (1.5)	25 (1.5)	87 (1.0)	46 (1.9)	21 (1.4)	45 (1.6)	37 (1.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.3 Index of Teachers' Confidence in Preparation to Teach Science (CPTS)

Index of Teachers' Confidence in Preparation to Teach Science

Index based on teachers' responses to 10 questions about how prepared they feel to teach different science topics (see reference exhibit R3.1) based on a 3-point scale: 1 = not well prepared; 2 = somewhat prepared; 3 = very well prepared. Average is computed across the 10 items for items for which the teacher did not respond do not teach. High level indicates average is greater than or equal to 2.75. Medium level indicates average is greater than or equal to 2.25 and less than 2.75. Low level indicates average is less than 2.25.

		High CPTS		Medium CPTS		Low CPTS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Academy School Dist. #20, CO		56 (0.4)	552 (3.1)	30 (0.4)	563 (3.9)	14 (0.2)	578 (4.0)
Project SMART Consortium, OH		42 (3.6)	538 (12.4)	46 (4.6)	541 (13.6)	12 (4.1)	520 (9.1)
Connecticut	s	40 (7.5)	541 (14.2)	43 (7.5)	544 (12.3)	17 (4.4)	519 (12.8)
Czech Republic		40 (2.8)	538 (4.8)	46 (2.8)	544 (5.8)	15 (2.4)	533 (6.2)
Michigan Invitational Group, MI		38 (3.7)	562 (4.8)	46 (6.3)	563 (9.2)	16 (4.8)	574 (12.5)
Oregon		35 (6.7)	541 (10.1)	44 (6.4)	529 (8.4)	21 (5.7)	545 (17.0)
Maryland	r	35 (6.2)	499 (12.5)	44 (5.5)	517 (8.5)	21 (5.0)	489 (18.5)
Naperville Sch. Dist. #203, IL		34 (4.9)	586 (5.2)	59 (5.1)	583 (6.1)	7 (1.6)	575 (8.7)
Rochester City Sch. Dist., NY		33 (6.3)	470 (16.8)	47 (5.4)	447 (6.3)	19 (4.4)	445 (18.5)
First in the World Consort., IL		33 (6.1)	575 (14.3)	66 (6.2)	560 (5.6)	1 (0.1)	~ ~
Indiana		33 (6.7)	531 (12.0)	55 (6.5)	548 (8.1)	12 (4.0)	520 (12.3)
Miami-Dade County PS, FL	s	32 (6.3)	436 (15.3)	48 (9.1)	430 (13.8)	20 (7.7)	413 (37.4)
Texas	r	30 (6.7)	497 (19.7)	45 (6.9)	513 (14.3)	25 (6.0)	516 (17.4)
Illinois		28 (6.5)	538 (12.1)	54 (6.4)	524 (7.6)	18 (3.0)	509 (9.4)
Fremont/Lincoln/WestSide PS, NE		28 (6.9)	536 (6.9)	59 (7.5)	489 (10.4)	13 (2.8)	547 (21.6)
United States	r	27 (3.0)	526 (8.7)	55 (3.5)	519 (5.8)	18 (2.5)	511 (9.2)
North Carolina		27 (5.7)	495 (13.7)	40 (5.4)	512 (7.6)	33 (6.1)	514 (9.5)
Massachusetts		27 (4.7)	529 (11.8)	62 (5.1)	542 (8.3)	11 (3.5)	502 (25.1)
Michigan		26 (5.6)	558 (8.0)	58 (5.7)	554 (10.6)	16 (4.1)	562 (8.7)
SW Math/Sci. Collaborative, PA		26 (4.4)	550 (9.7)	50 (5.8)	541 (9.6)	25 (6.5)	541 (15.5)
South Carolina		24 (6.3)	520 (13.3)	45 (5.7)	508 (8.9)	31 (5.1)	512 (14.2)
Missouri		23 (5.3)	531 (16.0)	57 (6.5)	519 (8.4)	20 (4.1)	527 (11.6)
Pennsylvania		23 (4.9)	542 (7.9)	49 (6.0)	517 (6.5)	28 (5.6)	547 (12.4)
Guilford County, NC		21 (4.9)	524 (21.7)	52 (5.6)	536 (13.1)	27 (4.9)	528 (14.5)
Idaho	r	21 (4.8)	521 (14.9)	53 (7.4)	533 (7.4)	27 (6.7)	522 (8.1)
Belgium (Flemish)		20 (2.5)	536 (9.2)	44 (3.2)	542 (4.7)	36 (3.3)	525 (7.1)
Jersey City Public Schools, NJ	r	20 (3.3)	452 (30.9)	39 (2.1)	435 (8.2)	41 (2.6)	448 (16.2)
Netherlands		19 (2.9)	550 (10.4)	45 (3.8)	545 (10.2)	35 (3.5)	543 (7.4)
Singapore		18 (3.3)	568 (14.4)	44 (4.1)	576 (10.4)	38 (4.4)	559 (13.1)
Canada	r	16 (2.4)	542 (5.3)	47 (3.2)	534 (3.6)	37 (2.8)	533 (4.6)
Chicago Public Schools, IL		15 (7.9)	490 (44.7)	60 (9.1)	452 (12.9)	25 (8.3)	427 (18.2)
Chinese Taipei		14 (3.0)	573 (7.9)	46 (4.8)	576 (5.9)	40 (4.5)	559 (6.3)
Delaware Science Coalition, DE	r	14 (5.8)	521 (32.4)	56 (7.2)	494 (10.1)	30 (6.7)	495 (16.8)
Italy		13 (2.8)	487 (11.6)	54 (3.9)	491 (5.6)	33 (3.4)	499 (5.9)
Hong Kong, SAR		9 (2.3)	552 (12.4)	34 (4.1)	526 (6.1)	57 (4.3)	529 (5.4)
Korea, Rep. of		6 (1.8)	543 (8.8)	32 (3.3)	552 (3.8)	62 (3.5)	548 (3.3)
Japan		3 (1.5)	564 (7.3)	15 (3.1)	548 (6.0)	82 (3.1)	549 (2.6)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
England		– –	– –	– –	– –	– –	– –
Russian Federation		– –	– –	– –	– –	– –	– –
International Avg. (All Countries)		20 (0.5)	487 (1.7)	41 (0.6)	485 (1.1)	39 (0.6)	477 (1.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

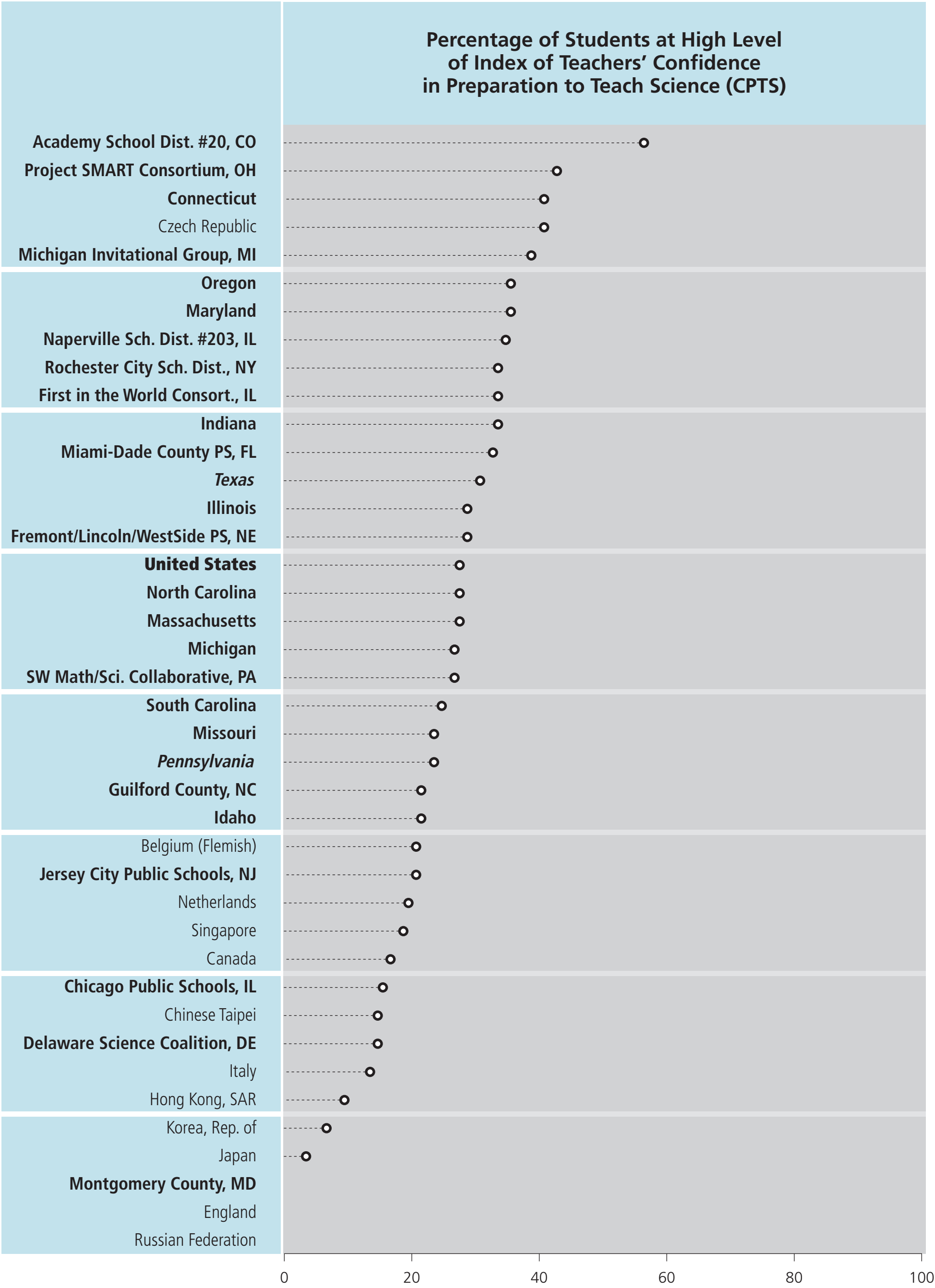
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 6.3
(Continued)

Index of Teachers' Confidence in Preparation to Teach Science (CPTS)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

How Much School Time Is Devoted to Science Instruction?

Exhibit 6.4 presents information about the amount of instruction in the sciences given to eighth-grade students in the TIMSS 1999 Benchmarking jurisdictions and the comparison countries. Since different systems have school years of different lengths (see Exhibit R3.6) and different arrangements of weekly and daily instruction, the information is given in terms of the average number of hours of science instruction over the school year as reported by science teachers.

Across countries where science is taught as a single subject, the average yearly instructional time for science was 122 hours, representing 12 percent of the total instructional time for all subjects. In general, students in countries with separate science subjects had more total instructional hours in the sciences, with over 220 hours in the Russian Federation and the Czech Republic, for example. Since these students study all of the subjects offered, the total time is the sum of the hours reported by each subject area teacher. In the United States, the average instructional time in science for eighth-grade students was 144 hours. Benchmarking entities that reported more than 160 hours were North and South Carolina, the Michigan Invitational Group, the Fremont/Lincoln/Westside Public Schools, Missouri, and the Academy School District. Entities reporting 120 hours or less were the Naperville School District, the Southwest Pennsylvania Math and Science Collaborative, and the Jersey City Public Schools.

Among the comparison general-science countries, the percentage of instructional time at the eighth grade devoted to the sciences ranged from 19 percent in England to six percent in Italy. In comparison, it ranged from 18 percent in the Michigan Invitational Group to 12 percent in five districts and consortia. Among the selected separate-science countries, the percentage was as high as 24 percent in the Czech Republic and 26 percent in the Russian Federation.

As shown in Exhibit 6.5, teachers of about 60 percent of the students in the single-science countries, on average internationally, reported that science classes meet for at least two hours per week but fewer than three and a half hours. For another 17 percent, classes meet for at least three and a half hours but fewer than five. On average, eighth graders in the United States spend more time in science class per week (61 percent spend three and a half to five hours) than do their counterparts in other general-science countries. This pattern of mostly three and a half to five hours held for nearly all of the Benchmarking entities, with the exception of North Carolina (primarily five hours or more), the Chicago and Jersey City Public Schools, and Naperville (the latter three primarily two to three and a half hours).

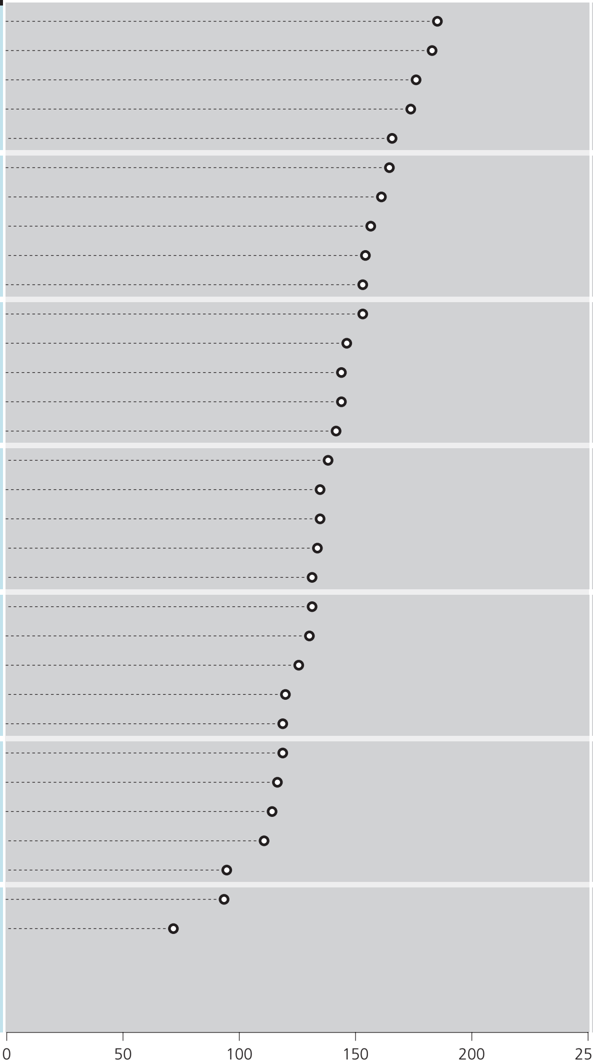
The data, however, reveal no clear pattern between the number of in-class instructional hours and science achievement either across or within participating entities. Common sense and research both support the idea that time on task is an important contributor to achievement, yet this time can be spent more or less efficiently. Time alone is not enough; it needs to be spent on high-quality science instruction. Devoting extensive class time to remedial activities can deprive students of this. Also, instructional time can be spent out of school in various tutoring programs; low-performing students may be receiving additional instruction.

Videotapes of mathematics classes in the United States and Japan in TIMSS 1995 revealed that outside interruptions like those for announcements or to conduct administrative tasks can affect the flow of the lesson and detract from instructional time.[3] As shown in Exhibit 6.6, on average internationally almost one-quarter of the students (23 percent) in general-science countries were in science classes that were interrupted pretty often or almost always, and 28 percent were in classes that were never interrupted. The percentage was generally lower in the separate-science countries. In Japan and Korea, more than 60 percent of students were in science classes that were never interrupted – compared with only 13 percent in the United States. In the United States, nearly one-third of the eighth graders were in science classes that were interrupted pretty often or almost always. If anything, the teachers in most of the Benchmarking jurisdictions reported even more interruptions than did teachers in the U.S. overall. The jurisdictions with 20 percent or more of students in classrooms that were never interrupted were the First in the World Consortium, Montgomery County, and Naperville. Conversely, the jurisdictions with the highest percentages of students in classrooms almost always interrupted (17 to 20 percent) were the public school systems of Jersey City, Miami-Dade, and Rochester. Students in science classrooms that were frequently interrupted had substantially lower achievement than their counterparts in classrooms with fewer interruptions.

---

[3] Stigler, J.W., Gonzales, P., Kawanaka, T., Knoll, S., and Serrano, A., (1999), *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States*, NCES 1999-074, Washington, DC: National Center for Education Statistics.

Exhibit 6.4 Instructional Time in the Sciences at Grade 8*



General/Integrated Science

		Students' Average Yearly Science Instructional Time in Hours		Science Instructional Time as a Percent of Total Instructional Time[1]
North Carolina	s	184 (14.5)	s	17 (1.5)
England	s	182 (10.7)	s	19 (1.2)
South Carolina	r	175 (9.6)		x x
Michigan Invitational Group, MI	r	173 (20.5)	s	18 (0.4)
Fremont/Lincoln/WestSide PS, NE	s	165 (23.0)		x x
Missouri	s	164 (8.6)	s	16 (0.9)
Academy School Dist. #20, CO		161 (1.1)		x x
Guilford County, NC	s	156 (13.5)		x x
Indiana	r	154 (9.4)	s	14 (0.9)
Massachusetts	s	153 (7.1)		x x
Idaho	s	153 (8.4)		x x
Delaware Science Coalition, DE	s	146 (11.7)		x x
Michigan	r	144 (8.2)		x x
United States	s	144 (4.7)		x x
Maryland	s	141 (10.9)		x x
Illinois	r	138 (8.1)	s	13 (0.9)
Chicago Public Schools, IL	s	135 (14.7)		x x
Oregon	r	135 (6.9)	s	13 (0.8)
Project SMART Consortium, OH	s	133 (1.4)		x x
Texas	s	131 (10.3)		x x
First in the World Consort., IL	s	131 (1.9)	s	12 (0.4)
Rochester City Sch. Dist., NY	s	130 (7.5)	s	12 (0.5)
Pennsylvania	r	126 (6.5)	s	12 (1.0)
Naperville Sch. Dist. #203, IL		120 (0.4)		13 (0.1)
Singapore		119 (2.8)		14 (0.4)
SW Math/Sci. Collaborative, PA	r	119 (5.2)	s	12 (0.8)
Korea, Rep. of		117 (3.3)		11 (0.4)
Canada	s	114 (2.7)	s	12 (0.3)
Hong Kong, SAR	r	111 (3.5)	s	11 (0.5)
Jersey City Public Schools, NJ	s	95 (2.5)		x x
Japan		94 (1.7)		9 (0.2)
Italy		72 (2.0)		6 (0.2)
Connecticut		x x		x x
Miami-Dade County PS, FL		x x		x x
Montgomery County, MD		x x		x x
International Avg. (All General Science Countries)		122 (1.1)		12 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Science instructional time provided by teachers, and total instructional time provided by schools.

* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

[1] Computed as the ratio of science instructional time to total instructional time averaged across students.

[a] Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

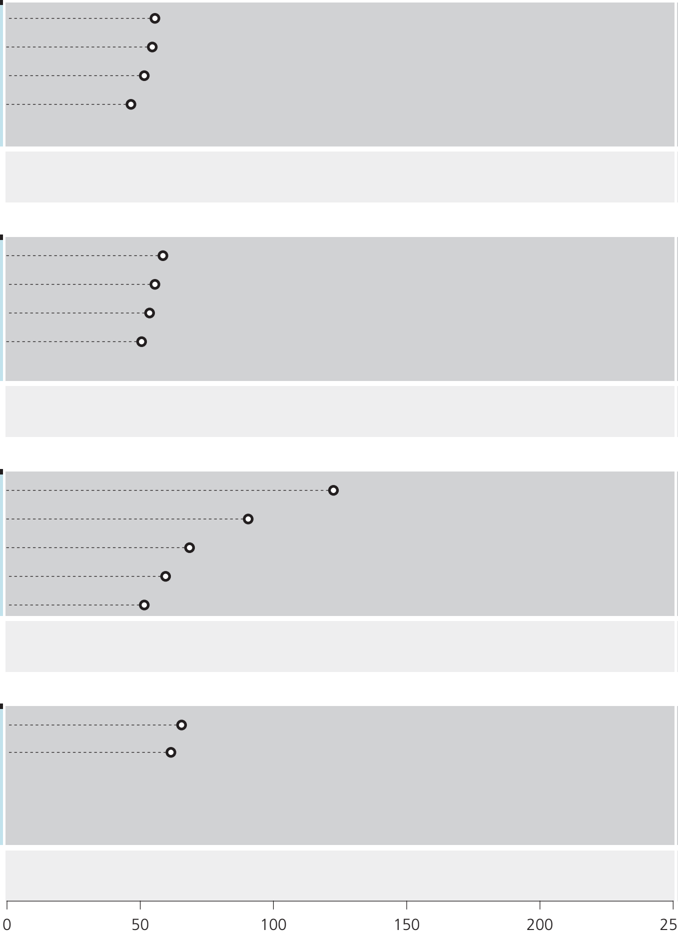
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates school and/or teacher response data available for 70-84% of students. An "s" indicates school and/or teacher response data available for 50-69% of students. An "x" indicates school and/or teacher response data available for <50% of students.

Exhibit 6.4 (Continued)

Instructional Time in the Sciences at Grade 8*



		Students' Average Yearly Science Instructional Time in Hours		Science Instructional Time as a Percent of Total Instructional Time[1]
Earth Science				
Netherlands	s	56 (2.3)	s	6 (0.3)
Czech Republic		55 (1.5)		6 (0.2)
Russian Federation	r	52 (1.8)	s	6 (0.2)
Belgium (Flemish)	r	47 (3.4)	r	5 (0.4)
Chinese Taipei		– –		– –
International Avg. (All Separate Science Countries)		56 (1.7)		6 (0.2)
Biology				
Czech Republic		59 (1.8)		6 (0.2)
Netherlands	s	56 (2.0)	s	5 (0.2)
Belgium (Flemish)	r	54 (3.2)	r	6 (0.3)
Russian Federation	r	51 (0.9)	s	6 (0.2)
Chinese Taipei [a]		– –		– –
International Avg. (All Separate Science Countries)		60 (0.9)		6 (0.1)
Physics				
Chinese Taipei [a]		123 (1.5)		9 (0.1)
Belgium (Flemish)	r	91 (7.5)	r	9 (0.8)
Netherlands [b]	s	69 (3.7)	s	7 (0.4)
Czech Republic	r	60 (1.6)	r	6 (0.2)
Russian Federation	r	52 (1.5)	s	6 (0.2)
International Avg. (All Separate Science Countries)		71 (1.0)		7 (0.1)
Chemistry				
Russian Federation	r	66 (1.6)	s	8 (0.2)
Czech Republic		62 (1.6)		6 (0.1)
Belgium (Flemish)		– –		– –
Chinese Taipei		– –		– –
Netherlands		– –		– –
International Avg. (All Separate Science Countries)				7 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.5 Number of Hours Science Is Taught Weekly*

8th Grade Science

General/Integrated Science

G

			5 Hours or More		3.5 Hours to < 5		2 Hours to < 3.5		Less Than 2 Hours	
			Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries	United States	r	13 (2.0)	490 (8.0)	61 (3.0)	523 (5.0)	16 (2.3)	533 (11.4)	11 (2.3)	521 (18.3)
	Canada	s	5 (1.5)	520 (8.7)	17 (3.2)	549 (6.6)	71 (3.5)	536 (3.3)	7 (1.6)	501 (9.0)
	England	s	4 (1.6)	668 (21.8)	17 (4.0)	568 (16.9)	72 (4.3)	532 (6.2)	7 (2.1)	582 (19.4)
	Hong Kong, SAR		10 (2.8)	514 (14.2)	7 (2.3)	551 (9.4)	79 (3.9)	532 (4.3)	4 (1.7)	525 (22.7)
	Italy		1 (0.8)	~ ~	1 (0.9)	~ ~	71 (3.7)	490 (5.0)	27 (3.5)	498 (5.8)
	Japan		0 (0.0)	~ ~	0 (0.0)	~ ~	96 (1.3)	547 (2.4)	4 (1.3)	599 (14.2)
	Korea, Rep. of		1 (0.8)	~ ~	4 (1.7)	531 (8.6)	84 (2.6)	550 (2.8)	10 (1.9)	546 (4.7)
	Singapore		4 (1.4)	608 (28.0)	50 (4.2)	586 (8.9)	42 (4.2)	550 (14.1)	5 (1.9)	497 (38.7)
States	Connecticut	s	1 (1.5)	~ ~	59 (8.1)	523 (13.4)	30 (7.4)	550 (12.8)	9 (3.8)	574 (28.2)
	Idaho	r	19 (4.5)	515 (11.3)	60 (6.8)	529 (8.9)	10 (4.4)	543 (15.8)	11 (3.5)	536 (17.5)
	Illinois		9 (3.0)	478 (20.9)	51 (6.6)	538 (8.0)	29 (5.0)	511 (8.4)	10 (3.7)	564 (16.9)
	Indiana		13 (4.1)	545 (13.4)	58 (6.6)	531 (9.5)	25 (6.0)	551 (11.7)	5 (2.3)	521 (67.5)
	Maryland	r	11 (3.8)	495 (17.1)	59 (5.4)	519 (7.3)	15 (4.1)	485 (21.3)	14 (4.3)	474 (17.9)
	Massachusetts	r	14 (4.0)	526 (12.1)	70 (4.9)	542 (8.5)	15 (4.0)	530 (20.5)	2 (1.2)	~ ~
	Michigan	r	10 (2.2)	536 (14.8)	62 (6.2)	553 (8.6)	13 (4.6)	557 (15.3)	15 (4.2)	572 (13.1)
	Missouri	r	16 (3.6)	504 (21.4)	71 (4.1)	534 (7.1)	7 (3.5)	508 (22.0)	5 (2.6)	508 (13.8)
	North Carolina		41 (7.9)	508 (8.6)	35 (6.6)	510 (13.7)	17 (4.0)	495 (14.1)	7 (3.1)	513 (9.3)
	Oregon		10 (4.4)	524 (26.3)	61 (6.5)	546 (8.2)	24 (6.2)	542 (8.5)	5 (2.9)	482 (20.9)
	Pennsylvania	r	8 (3.2)	537 (19.0)	50 (4.7)	519 (9.6)	30 (4.4)	537 (8.0)	12 (3.4)	535 (8.6)
	South Carolina		26 (5.7)	510 (8.2)	64 (6.5)	515 (10.9)	7 (3.0)	512 (10.2)	4 (1.6)	495 (25.5)
	Texas	r	6 (3.2)	494 (73.1)	62 (6.3)	517 (14.4)	15 (4.9)	534 (18.6)	16 (3.7)	492 (18.3)
Districts	Academy School Dist. #20, CO		19 (0.5)	555 (5.2)	81 (0.5)	560 (3.1)	0 (0.0)	~ ~	0 (0.0)	~ ~
	Chicago Public Schools, IL	r	10 (5.3)	400 (39.5)	12 (7.2)	439 (30.0)	75 (9.6)	463 (11.8)	3 (2.9)	421 (6.7)
	Delaware Science Coalition, DE	r	10 (3.7)	496 (26.1)	64 (6.6)	493 (13.1)	18 (5.0)	511 (21.4)	8 (4.7)	507 (14.2)
	First in the World Consort., IL		6 (5.0)	532 (27.0)	48 (4.9)	583 (6.5)	46 (6.6)	549 (7.9)	0 (0.0)	~ ~
	Fremont/Lincoln/WestSide PS, NE	r	8 (7.0)	518 (109.8)	78 (7.4)	507 (7.7)	14 (2.3)	548 (20.9)	0 (0.0)	~ ~
	Guilford County, NC		22 (5.5)	525 (14.7)	42 (5.6)	535 (16.5)	11 (2.2)	546 (21.4)	25 (5.4)	539 (13.1)
	Jersey City Public Schools, NJ	r	0 (0.0)	~ ~	21 (3.7)	475 (26.8)	55 (4.3)	447 (6.0)	24 (2.2)	428 (15.5)
	Miami-Dade County PS, FL	s	29 (9.7)	411 (16.2)	36 (8.9)	449 (11.7)	22 (8.3)	412 (22.6)	12 (4.4)	463 (36.6)
	Michigan Invitational Group, MI		21 (5.6)	553 (4.0)	59 (2.0)	577 (9.0)	6 (3.3)	515 (14.5)	15 (5.2)	551 (7.3)
	Montgomery County, MD		x x	x x	x x	x x	x x	x x	x x	x x
	Naperville Sch. Dist. #203, IL		0 (0.0)	~ ~	15 (0.7)	563 (7.9)	83 (0.7)	589 (4.7)	2 (0.3)	~ ~
	Project SMART Consortium, OH	r	7 (0.4)	506 (44.8)	46 (4.6)	542 (12.2)	44 (4.4)	536 (11.9)	3 (0.8)	544 (21.2)
	Rochester City Sch. Dist., NY	r	13 (4.8)	497 (23.9)	57 (7.0)	452 (13.9)	15 (4.6)	439 (15.5)	15 (3.4)	423 (22.7)
	SW Math/Sci. Collaborative, PA		1 (0.5)	~ ~	43 (7.2)	545 (14.0)	49 (5.9)	545 (9.0)	7 (3.1)	545 (21.1)
	International Avg. (All General Science Countries)		9 (0.4)	475 (4.2)	17 (0.6)	500 (4.9)	59 (0.8)	484 (2.7)	15 (0.5)	474 (3.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

[a] Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 6.5
(Continued)

Number of Hours Science Is Taught Weekly*

	5 Hours or More		3.5 Hours to < 5		2 Hours to < 3.5		Less Than 2 Hours	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Earth Science								
Belgium (Flemish)	2 (1.1)	~ ~	0 (0.0)	~ ~	14 (4.2)	530 (13.0)	84 (4.4)	541 (5.4)
Chinese Taipei	– –	– –	– –	– –	– –	– –	– –	– –
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	3 (1.7)	561 (13.4)	97 (1.7)	539 (4.5)
Netherlands	0 (0.0)	~ ~	5 (0.4)	466 (7.8)	6 (3.3)	590 (33.0)	89 (5.7)	550 (6.4)
Russian Federation	0 (0.5)	~ ~	0 (0.0)	~ ~	8 (2.0)	558 (21.6)	91 (2.1)	526 (6.4)
International Avg. (All Separate Science Countries)	1 (0.2)	~ ~	1 (0.2)	~ ~	9 (0.9)	514 (8.3)	90 (1.1)	512 (1.9)
Biology								
Belgium (Flemish) r	3 (1.5)	528 (14.2)	1 (0.0)	~ ~	17 (3.0)	547 (6.8)	79 (3.1)	547 (5.3)
Chinese Taipei [a]	– –	– –	– –	– –	– –	– –	– –	– –
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	4 (2.1)	562 (16.7)	95 (2.1)	540 (4.6)
Netherlands	0 (0.0)	~ ~	0 (0.0)	~ ~	1 (1.2)	~ ~	99 (1.2)	540 (8.9)
Russian Federation	0 (0.0)	~ ~	1 (0.5)	~ ~	9 (2.2)	548 (14.2)	90 (2.3)	526 (6.3)
International Avg. (All Separate Science Countries)	2 (0.3)	~ ~	2 (0.3)	~ ~	19 (0.8)	487 (5.4)	78 (0.9)	495 (1.7)
Physics								
Belgium (Flemish)	3 (2.1)	553 (35.1)	0 (0.0)	~ ~	43 (6.7)	550 (5.6)	54 (7.0)	551 (6.6)
Chinese Taipei [a]	1 (1.0)	~ ~	41 (4.4)	578 (6.8)	58 (4.5)	561 (4.9)	0 (0.0)	~ ~
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	7 (2.5)	596 (18.2)	93 (2.5)	537 (4.3)
Netherlands [b]	1 (0.9)	~ ~	0 (0.0)	~ ~	15 (3.9)	543 (6.3)	84 (4.0)	547 (8.7)
Russian Federation	1 (0.8)	~ ~	0 (0.0)	~ ~	6 (1.7)	554 (17.2)	92 (2.1)	527 (6.7)
International Avg. (All Separate Science Countries)	2 (0.4)	~ ~	4 (0.4)	507 (6.6)	27 (0.9)	500 (3.4)	67 (1.0)	495 (2.3)
Chemistry								
Belgium (Flemish)	– –	– –	– –	– –	– –	– –	– –	– –
Chinese Taipei	– –	– –	– –	– –	– –	– –	– –	– –
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	8 (2.7)	585 (18.5)	92 (2.7)	536 (4.0)
Netherlands	– –	– –	– –	– –	– –	– –	– –	– –
Russian Federation	0 (0.0)	~ ~	1 (0.6)	~ ~	63 (3.8)	526 (6.0)	36 (3.9)	532 (11.6)
International Avg. (All Separate Science Countries)	1 (0.3)	~ ~	2 (0.4)	~ ~	30 (1.2)	499 (4.2)	67 (1.2)	505 (2.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.6 Frequency of Outside Interruption During Science Lessons*

8th Grade Science

General/Integrated Science

G

		Never		Once in a While		Pretty Often		Almost Always	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries	United States	13 (0.7)	519 (7.3)	57 (1.2)	539 (4.7)	18 (0.7)	501 (5.3)	11 (0.8)	470 (7.5)
	Canada	13 (0.7)	530 (4.9)	63 (0.9)	542 (2.4)	16 (0.7)	523 (3.3)	9 (0.5)	514 (7.9)
	Chinese Taipei [a]	27 (1.1)	566 (4.7)	54 (1.0)	579 (5.4)	14 (0.8)	556 (7.3)	5 (0.6)	547 (11.4)
	England	14 (1.1)	557 (9.1)	68 (1.1)	549 (5.1)	14 (0.9)	513 (6.4)	5 (0.5)	479 (13.2)
	Hong Kong, SAR	41 (1.1)	534 (4.1)	47 (0.9)	534 (3.7)	9 (0.7)	507 (9.3)	3 (0.4)	498 (10.3)
	Italy	19 (1.1)	493 (7.9)	53 (1.2)	503 (4.0)	16 (0.9)	486 (6.7)	12 (0.8)	470 (7.3)
	Japan	64 (1.3)	550 (3.4)	32 (1.2)	553 (3.7)	4 (0.3)	530 (11.7)	1 (0.2)	~ ~
	Korea, Rep. of	61 (0.9)	544 (2.8)	34 (0.8)	561 (3.3)	4 (0.3)	536 (9.3)	2 (0.2)	~ ~
	Singapore	19 (0.7)	555 (11.1)	62 (1.2)	583 (7.0)	13 (0.8)	535 (10.6)	6 (0.5)	530 (11.4)
States	Connecticut	15 (1.3)	546 (11.7)	55 (2.2)	551 (9.7)	18 (1.5)	506 (11.8)	12 (1.3)	499 (12.2)
	Idaho	13 (1.2)	520 (10.7)	59 (1.7)	542 (5.3)	17 (1.3)	517 (10.3)	12 (1.4)	490 (7.3)
	Illinois	19 (1.4)	530 (8.1)	56 (1.7)	537 (7.3)	16 (1.2)	488 (9.9)	9 (1.0)	482 (10.0)
	Indiana	13 (1.1)	540 (8.0)	60 (1.9)	549 (6.5)	17 (1.3)	513 (10.5)	10 (1.4)	519 (19.5)
	Maryland	15 (1.2)	522 (8.0)	55 (1.5)	529 (6.6)	17 (1.2)	498 (9.5)	13 (1.0)	462 (8.9)
	Massachusetts	15 (1.0)	540 (10.7)	59 (1.2)	548 (7.5)	17 (1.1)	515 (7.7)	9 (0.7)	487 (15.9)
	Michigan	13 (1.6)	547 (11.2)	58 (1.6)	564 (6.4)	19 (1.0)	530 (9.8)	9 (1.3)	508 (9.5)
	Missouri	13 (1.2)	523 (9.7)	54 (1.7)	541 (7.2)	20 (1.1)	508 (7.2)	13 (1.1)	482 (9.4)
	North Carolina	8 (0.7)	509 (11.2)	57 (1.5)	527 (7.0)	21 (1.2)	498 (7.4)	14 (1.3)	462 (11.0)
	Oregon	13 (1.0)	532 (8.6)	57 (1.6)	554 (5.5)	19 (1.3)	530 (8.6)	11 (1.0)	505 (11.5)
	Pennsylvania	16 (1.1)	538 (12.3)	57 (1.4)	544 (6.8)	17 (0.8)	513 (8.9)	10 (1.0)	489 (7.1)
	South Carolina	11 (0.8)	504 (12.1)	57 (1.6)	538 (5.9)	20 (1.2)	485 (7.9)	12 (1.2)	460 (9.5)
	Texas	13 (0.9)	496 (17.4)	55 (1.4)	532 (8.9)	21 (1.1)	506 (13.4)	12 (0.9)	481 (12.9)
Districts	Academy School Dist. #20, CO	7 (0.9)	553 (11.9)	59 (1.6)	573 (3.0)	23 (1.3)	549 (6.1)	11 (0.9)	526 (6.2)
	Chicago Public Schools, IL	11 (1.5)	425 (12.1)	54 (3.3)	467 (10.3)	22 (2.0)	444 (10.3)	13 (1.4)	431 (14.9)
	Delaware Science Coalition, DE	16 (1.5)	506 (13.6)	54 (2.0)	528 (8.4)	18 (1.4)	497 (12.0)	13 (1.3)	467 (12.5)
	First in the World Consort., IL	22 (2.0)	570 (8.2)	62 (1.8)	572 (5.0)	12 (2.1)	537 (10.0)	4 (0.7)	521 (15.7)
	Fremont/Lincoln/WestSide PS, NE	12 (1.6)	519 (10.8)	55 (2.1)	541 (5.9)	19 (2.0)	497 (9.1)	14 (1.1)	451 (11.7)
	Guilford County, NC	10 (0.8)	525 (12.2)	60 (1.7)	553 (7.3)	20 (1.6)	519 (13.4)	10 (0.8)	488 (13.2)
	Jersey City Public Schools, NJ	11 (1.3)	408 (12.5)	49 (3.1)	460 (8.2)	23 (1.6)	446 (13.9)	17 (1.9)	425 (13.9)
	Miami-Dade County PS, FL	14 (0.8)	424 (12.2)	45 (1.8)	454 (9.1)	23 (1.7)	425 (8.2)	17 (1.4)	405 (22.0)
	Michigan Invitational Group, MI	10 (1.1)	567 (7.6)	64 (1.5)	575 (6.3)	17 (2.1)	555 (14.0)	8 (1.2)	523 (10.8)
	Montgomery County, MD	20 (1.4)	544 (7.8)	53 (1.3)	548 (5.0)	18 (1.3)	508 (7.5)	9 (0.7)	492 (12.1)
	Naperville Sch. Dist. #203, IL	30 (1.6)	589 (4.7)	56 (1.6)	588 (5.0)	9 (0.7)	572 (7.6)	5 (0.7)	542 (14.9)
	Project SMART Consortium, OH	18 (1.4)	554 (9.4)	57 (1.6)	553 (10.2)	17 (1.2)	517 (7.5)	8 (0.8)	478 (11.6)
	Rochester City Sch. Dist., NY s	10 (2.7)	494 (20.9)	48 (3.3)	489 (8.3)	22 (2.5)	444 (13.3)	20 (3.2)	450 (14.7)
	SW Math/Sci. Collaborative, PA	18 (2.4)	545 (12.6)	60 (2.5)	551 (6.8)	14 (1.4)	540 (9.5)	7 (1.1)	515 (14.1)
	International Avg. (All General Science Countries)	28 (0.2)	479 (1.3)	49 (0.2)	494 (1.1)	14 (0.1)	462 (1.6)	9 (0.1)	440 (2.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An "s" indicates a 50-69% student response rate.

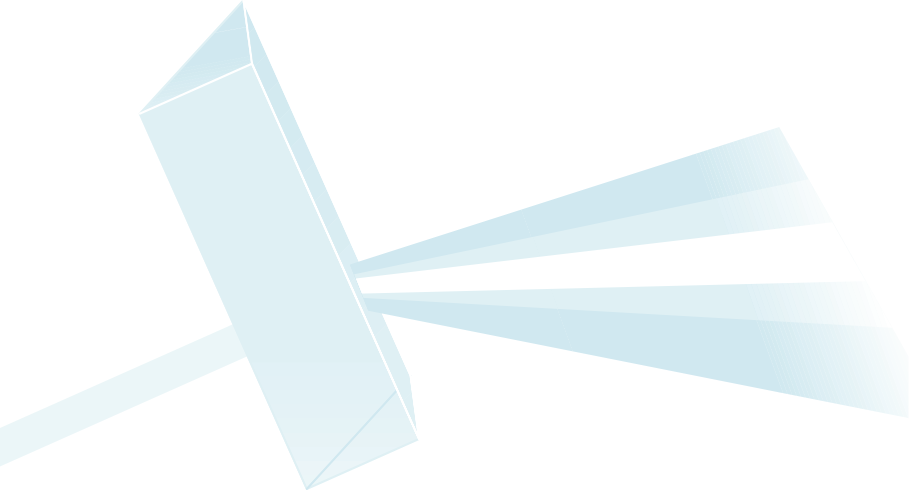
Exhibit 6.6
(Continued)

Frequency of Outside Interruption During Science Lessons*

8th Grade Science

	Never		Once in a While		Pretty Often		Almost Always	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Earth Science								
Belgium (Flemish)	35 (1.3)	541 (4.2)	53 (1.2)	551 (3.6)	8 (0.6)	525 (9.3)	5 (0.5)	503 (10.9)
Czech Republic	47 (1.7)	542 (4.1)	45 (1.5)	543 (5.9)	5 (0.5)	518 (9.3)	3 (0.7)	530 (16.1)
Netherlands	44 (1.5)	541 (8.3)	48 (1.7)	555 (6.8)	5 (0.6)	521 (15.8)	2 (0.5)	~ ~
Russian Federation	21 (1.5)	544 (11.4)	62 (1.3)	537 (6.1)	9 (0.7)	502 (10.2)	8 (0.7)	503 (8.9)
International Avg. (All Separate Science Countries)	40 (0.4)	526 (2.1)	47 (0.4)	523 (1.6)	7 (0.2)	491 (2.9)	6 (0.2)	473 (3.5)
Biology								
Belgium (Flemish)	36 (1.3)	538 (5.2)	55 (1.4)	543 (3.1)	6 (0.5)	542 (9.9)	4 (0.7)	485 (10.3)
Czech Republic	40 (1.7)	540 (4.3)	52 (1.6)	541 (5.6)	5 (0.6)	527 (14.0)	3 (0.4)	530 (20.0)
Netherlands	41 (1.8)	537 (9.0)	53 (2.0)	551 (8.1)	4 (0.7)	520 (16.1)	2 (0.6)	~ ~
Russian Federation	19 (1.5)	545 (13.4)	64 (1.3)	535 (6.0)	10 (0.7)	506 (7.2)	8 (0.5)	507 (9.3)
International Avg. (All Separate Science Countries)	36 (0.4)	521 (1.9)	51 (0.4)	522 (1.6)	8 (0.2)	496 (3.4)	5 (0.1)	477 (3.1)
Physics								
Belgium (Flemish)	32 (1.8)	548 (6.4)	58 (1.7)	546 (4.5)	7 (0.7)	538 (16.0)	4 (0.7)	529 (22.4)
Czech Republic	48 (1.8)	541 (4.2)	44 (1.5)	544 (6.7)	5 (0.8)	520 (14.0)	3 (0.6)	532 (16.0)
Netherlands [b]	42 (1.7)	544 (8.3)	50 (1.6)	550 (6.6)	5 (0.8)	533 (14.5)	3 (0.5)	521 (16.9)
Russian Federation	22 (1.5)	545 (10.8)	62 (1.4)	537 (6.4)	8 (0.5)	505 (9.5)	8 (0.5)	498 (7.5)
International Avg. (All Separate Science Countries)	38 (0.4)	525 (1.7)	48 (0.4)	523 (1.6)	8 (0.2)	495 (3.0)	6 (0.2)	486 (3.4)
Chemistry								
Belgium (Flemish)	– –	– –	– –	– –	– –	– –	– –	– –
Czech Republic	45 (1.8)	538 (4.2)	46 (1.6)	546 (5.4)	5 (0.6)	532 (10.8)	3 (0.7)	503 (14.8)
Netherlands	– –	– –	– –	– –	– –	– –	– –	– –
Russian Federation	21 (1.6)	548 (10.5)	62 (1.3)	534 (6.0)	9 (0.6)	503 (9.9)	8 (0.6)	509 (8.6)
International Avg. (All Separate Science Countries)	38 (0.4)	519 (2.0)	48 (0.4)	518 (2.0)	8 (0.2)	487 (3.3)	6 (0.2)	478 (3.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.



What Activities Do Students Do in Their Science Lessons?

Because it can affect pedagogical strategies, class size is shown in Exhibit 6.7. Teachers' reports on the size of their eighth-grade science class reveal that across countries the average was 31 students, but there was considerable variation even among the higher-performing countries – from 43 students in Korea to 20 in Belgium (Flemish). Average class size was relatively uniform across all of the Benchmarking entities, ranging from 23 to 32 students. The relationship between class size and achievement is difficult to disentangle, given the variety of policies and practices and the fact that smaller classes can be used for both advanced and remedial learning. It makes sense, however, that teachers may have an easier time managing and conducting more student centered instructional activities with smaller classes.

Extensive research about class size in relation to achievement indicates that the existence of such a relationship is dependent on the situation.[4] Dramatic reductions in class size can be related to gains in achievement, but the chief effects of smaller classes often are in relation to teacher attitudes and instructional behaviors. Also, the research is more consistent in suggesting that reductions in class size have the potential to help students in the primary grades. The TIMSS 1999 data support the complexity of this issue. Four of the five highest-performing countries – Chinese Taipei, Singapore, Japan, and Korea – were among those with the largest science classes. Within countries, several show little or no relationship between achievement and class size, often because students are mostly all in classes of similar size. Within other countries, there appears to be a curvilinear relationship, or those students with higher achievement appear to be in larger classes. In some countries, larger classes may represent the more usual situation for science teaching, with smaller classes used primarily for students needing remediation or for those students in the less-advanced tracks.

Exhibit 6.8 presents a profile of the activities most commonly encountered in science classes around the world, as reported by science teachers. On average internationally, the most common activity was teacher lecture (24 percent of class time), followed by students conducting experiments (15 percent) and teacher-guided student practice (14 percent). Re-teaching and clarification of content and procedures, student independent practice, tests and quizzes, and teacher demonstrations of experiments each occupied 10 percent of class time. In general for the United States as a whole and the Benchmarking entities, teachers' reports on the frequency of these

---

[4] Mayer, D.P., Mullens, J.E., and Moore, M.T. (2000), *Monitoring School Quality: An Indicators Report*, NCES 2001-030, Washington, DC: National Center for Education Statistics.

activities matched the international profile. According to U.S. science teachers, class time is spent as follows: 19 percent on lecture style teacher presentation; 23 percent on teacher-guided or independent student practice; 17 percent on students conducting experiments; eight percent on teachers demonstrating experiments; nine percent on re-teaching and clarification; nine percent on tests and quizzes, eight percent on homework review; six percent on administrative tasks; and three percent on other activities.

As shown in Exhibit 6.9, most students internationally (80 percent on average in general-science countries) agreed with teachers' reports about the prevalence of teacher-guided activities, saying that their teachers frequently showed them how to do science problems. Approximately 70 percent of the students in the United States overall and in most of the Benchmarking entities reported this also. According to students, working independently on worksheets or textbooks also occurred frequently internationally (56 percent), and was even more pervasive throughout the Benchmarking entities, where between 70 and 85 percent in most entities reported doing this activity almost always or pretty often. As for working on science projects, the Benchmarking entities typically were above the international average (51 percent), ranging from 49 to 77 percent.

Compared with students internationally, eighth graders in each of the Benchmarking jurisdictions and in the United States overall reported an unusually large amount of classroom time devoted to working on homework. Internationally, 51 percent of the students reported frequently discussing their completed homework in science class. The figure for the United States was 63 percent, and it ranged from 52 percent in Texas to 82 percent in Naperville for the Benchmarking jurisdictions. A slightly greater difference was evident for frequently beginning homework in class – 41 percent internationally compared with 57 percent for the United States. In the Benchmarking jurisdictions, from 41 to 74 percent of the students reported beginning their homework in class almost always or pretty often.

As might be anticipated, students reported that use of the board was an extremely common presentational mode in science class (see Exhibit 6.10). On average internationally for the general-science countries, 86 percent of students reported that teachers used the board at least pretty often, and 42 percent reported that students did so. Using the board seems to be less common in the United States, especially for students (29 percent). In the United States, use of an overhead projector is a popular presentational mode, especially for teachers – 59 percent compared with 32 percent internationally. This mode was used frequently for more than

70 percent of the students in Maryland, North Carolina, Oregon, South Carolina, Texas, the Academy School District, Guilford County, Montgomery County, and Rochester. Use of a computer by the teacher to demonstrate ideas in science was more prevalent in the U.S. (20 percent of students) than internationally (10 percent), and among Benchmarking entities ranged from 12 percent in Chicago and Guilford County to 28 percent in Jersey City and Montgomery County.

Effective science instruction requires the teacher to guide, focus, challenge, and encourage student learning. Problem-solving activities typically call upon students to use higher-order thinking skills. To examine the emphasis on reasoning and problem-solving in science class, TIMSS created an index of teachers' emphasis on scientific reasoning and problem-solving (ESRPS). As shown in Exhibit 6.11, the index is based on teachers' reports about how often they asked students to explain the reasoning behind an idea, represent and analyze relationships using tables, charts, and graphs, work on problems for which there is no immediately obvious method of solution, write explanations about what was observed and why it happened, and put events or objects in order and give a reason for the organization. Students were placed in the high category if, on average, they were asked to do these activities in most of their lessons. The medium level represents students asked to do these activities in some to most lessons, and students in the low category did them only in some lessons or rarely.

On average internationally, 16 percent of students had teachers who placed a high emphasis on scientific reasoning and problem-solving, ranging from four percent in Belgium (Flemish) to about one-third in Japan among the comparison countries. While the emphasis on scientific reasoning and problem-solving was associated with achievement in some countries, there was no strong or consistent relationship internationally or across entities. There was tremendous variation among the Benchmarking participants on this index, ranging from 63 percent of students in the high category in Naperville to nine percent or less in Chicago, Rochester, the Michigan Invitational Group, and Idaho.

Exhibit R3.7 in the reference section shows the percentages of students asked in most or every lesson to engage in each of the activities included in the problem-solving index. The most common problem-solving activity was for teachers to ask students to explain the reasoning behind an idea. On average internationally, 68 percent of students had teachers who asked them to do this in most or every lesson. On average also, a majority of students (52 percent) were asked to write explanations about what was observed and why it happened in most or every lesson, but only 15 percent were asked to work on problems for which there was no immediately obvious method of solution. In the United States and among Benchmarking participants generally, teachers more often asked students to explain the reasoning behind an idea (80 percent of students in the United States, and up to 100 percent in Naperville), but otherwise approximated the international averages.

The choices teachers make determine, to a large extent, what students learn. An important aspect of teaching science is the emphasis placed on scientific investigation. In order to measure this, TIMSS created an index of emphasis on conducting experiments in science classes (ECES), shown in Exhibit 6.12. The index is based on students' and teachers' reports of the frequency of the teacher demonstrating experiments and the students conducting experiments or practical investigations. A high level indicates that the teacher reported that at least 25 percent of class time is spent on the teacher demonstrating or students conducting experiments, and the student reported that these occur almost always or pretty often. A low level indicates that the teacher reported that 10 percent or less of class time is spent on the teacher demonstrating or students conducting experiments, and the student reported that these occur once in a while or never. The middle category includes all other combinations of responses.

Internationally on average, 38 percent of students in countries with general/integrated science were in classes with a high emphasis on experiments, ranging from two percent in Italy to 78 percent in Hong Kong. There was great variation among the Benchmarking participants also, from a high of 79 percent in Naperville to a low of 17 percent in the Delaware Science Coalition. In general, lower percentages of students in the high category were found in the countries with separate sciences, but this varied across science subjects, with the greatest emphasis on experiments in the physical sciences. Earth science had the least emphasis on experiments. Across countries, 52 percent of earth science students were in the low category, but only 21 percent of students in biology, five percent in physics and chemistry, and three percent in general/integrated science had classes with low emphasis on experiments.

Exhibits R3.8 and R3.9 in the reference section summarize students' responses to the questions on the frequency of teachers demonstrating and students conducting experiments that were included in the index of emphasis on conducting experiments. On average internationally, 71 percent of students in general/integrated science reported that their teachers demonstrate experiments almost always or pretty often. Only 29 percent of Italian students reported that their teachers did so, compared with 91 percent of the students in England. The United States and the Benchmarking participants generally were close to the international average. Among separate-science countries, teacher demonstrations of experiments were reported most often in chemistry (68 percent) and physics (61 percent), and less frequently in biology (42 percent) and earth science (19 percent).

Students' reports on the frequency with which they conduct experiments or practical investigations in class show a similar pattern across science subjects but a lower frequency than for teachers' demonstration of experiments. Internationally, 57 percent of students in countries with general/integrated science reported that they do an experiment or practical investigation almost always or pretty often. Across countries with separate sciences, only 15 percent of the students in earth science, 27 percent in biology, and 39 percent in physics and chemistry reported doing experiments this frequently. In the United States, 65 percent of students reported frequently doing experiments or practical investigations, and among Benchmarking participants the percentage ranged from 44 percent in Chicago to more than 85 percent in the Academy School District, First in the World, and Naperville.

Teachers were not asked about the emphasis placed on using things from everyday life in solving science problems, but students were (see Exhibit R3.10). In most of the countries, students reported a moderate emphasis on doing this type of problem in science class. Almost half (49 percent), on average internationally, said these activities occur once in a while or pretty often in science class. The figures were comparable for the United States and most Benchmarking jurisdictions. More than half the students in Connecticut, Maryland, North and South Carolina, Chicago, the Fremont/Lincoln/Westside Public Schools, Guilford County, Jersey City, Miami-Dade, Naperville, and Rochester reported that they use things from everyday life in solving science problems almost always or pretty often.

Exhibit 6.7 Science Class Size

8th Grade Science

		Overall Average Class Size	1 - 20 Students		21 - 35 Students		36 or More Students	
			Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries								
United States	r	26 (0.5)	15 (2.1)	530 (9.4)	80 (2.4)	522 (5.4)	5 (1.4)	493 (14.9)
Belgium (Flemish)	r	20 (0.5)	61 (3.9)	527 (5.1)	38 (3.9)	540 (7.2)	1 (1.0)	~ ~
Canada	s	27 (0.3)	12 (2.1)	525 (7.8)	86 (2.2)	535 (3.1)	2 (0.8)	~ ~
Chinese Taipei		39 (0.5)	0 (0.0)	~ ~	14 (2.9)	564 (12.4)	86 (2.9)	569 (4.8)
Czech Republic		24 (0.4)	19 (3.8)	525 (7.6)	81 (3.8)	544 (5.3)	0 (0.0)	~ ~
England		x x	x x	x x	x x	x x	x x	x x
Hong Kong, SAR		39 (0.3)	1 (0.0)	~ ~	13 (3.1)	487 (8.2)	86 (3.2)	537 (4.1)
Italy		20 (0.3)	55 (3.9)	486 (5.3)	44 (3.9)	502 (6.1)	1 (0.0)	~ ~
Japan		36 (0.3)	1 (0.0)	~ ~	41 (3.1)	547 (3.4)	58 (3.0)	550 (2.8)
Korea, Rep. of		43 (0.7)	0 (0.0)	~ ~	10 (2.2)	537 (6.1)	90 (2.2)	550 (2.7)
Netherlands	r	25 (0.4)	11 (3.3)	492 (20.1)	89 (3.3)	554 (8.1)	0 (0.0)	~ ~
Russian Federation		24 (0.5)	19 (3.1)	501 (11.3)	81 (3.1)	536 (6.7)	0 (0.0)	~ ~
Singapore		37 (0.3)	1 (0.4)	~ ~	32 (3.8)	565 (16.0)	68 (3.8)	571 (8.0)
States								
Connecticut	s	24 (1.5)	32 (6.2)	516 (15.7)	64 (6.9)	549 (12.3)	4 (2.6)	458 (93.8)
Idaho	s	23 (0.6)	25 (4.9)	524 (13.4)	74 (4.9)	529 (7.9)	1 (0.3)	~ ~
Illinois	r	25 (0.6)	15 (2.7)	531 (11.0)	82 (2.9)	525 (6.0)	3 (1.4)	432 (15.5)
Indiana	r	25 (1.5)	30 (6.9)	555 (9.8)	67 (6.8)	532 (9.3)	3 (1.8)	552 (28.9)
Maryland	s	27 (0.5)	6 (1.5)	533 (25.1)	94 (1.6)	506 (8.0)	1 (0.4)	~ ~
Massachusetts	r	24 (0.8)	24 (3.4)	520 (14.6)	75 (3.4)	546 (7.4)	1 (1.0)	~ ~
Michigan	r	26 (0.6)	11 (3.3)	552 (13.8)	88 (3.4)	558 (7.4)	1 (1.0)	~ ~
Missouri	r	24 (0.9)	31 (4.6)	508 (13.0)	65 (4.6)	533 (6.4)	4 (2.7)	555 (22.6)
North Carolina	r	27 (1.9)	20 (5.8)	490 (18.5)	71 (7.1)	510 (7.6)	9 (4.4)	504 (22.4)
Oregon	r	27 (1.1)	17 (4.0)	526 (15.2)	81 (4.0)	547 (5.9)	1 (1.3)	~ ~
Pennsylvania	r	24 (0.6)	21 (4.5)	522 (8.1)	78 (4.5)	527 (7.4)	1 (0.5)	~ ~
South Carolina	r	25 (1.5)	31 (5.2)	503 (9.4)	63 (6.1)	518 (9.1)	6 (3.3)	565 (35.5)
Texas	s	25 (2.1)	25 (5.3)	484 (23.0)	69 (3.1)	531 (10.1)	5 (0.5)	536 (6.5)
Districts and Consortia								
Academy School Dist. #20, CO		27 (0.1)	2 (0.3)	~ ~	98 (0.3)	558 (2.2)	0 (0.0)	~ ~
Chicago Public Schools, IL	r	27 (1.4)	9 (4.5)	437 (16.0)	80 (5.9)	454 (10.8)	11 (6.6)	419 (9.2)
Delaware Science Coalition, DE	s	28 (0.7)	7 (2.1)	399 (21.4)	80 (6.2)	508 (12.9)	13 (5.7)	427 (15.7)
First in the World Consort., IL		27 (0.3)	17 (3.4)	577 (11.7)	78 (3.7)	562 (6.1)	5 (0.6)	590 (30.7)
Fremont/Lincoln/WestSide PS, NE	r	25 (1.9)	23 (5.8)	527 (20.4)	75 (4.7)	515 (8.1)	3 (0.1)	382 (7.2)
Guilford County, NC		26 (0.4)	7 (2.7)	569 (25.2)	90 (2.7)	528 (9.0)	3 (0.5)	619 (17.4)
Jersey City Public Schools, NJ	s	27 (2.4)	19 (7.1)	450 (12.3)	71 (5.8)	443 (11.8)	9 (4.4)	454 (16.3)
Miami-Dade County PS, FL	s	32 (1.0)	9 (4.1)	345 (38.3)	59 (7.3)	449 (12.4)	32 (6.8)	428 (11.6)
Michigan Invitational Group, MI	r	26 (0.2)	5 (1.3)	552 (7.9)	94 (1.3)	566 (7.5)	1 (0.0)	~ ~
Montgomery County, MD		x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		27 (0.2)	7 (1.6)	583 (8.2)	93 (1.6)	584 (4.1)	0 (0.0)	~ ~
Project SMART Consortium, OH	r	24 (0.3)	22 (3.0)	545 (17.5)	77 (2.9)	537 (9.5)	0 (0.0)	~ ~
Rochester City Sch. Dist., NY		23 (0.6)	29 (5.1)	442 (16.1)	71 (5.1)	461 (10.9)	0 (0.0)	~ ~
SW Math/Sci. Collaborative, PA		25 (1.1)	19 (4.7)	534 (17.1)	78 (4.6)	543 (7.9)	2 (0.2)	~ ~
International Avg. (All Countries)		31 (0.1)	16 (0.4)	477 (2.8)	52 (0.5)	486 (1.5)	31 (0.4)	462 (4.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit 6.8 Time Spent on Various Activities in Science Class

8th Grade Science

	Administrative Tasks	Homework Review	Lecture-Style Presentation by Teacher	Teacher-Guided Student Practice	Re-teaching and Clarification of Content/ Procedures	Student Independent Practice	Tests and Quizzes	Teacher Demonstrations of Experiments	Students Conducting Experiments	Other
	Average Percentage of Class Time Spent in a Typical Month of Lessons									
Countries										
United States	r 6 (0.5)	r 8 (0.4)	r 19 (0.8)	r 12 (0.5)	r 9 (0.3)	r 11 (0.4)	r 9 (0.3)	r 8 (0.4)	r 17 (0.9)	r 3 (0.5)
Belgium (Flemish)	r 4 (0.3)	r 5 (0.5)	r 32 (1.9)	r 11 (0.7)	r 10 (0.6)	r 9 (0.5)	r 9 (0.4)	r 10 (0.7)	r 8 (0.8)	r 2 (0.4)
Canada	r 4 (0.2)	r 9 (0.4)	r 19 (0.8)	r 12 (0.4)	r 8 (0.3)	r 11 (0.9)	r 8 (0.3)	r 8 (0.4)	r 22 (1.1)	s 3 (0.6)
Chinese Taipei	3 (0.6)	8 (0.4)	39 (1.4)	9 (0.6)	8 (0.4)	5 (0.3)	8 (0.4)	6 (0.3)	13 (0.7)	1 (0.3)
Czech Republic	2 (0.2)	4 (0.2)	32 (0.6)	18 (0.6)	9 (0.3)	12 (0.4)	8 (0.2)	7 (0.3)	5 (0.3)	3 (0.2)
England	s 3 (0.3)	s 3 (0.3)	s 13 (0.7)	s 19 (1.2)	s 8 (0.5)	s 13 (0.7)	s 7 (0.3)	10 (0.4)	s 24 (1.4)	x x
Hong Kong, SAR	4 (0.5)	7 (0.5)	20 (1.2)	8 (0.6)	7 (0.5)	6 (0.5)	6 (0.3)	13 (0.7)	29 (1.3)	2 (0.4)
Italy	2 (0.2)	10 (0.5)	29 (0.8)	15 (0.6)	13 (0.5)	7 (0.4)	12 (0.5)	7 (0.4)	5 (0.4)	r 1 (0.3)
Japan	2 (0.3)	3 (0.3)	31 (1.4)	11 (0.9)	11 (0.6)	5 (0.5)	5 (0.3)	9 (0.6)	24 (1.5)	2 (0.4)
Korea, Rep. of	4 (0.7)	6 (0.4)	34 (1.4)	8 (0.5)	9 (0.5)	7 (0.6)	5 (0.3)	7 (0.4)	18 (1.0)	2 (0.3)
Netherlands	4 (0.4)	13 (0.7)	13 (1.0)	7 (0.5)	14 (0.7)	23 (1.1)	r 10 (0.4)	5 (0.2)	5 (0.5)	6 (0.7)
Russian Federation	2 (0.1)	13 (0.4)	29 (0.6)	12 (0.3)	9 (0.1)	11 (0.3)	9 (0.3)	6 (0.2)	6 (0.2)	5 (0.2)
Singapore	4 (0.4)	9 (0.5)	27 (1.3)	11 (1.0)	7 (0.5)	7 (0.5)	7 (0.4)	7 (0.6)	23 (1.1)	2 (0.2)
States										
Connecticut	s 4 (0.4)	s 8 (0.6)	s 16 (1.7)	s 12 (1.3)	s 9 (0.6)	s 9 (0.6)	s 8 (0.5)	8 (0.8)	s 25 (2.2)	s 2 (0.5)
Idaho	r 5 (0.6)	r 8 (0.6)	r 18 (1.2)	r 12 (0.8)	r 9 (0.7)	r 14 (1.0)	r 8 (0.6)	r 9 (0.7)	r 15 (1.9)	r 3 (0.9)
Illinois	4 (0.4)	8 (0.5)	21 (1.9)	12 (1.0)	8 (0.8)	11 (1.1)	9 (1.0)	7 (0.7)	r 21 (3.4)	r 4 (1.3)
Indiana	5 (0.7)	8 (0.6)	17 (1.8)	11 (0.8)	9 (1.1)	12 (1.0)	9 (0.7)	8 (0.6)	20 (2.0)	r 4 (0.9)
Maryland	r 6 (0.7)	r 7 (0.5)	r 10 (0.9)	r 11 (0.7)	r 9 (0.7)	r 12 (1.0)	r 8 (0.6)	r 9 (0.7)	r 26 (2.2)	s 2 (0.4)
Massachusetts	r 5 (0.6)	r 10 (1.5)	r 16 (1.0)	r 10 (0.9)	r 10 (0.5)	r 10 (1.0)	r 10 (1.0)	r 9 (0.8)	r 21 (1.7)	s 4 (1.1)
Michigan	r 6 (0.8)	r 10 (0.7)	r 17 (1.3)	r 11 (0.7)	r 8 (0.5)	r 11 (0.9)	r 8 (0.4)	r 9 (0.5)	r 20 (1.9)	r 3 (0.6)
Missouri	r 5 (0.5)	r 9 (0.5)	r 16 (1.5)	r 14 (1.0)	r 9 (0.7)	r 12 (1.0)	r 9 (0.6)	r 8 (0.7)	r 16 (2.2)	r 4 (0.8)
North Carolina	6 (0.7)	9 (0.8)	18 (1.7)	16 (1.1)	9 (0.7)	13 (1.0)	9 (0.4)	8 (1.0)	14 (1.4)	r 3 (0.7)
Oregon	6 (0.6)	7 (0.5)	13 (1.3)	11 (0.8)	8 (0.8)	13 (1.1)	7 (0.5)	9 (0.8)	23 (2.0)	r 3 (1.0)
Pennsylvania	7 (1.0)	10 (1.4)	21 (1.6)	15 (2.5)	11 (0.9)	13 (2.0)	10 (1.8)	8 (1.3)	17 (3.2)	r 2 (0.6)
South Carolina	6 (0.6)	8 (0.5)	17 (1.4)	12 (0.8)	10 (0.5)	11 (0.8)	11 (0.8)	9 (1.1)	16 (1.6)	r 3 (0.9)
Texas	r 7 (1.7)	r 8 (0.7)	r 17 (1.9)	r 14 (1.0)	r 9 (0.8)	r 12 (1.1)	r 8 (0.7)	r 7 (0.9)	r 22 (2.1)	r 3 (0.4)
Districts and Consortia										
Academy School Dist. #20, CO	6 (0.0)	10 (0.1)	13 (0.1)	9 (0.0)	8 (0.0)	12 (0.1)	8 (0.0)	6 (0.0)	26 (0.1)	1 (0.0)
Chicago Public Schools, IL	r 4 (0.8)	r 7 (0.9)	r 21 (2.8)	r 14 (2.2)	r 9 (1.0)	r 11 (1.2)	r 9 (1.2)	r 8 (1.2)	r 16 (2.6)	r 2 (0.9)
Delaware Science Coalition, DE	s 5 (0.6)	s 9 (0.7)	s 21 (1.9)	s 13 (1.1)	s 9 (0.7)	s 11 (0.7)	s 8 (0.8)	8 (0.5)	s 13 (1.0)	s 3 (0.8)
First in the World Consort., IL	4 (0.3)	7 (0.6)	18 (1.4)	11 (1.0)	9 (0.4)	10 (0.6)	6 (0.5)	9 (0.6)	24 (1.8)	2 (0.8)
Fremont/Lincoln/WestSide PS, NE	8 (0.6)	7 (0.5)	15 (1.2)	10 (1.0)	9 (1.3)	14 (4.7)	6 (0.3)	5 (0.7)	25 (3.0)	r 2 (1.0)
Guilford County, NC	6 (0.5)	8 (0.6)	15 (1.2)	14 (0.9)	9 (0.6)	12 (0.6)	9 (0.5)	8 (0.5)	18 (1.3)	4 (0.9)
Jersey City Public Schools, NJ	r 6 (0.3)	r 8 (0.2)	r 18 (1.0)	r 11 (0.4)	r 12 (0.5)	r 15 (0.6)	r 10 (0.0)	r 9 (0.3)	r 19 (1.1)	s 3 (0.6)
Miami-Dade County PS, FL	s 6 (0.5)	s 9 (0.6)	s 14 (1.3)	s 10 (1.0)	s 10 (0.8)	s 11 (1.2)	s 10 (0.8)	11 (1.0)	s 20 (1.9)	s 5 (1.3)
Michigan Invitational Group, MI	5 (0.2)	9 (0.8)	20 (0.7)	10 (0.6)	8 (0.3)	12 (1.0)	8 (0.3)	8 (0.6)	16 (1.1)	r 3 (0.3)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	3 (0.2)	9 (0.5)	13 (0.8)	11 (0.5)	9 (0.3)	10 (0.6)	9 (0.5)	5 (0.2)	29 (0.6)	1 (0.0)
Project SMART Consortium, OH	r 5 (0.4)	r 9 (0.3)	r 15 (1.0)	r 11 (0.3)	r 8 (0.6)	r 11 (0.6)	r 8 (0.2)	r 8 (0.6)	r 21 (1.1)	r 5 (0.5)
Rochester City Sch. Dist., NY	r 8 (0.7)	r 10 (0.5)	r 13 (0.8)	r 10 (0.5)	r 13 (0.4)	r 9 (0.5)	r 10 (0.5)	r 7 (0.5)	r 23 (1.1)	r 5 (1.1)
SW Math/Sci. Collaborative, PA	6 (1.1)	8 (0.9)	19 (2.1)	13 (0.9)	9 (0.8)	11 (1.3)	8 (0.5)	11 (1.2)	17 (1.8)	r 2 (0.7)
International Avg. (All Countries)	4 (0.1)	9 (0.1)	24 (0.2)	14 (0.2)	10 (0.1)	10 (0.1)	10 (0.1)	10 (0.1)	15 (0.2)	3 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% students.

Exhibit 6.9 Students Doing Various Activities in Science Class*

8th Grade Science

		Percentage of Students Reporting Almost Always or Pretty Often				
		We Discuss Our Completed Homework	Teacher Shows Us How to Do Science Problems	We Work on Worksheets or Textbooks on Our Own	We Work on Science Projects	We Begin Our Homework
G General/Integrated Science						
Countries	United States	63 (1.9)	69 (1.4)	76 (1.5)	59 (1.3)	57 (2.0)
	Canada	56 (1.4)	74 (1.2)	76 (1.1)	62 (1.5)	68 (1.8)
	Chinese Taipei [a]	50 (1.4)	88 (0.7)	61 (1.3)	52 (1.3)	29 (0.9)
	England	53 (1.6)	87 (0.9)	63 (2.1)	55 (1.6)	28 (1.3)
	Hong Kong, SAR	33 (1.0)	86 (0.8)	54 (1.1)	43 (1.1)	34 (1.1)
	Italy	49 (1.4)	56 (1.5)	38 (1.3)	35 (1.7)	30 (1.6)
	Japan	10 (0.8)	74 (1.1)	29 (1.3)	21 (0.8)	7 (0.6)
	Korea, Rep. of	14 (0.8)	73 (1.1)	27 (0.8)	36 (1.0)	12 (0.6)
	Singapore	58 (0.9)	85 (0.9)	75 (0.9)	39 (1.5)	44 (1.6)
States	Connecticut	71 (2.9)	71 (2.4)	75 (2.5)	60 (3.0)	51 (2.5)
	Idaho	57 (2.0)	71 (2.1)	79 (2.0)	65 (2.4)	72 (2.2)
	Illinois	66 (2.2)	66 (1.9)	76 (2.3)	61 (2.1)	67 (1.9)
	Indiana	63 (1.8)	68 (2.4)	74 (2.8)	65 (2.3)	73 (2.4)
	Maryland	64 (1.9)	72 (1.6)	77 (1.7)	60 (1.9)	41 (1.9)
	Massachusetts	67 (2.5)	74 (2.0)	73 (1.7)	60 (2.2)	49 (2.0)
	Michigan	67 (2.4)	69 (2.3)	82 (1.3)	60 (2.5)	74 (2.3)
	Missouri	63 (2.4)	67 (2.1)	80 (1.9)	63 (2.7)	72 (2.6)
	North Carolina	70 (2.1)	78 (1.9)	84 (2.1)	61 (2.2)	61 (2.6)
	Oregon	58 (1.9)	64 (1.5)	71 (2.3)	73 (2.2)	65 (2.6)
	Pennsylvania	61 (3.1)	61 (2.0)	72 (2.6)	57 (3.8)	50 (2.6)
	South Carolina	71 (2.5)	71 (2.5)	81 (2.3)	56 (2.3)	58 (3.0)
	Texas	52 (2.6)	67 (2.8)	78 (2.0)	56 (2.5)	54 (2.3)
Districts	Academy School Dist. #20, CO	73 (1.5)	76 (1.1)	74 (1.1)	65 (1.4)	69 (1.4)
	Chicago Public Schools, IL	65 (4.3)	69 (3.0)	79 (3.0)	49 (4.3)	55 (4.0)
	Delaware Science Coalition, DE	61 (3.7)	64 (2.2)	81 (2.1)	59 (2.2)	55 (2.5)
	First in the World Consort., IL	65 (2.9)	68 (1.8)	69 (2.5)	68 (2.7)	48 (2.7)
	Fremont/Lincoln/WestSide PS, NE	67 (1.9)	75 (3.1)	76 (2.2)	69 (1.9)	63 (2.3)
	Guilford County, NC	67 (2.3)	73 (2.0)	87 (1.1)	59 (2.1)	58 (2.6)
	Jersey City Public Schools, NJ	63 (2.0)	78 (3.8)	78 (2.0)	60 (2.3)	41 (2.5)
	Miami-Dade County PS, FL	63 (3.7)	78 (2.4)	82 (1.1)	63 (3.3)	51 (3.8)
	Michigan Invitational Group, MI	70 (1.6)	67 (2.2)	81 (1.5)	58 (2.2)	69 (1.8)
	Montgomery County, MD	55 (3.3)	59 (1.7)	74 (1.9)	61 (3.8)	43 (2.8)
	Naperville Sch. Dist. #203, IL	82 (1.7)	75 (2.0)	79 (1.9)	62 (1.9)	66 (1.6)
	Project SMART Consortium, OH	71 (2.2)	66 (2.2)	74 (1.9)	57 (1.9)	63 (2.2)
	Rochester City Sch. Dist., NY	s 64 (3.8)	s 82 (1.4)	s 84 (1.8)	s 77 (2.9)	s 54 (4.2)
	SW Math/Sci. Collaborative, PA	57 (3.8)	67 (2.7)	75 (2.7)	54 (3.3)	52 (3.8)
	International Avg. (All General Science Countries)	51 (0.3)	80 (0.2)	56 (0.3)	51 (0.3)	41 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit 6.9 (Continued)

Students Doing Various Activities in Science Class*

	Percentage of Students Reporting Almost Always or Pretty Often				
	We Discuss Our Completed Homework	Teacher Shows Us How to Do Science Problems	We Work on Worksheets or Textbooks on Our Own	We Work on Science Projects	We Begin Our Homework
Earth Science					
Belgium (Flemish)	22 (1.4)	21 (1.0)	46 (1.3)	15 (0.9)	10 (0.8)
Czech Republic	27 (1.8)	96 (0.7)	49 (2.6)	15 (1.3)	13 (1.2)
Netherlands	70 (2.3)	43 (2.4)	80 (1.9)	14 (1.6)	74 (2.1)
Russian Federation	39 (1.2)	44 (1.6)	62 (1.3)	29 (1.3)	21 (0.8)
International Avg. (All Separate Science Countries)	41 (0.5)	60 (0.5)	56 (0.5)	31 (0.5)	29 (0.4)
Biology					
Belgium (Flemish)	22 (1.1)	21 (1.7)	42 (1.5)	24 (1.3)	7 (0.9)
Czech Republic	25 (1.6)	98 (0.6)	41 (2.5)	15 (1.2)	15 (1.2)
Netherlands	57 (4.0)	45 (2.1)	79 (3.6)	17 (1.7)	70 (3.1)
Russian Federation	38 (1.2)	36 (1.5)	64 (1.5)	27 (1.4)	18 (1.1)
International Avg. (All Separate Science Countries)	40 (0.5)	54 (0.4)	51 (0.5)	32 (0.4)	27 (0.4)
Physics					
Belgium (Flemish)	28 (2.1)	58 (2.6)	45 (2.0)	35 (1.8)	11 (1.3)
Czech Republic	29 (1.7)	98 (0.4)	40 (1.6)	27 (1.4)	14 (1.4)
Netherlands [b]	64 (2.9)	55 (2.5)	81 (1.9)	17 (1.5)	73 (2.7)
Russian Federation	44 (1.2)	89 (0.9)	64 (1.3)	33 (1.1)	24 (1.0)
International Avg. (All Separate Science Countries)	45 (0.5)	81 (0.3)	52 (0.4)	40 (0.4)	31 (0.4)
Chemistry					
Belgium (Flemish)	– –	– –	– –	– –	– –
Czech Republic	30 (1.9)	97 (0.9)	40 (2.1)	35 (1.4)	13 (1.2)
Netherlands	– –	– –	– –	– –	– –
Russian Federation	48 (1.2)	89 (0.8)	64 (1.6)	30 (1.2)	21 (1.1)
International Avg. (All Separate Science Countries)	45 (0.5)	85 (0.3)	50 (0.5)	44 (0.5)	28 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.10 Presentational Modes Used in Science Class*

8th Grade Science

General/Integrated Science

		Percentage of Students Reporting Almost Always or Pretty Often				
		Teacher Uses the Board	Teacher Uses an Overhead Projector	Teacher Uses a Computer to Demonstrate Ideas in Science	Students Use the Board	Students Use an Overhead Projector
Countries	United States	75 (1.6)	59 (2.3)	20 (1.4)	29 (1.0)	19 (1.1)
	Canada	81 (1.0)	55 (1.8)	10 (0.7)	19 (0.8)	11 (0.6)
	Chinese Taipei [a]	92 (0.6)	7 (1.0)	5 (0.4)	39 (1.1)	3 (0.4)
	England	93 (1.2)	36 (2.7)	8 (0.8)	16 (1.2)	6 (0.6)
	Hong Kong, SAR	88 (0.9)	25 (2.1)	9 (1.2)	32 (1.2)	6 (0.6)
	Italy	73 (1.4)	9 (0.9)	9 (0.9)	59 (1.3)	7 (0.7)
	Japan	98 (0.3)	10 (1.5)	2 (0.8)	21 (1.5)	1 (0.2)
	Korea, Rep. of	86 (1.1)	26 (2.4)	13 (1.7)	23 (1.1)	7 (0.8)
	Singapore	92 (0.9)	81 (1.5)	19 (2.0)	40 (1.6)	22 (1.0)
States	Connecticut	78 (3.1)	57 (4.8)	18 (2.0)	32 (2.8)	18 (1.8)
	Idaho	78 (2.3)	56 (4.3)	24 (2.5)	26 (2.1)	17 (1.5)
	Illinois	71 (2.6)	57 (4.4)	20 (2.0)	27 (2.6)	16 (1.4)
	Indiana	73 (2.3)	53 (3.8)	22 (2.5)	29 (2.5)	18 (1.6)
	Maryland	68 (2.4)	78 (2.5)	22 (1.6)	34 (1.9)	33 (1.8)
	Massachusetts	79 (2.5)	52 (4.1)	17 (2.0)	29 (2.1)	16 (1.3)
	Michigan	77 (2.2)	57 (3.3)	17 (1.6)	29 (2.7)	19 (1.6)
	Missouri	77 (2.0)	59 (3.4)	22 (2.3)	31 (2.6)	21 (1.8)
	North Carolina	76 (2.3)	74 (3.3)	19 (1.4)	41 (2.1)	30 (2.2)
	Oregon	62 (2.8)	76 (3.8)	20 (2.2)	26 (1.9)	28 (2.3)
	Pennsylvania	74 (2.7)	57 (3.3)	17 (1.9)	26 (1.9)	14 (1.3)
	South Carolina	70 (2.1)	73 (3.6)	21 (2.2)	29 (1.7)	20 (1.1)
	Texas	72 (2.0)	76 (2.2)	21 (2.1)	26 (1.8)	22 (1.9)
Districts	Academy School Dist. #20, CO	82 (1.0)	84 (1.1)	19 (1.0)	33 (1.2)	25 (1.3)
	Chicago Public Schools, IL	70 (5.1)	28 (7.2)	12 (2.2)	29 (3.6)	16 (4.0)
	Delaware Science Coalition, DE	71 (2.9)	56 (3.7)	20 (1.9)	24 (2.0)	20 (1.7)
	First in the World Consort., IL	79 (3.2)	59 (6.2)	20 (1.8)	29 (1.5)	19 (2.5)
	Fremont/Lincoln/WestSide PS, NE	72 (2.1)	68 (3.5)	26 (2.4)	35 (3.3)	26 (2.4)
	Guilford County, NC	72 (2.1)	71 (4.2)	12 (1.3)	32 (2.7)	26 (2.2)
	Jersey City Public Schools, NJ	81 (1.5)	46 (2.2)	28 (1.8)	29 (1.5)	17 (1.3)
	Miami-Dade County PS, FL	74 (3.2)	58 (4.1)	25 (2.5)	34 (2.7)	26 (2.4)
	Michigan Invitational Group, MI	84 (1.4)	57 (2.0)	17 (2.9)	26 (2.5)	17 (1.8)
	Montgomery County, MD	62 (3.2)	77 (3.1)	28 (2.8)	25 (2.1)	25 (1.7)
	Naperville Sch. Dist. #203, IL	90 (0.9)	66 (2.0)	18 (1.1)	30 (2.0)	23 (1.4)
	Project SMART Consortium, OH	70 (2.0)	61 (2.4)	24 (1.8)	31 (2.3)	21 (1.6)
	Rochester City Sch. Dist., NY	s 59 (3.6)	80 (2.9)	26 (2.8)	33 (3.2)	37 (3.9)
	SW Math/Sci. Collaborative, PA	75 (3.9)	45 (5.0)	15 (2.4)	25 (2.8)	12 (1.5)
	International Avg. (All General Science Countries)	86 (0.2)	32 (0.4)	10 (0.2)	42 (0.2)	13 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit 6.10
(Continued)

Presentational Modes Used in Science Class*

	Percentage of Students Reporting Almost Always or Pretty Often				
	Teacher Uses the Board	Teacher Uses an Overhead Projector	Teacher Uses a Computer to Demonstrate Ideas in Science	Students Use the Board	Students Use an Overhead Projector
Earth Science					
Belgium (Flemish)	68 (2.2)	57 (2.4)	3 (0.4)	12 (0.7)	6 (0.6)
Czech Republic	65 (2.8)	12 (1.6)	3 (0.5)	40 (2.2)	5 (0.7)
Netherlands	71 (2.5)	19 (3.0)	6 (1.0)	8 (1.1)	5 (1.1)
Russian Federation	78 (1.1)	8 (0.7)	2 (0.4)	65 (1.3)	5 (0.5)
International Avg. (All Separate Science Countries)	65 (0.6)	25 (0.6)	5 (0.2)	39 (0.5)	10 (0.3)
Biology					
Belgium (Flemish)	75 (1.9)	50 (2.3)	3 (0.6)	13 (0.9)	4 (0.7)
Czech Republic	79 (2.3)	17 (2.1)	3 (1.0)	40 (2.2)	4 (0.5)
Netherlands	75 (2.4)	14 (2.7)	3 (0.7)	7 (0.9)	3 (0.6)
Russian Federation	80 (1.3)	10 (1.0)	2 (0.2)	61 (1.6)	5 (0.6)
International Avg. (All Separate Science Countries)	73 (0.5)	28 (0.5)	5 (0.2)	37 (0.4)	9 (0.2)
Physics					
Belgium (Flemish)	77 (2.2)	26 (2.9)	4 (0.8)	18 (1.5)	5 (0.7)
Czech Republic	87 (1.1)	18 (1.8)	5 (0.7)	66 (2.1)	6 (0.6)
Netherlands[b]	73 (2.0)	13 (2.1)	5 (1.0)	9 (1.3)	3 (0.5)
Russian Federation	91 (0.6)	10 (0.9)	3 (0.4)	82 (1.0)	6 (0.5)
International Avg. (All Separate Science Countries)	83 (0.3)	23 (0.5)	7 (0.2)	56 (0.4)	10 (0.2)
Chemistry					
Belgium (Flemish)	– –	– –	– –	– –	– –
Czech Republic	90 (1.3)	19 (2.3)	3 (0.8)	67 (2.2)	5 (0.8)
Netherlands	– –	– –	– –	– –	– –
Russian Federation	93 (0.6)	9 (0.7)	2 (0.3)	84 (1.2)	5 (0.5)
International Avg. (All Separate Science Countries)	87 (0.3)	23 (0.5)	6 (0.2)	68 (0.4)	10 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.11 Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving (ESRPS)

8th Grade Science

Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving

Index based on teachers' responses to five questions about how often they ask students to: 1) explain the reasoning behind an idea; 2) represent and analyze relationships using tables, charts, graphs; 3) work on problems for which there is no immediately obvious method of solution; 4) write explanations about what was observed and why it happened; 5) put events or objects in order and give a reason for the organization (see reference exhibit R3.7). Average is computed across the five items based on a 4-point scale: 1 = never or almost never; 2 = some lessons; 3 = most lessons; 4 = every lesson. High level indicates average is greater than or equal to 3. Medium level indicates average is greater than or equal to 2.25 and less than 3. Low level indicates average is less than 2.25.

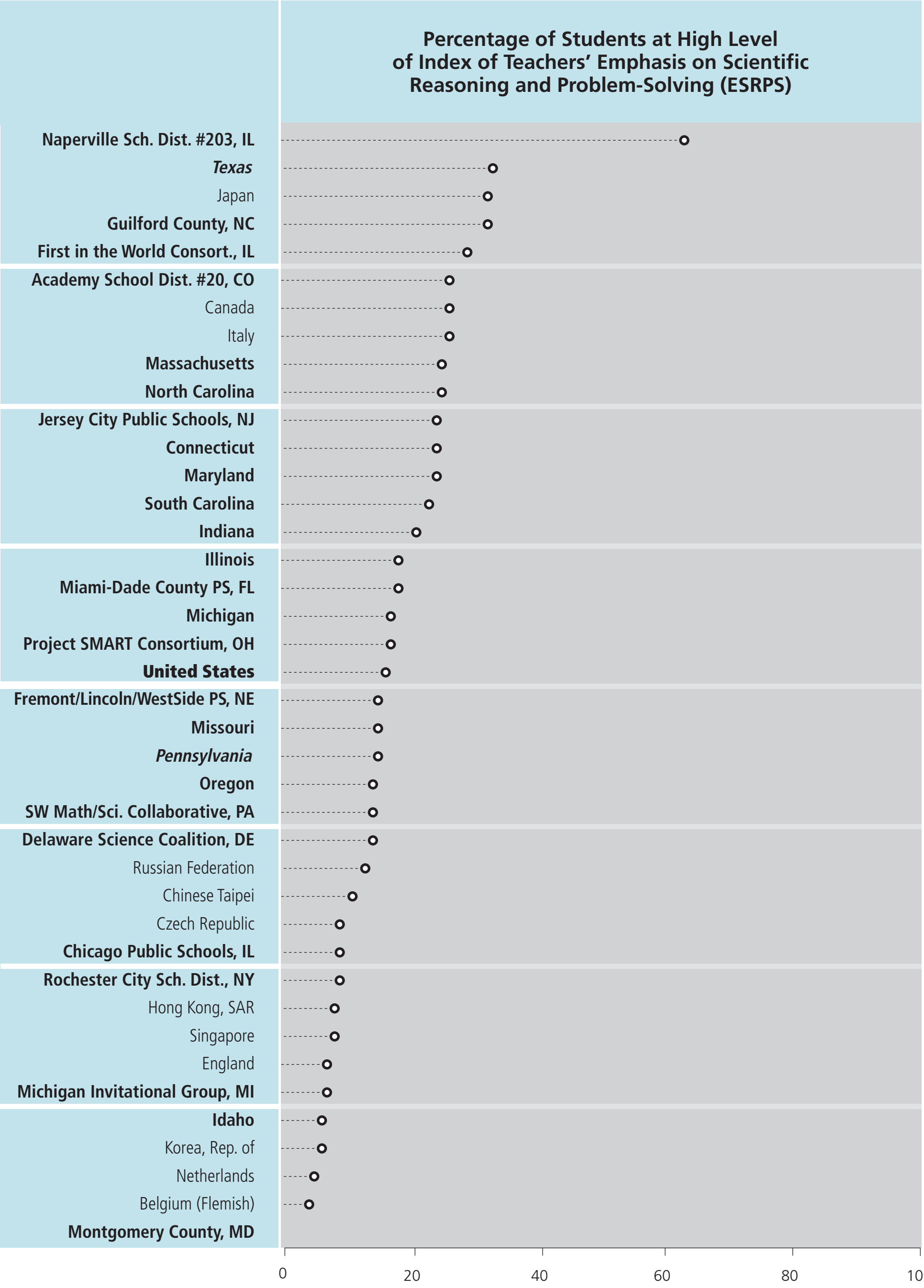
		High ESRPS		Medium ESRPS		Low ESRPS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Naperville Sch. Dist. #203, IL		63 (4.1)	578 (5.1)	31 (4.1)	592 (9.1)	6 (0.7)	615 (14.8)
Texas	r	33 (7.7)	506 (20.4)	48 (6.3)	528 (10.7)	19 (4.0)	479 (25.0)
Japan		32 (4.0)	555 (3.1)	37 (4.4)	549 (3.5)	31 (3.9)	545 (3.7)
Guilford County, NC		32 (5.2)	526 (15.9)	40 (4.8)	543 (12.3)	28 (4.1)	524 (20.2)
First in the World Consort., IL		29 (6.2)	553 (11.5)	46 (7.5)	576 (9.4)	25 (2.7)	556 (6.1)
Academy School Dist. #20, CO		26 (0.3)	556 (3.9)	57 (0.4)	563 (3.4)	17 (0.3)	550 (2.4)
Canada	r	26 (3.1)	551 (5.5)	48 (3.4)	530 (4.4)	26 (2.7)	528 (5.7)
Italy		26 (3.8)	490 (7.4)	46 (4.4)	490 (5.9)	28 (3.7)	502 (6.8)
Massachusetts	r	25 (4.6)	517 (12.3)	52 (5.4)	535 (9.4)	23 (3.4)	552 (15.0)
North Carolina		25 (5.7)	509 (18.8)	41 (5.2)	505 (8.5)	35 (5.2)	504 (11.3)
Jersey City Public Schools, NJ	r	24 (4.8)	460 (12.0)	56 (6.0)	449 (13.2)	20 (5.2)	435 (9.8)
Connecticut	s	24 (7.3)	525 (15.4)	46 (6.2)	547 (15.8)	30 (6.3)	527 (13.4)
Maryland	s	24 (3.7)	490 (14.9)	53 (4.7)	509 (11.1)	23 (4.8)	506 (12.0)
South Carolina		23 (5.3)	511 (16.7)	51 (5.5)	519 (8.3)	26 (5.2)	504 (17.7)
Indiana		21 (5.0)	527 (13.0)	58 (6.6)	544 (8.1)	22 (5.6)	532 (13.7)
Illinois		18 (5.5)	542 (12.8)	43 (6.0)	522 (8.9)	39 (6.6)	524 (7.9)
Miami-Dade County PS, FL	s	18 (4.4)	403 (17.3)	55 (8.1)	420 (11.6)	28 (9.0)	469 (12.2)
Michigan	r	17 (5.2)	531 (12.4)	46 (6.5)	562 (9.2)	37 (5.0)	556 (8.6)
Project SMART Consortium, OH	r	17 (2.9)	522 (15.7)	35 (4.0)	529 (14.7)	47 (4.2)	549 (13.0)
United States	r	16 (2.3)	519 (9.7)	51 (3.2)	524 (6.3)	33 (3.7)	514 (6.5)
Fremont/Lincoln/WestSide PS, NE		15 (6.9)	530 (7.7)	44 (6.2)	508 (9.6)	41 (9.2)	511 (12.7)
Missouri	r	15 (4.9)	530 (20.9)	49 (6.9)	524 (9.4)	35 (5.2)	530 (8.5)
Pennsylvania		15 (6.5)	543 (14.9)	43 (5.3)	534 (5.3)	43 (8.3)	518 (10.0)
Oregon		14 (4.2)	533 (14.9)	48 (6.3)	540 (10.9)	38 (6.3)	540 (9.1)
SW Math/Sci. Collaborative, PA		14 (4.2)	533 (11.5)	45 (8.5)	546 (9.4)	41 (9.2)	546 (14.3)
Delaware Science Coalition, DE	r	14 (4.6)	527 (26.1)	55 (6.7)	489 (10.6)	32 (7.2)	500 (16.1)
Russian Federation		13 (1.5)	548 (13.0)	50 (2.6)	530 (7.1)	37 (2.5)	523 (5.7)
Chinese Taipei		11 (2.5)	589 (13.5)	34 (4.3)	576 (7.4)	54 (4.4)	559 (4.9)
Czech Republic		9 (1.7)	543 (8.2)	42 (3.1)	543 (6.1)	48 (3.4)	537 (4.5)
Chicago Public Schools, IL	r	9 (5.3)	377 (36.2)	65 (7.3)	466 (13.0)	26 (7.6)	447 (8.1)
Rochester City Sch. Dist., NY	r	9 (3.1)	406 (23.0)	64 (5.7)	459 (10.0)	28 (5.2)	446 (18.2)
Hong Kong, SAR		8 (2.5)	554 (12.3)	29 (4.4)	538 (7.0)	63 (4.6)	524 (4.9)
Singapore		8 (2.4)	600 (20.7)	29 (3.8)	579 (15.8)	63 (4.2)	559 (10.0)
England	s	7 (2.3)	541 (28.3)	41 (4.6)	557 (7.5)	51 (4.7)	540 (8.0)
Michigan Invitational Group, MI		7 (0.7)	513 (6.7)	46 (4.3)	565 (8.2)	46 (4.6)	572 (7.5)
Idaho	r	6 (3.0)	518 (12.5)	54 (5.8)	532 (7.5)	40 (6.4)	524 (11.4)
Korea, Rep. of		6 (1.9)	541 (10.4)	48 (4.1)	552 (3.3)	46 (3.9)	547 (3.2)
Netherlands		5 (1.4)	570 (13.1)	35 (4.3)	559 (6.9)	60 (4.6)	536 (10.1)
Belgium (Flemish)		4 (0.8)	550 (7.4)	20 (2.6)	537 (11.5)	77 (2.6)	533 (4.7)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
International Avg. (All Countries)		16 (0.4)	490 (1.9)	44 (0.6)	488 (1.2)	40 (0.6)	482 (1.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.12 Index of Emphasis on Conducting Experiments in Science Classes (ECES)

TIMSS 1999
Benchmarking
Boston College

8th Grade Science

Index of Emphasis on Conducting Experiments in Science Classes

Index based on teachers' reports on the percentage of time they spend demonstrating experiments; teachers' reports on the percentage of time students spend conducting experiments; students' reports on how often the teacher gives a demonstration of an experiment in science lessons; students' reports on how often they conduct an experiment or practical investigation in class (see exhibits 6.8, R3.8 and R3.9). In countries where science is taught as separate subjects, students were asked about each subject area separately, and only teachers who teach a particular subject are represented in the figures shown for that subject. High level indicates the teacher reported that at least 25 percent of class time is spent on the teacher demonstrating experiments or students conducting experiments, and the student reported that the teacher gives a demonstration of an experiment or the student conducts an experiment or practical investigation in class almost always or pretty often. Low level indicates the teacher reported that less than 10 percent of class time is spent on the teacher demonstrating experiments or students conducting experiments, and the student reported that the teacher gives a demonstration of an experiment and the student conducts an experiment or practical investigation in class once in a while or never. Medium level includes all other possible combinations of responses.

General/Integrated Science (ECES-G)

G

		High ECES		Medium ECES		Low ECES	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Naperville Sch. Dist. #203, IL		79 (3.8)	584 (5.3)	21 (3.8)	592 (11.8)	0 (0.0)	~ ~
Hong Kong, SAR		78 (3.3)	536 (3.8)	22 (3.2)	516 (9.3)	1 (0.4)	~ ~
England	s	59 (4.9)	556 (7.9)	40 (4.9)	539 (8.0)	0 (0.0)	~ ~
Maryland	s	59 (5.3)	518 (8.9)	40 (5.3)	502 (7.3)	1 (0.4)	~ ~
First in the World Consort., IL		56 (6.9)	573 (6.0)	44 (6.9)	555 (8.0)	0 (0.0)	~ ~
Academy School Dist. #20, CO		56 (0.7)	563 (3.5)	44 (0.7)	558 (2.9)	0 (0.0)	~ ~
Connecticut	s	56 (6.9)	550 (13.8)	44 (6.9)	534 (8.0)	0 (0.3)	~ ~
Singapore		55 (4.1)	580 (10.0)	44 (4.0)	556 (12.7)	1 (0.6)	~ ~
Japan		54 (4.0)	552 (3.2)	45 (3.8)	549 (2.6)	1 (0.6)	~ ~
Fremont/Lincoln/WestSide PS, NE	r	52 (8.2)	524 (9.4)	47 (7.7)	514 (9.7)	1 (0.6)	~ ~
Oregon	r	49 (4.9)	557 (8.5)	50 (4.8)	533 (5.7)	2 (0.8)	~ ~
Canada	r	47 (3.8)	539 (4.1)	52 (3.9)	533 (3.6)	1 (0.5)	~ ~
Miami-Dade County PS, FL	s	47 (10.3)	420 (6.8)	53 (10.3)	451 (15.8)	0 (0.0)	~ ~
Michigan	r	44 (6.0)	566 (5.6)	54 (6.1)	548 (10.1)	2 (1.6)	~ ~
Project SMART Consortium, OH	r	43 (3.5)	544 (11.8)	57 (3.5)	535 (10.9)	0 (0.0)	~ ~
Texas	s	41 (6.0)	524 (11.5)	56 (5.8)	518 (14.8)	3 (1.1)	421 (48.8)
Indiana	r	41 (6.9)	545 (10.2)	59 (6.9)	540 (8.1)	1 (0.4)	~ ~
Massachusetts	r	40 (4.9)	551 (6.3)	58 (5.0)	532 (9.1)	2 (1.5)	~ ~
SW Math/Sci. Collaborative, PA		39 (6.9)	559 (6.8)	57 (6.3)	539 (11.0)	4 (2.9)	511 (20.7)
Jersey City Public Schools, NJ	r	38 (4.0)	435 (9.8)	60 (4.0)	460 (12.7)	2 (0.2)	~ ~
Illinois	r	34 (6.3)	542 (7.1)	61 (6.4)	520 (7.6)	4 (1.9)	533 (27.9)
Idaho	r	34 (6.5)	534 (11.5)	65 (6.6)	528 (7.1)	1 (0.9)	~ ~
Pennsylvania	r	33 (6.8)	549 (8.9)	60 (4.4)	528 (7.8)	7 (4.1)	491 (12.2)
United States	r	31 (2.6)	531 (6.8)	64 (2.6)	523 (5.3)	4 (1.1)	529 (7.5)
Missouri	r	31 (5.8)	536 (7.7)	62 (5.7)	524 (10.4)	7 (3.0)	526 (23.0)
Chicago Public Schools, IL	r	29 (9.2)	493 (17.7)	65 (8.2)	439 (9.4)	7 (4.3)	462 (28.1)
South Carolina	r	28 (5.1)	528 (9.9)	71 (5.0)	510 (6.9)	1 (0.7)	~ ~
Korea, Rep. of		27 (3.1)	558 (3.4)	71 (3.0)	546 (3.0)	2 (0.7)	~ ~
Guilford County, NC		27 (4.0)	540 (15.6)	73 (4.0)	532 (9.2)	1 (0.0)	~ ~
North Carolina	r	24 (6.1)	505 (14.1)	72 (6.1)	510 (6.2)	4 (1.6)	486 (27.0)
Michigan Invitational Group, MI	r	22 (2.8)	577 (20.5)	78 (2.8)	564 (4.5)	0 (0.0)	~ ~
Delaware Science Coalition, DE	s	17 (5.5)	519 (28.9)	79 (5.7)	513 (9.2)	3 (0.9)	506 (38.5)
Chinese Taipei [a]		14 (2.8)	574 (9.2)	84 (2.9)	570 (4.9)	2 (0.6)	~ ~
Italy		2 (0.6)	~ ~	73 (3.0)	493 (4.3)	25 (2.9)	498 (6.7)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Rochester City Sch. Dist., NY		x x	x x	x x	x x	x x	x x
International Avg. (All General Science Countries)		38 (0.7)	483 (1.7)	59 (0.7)	478 (1.3)	3 (0.2)	459 (5.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

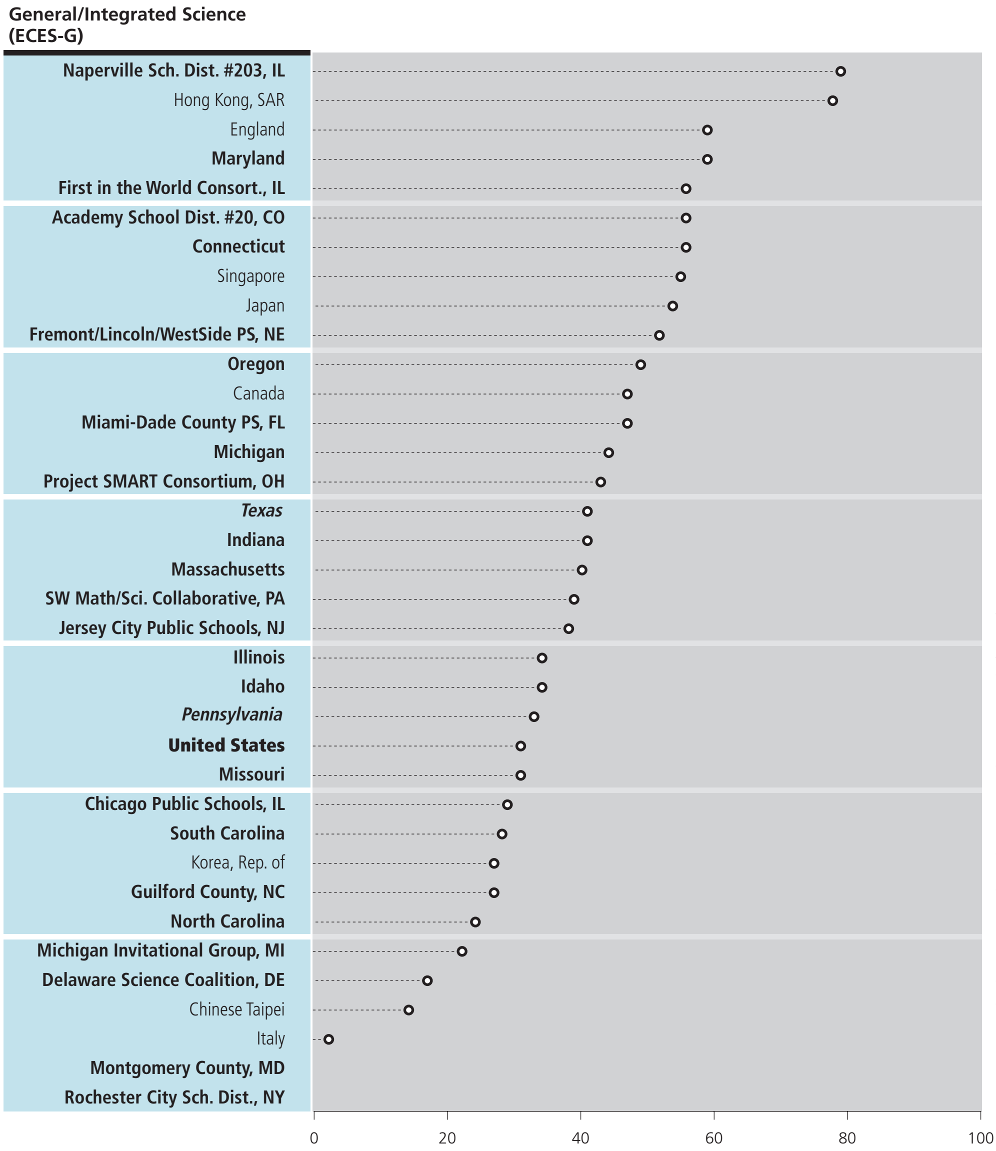
A tilde (~) indicates insufficient data to report achievement.

An "r" indicates teacher and/or student response data available for 70-84% of students. An "s" indicates teacher and/or student response data available for 50-69% of students. An "x" indicates teacher and/or student response data available for <50% of students.

Exhibit 6.12
(Continued 1)

Index of Emphasis on Conducting Experiments in Science Classes (ECES)

Percentage of Students at High Level of Index of Emphasis on Conducting Experiments in Science Classes (ECES)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.12
(Continued 2)

Index of Emphasis on Conducting Experiments in Science Classes (ECES)

8th Grade Science

		High ECES		**Medium** ECES		**Low** ECES	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Earth Science (ECES-E)							
Belgium (Flemish)	r	2 (0.6)	~ ~	43 (3.6)	530 (5.3)	56 (3.8)	549 (5.9)
Czech Republic		0 (0.0)	~ ~	24 (4.4)	526 (5.3)	76 (4.4)	544 (4.3)
Netherlands	r	0 (0.0)	~ ~	12 (1.9)	526 (15.6)	88 (1.9)	551 (7.3)
Russian Federation		0 (0.0)	~ ~	45 (2.8)	521 (8.6)	55 (2.8)	538 (7.0)
International Avg. (All Separate Science Countries)		1 (0.2)	~ ~	48 (1.1)	505 (2.7)	52 (1.1)	525 (2.2)
Biology (ECES-B)							
Belgium (Flemish)	r	15 (2.7)	543 (5.6)	77 (3.1)	549 (4.6)	8 (1.7)	537 (11.7)
Netherlands	r	1 (0.7)	~ ~	76 (5.1)	545 (12.1)	23 (5.1)	533 (10.3)
Russian Federation		1 (0.4)	~ ~	79 (2.5)	530 (6.7)	20 (2.5)	540 (9.0)
Czech Republic		0 (0.0)	~ ~	72 (3.5)	538 (5.0)	28 (3.5)	547 (7.3)
International Avg. (All Separate Science Countries)		4 (0.4)	494 (10.9)	76 (1.0)	515 (1.9)	21 (0.9)	520 (2.9)
Physics (ECES-P)							
Belgium (Flemish)	r	46 (6.6)	557 (10.5)	52 (6.7)	549 (6.6)	2 (0.2)	~ ~
Netherlands [b]	r	16 (4.4)	550 (11.8)	78 (5.0)	551 (7.9)	6 (3.2)	497 (36.9)
Czech Republic		14 (2.9)	536 (10.9)	82 (2.8)	544 (4.7)	5 (1.4)	555 (12.8)
Russian Federation		5 (1.9)	538 (18.4)	90 (2.1)	533 (6.2)	5 (1.0)	516 (16.9)
International Avg. (All Separate Science Countries)		21 (1.0)	524 (3.3)	74 (1.0)	514 (1.7)	5 (0.5)	507 (5.3)
Chemistry (ECES-C)							
Czech Republic		10 (3.0)	556 (13.9)	87 (3.0)	538 (4.2)	3 (0.9)	545 (14.0)
Russian Federation		2 (1.5)	~ ~	93 (1.5)	532 (6.3)	5 (0.9)	532 (17.4)
Belgium (Flemish)		– –	– –	– –	– –	– –	– –
Netherlands		– –	– –	– –	– –	– –	– –
International Avg. (All Separate Science Countries)		11 (0.9)	508 (5.5)	84 (0.9)	506 (2.0)	5 (0.4)	495 (5.9)

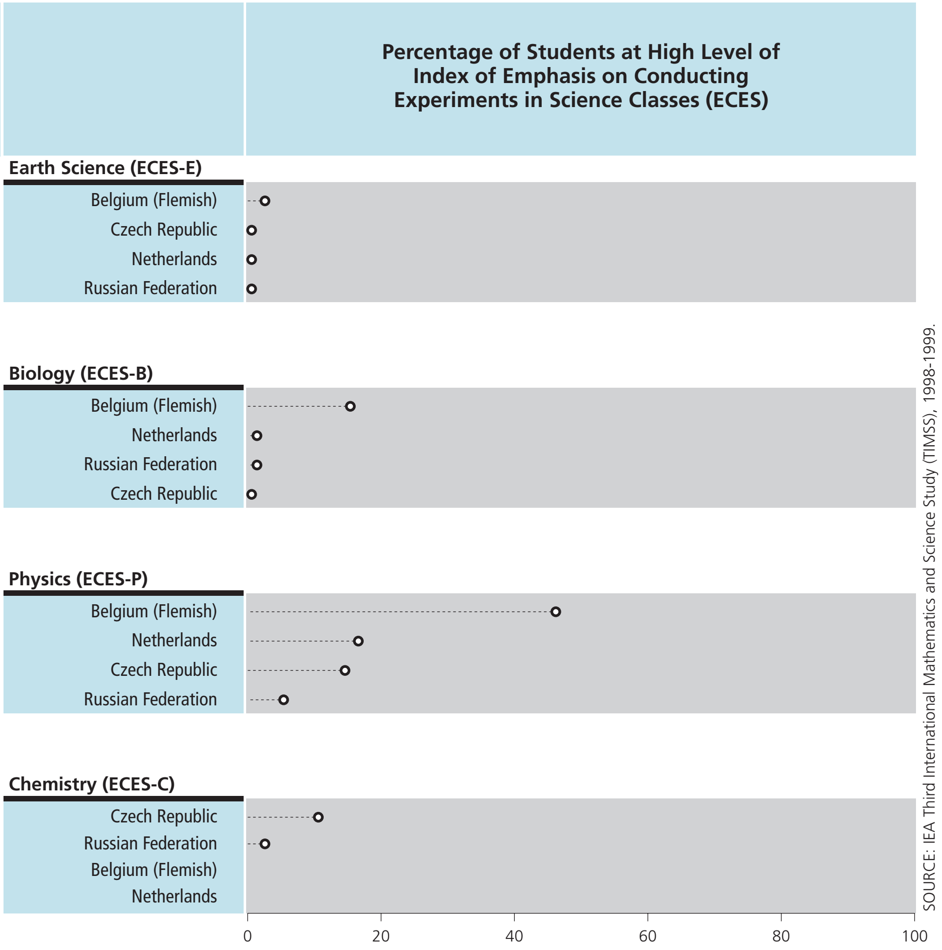
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

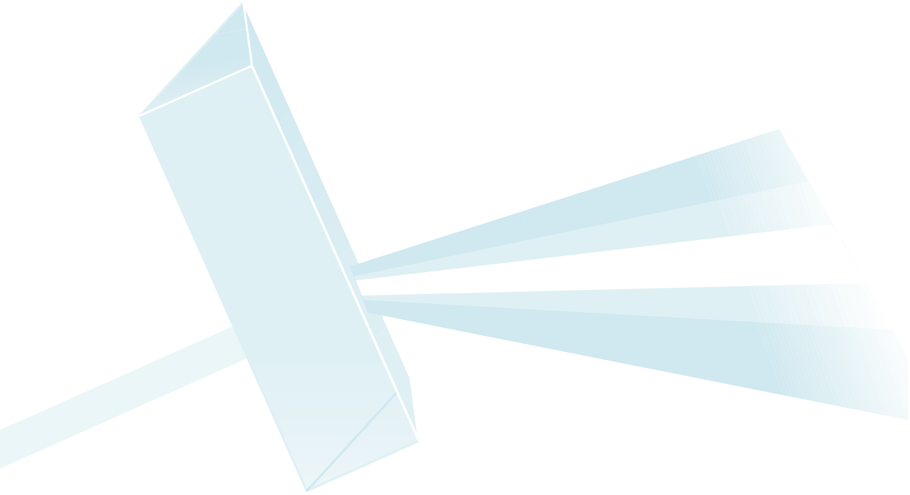
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

An “r” indicates teacher and/or student response data available for 70-84% of students.



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.



How Are Computers Used?

Students' reports on the frequency of computer use in science class are presented in Exhibit 6.13. Internationally, very few students reported frequent use of computers in any of the science subjects, although somewhat greater use was found across the countries with general/integrated science. Computer use was most frequent in the United States, where 21 percent of students reported using computers in science class almost always or pretty often, compared with eight percent on average internationally. Use among Benchmarking participants ranged from 12 percent in the Chicago Public Schools to 35 percent in the Jersey City Public Schools.

Because the Internet provides a wealth of opportunities for students to collect and analyze information, TIMSS began asking about students' access to the Internet and whether they used the World Wide Web to access information for science projects. The data in Exhibit 6.14 indicate great variation in Internet access across countries and across the Benchmarking participants. Still, the international averages show about one-quarter of the students with access to the Internet at school. The international average for using the Internet to access information for science class on even a monthly basis was 12 percent (less than half those reporting access). For the Benchmarking jurisdictions, Internet access at school ranged from 31 to 32 percent in Rochester and Chicago to 98 percent in First in the World and Naperville. Jurisdictions reporting 30 percent or more of the students accessing information for science class on a monthly basis were Connecticut, Massachusetts, the Academy School District, the Delaware Science Coalition, First in the World, Jersey City, Montgomery County, and Naperville. In general, Internet use for science projects was more common among Benchmarking participants than in any of the comparison countries.

Exhibit 6.13 Frequency of Computer Use in Science Classes*

8th Grade Science

Percentage of Students Reporting Almost Always or Pretty Often

Participants with General/ Integrated Science		
Countries		
United States		21 (1.4)
Canada		14 (0.7)
Chinese Taipei [a]		5 (0.3)
England		10 (1.1)
Hong Kong, SAR		6 (0.6)
Italy		10 (1.2)
Japan		2 (0.8)
Korea, Rep. of		7 (0.9)
Singapore		15 (1.4)
States		
Connecticut		20 (2.0)
Idaho		22 (2.8)
Illinois		20 (2.0)
Indiana		20 (1.8)
Maryland		20 (1.8)
Massachusetts		18 (2.3)
Michigan		15 (1.6)
Missouri		21 (2.6)
North Carolina		20 (1.5)
Oregon		22 (2.5)
Pennsylvania		16 (1.9)
South Carolina		20 (1.9)
Texas		17 (1.3)
Districts and Consortia		
Academy School Dist. #20, CO		23 (1.1)
Chicago Public Schools, IL		12 (2.2)
Delaware Science Coalition, DE		21 (1.4)
First in the World Consort., IL		30 (2.5)
Fremont/Lincoln/WestSide PS, NE		30 (2.6)
Guilford County, NC		17 (1.9)
Jersey City Public Schools, NJ		35 (2.4)
Miami-Dade County PS, FL		24 (2.4)
Michigan Invitational Group, MI		18 (2.2)
Montgomery County, MD		31 (3.8)
Naperville Sch. Dist. #203, IL		23 (1.5)
Project SMART Consortium, OH		27 (1.9)
Rochester City Sch. Dist., NY	s	24 (3.7)
SW Math/Sci. Collaborative, PA		16 (2.7)
International Avg. (All General Science Countries)		8 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries with Separate Science Subjects	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	2 (0.4)	2 (0.6)	3 (0.5)	– –
Czech Republic	2 (0.4)	2 (0.8)	2 (0.6)	1 (0.5)
Netherlands [b]	5 (0.7)	2 (0.3)	3 (0.4)	– –
Russian Federation	2 (0.3)	1 (0.2)	2 (0.3)	2 (0.2)
International Avg. (All Separate Science Countries)	4 (0.2)	3 (0.2)	5 (0.2)	4 (0.2)

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit 6.14 Access to the Internet and Use of the Internet for Science Projects

	Percentage of Students				
	Have Access to the Internet			Use the Internet for Science Projects at Least Once a Month	
	At Home	At School	Elsewhere	Use E-mail to Work with Students in Other Schools	Use the World Wide Web to Access Information
Countries					
United States	59 (1.7)	76 (3.2)	81 (0.9)	9 (0.5)	29 (1.3)
Belgium (Flemish)	27 (0.9)	44 (2.7)	64 (1.1)	3 (0.4)	10 (0.9)
Canada	57 (1.3)	87 (1.5)	84 (0.8)	6 (0.4)	25 (0.9)
Chinese Taipei	32 (1.1)	61 (3.2)	41 (0.8)	9 (0.4)	15 (0.6)
Czech Republic	7 (0.7)	16 (2.6)	39 (1.6)	2 (0.3)	5 (0.5)
England	36 (1.1)	65 (3.1)	53 (1.3)	6 (0.5)	22 (1.1)
Hong Kong, SAR	34 (1.1)	26 (2.2)	34 (0.8)	8 (0.6)	13 (0.7)
Italy	13 (0.7)	20 (2.2)	27 (1.1)	5 (0.5)	8 (0.7)
Japan	r 13 (0.9)	6 (1.6)	2 (0.3)	7 (0.8)	7 (0.8)
Korea, Rep. of	23 (0.7)	6 (1.2)	36 (1.0)	4 (0.3)	6 (0.4)
Netherlands	41 (1.8)	53 (5.4)	74 (1.8)	4 (0.7)	8 (0.8)
Russian Federation	3 (0.3)	1 (0.4)	17 (0.9)	3 (0.3)	4 (0.4)
Singapore	47 (1.9)	48 (3.2)	39 (0.9)	9 (0.6)	19 (0.9)
States					
Connecticut	71 (2.5)	85 (2.3)	85 (0.8)	11 (1.1)	32 (1.6)
Idaho	53 (2.7)	84 (4.1)	78 (1.4)	8 (0.8)	25 (2.4)
Illinois	56 (2.3)	79 (3.6)	79 (1.5)	8 (0.7)	26 (1.9)
Indiana	59 (2.0)	70 (5.8)	85 (1.5)	8 (0.8)	22 (1.8)
Maryland	66 (1.8)	77 (3.2)	83 (0.8)	11 (0.9)	28 (1.4)
Massachusetts	68 (2.1)	78 (3.6)	83 (1.3)	11 (1.1)	35 (1.9)
Michigan	61 (2.4)	80 (3.7)	83 (1.2)	8 (0.8)	24 (1.5)
Missouri	49 (1.5)	77 (5.3)	82 (1.0)	8 (0.5)	24 (1.0)
North Carolina	51 (2.0)	80 (2.7)	82 (0.9)	9 (0.7)	25 (1.5)
Oregon	61 (2.1)	85 (4.4)	82 (1.7)	7 (0.6)	28 (2.2)
Pennsylvania	64 (2.7)	69 (4.0)	82 (0.9)	8 (0.5)	28 (1.9)
South Carolina	52 (2.2)	92 (1.5)	81 (1.3)	9 (0.7)	26 (1.4)
Texas	54 (3.5)	82 (3.5)	79 (2.2)	11 (0.8)	27 (1.4)
Districts and Consortia					
Academy School Dist. #20, CO	84 (1.1)	93 (0.7)	78 (1.2)	9 (0.9)	37 (1.3)
Chicago Public Schools, IL	35 (2.4)	32 (6.8)	72 (1.9)	7 (1.0)	18 (2.3)
Delaware Science Coalition, DE	66 (2.3)	88 (1.5)	84 (1.0)	13 (1.1)	38 (1.8)
First in the World Consort., IL	82 (1.0)	98 (0.6)	86 (1.7)	10 (1.4)	40 (2.1)
Fremont/Lincoln/WestSide PS, NE	61 (1.9)	91 (1.4)	85 (1.6)	8 (1.2)	24 (2.2)
Guilford County, NC	64 (1.9)	89 (1.0)	89 (1.1)	8 (0.8)	28 (2.0)
Jersey City Public Schools, NJ	38 (2.2)	92 (1.2)	71 (2.1)	14 (1.6)	36 (2.6)
Miami-Dade County PS, FL	47 (3.1)	59 (6.7)	73 (2.4)	17 (1.9)	29 (2.1)
Michigan Invitational Group, MI	62 (2.1)	90 (1.3)	83 (1.4)	5 (0.8)	28 (2.0)
Montgomery County, MD	77 (1.8)	92 (1.0)	74 (2.2)	12 (1.1)	39 (2.8)
Naperville Sch. Dist. #203, IL	86 (1.0)	98 (0.4)	87 (0.8)	9 (0.6)	30 (1.3)
Project SMART Consortium, OH	63 (1.8)	83 (1.1)	91 (0.7)	9 (0.8)	27 (1.4)
Rochester City Sch. Dist., NY	31 (2.3)	31 (1.6)	74 (2.0)	10 (0.9)	19 (1.3)
SW Math/Sci. Collaborative, PA	58 (2.7)	80 (4.7)	83 (1.6)	6 (0.7)	23 (1.9)
International Avg. (All Countries)	19 (0.2)	27 (0.4)	43 (0.2)	7 (0.1)	12 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates a 70-84% student response rate.

What Are the Roles of Homework and Assessment?

The amount of time students spend on homework assignments is an important consideration in examining their opportunity to learn science. Exhibit 6.15 presents the index of teachers' emphasis on science homework (ESH). Students in the high category had teachers who reported giving relatively long homework assignments (more than 30 minutes) on a relatively frequent basis (at least once or twice a week). Those in the low category had teachers who gave short assignments (less than 30 minutes) relatively infrequently (less than once a week or never). The medium level includes all other combinations of responses. Details from teachers' reports about the length and frequency of their homework assignments are found in the reference section in Exhibit R3.11.

The results show substantial variation across countries and Benchmarking entities in the emphasis placed on homework. Together with Italy among the comparison countries, the Academy School District had more than half its students in the high category. For the remaining Benchmarking participants, the majority of students were in the medium category. Countries with one-third or more of their students in the low category included Korea, Japan, Belgium (Flemish), and the Czech Republic. Only the Fremont/Lincoln/Westside Public Schools had a comparable percentage among Benchmarking participants. There was little relationship between the amount of homework assigned and students' performance. Again, lower-performing students may need more homework assignments for remedial reasons.

Since problem-solving activities will potentially be more beneficial if they can be extended to out-of-class-situations and stretched over a longer time, TIMSS asked teachers how often they assigned science homework based on projects and investigations. The data in Exhibit R3.12 in the reference section show that this was a more common practice in the United States and the Benchmarking jurisdictions than in the comparison countries, with the exception of Canada. Although the percentage of students in classes where this type of science homework is sometimes or always assigned was well above the international average of 34 percent in most Benchmarking jurisdictions, it ranged from 18 percent in the Rochester City School District to 92 percent in the Naperville School District. In some countries the students who were sometimes or always assigned science projects as homework performed slightly better than those who were rarely or never assigned it.

One theme in recommendations for educational reform is to make assessment a continuous process that relies on a variety of methods and sources of data, rather than on a few high-stakes tests. Exhibit 6.16 shows teachers' reports about the weight given to various types of assessment. Teachers in the United States as a whole and in most of the Benchmarking jurisdictions reported placing less weight on informal assessment approaches than did teachers internationally. On average internationally, the most emphasis was placed on teacher-made tests requiring explanations and on students' responses in class, which were given quite a lot or a great deal of weight for 76 and 75 percent of the students, respectively. The next heaviest weight internationally was given to observations of students (68 percent). While the weight given teacher-made tests requiring explanations was similar to or greater than the international average in many Benchmarking jurisdictions, students' responses in class and observations of students were given less weight in the United States as a whole and in most Benchmarking jurisdictions (generally for about half the students or less). Exceptions included Chicago, the Delaware Science Coalition, Jersey City, and Miami-Dade.

Internationally, the least weight reportedly was given to external standardized tests, with just 33 percent of students having science teachers who reported giving them quite a lot or a great deal of weight. Science teachers in the United States and across Benchmarking participants generally gave less weight to these tests. The percentage of students whose teachers give a lot of weight to such assessments ranged from less than 10 percent in Indiana, Maryland, Pennsylvania, the Academy School District, First in the World, and Naperville, to more than 40 percent in the Jersey City Public Schools.

As shown in Exhibit R3.13, eighth-grade students reported substantial variation in the frequency of testing in their science classes. On average internationally, 58 percent of students in general/integrated science classes and about 50 percent of students in separate science classes reported having a quiz or test almost always or pretty often. Testing was reported to be relatively frequent in the United States, where 77 percent of students reported often having a quiz or test in science class. Across the Benchmarking participants generally, between 70 and 85 percent of eighth-grade students were in science classes with frequent testing.

Exhibit 6.15 Index of Teachers' Emphasis on Science Homework (ESH)

8th Grade Science

Index of Teachers' Emphasis on Science Homework

Index based on teachers' responses to two questions about how often they usually assign science homework and how many minutes of science homework they usually assign students (see reference exhibit R3.11). High level indicates the assignment of more than 30 minutes of homework at least once or twice a week. Low level indicates the assignment of less than 30 minutes of homework less than once a week or never assigning homework. Medium level includes all other possible combinations of responses.

	High ESH		Medium ESH		Low ESH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Italy	58 (3.3)	493 (5.9)	34 (3.2)	495 (5.5)	8 (1.8)	486 (12.0)
Academy School Dist. #20, CO	50 (0.4)	563 (2.8)	50 (0.4)	555 (2.9)	0 (0.0)	~ ~
Singapore	35 (4.3)	570 (12.3)	55 (4.1)	575 (11.2)	11 (2.4)	524 (19.3)
Rochester City Sch. Dist., NY	34 (4.7)	468 (14.9)	52 (5.3)	444 (7.9)	13 (4.4)	447 (15.9)
Chicago Public Schools, IL	32 (8.9)	449 (20.4)	68 (8.9)	452 (11.2)	0 (0.0)	~ ~
Russian Federation	32 (2.6)	527 (8.3)	66 (2.6)	530 (6.6)	3 (0.8)	542 (18.4)
Chinese Taipei	26 (3.8)	584 (7.8)	54 (4.4)	566 (5.5)	20 (3.3)	558 (7.9)
Michigan Invitational Group, MI	25 (2.6)	567 (19.0)	75 (2.6)	563 (5.4)	0 (0.0)	~ ~
England	22 (2.9)	563 (11.3)	74 (3.1)	533 (5.2)	4 (1.3)	511 (12.4)
Project SMART Consortium, OH	19 (2.8)	568 (16.5)	70 (2.3)	534 (9.9)	12 (2.6)	510 (13.9)
Massachusetts	18 (3.8)	529 (15.5)	82 (3.8)	534 (8.2)	0 (0.0)	~ ~
Oregon	17 (5.1)	548 (11.0)	68 (5.8)	534 (7.0)	14 (4.8)	538 (12.3)
Miami-Dade County PS, FL	17 (5.1)	435 (11.3)	81 (5.7)	424 (11.3)	2 (2.2)	~ ~
Naperville Sch. Dist. #203, IL	17 (2.8)	594 (9.6)	83 (2.8)	583 (4.6)	0 (0.0)	~ ~
Jersey City Public Schools, NJ	16 (2.8)	438 (16.2)	82 (2.9)	439 (11.5)	3 (0.1)	403 (10.6)
United States	15 (1.8)	507 (9.5)	77 (2.4)	517 (5.2)	8 (1.7)	505 (15.6)
Pennsylvania	15 (4.5)	531 (16.8)	76 (5.3)	531 (6.7)	9 (3.0)	496 (19.9)
Hong Kong, SAR	14 (2.8)	527 (8.3)	68 (4.0)	533 (4.2)	19 (3.6)	521 (11.6)
Illinois	13 (3.9)	499 (16.8)	74 (6.0)	521 (8.0)	12 (4.2)	549 (8.5)
Texas	13 (3.5)	518 (22.2)	70 (4.6)	508 (12.3)	17 (5.0)	505 (13.3)
Michigan	12 (3.4)	524 (15.7)	81 (4.3)	544 (9.6)	7 (3.2)	566 (10.3)
Missouri	11 (3.7)	534 (9.6)	76 (4.9)	519 (7.6)	14 (3.1)	538 (8.2)
Canada	10 (2.3)	542 (8.9)	80 (2.8)	534 (2.6)	10 (1.9)	515 (6.4)
Connecticut	10 (3.2)	521 (27.2)	89 (3.2)	531 (10.9)	1 (0.5)	~ ~
Indiana	9 (2.8)	548 (21.1)	80 (5.7)	531 (7.2)	11 (4.4)	544 (29.4)
SW Math/Sci. Collaborative, PA	8 (3.6)	531 (12.5)	78 (6.2)	544 (8.9)	13 (4.6)	548 (11.1)
Montgomery County, MD	8 (2.2)	522 (14.1)	87 (2.1)	532 (4.1)	5 (0.4)	542 (9.3)
Korea, Rep. of	8 (2.2)	559 (7.9)	55 (3.9)	549 (3.3)	37 (3.8)	547 (3.4)
Maryland	7 (1.8)	479 (18.3)	88 (2.4)	509 (8.2)	5 (1.5)	494 (12.9)
Idaho	7 (2.0)	531 (22.7)	69 (6.5)	526 (6.3)	24 (6.0)	527 (9.4)
North Carolina	6 (2.6)	495 (22.5)	82 (4.0)	510 (7.8)	12 (2.8)	497 (11.9)
Fremont/Lincoln/WestSide PS, NE	6 (4.3)	525 (88.6)	60 (4.6)	519 (5.3)	33 (3.8)	497 (15.4)
South Carolina	5 (2.4)	538 (10.4)	87 (3.4)	510 (7.5)	8 (2.2)	514 (13.6)
Netherlands	5 (1.3)	573 (9.5)	82 (3.0)	548 (6.6)	13 (3.1)	514 (11.3)
Guilford County, NC	5 (1.6)	536 (37.2)	83 (3.8)	536 (9.4)	12 (3.4)	518 (25.1)
Japan	4 (1.7)	546 (11.0)	53 (4.1)	551 (3.0)	43 (4.2)	548 (2.9)
First in the World Consort., IL	3 (3.3)	540 (38.9)	87 (3.5)	566 (5.7)	10 (1.2)	573 (5.3)
Delaware Science Coalition, DE	3 (2.5)	527 (12.0)	89 (4.6)	500 (9.0)	8 (3.9)	482 (36.8)
Belgium (Flemish)	1 (0.5)	~ ~	39 (3.5)	528 (6.3)	60 (3.4)	537 (4.7)
Czech Republic	0 (0.3)	~ ~	29 (2.9)	541 (4.8)	70 (2.9)	539 (5.0)
International Avg. (All Countries)	19 (0.4)	484 (2.6)	62 (0.6)	486 (1.0)	18 (0.4)	485 (2.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

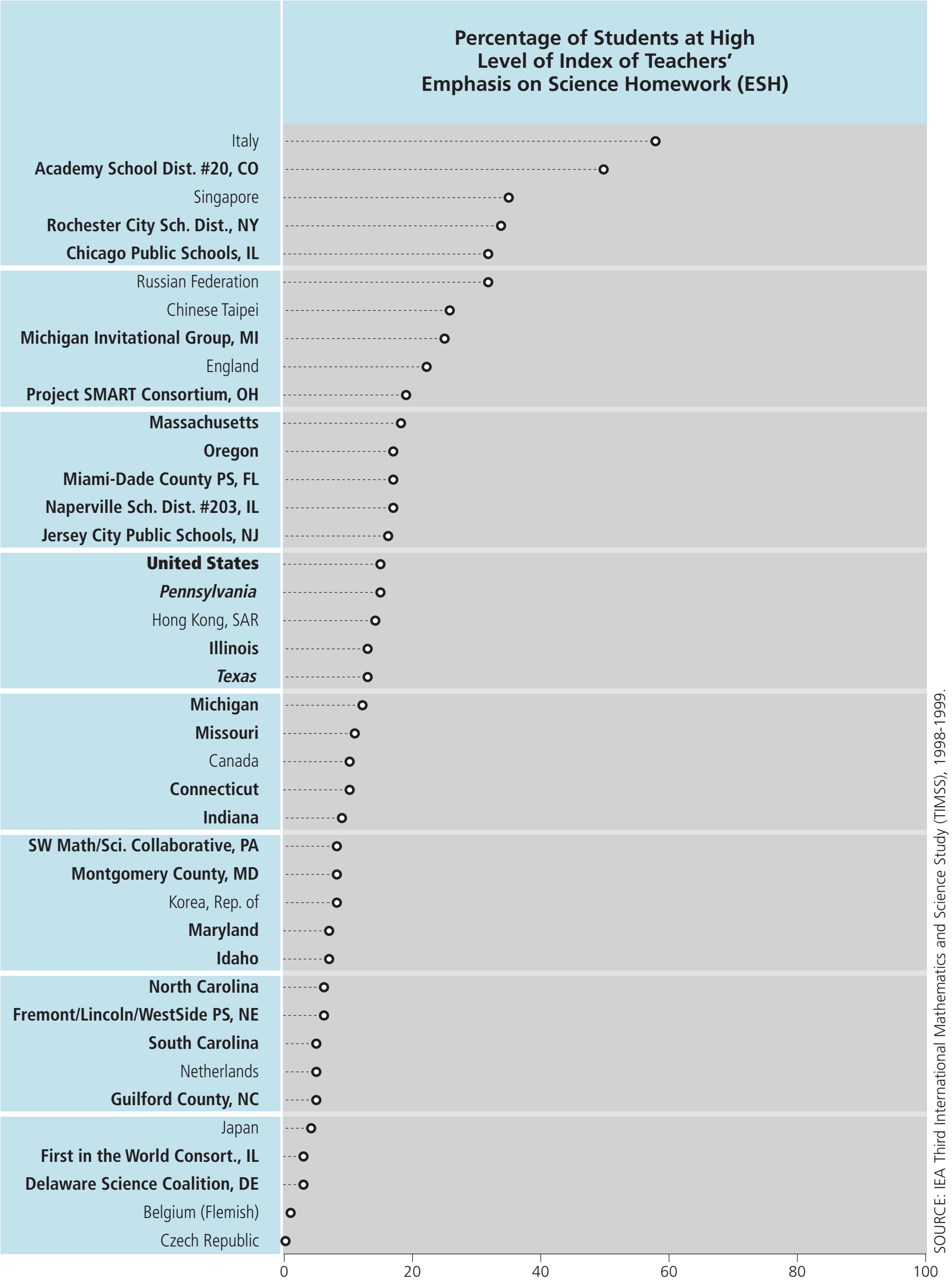
A tilde (~) indicates insufficient data to report achievement.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.15
(Continued)

Index of Teachers' Emphasis on Science Homework (ESH)

8th Grade Science



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 6.16 Types of Assessment Teachers Give Quite a Lot or A Great Deal of Weight

8th Grade Science

	Percentage of Students by Type of Assessment						
	External Standardized Tests	Teacher-Made Tests Requiring Explanations	Teacher-Made Objective Tests	Homework Assignments	Projects or Practical Exercises	Observations of Students	Students' Responses in Class
Countries							
United States	r 18 (2.5)	r 70 (2.8)	r 60 (3.2)	r 66 (2.8)	r 82 (2.7)	r 49 (3.6)	r 49 (2.6)
Belgium (Flemish)	9 (2.1)	96 (1.6)	30 (2.7)	r 32 (2.9)	r 43 (3.6)	r 44 (3.3)	56 (3.3)
Canada	r 13 (2.5)	r 66 (3.0)	r 59 (3.6)	r 60 (3.0)	r 84 (3.0)	r 50 (3.1)	r 44 (3.0)
Chinese Taipei	36 (4.1)	43 (4.5)	69 (4.1)	67 (3.6)	55 (4.1)	67 (3.8)	76 (3.4)
Czech Republic	45 (3.2)	96 (1.2)	40 (3.3)	23 (2.8)	56 (3.3)	78 (2.4)	97 (0.8)
England	s 57 (3.9)	s 68 (4.3)	s 25 (4.2)	s 77 (3.6)	s 80 (3.0)	s 74 (3.6)	s 71 (4.2)
Hong Kong, SAR	17 (3.1)	58 (4.2)	76 (3.5)	33 (3.8)	23 (3.8)	23 (3.6)	30 (4.1)
Italy	22 (2.8)	95 (1.7)	74 (3.2)	64 (4.0)	71 (3.4)	96 (1.6)	98 (1.2)
Japan	15 (2.6)	64 (4.3)	55 (4.3)	48 (4.3)	81 (3.6)	74 (3.9)	66 (3.5)
Korea, Rep. of	51 (4.1)	84 (2.8)	76 (3.6)	89 (2.5)	99 (0.6)	92 (2.2)	81 (3.1)
Netherlands	24 (3.2)	97 (1.0)	73 (4.6)	17 (2.6)	32 (3.6)	24 (3.5)	23 (3.1)
Russian Federation	– –	97 (0.6)	64 (1.9)	77 (2.2)	83 (1.6)	97 (0.7)	96 (1.1)
Singapore	28 (3.9)	70 (4.2)	67 (3.5)	39 (4.5)	61 (4.2)	40 (4.2)	36 (4.5)
States							
Connecticut	s 12 (4.6)	s 85 (5.2)	s 58 (7.7)	s 74 (5.3)	s 89 (4.4)	s 69 (5.8)	s 53 (6.2)
Idaho	r 15 (4.5)	r 70 (5.6)	r 63 (6.7)	r 61 (6.0)	r 81 (5.3)	r 28 (6.4)	r 23 (7.0)
Illinois	r 13 (4.3)	63 (7.1)	71 (5.9)	67 (5.7)	81 (4.8)	41 (6.6)	37 (6.6)
Indiana	9 (3.7)	73 (5.7)	70 (6.7)	52 (7.5)	80 (5.0)	39 (8.0)	36 (6.8)
Maryland	r 6 (3.0)	r 80 (4.2)	s 53 (5.5)	s 43 (4.6)	s 99 (0.8)	s 45 (6.3)	r 43 (5.9)
Massachusetts	r 22 (4.1)	r 83 (4.7)	r 50 (5.7)	r 63 (6.0)	r 86 (3.6)	r 48 (6.5)	r 39 (6.1)
Michigan	r 18 (5.4)	r 83 (3.6)	r 63 (7.1)	r 70 (6.3)	r 87 (4.0)	r 41 (5.2)	r 36 (5.5)
Missouri	r 11 (4.2)	r 76 (5.0)	r 71 (6.0)	r 56 (5.7)	r 83 (4.0)	r 35 (6.5)	r 31 (6.3)
North Carolina	23 (6.0)	76 (5.0)	67 (5.3)	54 (6.3)	87 (4.4)	53 (6.6)	54 (6.3)
Oregon	12 (4.4)	65 (5.5)	70 (5.3)	72 (6.6)	96 (1.9)	39 (6.5)	36 (5.1)
Pennsylvania	9 (3.3)	69 (4.3)	77 (4.3)	54 (7.2)	83 (5.7)	50 (5.7)	46 (5.0)
South Carolina	18 (4.3)	77 (5.7)	71 (5.2)	44 (6.5)	79 (4.3)	48 (6.3)	41 (6.8)
Texas	r 13 (4.7)	r 68 (6.8)	r 78 (5.8)	r 59 (5.6)	r 92 (2.6)	r 58 (5.6)	r 58 (6.3)
Districts and Consortia							
Academy School Dist. #20, CO	0 (0.0)	92 (0.1)	84 (0.4)	69 (0.3)	92 (0.1)	18 (0.3)	28 (0.4)
Chicago Public Schools, IL	r 22 (11.2)	r 66 (9.9)	r 67 (7.7)	r 49 (9.4)	r 73 (10.9)	r 63 (11.4)	r 72 (10.4)
Delaware Science Coalition, DE	r 12 (3.9)	r 76 (5.6)	r 67 (6.1)	s 44 (7.1)	r 82 (2.8)	r 60 (6.1)	r 59 (5.0)
First in the World Consort., IL	6 (2.4)	84 (4.9)	59 (4.5)	45 (6.9)	100 (0.0)	58 (6.0)	39 (4.7)
Fremont/Lincoln/WestSide PS, NE	14 (7.6)	68 (8.3)	60 (4.6)	57 (9.6)	99 (0.4)	r 27 (3.3)	r 18 (4.8)
Guilford County, NC	14 (5.2)	82 (5.1)	68 (5.2)	43 (4.8)	90 (4.2)	58 (5.5)	55 (4.8)
Jersey City Public Schools, NJ	r 42 (4.5)	r 88 (4.0)	r 71 (2.7)	r 62 (4.9)	r 82 (1.7)	r 63 (4.9)	r 68 (4.4)
Miami-Dade County PS, FL	s 20 (7.3)	s 66 (7.9)	s 68 (8.4)	s 57 (6.4)	s 88 (4.6)	s 72 (7.9)	s 60 (9.7)
Michigan Invitational Group, MI	10 (0.7)	72 (4.0)	75 (4.2)	59 (4.5)	70 (3.4)	44 (2.8)	18 (1.1)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	8 (3.6)	91 (3.9)	54 (3.6)	59 (1.7)	90 (3.6)	61 (3.7)	23 (4.1)
Project SMART Consortium, OH	r 16 (1.3)	r 51 (5.0)	r 66 (4.5)	r 65 (3.9)	r 71 (4.1)	r 29 (3.6)	r 25 (4.2)
Rochester City Sch. Dist., NY	r 27 (3.5)	r 84 (4.0)	r 68 (5.2)	r 30 (5.1)	r 97 (2.5)	r 41 (6.1)	r 32 (6.0)
SW Math/Sci. Collaborative, PA	13 (5.4)	65 (4.2)	79 (5.5)	53 (6.1)	78 (5.3)	36 (6.1)	43 (6.6)
International Avg. (All Countries)	33 (0.5)	76 (0.5)	60 (0.6)	58 (0.6)	65 (0.6)	68 (0.5)	75 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

In What Types of Professional Development Activities Do U.S. Science Teachers Participate?

As a TIMSS 1999 national option, the United States asked science teachers to describe their professional development during the 1998-99 school year, defined as June 1998 to May 1999. Since no other countries asked these questions, cross-country comparisons are not possible. Comparisons, however, can be made to the United States as a whole and among the Benchmarking jurisdictions. Teachers were asked both how often they observed and were observed by other teachers (see Exhibit 6.17). In the U.S. overall, these observations of and by teachers were reported by the science teachers of 24 and 36 percent of the students, respectively. Among the Benchmarking states, the results for classroom observation as a professional development approach resembled the national results. Among districts and consortia, observations were used more extensively in Guilford County, Montgomery County, and the Rochester City School District.

The professional development activities teachers were asked about include the following school- and district-based activities: immersion or internship activities; receiving mentoring, coaching, lead teaching, or observation; teacher resource centers; committees or task forces; and teacher study groups. As shown in Exhibit 6.18, participation on committees or task forces was the most frequently used of these activities. It was reported nationally by the science teachers of more than half the eighth graders (54 percent), and was similarly popular among the Benchmarking participants.

Science teachers were asked about their participation in several types of workshops, conferences, and networks, including within-district workshops and institutes; out-of-district workshops and institutes; teacher collaborative or networks; out-of-district conferences; and other forms of organized professional development (see Exhibit 6.19). They were also asked about individual activities, including taking courses for college credit; individual research projects; individual learning; and other individual professional development activities (see Exhibit 6.20). Of all of the professional development activities, within-district workshops or institutes (75 percent of the students) and individual learning (83 percent) were generally the most frequent activities in which science teachers of U.S. eighth-grade students participated during the 1998-99 school year. Even though there was considerable variation, these activities were also widely reported by teachers in the Benchmarking jurisdictions.

Teachers' reports about the areas heavily emphasized in their professional development are presented in Exhibit 6.21. Nationally, science teachers of 59 percent of eighth graders reported that curriculum was emphasized quite a lot or a great deal. The next greatest emphasis was on general pedagogy (54 percent of students) and content knowledge (51 percent), followed by subject-specific pedagogy and instructional technology (47 percent for each). Teachers reported the least emphasis on assessment (38 percent) and leadership development (20 percent). Again, although there was variation across the Benchmarking participants, the national pattern held in many jurisdictions.

Further detail about the types of content emphasized in professional development is provided in Exhibit 6.22. Nationally, teachers reported that the six content areas (earth science; biology; chemistry; physics; environmental and resource issues; and the nature of science and scientific inquiry and skills) were emphasized about equally, with most emphasis on the nature of science and inquiry skills (60 percent) and least on chemistry (39 percent). In general, a similar pattern was found in the Benchmarking states. There was more variation within some districts and consortia. For example, the Delaware Science Coalition focused relatively more emphasis on professional development in earth science (75 percent), environmental and resource issues (62 percent), and the nature of science and inquiry skills (73 percent) than in the other areas (21 to 29 percent). The Rochester City School District placed little emphasis on earth science (five percent), but rather more on biology (54 percent).

Science teachers in the United States reported a relatively heavy focus on curriculum in their professional development activities. Their reports about familiarity with various curriculum documents are presented in Exhibit 6.23. Nationally, teachers of most students (more than 90 percent) reported that they were fairly or very familiar with the curriculum guides for their school and their school district, and this held across most of the Benchmarking jurisdictions. U.S. science teachers of only 31 percent of the eighth-grade students reported being very familiar with the AAAS *Benchmarks for Science Literacy*. For the Benchmarking states, this ranged from just 15 percent in Idaho to 61 percent in Maryland. For districts and consortia, it ranged from 20 percent in the Southwest Pennsylvania Math and Science Collaborative to 63 percent in the Fremont/Lincoln/Westside Public Schools.

Fewer teachers than might be anticipated reported being at least fairly familiar with their state curriculum guides. Nationally, 79 percent of the eighth graders had science teachers who so reported. Among states the figure ranged from 53 percent in Pennsylvania to 97 percent in Massachusetts and South Carolina, and among districts and consortia from 44 percent in the Southwest Pennsylvania Math and Science Collaborative to 97 percent in the Delaware Science Coalition and Guilford County.

Exhibit 6.17

Students Taught by Teachers Who Participated in Professional Development – Classroom Observation

8th Grade Science

		Observation of Other Teachers[1]			Observation by Other Teachers[2]	
		Percent of Students	Number of Class Periods Observed Averaged Across Students[3]		Percent of Students	Number of Class Periods Observed Averaged Across Students[3]
States						
Connecticut	s	17 (4.8)	4 (1.0)	r	30 (6.0)	7 (2.3)
Idaho		24 (5.2)	5 (1.8)		28 (5.9)	5 (1.2)
Illinois		13 (3.9)	3 (0.5)		21 (4.8)	15 (4.6)
Indiana		13 (4.1)	3 (0.7)		22 (4.8)	7 (2.8)
Maryland	r	27 (5.1)	7 (2.2)		39 (5.3)	3 (0.3)
Massachusetts		23 (3.8)	4 (0.7)		38 (5.9)	5 (1.0)
Michigan	r	14 (3.5)	6 (2.2)		44 (5.9)	4 (1.3)
Missouri		24 (4.9)	5 (2.1)		39 (6.6)	6 (2.7)
North Carolina		35 (6.4)	3 (0.2)		48 (5.1)	5 (1.5)
Oregon	r	14 (4.6)	4 (0.7)		27 (6.7)	5 (0.9)
Pennsylvania		28 (7.6)	6 (1.2)		34 (7.2)	4 (0.9)
South Carolina		28 (5.1)	4 (0.7)		38 (5.0)	4 (0.7)
Texas	r	41 (6.4)	8 (1.7)		48 (6.3)	5 (0.8)
Districts and Consortia						
Academy School Dist. #20, CO		26 (0.4)	6 (0.1)		20 (0.3)	3 (0.0)
Chicago Public Schools, IL	r	18 (9.7)	4 (1.8)		28 (10.0)	2 (0.9)
Delaware Science Coalition, DE		19 (3.6)	4 (0.5)		36 (6.0)	2 (0.4)
First in the World Consort., IL		23 (6.9)	8 (2.1)		33 (7.2)	8 (1.2)
Fremont/Lincoln/WestSide PS, NE		38 (9.1)	3 (0.3)		36 (7.2)	3 (0.3)
Guilford County, NC		42 (5.8)	3 (0.4)		61 (4.5)	3 (0.3)
Jersey City Public Schools, NJ	r	13 (3.9)	4 (0.2)		39 (2.8)	18 (1.9)
Miami-Dade County PS, FL	r	25 (6.3)	4 (1.0)	r	38 (7.7)	3 (0.4)
Michigan Invitational Group, MI	r	27 (3.7)	5 (0.3)		29 (2.9)	7 (0.8)
Montgomery County, MD	s	43 (6.3)	5 (0.9)		72 (6.9)	4 (0.5)
Naperville Sch. Dist. #203, IL		18 (4.3)	3 (0.5)		18 (4.3)	3 (0.2)
Project SMART Consortium, OH		28 (4.1)	4 (0.3)		42 (4.3)	4 (0.4)
Rochester City Sch. Dist., NY		44 (4.2)	6 (2.0)	s	59 (4.7)	20 (2.2)
SW Math/Sci. Collaborative, PA		27 (6.9)	3 (0.4)		43 (8.8)	5 (2.5)
United States	r	24 (3.5)	5 (0.9)		36 (3.8)	5 (0.9)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

[1] Based on complete class periods teachers observed other teachers in their school teach science from the beginning of the 1998-99 school year until the time of testing.

[2] Based on complete class periods teachers were observed while teaching science by other teachers in their school from the beginning of the 1998-99 school year until the time of testing.

[3] Teachers who did not participate in the professional development activity were not included in the average.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.18 Students Taught by Teachers Who Participated in Professional Development – School- and District-Based Activities*

8th Grade Science

	Immersion or Internship Activities		Receipt of Mentoring or Observation		Teacher Resource Center		Committees or Task Forces		Teacher Study Groups	
	Percent of Students	Teacher Hours Averaged Across Students^1	Percent of Students	Teacher Hours Averaged Across Students^1	Percent of Students	Teacher Hours Averaged Across Students^1	Percent of Students	Teacher Hours Averaged Across Students^1	Percent of Students	Teacher Hours Averaged Across Students^1
States										
Connecticut	s 3 (2.0)	46 (36.0)	s 24 (5.7)	9 (2.3)	s 11 (4.3)	12 (3.2)	s 60 (6.4)	15 (3.4)	s 25 (5.8)	10 (1.7)
Idaho	2 (0.1)	~ ~	23 (5.4)	7 (1.1)	6 (1.7)	11 (7.5)	35 (6.7)	13 (1.8)	r 17 (3.2)	9 (3.2)
Illinois	1 (0.5)	~ ~	13 (4.6)	12 (4.3)	27 (7.0)	5 (1.0)	64 (7.1)	9 (1.6)	25 (6.4)	18 (7.4)
Indiana	r 8 (4.4)	47 (12.0)	32 (5.4)	9 (2.8)	r 12 (4.4)	4 (1.6)	70 (5.6)	13 (3.1)	r 22 (4.6)	15 (7.7)
Maryland	r 6 (3.1)	45 (28.2)	r 34 (5.0)	7 (1.6)	r 23 (4.9)	6 (0.5)	r 51 (5.9)	12 (1.5)	r 25 (4.0)	12 (2.3)
Massachusetts	9 (3.9)	20 (5.4)	29 (5.3)	9 (3.8)	r 16 (4.0)	7 (1.6)	66 (6.2)	17 (2.7)	35 (6.2)	16 (3.3)
Michigan	r 6 (3.3)	70 (21.8)	r 32 (7.3)	6 (1.7)	r 25 (5.3)	7 (1.5)	r 59 (5.7)	11 (1.3)	r 25 (5.7)	9 (1.7)
Missouri	r 2 (1.3)	~ ~	r 38 (7.5)	13 (3.4)	r 23 (6.6)	3 (0.5)	r 57 (4.9)	13 (1.9)	r 25 (6.1)	7 (1.4)
North Carolina	r 10 (4.2)	29 (7.1)	r 46 (6.5)	6 (0.9)	r 25 (5.0)	8 (3.0)	r 50 (5.8)	8 (1.3)	r 32 (5.1)	21 (6.6)
Oregon	r 5 (2.4)	22 (15.4)	r 35 (7.5)	8 (3.1)	r 16 (5.7)	3 (0.5)	r 61 (6.5)	26 (5.9)	r 28 (6.8)	10 (2.4)
Pennsylvania	6 (2.0)	7 (2.7)	34 (6.6)	5 (0.8)	15 (4.1)	7 (1.8)	48 (5.6)	10 (1.1)	19 (4.1)	14 (5.3)
South Carolina	7 (3.1)	6 (4.9)	39 (6.4)	8 (1.1)	19 (4.5)	9 (2.6)	50 (6.8)	8 (1.1)	18 (5.4)	7 (2.2)
Texas	r 13 (4.6)	18 (5.9)	r 47 (6.7)	11 (3.1)	r 30 (5.9)	12 (4.3)	r 54 (7.1)	12 (2.9)	r 23 (5.5)	7 (1.2)
Districts and Consortia										
Academy School Dist. #20, CO	0 (0.0)	~ ~	40 (0.4)	3 (0.0)	0 (0.0)	~ ~	r 60 (0.5)	12 (0.1)	r 10 (0.3)	2 (0.0)
Chicago Public Schools, IL	r 4 (0.5)	2 (0.0)	r 24 (11.3)	11 (7.7)	r 42 (12.4)	3 (0.5)	r 44 (8.8)	8 (1.2)	r 19 (6.9)	14 (8.6)
Delaware Science Coalition, DE	r 23 (3.7)	24 (6.4)	r 25 (4.4)	10 (2.3)	30 (5.2)	5 (0.8)	29 (5.7)	14 (2.1)	24 (4.9)	9 (4.2)
First in the World Consort., IL	r 0 (0.0)	~ ~	28 (7.3)	10 (2.4)	38 (7.7)	5 (0.9)	59 (6.9)	10 (2.1)	57 (4.2)	8 (1.1)
Fremont/Lincoln/WestSide PS, NE	r 0 (0.0)	~ ~	39 (7.6)	3 (0.2)	r 19 (7.8)	3 (0.2)	71 (9.5)	13 (3.5)	35 (7.8)	10 (1.5)
Guilford County, NC	3 (1.9)	8 (0.0)	45 (4.8)	6 (1.2)	r 30 (4.4)	5 (0.7)	49 (3.5)	12 (1.1)	29 (6.3)	20 (3.9)
Jersey City Public Schools, NJ	s 4 (0.2)	20 (0.0)	s 36 (1.8)	8 (0.3)	s 12 (0.6)	17 (0.0)	s 48 (2.5)	4 (0.1)	s 29 (1.6)	24 (0.4)
Miami-Dade County PS, FL	r 6 (3.8)	11 (6.0)	r 32 (6.9)	6 (3.1)	r 42 (4.9)	11 (4.0)	r 46 (6.9)	8 (2.1)	r 30 (9.5)	14 (4.2)
Michigan Invitational Group, MI	r 4 (0.3)	6 (0.0)	r 17 (2.6)	12 (0.9)	r 22 (4.6)	4 (0.6)	r 64 (4.6)	13 (2.6)	r 9 (3.1)	4 (0.5)
Montgomery County, MD	s 4 (3.5)	84 (24.7)	s 41 (9.6)	13 (5.1)	s 13 (7.2)	2 (0.5)	s 37 (6.3)	21 (8.2)	s 23 (9.2)	24 (5.7)
Naperville Sch. Dist. #203, IL	0 (0.0)	~ ~	38 (4.4)	3 (0.2)	16 (2.1)	30 (1.5)	86 (3.9)	15 (1.8)	10 (3.8)	2 (0.0)
Project SMART Consortium, OH	0 (0.0)	~ ~	34 (5.8)	17 (4.9)	12 (4.1)	3 (0.7)	44 (5.4)	8 (0.6)	20 (2.9)	12 (2.1)
Rochester City Sch. Dist., NY	14 (3.4)	86 (0.9)	34 (6.1)	32 (4.5)	r 27 (3.0)	5 (0.9)	47 (4.9)	19 (2.4)	25 (5.0)	12 (1.8)
SW Math/Sci. Collaborative, PA	12 (4.0)	8 (4.1)	35 (7.1)	7 (1.7)	21 (5.4)	13 (3.7)	51 (7.0)	9 (2.2)	18 (4.5)	9 (2.0)
United States	r 9 (2.2)	32 (9.5)	r 30 (2.8)	7 (1.3)	r 20 (2.2)	9 (1.5)	r 54 (4.6)	13 (1.4)	r 23 (3.4)	9 (1.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Based on participation in professional development activities from June 1998 until the time of testing.

[1] Teachers who did not participate in the professional development activity were not included in the average.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report average hours.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.19

Students Taught by Teachers Who Participated in Professional Development – Workshops, Conferences, and Networks*

8th Grade Science

	Within-District Workshops/ Institutes		Out-of-District Workshops/ Institutes		Teacher Collaborative or Networks		Out-of-District Conferences		Other Organized Professional Development	
	Percent of Students	Teacher Hours Averaged Across Students[1]	Percent of Students	Teacher Hours Averaged Across Students[1]	Percent of Students	Teacher Hours Averaged Across Students[1]	Percent of Students	Teacher Hours Averaged Across Students[1]	Percent of Students	Teacher Hours Averaged Across Students[1]
States										
Connecticut	s 91 (2.4)	15 (2.1)	s 43 (6.7)	9 (1.6)	s 22 (6.4)	16 (4.5)	s 38 (7.1)	12 (2.5)	s 18 (5.6)	9 (2.3)
Idaho	65 (7.2)	14 (1.4)	31 (7.2)	20 (3.5)	16 (4.0)	20 (6.2)	36 (7.6)	15 (2.4)	r 17 (4.4)	15 (7.7)
Illinois	r 69 (7.2)	13 (1.7)	43 (8.0)	24 (3.9)	23 (5.0)	12 (2.5)	29 (7.6)	11 (1.6)	27 (5.7)	8 (1.1)
Indiana	66 (6.8)	7 (0.9)	43 (7.8)	14 (4.4)	31 (6.8)	10 (3.0)	r 47 (6.7)	18 (4.5)	r 13 (4.3)	7 (2.0)
Maryland	r 80 (4.9)	17 (1.7)	r 31 (5.1)	18 (3.9)	r 30 (5.6)	11 (1.8)	r 30 (5.9)	12 (1.6)	r 29 (5.4)	14 (4.2)
Massachusetts	82 (4.5)	18 (2.1)	42 (6.2)	17 (3.1)	38 (6.7)	13 (2.8)	51 (6.3)	12 (1.1)	r 23 (5.7)	12 (3.2)
Michigan	r 68 (5.9)	11 (1.4)	r 62 (5.6)	12 (2.1)	r 13 (3.8)	10 (2.3)	r 53 (6.0)	10 (0.8)	r 18 (4.5)	6 (1.0)
Missouri	r 86 (5.3)	16 (2.6)	r 49 (6.8)	13 (2.6)	r 24 (5.8)	14 (3.6)	r 45 (6.6)	19 (4.5)	r 25 (6.2)	8 (2.8)
North Carolina	r 73 (6.0)	14 (2.0)	r 24 (6.6)	35 (9.7)	r 28 (6.4)	15 (4.1)	r 29 (5.9)	15 (2.9)	r 17 (3.7)	11 (4.6)
Oregon	r 91 (2.8)	18 (3.3)	r 40 (7.6)	12 (3.4)	r 28 (6.6)	10 (3.4)	r 35 (7.4)	9 (1.8)	r 23 (6.0)	14 (6.8)
Pennsylvania	65 (5.0)	14 (3.3)	34 (4.8)	13 (2.2)	24 (4.0)	9 (2.9)	17 (2.9)	15 (3.1)	21 (5.6)	7 (1.4)
South Carolina	85 (4.5)	18 (2.4)	39 (7.1)	17 (2.4)	29 (4.7)	10 (2.0)	45 (6.6)	13 (1.7)	28 (5.0)	12 (4.4)
Texas	r 91 (3.3)	19 (2.5)	r 62 (6.9)	16 (2.4)	r 30 (5.4)	18 (8.6)	r 55 (7.0)	17 (3.1)	s 23 (6.0)	6 (0.7)
Districts and Consortia										
Academy School Dist. #20, CO	62 (0.4)	10 (0.1)	41 (0.4)	29 (0.3)	47 (0.4)	15 (0.2)	53 (0.4)	14 (0.1)	r 13 (0.2)	5 (0.0)
Chicago Public Schools, IL	r 71 (9.7)	10 (2.4)	r 31 (7.3)	9 (1.3)	r 27 (9.4)	9 (4.2)	r 25 (9.5)	7 (1.8)	s 38 (12.4)	8 (3.5)
Delaware Science Coalition, DE	66 (5.9)	16 (1.8)	29 (5.3)	15 (3.3)	32 (5.3)	10 (3.8)	26 (5.2)	19 (4.6)	r 14 (4.1)	10 (2.2)
First in the World Consort., IL	53 (5.4)	10 (2.0)	33 (6.3)	11 (0.4)	45 (7.8)	38 (5.0)	34 (7.2)	15 (3.1)	45 (7.0)	13 (1.4)
Fremont/Lincoln/WestSide PS, NE	96 (2.5)	10 (0.9)	35 (1.6)	8 (1.0)	24 (5.6)	3 (0.1)	37 (7.9)	11 (1.7)	26 (8.7)	5 (1.1)
Guilford County, NC	82 (5.8)	22 (2.7)	17 (3.7)	11 (0.7)	18 (5.4)	17 (4.0)	17 (2.2)	8 (1.0)	18 (4.9)	11 (1.7)
Jersey City Public Schools, NJ	s 72 (1.5)	8 (0.2)	r 43 (2.1)	24 (0.6)	s 29 (1.4)	9 (0.1)	s 22 (1.2)	15 (0.3)	s 16 (1.2)	6 (0.2)
Miami-Dade County PS, FL	r 80 (7.5)	28 (5.6)	r 29 (7.2)	18 (8.9)	r 16 (4.6)	17 (4.6)	r 11 (4.8)	12 (3.2)	s 26 (6.4)	21 (9.5)
Michigan Invitational Group, MI	r 76 (5.1)	9 (0.5)	r 61 (5.0)	10 (1.1)	r 29 (5.3)	9 (0.9)	r 35 (3.9)	13 (1.3)	r 21 (4.5)	12 (1.4)
Montgomery County, MD	s 65 (11.2)	19 (2.7)	s 34 (7.0)	18 (3.3)	s 29 (7.5)	12 (2.4)	s 36 (9.5)	11 (2.6)	s 49 (6.9)	16 (1.4)
Naperville Sch. Dist. #203, IL	95 (1.9)	21 (1.2)	40 (4.5)	24 (6.0)	r 51 (2.1)	11 (0.7)	6 (1.7)	6 (0.0)	28 (4.3)	12 (1.0)
Project SMART Consortium, OH	74 (4.3)	12 (0.9)	39 (5.5)	16 (1.7)	13 (2.6)	7 (0.7)	17 (2.9)	8 (1.0)	17 (5.0)	14 (3.0)
Rochester City Sch. Dist., NY	r 73 (6.7)	10 (0.5)	22 (3.6)	7 (0.4)	r 23 (4.0)	16 (1.8)	21 (4.0)	24 (5.0)	22 (4.4)	25 (9.4)
SW Math/Sci. Collaborative, PA	72 (7.6)	12 (2.0)	37 (5.4)	20 (5.5)	28 (7.0)	8 (3.3)	27 (6.1)	15 (2.7)	17 (7.0)	7 (3.1)
United States	r 75 (3.1)	16 (1.1)	r 46 (3.7)	13 (1.5)	r 22 (3.0)	12 (2.8)	r 35 (2.8)	14 (1.7)	r 18 (2.8)	17 (3.8)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Based on participation in professional development activities from June 1998 until the time of testing.

[1] Teachers who did not participate in the professional development activity were not included in the average.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.20 Students Taught by Teachers Who Participated in Professional Development – Individual Activities*

8th Grade Science

	Courses for College Credit¹		Individual Research Projects		Individual Learning		Other Individual Professional Development	
	Percent of Students	Teacher Hours Averaged Across Students²	Percent of Students	Teacher Hours Averaged Across Students²	Percent of Students	Teacher Hours Averaged Across Students²	Percent of Students	Teacher Hours Averaged Across Students²
States								
Connecticut	s 17 (6.2)	73 (10.7)	s 38 (7.4)	20 (3.8)	s 80 (3.9)	41 (4.6)	s 49 (6.6)	19 (2.9)
Idaho	72 (6.8)	34 (4.5)	r 27 (6.1)	22 (3.8)	87 (4.9)	37 (4.8)	r 33 (6.9)	34 (5.7)
Illinois	25 (5.4)	23 (7.7)	36 (6.3)	24 (4.7)	92 (3.0)	37 (3.6)	r 29 (6.4)	24 (3.5)
Indiana	r 26 (6.2)	27 (7.3)	22 (5.9)	22 (7.5)	88 (6.9)	32 (4.6)	r 24 (5.5)	31 (10.8)
Maryland	r 43 (6.6)	26 (3.3)	r 37 (6.6)	18 (2.5)	r 88 (3.2)	37 (3.8)	r 32 (5.6)	29 (5.1)
Massachusetts	23 (5.0)	51 (10.5)	37 (6.2)	21 (3.5)	84 (5.1)	40 (3.5)	s 39 (7.8)	28 (7.4)
Michigan	r 25 (4.4)	35 (8.5)	r 39 (6.6)	22 (4.2)	r 92 (3.8)	35 (3.8)	r 36 (5.4)	25 (6.8)
Missouri	r 28 (6.9)	24 (8.5)	r 38 (6.5)	7 (1.1)	r 96 (2.3)	27 (3.6)	r 41 (6.6)	22 (5.5)
North Carolina	r 20 (3.3)	14 (3.9)	39 (4.3)	22 (6.3)	84 (3.3)	33 (4.0)	r 36 (7.1)	32 (7.5)
Oregon	r 27 (6.9)	30 (5.7)	r 42 (7.8)	15 (3.9)	r 85 (3.8)	32 (4.9)	s 43 (7.8)	29 (6.3)
Pennsylvania	24 (4.6)	38 (8.2)	28 (4.9)	16 (2.9)	75 (4.2)	37 (4.0)	37 (4.5)	29 (5.0)
South Carolina	39 (6.4)	29 (5.0)	42 (5.9)	16 (3.4)	89 (3.8)	30 (4.1)	r 27 (6.4)	24 (6.5)
Texas	r 30 (5.5)	18 (6.5)	r 18 (5.3)	14 (4.0)	r 83 (5.0)	33 (3.4)	r 42 (4.7)	21 (4.2)
Districts and Consortia								
Academy School Dist. #20, CO	74 (0.4)	31 (0.4)	43 (0.5)	15 (0.1)	83 (0.2)	30 (0.2)	r 22 (0.2)	15 (0.0)
Chicago Public Schools, IL	r 55 (12.6)	16 (4.3)	r 56 (10.5)	11 (2.7)	r 88 (6.5)	35 (9.3)	s 23 (10.4)	21 (8.7)
Delaware Science Coalition, DE	r 22 (5.1)	29 (6.0)	28 (3.5)	25 (6.5)	79 (4.3)	47 (4.3)	r 28 (6.6)	37 (4.9)
First in the World Consort., IL	r 23 (7.8)	14 (5.9)	51 (8.6)	42 (10.3)	100 (0.0)	39 (5.0)	59 (6.4)	28 (4.6)
Fremont/Lincoln/WestSide PS, NE	20 (7.4)	82 (5.7)	r 31 (10.5)	7 (1.0)	84 (4.6)	28 (3.4)	r 44 (7.0)	22 (2.5)
Guilford County, NC	7 (3.2)	22 (6.3)	30 (5.7)	23 (7.2)	88 (4.2)	24 (3.6)	40 (5.9)	22 (5.2)
Jersey City Public Schools, NJ	s 13 (4.1)	73 (7.7)	s 22 (3.7)	17 (0.4)	r 71 (1.4)	37 (1.7)	s 24 (1.3)	18 (0.5)
Miami-Dade County PS, FL	r 31 (7.8)	19 (5.2)	r 45 (7.5)	16 (4.3)	r 76 (6.9)	34 (5.7)	s 48 (9.2)	22 (5.4)
Michigan Invitational Group, MI	r 17 (2.3)	43 (4.4)	r 41 (5.6)	14 (1.2)	r 91 (2.8)	34 (2.6)	s 29 (3.1)	19 (0.9)
Montgomery County, MD	s 47 (5.6)	28 (9.4)	s 31 (8.5)	28 (5.9)	s 91 (1.3)	42 (3.5)	s 33 (7.3)	26 (8.3)
Naperville Sch. Dist. #203, IL	16 (2.1)	11 (0.7)	57 (5.2)	9 (0.4)	96 (0.8)	32 (1.9)	s 22 (2.7)	34 (5.9)
Project SMART Consortium, OH	30 (4.6)	36 (4.0)	32 (3.3)	21 (2.3)	94 (2.5)	40 (2.8)	r 28 (5.0)	20 (2.2)
Rochester City Sch. Dist., NY	r 24 (4.3)	7 (0.6)	21 (4.4)	30 (3.3)	89 (3.7)	41 (3.1)	37 (5.1)	39 (7.0)
SW Math/Sci. Collaborative, PA	18 (5.5)	16 (5.9)	36 (6.6)	15 (3.4)	87 (5.5)	44 (5.6)	37 (8.8)	34 (6.8)
United States	r 30 (2.9)	42 (5.9)	r 38 (3.0)	18 (1.8)	r 83 (2.8)	38 (2.5)	r 37 (3.4)	27 (3.0)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Based on participation in professional development activities from June 1998 until the time of testing.

[1] The response range had a maximum of 90 hours spent in courses for college credit.

[2] Teachers who did not participate in the professional development activity were not included in the average.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.21 Professional Development Topics Emphasized Quite a Lot or A Great Deal

8th Grade Science

	Percentage of Students Whose Teachers Reported That the Topic is Emphasized Quite a Lot or A Great Deal in Their Professional Development[1]						
	Content Knowledge	Curriculum	General Instruction/ Pedagogy	Subject-Specific Instruction/ Pedagogy	Assessment	Instructional Technology	Leadership Development
States							
Connecticut	s 40 (6.5)	s 56 (7.1)	s 44 (7.1)	s 33 (6.0)	s 35 (6.7)	s 43 (6.3)	s 14 (4.1)
Idaho	37 (5.1)	43 (6.0)	39 (5.4)	32 (5.6)	17 (5.0)	59 (6.4)	20 (4.6)
Illinois	45 (6.8)	50 (6.4)	46 (7.7)	38 (7.5)	32 (7.1)	50 (7.9)	21 (5.4)
Indiana	r 41 (5.7)	r 63 (5.6)	r 49 (6.3)	r 42 (6.1)	r 36 (6.2)	r 49 (6.3)	r 25 (5.6)
Maryland	r 30 (5.1)	r 63 (5.4)	r 51 (7.1)	r 35 (5.7)	r 37 (6.6)	r 47 (6.0)	r 15 (3.3)
Massachusetts	53 (5.8)	65 (6.2)	41 (5.2)	31 (4.3)	36 (5.5)	40 (5.4)	r 19 (5.3)
Michigan	r 46 (6.7)	r 64 (5.7)	r 45 (5.7)	r 47 (6.5)	r 29 (5.9)	r 36 (6.5)	r 18 (4.9)
Missouri	r 34 (5.4)	r 69 (5.6)	r 70 (5.9)	r 52 (7.4)	r 59 (6.9)	r 37 (7.4)	r 17 (4.8)
North Carolina	r 41 (6.1)	r 50 (5.6)	r 53 (5.7)	r 38 (5.4)	r 28 (4.7)	r 50 (6.4)	r 28 (6.1)
Oregon	r 39 (6.9)	r 65 (7.4)	r 30 (6.4)	r 38 (7.8)	r 51 (6.9)	r 44 (7.2)	r 8 (3.6)
Pennsylvania	44 (5.6)	43 (6.4)	38 (5.2)	27 (4.6)	r 30 (5.1)	49 (5.4)	20 (4.4)
South Carolina	41 (5.3)	80 (3.8)	44 (5.7)	46 (5.3)	29 (5.2)	49 (4.4)	18 (3.8)
Texas	r 52 (5.6)	r 69 (4.3)	r 67 (6.3)	r 49 (6.2)	r 23 (7.2)	r 58 (7.1)	r 19 (5.8)
Districts and Consortia							
Academy School Dist. #20, CO	36 (0.4)	69 (0.4)	58 (0.4)	62 (0.4)	38 (0.4)	59 (0.4)	14 (0.2)
Chicago Public Schools, IL	r 48 (12.5)	r 52 (13.3)	r 51 (12.7)	r 53 (13.1)	r 43 (10.5)	r 44 (14.0)	s 31 (10.6)
Delaware Science Coalition, DE	24 (3.5)	58 (5.5)	22 (4.4)	39 (4.7)	18 (4.5)	44 (6.7)	16 (4.2)
First in the World Consort., IL	38 (7.5)	41 (8.9)	70 (5.1)	64 (7.7)	33 (7.4)	42 (5.0)	12 (2.6)
Fremont/Lincoln/WestSide PS, NE	31 (8.1)	66 (4.9)	43 (3.9)	17 (7.8)	27 (8.0)	64 (4.0)	11 (0.5)
Guilford County, NC	34 (5.0)	57 (3.6)	67 (3.4)	48 (3.8)	44 (4.3)	59 (4.7)	31 (5.9)
Jersey City Public Schools, NJ	s 58 (2.2)	s 61 (2.1)	s 58 (2.3)	s 50 (2.6)	s 55 (2.4)	s 48 (2.7)	s 37 (3.2)
Miami-Dade County PS, FL	r 59 (11.1)	r 63 (5.9)	r 70 (7.9)	r 63 (9.9)	r 55 (7.6)	r 47 (10.8)	r 29 (8.2)
Michigan Invitational Group, MI	r 28 (4.6)	r 63 (5.7)	r 44 (5.2)	r 31 (5.5)	r 17 (2.7)	r 35 (5.3)	r 23 (4.0)
Montgomery County, MD	s 40 (8.6)	s 66 (8.7)	s 68 (5.4)	s 46 (7.0)	s 20 (6.6)	s 58 (8.9)	s 25 (6.8)
Naperville Sch. Dist. #203, IL	26 (4.3)	94 (2.1)	31 (4.2)	42 (5.6)	r 56 (5.2)	76 (3.7)	28 (2.0)
Project SMART Consortium, OH	39 (3.6)	72 (4.4)	36 (4.0)	41 (3.7)	11 (2.2)	59 (4.4)	8 (2.8)
Rochester City Sch. Dist., NY	r 26 (5.2)	r 44 (6.4)	r 78 (4.7)	r 37 (6.1)	r 25 (5.7)	r 21 (5.9)	r 18 (5.1)
SW Math/Sci. Collaborative, PA	43 (6.1)	52 (7.8)	39 (6.1)	31 (6.3)	25 (6.4)	56 (9.0)	16 (5.8)
United States	51 (4.2)	59 (3.7)	54 (3.6)	47 (3.7)	38 (3.8)	47 (3.9)	20 (2.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

[1] Based on participation in professional development activities from June 1998 until the time of testing. Does not include students whose teachers reported that they do not teach the topic.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.22 Content Areas Focused On in Professional Development

8th Grade Science

	Percentage of Students Whose Teachers Reported That the Content Area is Focused On in Their Professional Development[1]					
	Earth Science	Biology	Chemistry	Physics	Environmental and Resource Issues	Nature of Science and Scientific Inquiry Skills
States						
Connecticut	s 31 (7.7)	s 25 (6.8)	s 43 (7.7)	s 33 (7.0)	s 46 (8.0)	s 61 (8.0)
Idaho	r 44 (6.5)	r 27 (7.0)	r 38 (5.7)	r 44 (7.7)	r 38 (5.2)	r 49 (5.8)
Illinois	r 46 (7.3)	39 (8.6)	46 (8.2)	r 33 (7.3)	50 (6.7)	50 (7.3)
Indiana	r 48 (7.0)	r 36 (6.7)	r 61 (6.3)	r 47 (8.1)	r 47 (7.7)	r 63 (5.6)
Maryland	r 54 (6.8)	r 35 (5.7)	r 41 (6.2)	r 41 (6.0)	r 41 (5.4)	r 57 (5.9)
Massachusetts	r 52 (6.7)	r 37 (6.7)	r 41 (5.2)	r 42 (6.2)	r 38 (5.2)	r 54 (6.5)
Michigan	r 39 (6.4)	r 34 (7.1)	r 41 (5.6)	r 60 (5.8)	r 44 (7.4)	r 60 (7.4)
Missouri	r 53 (9.0)	r 36 (8.3)	r 33 (6.6)	r 31 (6.4)	r 52 (6.8)	r 68 (5.2)
North Carolina	r 43 (6.3)	r 22 (4.5)	r 30 (5.7)	r 20 (4.7)	r 35 (6.6)	r 42 (6.7)
Oregon	r 60 (6.8)	r 37 (7.0)	r 38 (6.6)	r 34 (6.7)	r 36 (7.1)	r 74 (5.7)
Pennsylvania	r 32 (6.0)	r 31 (5.7)	r 34 (6.9)	r 30 (6.6)	r 38 (6.0)	r 45 (5.7)
South Carolina	68 (5.2)	36 (6.0)	41 (6.2)	43 (6.6)	61 (6.6)	73 (5.8)
Texas	r 76 (5.2)	r 55 (7.7)	r 58 (7.7)	r 48 (7.6)	r 51 (6.4)	r 67 (6.5)
Districts and Consortia						
Academy School Dist. #20, CO	53 (0.5)	27 (0.3)	44 (0.4)	47 (0.5)	35 (0.3)	58 (0.4)
Chicago Public Schools, IL	s 48 (13.5)	s 54 (12.7)	s 32 (14.1)	s 39 (13.9)	r 60 (12.3)	s 73 (5.9)
Delaware Science Coalition, DE	r 75 (5.2)	s 21 (6.6)	s 26 (5.6)	s 29 (7.7)	r 62 (6.1)	s 72 (6.6)
First in the World Consort., IL	25 (8.5)	27 (7.8)	33 (8.6)	42 (8.1)	28 (9.1)	62 (7.8)
Fremont/Lincoln/WestSide PS, NE	32 (7.4)	39 (3.4)	40 (4.8)	34 (4.6)	53 (9.9)	64 (8.9)
Guilford County, NC	53 (6.3)	r 10 (3.1)	r 31 (5.5)	r 19 (5.4)	35 (6.1)	59 (6.5)
Jersey City Public Schools, NJ	s 67 (3.6)	s 60 (3.3)	s 43 (2.4)	s 52 (2.9)	s 51 (2.8)	s 65 (2.1)
Miami-Dade County PS, FL	s 42 (8.9)	s 33 (8.3)	r 38 (9.3)	s 43 (5.3)	r 57 (9.7)	s 73 (6.9)
Michigan Invitational Group, MI	r 47 (5.7)	r 25 (4.9)	r 37 (3.6)	r 36 (4.0)	r 29 (4.5)	r 58 (5.1)
Montgomery County, MD	s 81 (6.2)	s 17 (5.5)	s 30 (6.5)	s 15 (3.1)	s 24 (6.4)	s 70 (4.8)
Naperville Sch. Dist. #203, IL	r 17 (3.1)	r 37 (5.5)	28 (4.4)	30 (4.4)	r 29 (5.3)	57 (5.0)
Project SMART Consortium, OH	42 (4.6)	26 (3.5)	28 (4.1)	24 (3.0)	25 (4.3)	57 (4.6)
Rochester City Sch. Dist., NY	r 5 (2.4)	r 54 (6.2)	r 34 (4.7)	r 35 (5.1)	r 21 (5.6)	r 65 (4.8)
SW Math/Sci. Collaborative, PA	36 (7.4)	27 (7.5)	41 (8.7)	44 (9.1)	36 (6.9)	55 (6.0)
United States	r 52 (3.8)	r 42 (3.5)	r 39 (3.8)	r 41 (3.9)	r 47 (4.2)	r 60 (4.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

[1] Content areas are focused on in professional development if 80% or more of the TIMSS topics in the content area are reported by teachers to have been focused on in their professional development from June 1998 until the time of testing.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit 6.23 Familiarity with Curriculum Documents

	Percentage of Students Whose Teachers Reported Being Fairly Familiar or Very Familiar with the Curriculum Document					
	American Association for the Advancement of Science (AAAS) *Benchmarks for Science Literacy*	State Education Department Curriculum Guide	School District Curriculum Guide	School Curriculum Guide	National Assessment of Educational Progress (NAEP) Assessment Frameworks/ Specifications	State Education Department Assessment Specifications
States						
Connecticut	s 58 (7.0)	s 67 (7.8)	s 94 (3.5)	s 95 (1.8)	s 42 (6.9)	s 45 (9.1)
Idaho	r 15 (4.0)	r 77 (6.4)	r 88 (6.7)	r 86 (6.9)	r 5 (3.0)	r 24 (4.7)
Illinois	35 (6.6)	66 (8.1)	93 (3.8)	80 (4.0)	20 (4.6)	r 57 (6.7)
Indiana	48 (6.3)	96 (2.0)	95 (2.8)	100 (0.2)	13 (4.3)	43 (7.1)
Maryland	r 61 (6.2)	r 69 (5.0)	r 98 (1.0)	s 90 (2.6)	r 37 (7.1)	s 68 (5.8)
Massachusetts	30 (4.8)	97 (1.9)	96 (2.4)	r 96 (2.6)	33 (6.2)	66 (6.4)
Michigan	r 32 (6.2)	r 87 (4.4)	r 95 (3.0)	r 95 (3.1)	26 (4.7)	r 69 (5.9)
Missouri	26 (6.6)	81 (5.9)	96 (2.9)	94 (3.3)	r 45 (7.7)	79 (5.4)
North Carolina	32 (6.1)	99 (1.1)	91 (2.1)	90 (1.2)	29 (6.5)	r 48 (6.2)
Oregon	51 (5.0)	88 (4.8)	96 (2.4)	97 (1.5)	30 (6.6)	88 (4.3)
Pennsylvania	33 (5.5)	53 (6.1)	91 (3.9)	69 (4.4)	24 (4.0)	r 51 (6.4)
South Carolina	30 (6.2)	97 (2.1)	93 (4.2)	86 (6.1)	59 (4.9)	61 (7.1)
Texas	r 28 (8.0)	r 69 (5.6)	r 94 (3.4)	s 94 (3.8)	r 26 (6.5)	r 65 (7.1)
Districts and Consortia						
Academy School Dist. #20, CO	45 (0.5)	86 (0.3)	82 (0.4)	91 (0.3)	18 (0.2)	52 (0.4)
Chicago Public Schools, IL	47 (13.3)	r 72 (12.3)	99 (0.8)	r 97 (3.5)	25 (9.3)	r 52 (9.8)
Delaware Science Coalition, DE	r 29 (5.2)	r 97 (2.4)	r 88 (3.8)	r 80 (5.3)	s 45 (9.0)	r 50 (6.7)
First in the World Consort., IL	r 37 (7.0)	80 (5.4)	100 (0.0)	100 (0.0)	r 30 (7.6)	67 (6.9)
Fremont/Lincoln/WestSide PS, NE	63 (4.5)	87 (1.0)	100 (0.0)	r 99 (0.7)	39 (6.8)	43 (8.3)
Guilford County, NC	25 (5.7)	97 (2.5)	r 76 (5.8)	r 66 (5.7)	21 (4.1)	54 (6.7)
Jersey City Public Schools, NJ	r 31 (3.3)	r 90 (0.7)	r 97 (0.2)	r 92 (0.5)	r 50 (3.0)	r 70 (1.8)
Miami-Dade County PS, FL	s 28 (6.9)	s 89 (5.7)	s 95 (2.6)	s 80 (8.2)	s 32 (4.7)	s 59 (11.0)
Michigan Invitational Group, MI	44 (7.2)	r 82 (6.0)	100 (0.0)	97 (1.9)	r 18 (3.1)	r 75 (6.0)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	53 (3.9)	84 (0.8)	96 (0.4)	95 (0.6)	12 (2.4)	39 (4.1)
Project SMART Consortium, OH	29 (2.7)	59 (4.3)	94 (2.6)	89 (4.2)	11 (1.6)	36 (5.1)
Rochester City Sch. Dist., NY	37 (5.6)	63 (4.9)	100 (0.0)	r 77 (5.6)	19 (4.7)	28 (5.7)
SW Math/Sci. Collaborative, PA	20 (5.6)	44 (5.5)	94 (3.1)	87 (5.7)	10 (4.2)	43 (6.6)
United States	31 (3.5)	r 79 (3.3)	r 90 (2.1)	r 93 (1.8)	r 26 (2.5)	r 52 (3.6)

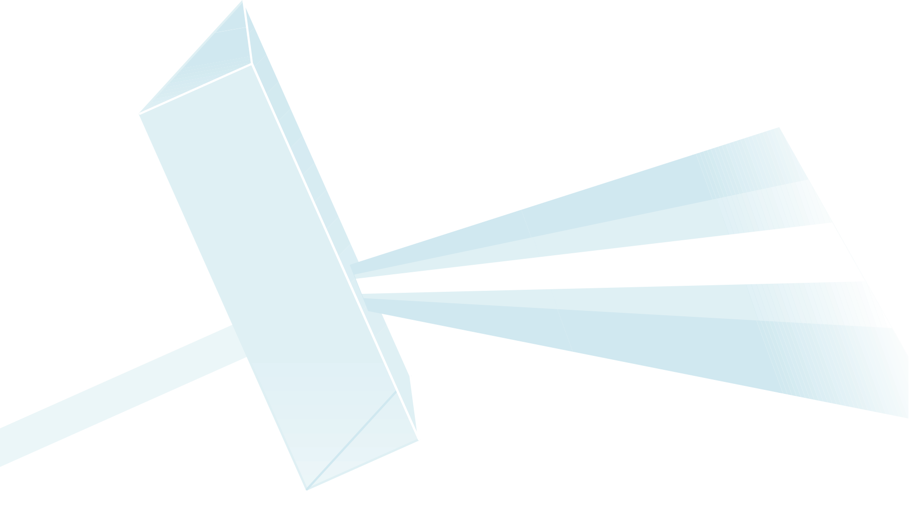
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

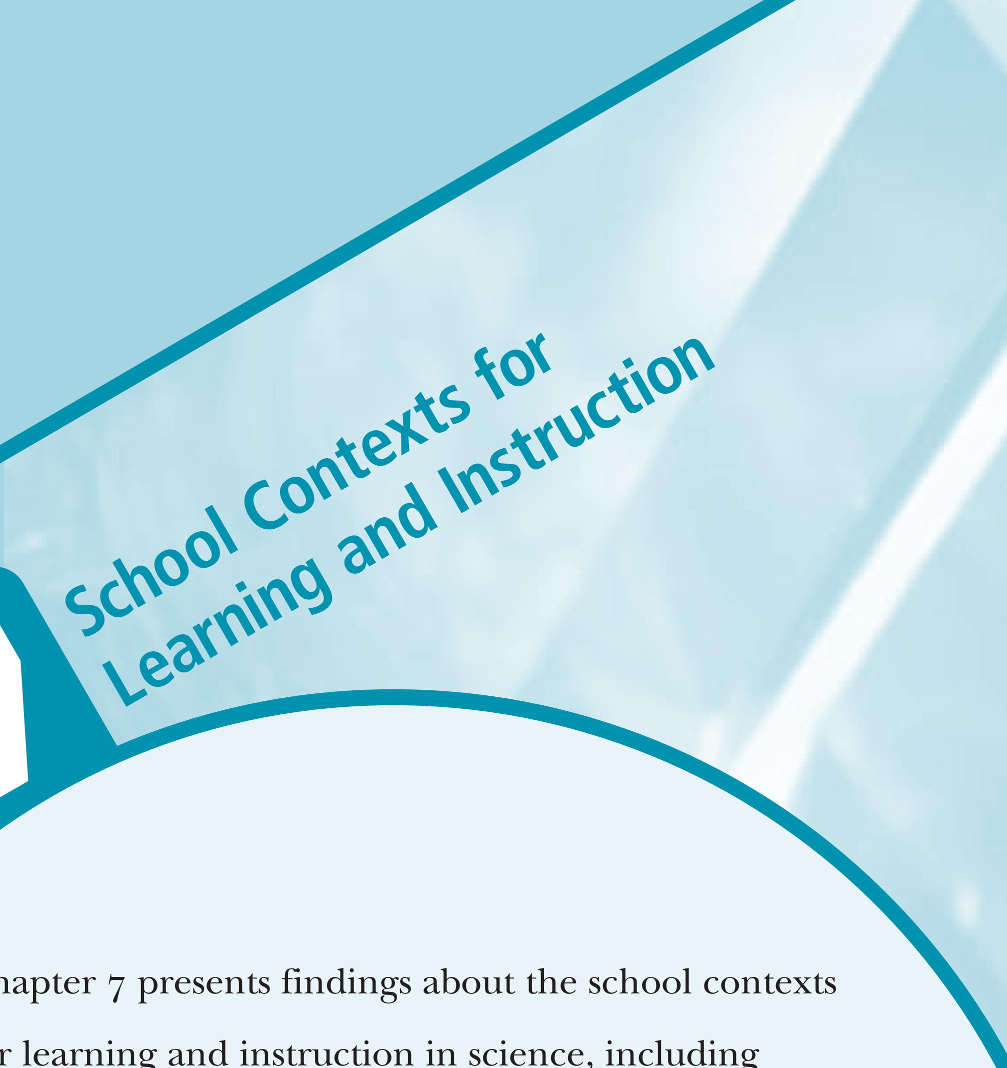
Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.



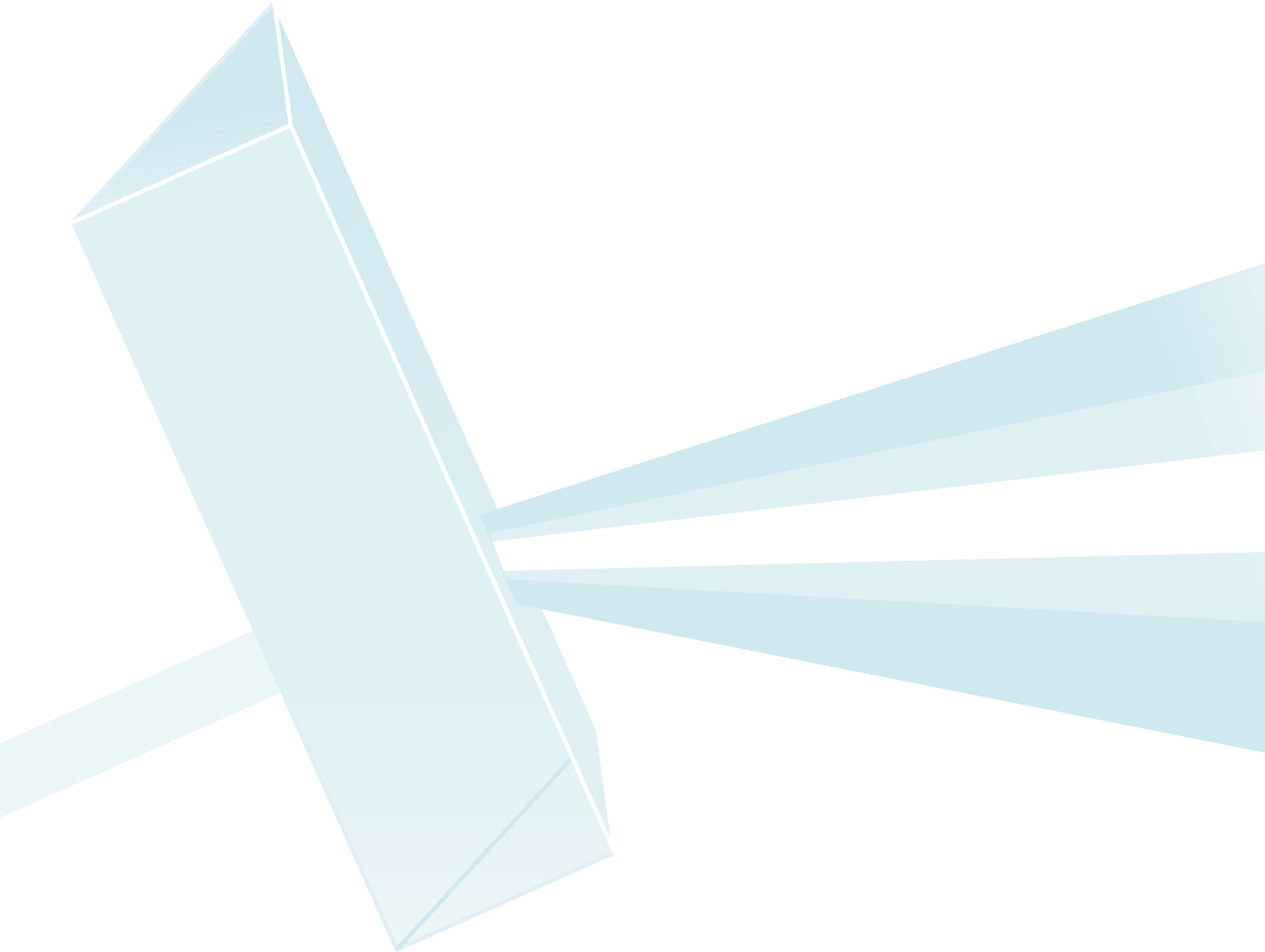


CHAPTER 7

School Contexts for Learning and Instruction

Chapter 7 presents findings about the school contexts for learning and instruction in science, including school characteristics, policies, and practices. Information is presented about the percentage of students eligible for free or reduced-price lunch for each Benchmarking participant, and about the extent of school resources, including computers and Internet access, for the Benchmarking participants and for selected reference countries. Data are also provided on the role of the school principal and on issues related to school climate and environment, including attendance problems and school safety.

7



What Is the Economic Composition of the Student Body?

There is considerable evidence that student achievement is greater in schools with higher proportions of students from advantaged socioeconomic backgrounds.[1] To provide information on the composition of the student body, schools' reports on the percentage of their students that are eligible to receive free or reduced-price lunch are summarized in Exhibit 7.1 for each of the Benchmarking participants.[2] The Benchmarking participants span almost the complete range on this factor, from the Naperville School District and the Academy School District, with just a few percent of low-income students, to the Jersey City Public Schools, where almost all students (89 percent) were eligible to receive free or reduced-price lunch. Although science achievement was not perfectly correlated with the percentage of students eligible for free or reduced-price lunch, it is noticeable that several high-performing jurisdictions had low percentages of eligible students, and that three of the four lowest-performing[3] – the Chicago Public Schools, the Rochester City School District, and the Jersey City Public Schools – had the highest percentages of such students.

---

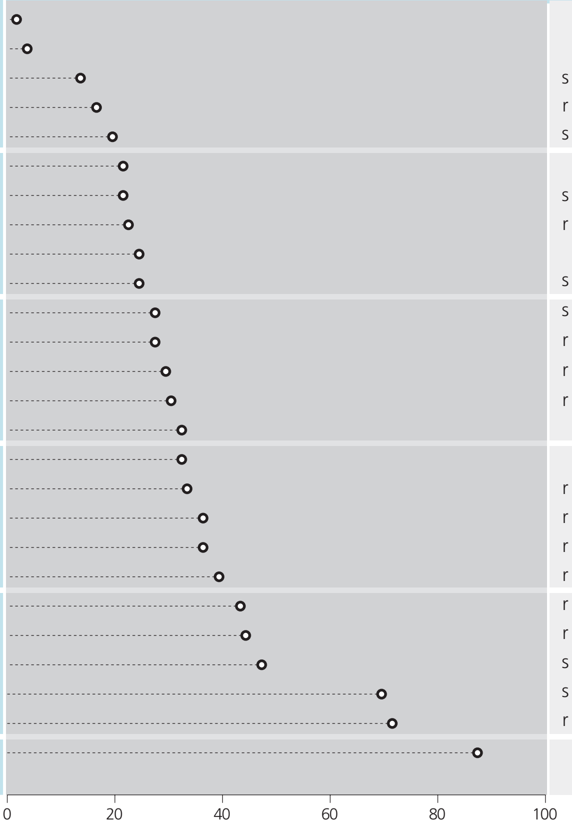
[1] Data on this issue from TIMSS 1995 are presented in Martin, M.O., Mullis, I.V.S., Gregory, K.D., Hoyle, C.D., and Shen, C. (2000), *Effective Schools in Science and Mathematics: IEA's Third International Mathematics and Science Study*, Chestnut Hill, MA: Boston College.

[2] These data were collected only in the United States and in the Benchmarking jurisdictions.

[3] The response rate from schools in the Miami-Dade County Public Schools was insufficient for reliable reporting.

Exhibit 7.1 Students Eligible to Receive Free/Reduced Price Lunch

Percentage of Students Eligible to Receive Free/Reduced Price Lunch



Naperville Sch. Dist. #203, IL		2 (0.0)
Academy School Dist. #20, CO		4 (0.0)
First in the World Consort., IL	s	14 (0.3)
Michigan	r	17 (2.8)
Connecticut	s	20 (4.6)
Michigan Invitational Group, MI		22 (0.4)
Project SMART Consortium, OH	s	22 (0.6)
Fremont/Lincoln/WestSide PS, NE	r	23 (0.4)
Indiana		25 (2.6)
Montgomery County, MD	s	25 (3.8)
Massachusetts	s	28 (3.3)
Maryland	r	28 (3.0)
Pennsylvania	r	30 (6.3)
Illinois	r	31 (3.4)
SW Math/Sci. Collaborative, PA		33 (2.9)
Oregon		33 (2.5)
Missouri	r	34 (2.8)
Idaho	r	37 (3.0)
Guilford County, NC	r	37 (0.5)
Delaware Science Coalition, DE	r	40 (0.5)
North Carolina	r	44 (2.3)
South Carolina	r	45 (3.0)
Texas	s	48 (4.4)
Chicago Public Schools, IL	s	71 (10.6)
Rochester City Sch. Dist., NY	r	73 (0.4)
Jersey City Public Schools, NJ		89 (0.3)
Miami-Dade County PS, FL		x x
United States	r	39 (2.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

What School Resources Are Available to Support Science Learning?

TIMSS collected data on a range of school resources, including those of a general nature such as buildings and infrastructure, as well as laboratory equipment and other materials specifically related to science learning. To measure the extent of school resources in each participating entity, TIMSS created an index of availability of school resources for science instruction (ASRSI). As described in Exhibit 7.2, the index is based on schools' average response to five questions about shortages that affect their general capacity to provide instruction and six questions about shortages that affect science instruction in particular. Students were placed in the high category if principals reported that shortages, both general and for science in particular, had no or little effect on instructional capacity. The medium level indicates that one type of shortage affects instruction some or a lot, and the low level that both shortages affect it some or a lot.

Schools in the United States appear to be fairly well-resourced in comparison with the TIMSS 1999 countries. Across the United States as a whole, 34 percent of students were in schools reporting that resource shortages had little effect on instruction, compared with 18 percent on average internationally. Of the reference countries, only Belgium (Flemish), Singapore, and the Czech Republic reported higher percentages in this category. Across the Benchmarking participants, reports varied widely. In the Academy School District, the First in the World Consortium, and Naperville, more than 75 percent of students were in well-resourced schools, whereas in South Carolina, Oregon, and North Carolina 15 percent or less were in such schools.

In many of the Benchmarking jurisdictions and TIMSS 1999 countries, students in schools in the high category had higher average science achievement than those in the low category. For example, in the United States 34 percent of the students were in the high category with an average science achievement of 531, compared with six percent in the low category with an average of 512. However, the relationship between a country's average science achievement and availability of instructional resources is complex. For example, in some countries that performed significantly above the international average, including Korea, Chinese Taipei, and the Russian Federation, few students (seven percent or less) were in schools with high availability of resources for science instruction. In contrast, in other high-performing countries such as Belgium (Flemish), the Czech Republic, England, Japan, the Netherlands, and Singapore, five percent or less of the students were in schools with low availability of resources.

Exhibit R4.1 in the reference section shows the results for each of the types of facilities and materials summarized in the general capacity part of the index. There was substantial variation across countries, but internationally on average, nearly half the students were in schools where science instruction was negatively affected by shortages or inadequacies in instructional materials, the budget for supplies, school buildings, and instructional space. Generally, the Benchmarking participants reported fewer students in schools where science instruction was negatively affected by resource shortages, but again the situation varied widely across jurisdictions. Shortage of instructional space was a problem in Oregon, the Fremont/Lincoln/Westside Public Schools, Jersey City, Miami-Dade, and Montgomery County, where more than half of the eighth-grade students were affected. Inadequate school buildings or grounds were also a problem in Miami-Dade, and Oregon had more than half its students in schools that reported shortages of instructional materials and budget for supplies.

Exhibit R4.2, also in the reference section, shows the results for each of the types of equipment and materials summarized in the science instructional capacity part of the index. About 60 percent of the students, on average across all the TIMSS 1999 countries, were in schools where shortages or inadequacies in computers and computer software affected the capacity to provide science instruction. Although the Benchmarking entities generally reported fewer students affected by such shortages, Idaho, North Carolina, Oregon, the Delaware Science Coalition, and Rochester were similar to the international average. Shortages of both computers and computer software were also reported for a majority of the students in Maryland, Missouri, and Texas. The United States as a whole reported that 38 percent of the students were in schools where shortages in science laboratory equipment and materials affected the capacity to provide instruction, compared with 58 percent internationally. However, a majority of the students in Idaho, North Carolina, Oregon, Chicago, and the Delaware Science Coalition were in such schools. North Carolina also reported shortages in library materials and audio-visual resources for science instruction.

Exhibits R4.3 and R4.4 in the reference section present more data on access to computers and the Internet for instructional purposes. Benchmarking participants appear to be relatively well equipped with computers, compared with countries internationally, as almost all students were in schools with fewer than 15 students per computer. Internet access was also widespread across Benchmarking entities. In all states except Indiana, Missouri, and Pennsylvania, more than 90 percent of students were in schools with Internet access. School districts with relatively low levels of Internet access were those in Rochester (69 percent) and Chicago (just 44 percent).

Exhibit 7.2 Index of Availability of School Resources for Science Instruction (ASRSI)

8th Grade Science

Index of Availability of School Resources for Science Instruction

Index based on schools' average response to five questions about shortages that affect general capacity to provide instruction (instructional materials; budget for supplies; school buildings and grounds; heating/cooling and lighting systems; instructional space), and the average response to six questions about shortages that affect science instruction (laboratory equipment and materials; computers; computer software; calculators; library materials; audio-visual resources) (see reference exhibits R4.1-R4.2). High level indicates that both shortages, on average, affect instructional capacity none or a little. Medium level indicates that one shortage affects instructional capacity none or a little and the other shortage affects instructional capacity some or a lot. Low level indicates that both shortages affect instructional capacity some or a lot.

		High ASRSI		Medium ASRSI		Low ASRSI	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Academy School Dist. #20, CO		83 (0.4)	561 (2.1)	17 (0.4)	546 (7.0)	0 (0.0)	~ ~
First in the World Consort., IL	r	79 (1.0)	565 (6.4)	21 (1.0)	539 (11.9)	0 (0.0)	~ ~
Naperville Sch. Dist. #203, IL		76 (1.5)	581 (5.0)	24 (1.5)	594 (5.7)	0 (0.0)	~ ~
Belgium (Flemish)		60 (4.5)	531 (4.8)	40 (4.5)	538 (8.1)	0 (0.0)	~ ~
Singapore		56 (3.9)	569 (11.8)	40 (4.1)	569 (9.8)	4 (1.4)	554 (25.1)
Connecticut	s	53 (11.0)	547 (18.2)	42 (10.8)	532 (10.4)	6 (3.9)	532 (18.9)
Miami-Dade County PS, FL	s	50 (13.9)	466 (9.6)	42 (13.8)	417 (18.7)	8 (7.4)	398 (12.2)
Montgomery County, MD	s	48 (13.6)	532 (7.4)	52 (13.6)	527 (7.8)	0 (0.0)	~ ~
Illinois		47 (6.5)	537 (9.1)	49 (6.8)	518 (8.6)	4 (2.8)	520 (24.0)
SW Math/Sci. Collaborative, PA		45 (9.0)	550 (10.5)	50 (9.3)	541 (13.2)	5 (3.4)	521 (6.9)
Czech Republic		43 (4.3)	542 (6.5)	57 (4.3)	538 (4.9)	0 (0.1)	~ ~
Rochester City Sch. Dist., NY	r	40 (1.6)	485 (13.7)	44 (1.6)	425 (12.9)	16 (0.5)	433 (15.3)
Michigan		40 (7.2)	574 (9.5)	55 (7.8)	544 (8.5)	6 (3.5)	537 (15.8)
Project SMART Consortium, OH		39 (1.5)	552 (15.4)	57 (1.5)	527 (10.7)	4 (0.5)	542 (34.7)
Indiana		39 (7.9)	535 (10.9)	58 (7.8)	534 (8.5)	3 (2.3)	539 (14.8)
Pennsylvania		39 (7.0)	545 (8.7)	60 (7.0)	529 (10.0)	1 (0.7)	~ ~
Fremont/Lincoln/WestSide PS, NE	r	36 (1.8)	529 (11.1)	52 (1.7)	491 (5.3)	11 (1.3)	577 (22.1)
Maryland	r	35 (6.5)	480 (12.4)	47 (7.2)	525 (10.1)	18 (5.8)	495 (16.6)
United States	r	34 (3.3)	531 (8.5)	60 (3.2)	508 (6.2)	6 (2.4)	512 (12.0)
Texas	r	33 (7.6)	498 (25.0)	63 (8.3)	521 (11.7)	4 (3.9)	478 (11.2)
Netherlands	r	33 (6.5)	542 (9.7)	66 (6.5)	547 (11.8)	1 (0.7)	~ ~
Delaware Science Coalition, DE	r	32 (1.5)	464 (8.3)	59 (1.9)	508 (13.3)	9 (1.8)	518 (54.9)
Massachusetts	s	31 (6.4)	552 (19.7)	68 (6.6)	534 (7.8)	2 (0.1)	~ ~
Japan		30 (3.7)	556 (3.5)	65 (4.1)	547 (3.1)	5 (1.9)	545 (6.6)
Idaho	r	28 (8.2)	524 (11.7)	65 (9.3)	534 (8.1)	7 (4.2)	487 (17.8)
Canada		28 (2.0)	542 (3.9)	66 (2.4)	529 (3.1)	6 (1.3)	540 (10.5)
England	r	27 (4.2)	572 (10.6)	68 (4.6)	530 (6.3)	5 (2.1)	547 (11.6)
Missouri		26 (6.3)	529 (7.9)	70 (6.6)	520 (8.6)	4 (2.4)	536 (22.5)
Michigan Invitational Group, MI		26 (1.3)	569 (14.0)	69 (1.5)	568 (6.6)	5 (1.2)	509 (19.8)
Jersey City Public Schools, NJ		25 (0.8)	438 (21.0)	63 (1.2)	444 (14.4)	12 (0.7)	437 (9.0)
Guilford County, NC	r	24 (1.2)	532 (11.6)	76 (1.2)	538 (11.3)	0 (0.0)	~ ~
Italy		23 (3.2)	495 (9.4)	71 (3.8)	494 (4.5)	7 (2.0)	483 (8.5)
Chicago Public Schools, IL	s	22 (10.9)	489 (21.5)	68 (10.2)	432 (8.6)	10 (6.7)	452 (51.5)
Hong Kong, SAR		19 (3.3)	524 (12.2)	73 (3.5)	533 (4.5)	8 (2.3)	521 (11.6)
South Carolina		15 (6.0)	505 (23.4)	79 (7.2)	507 (7.4)	6 (4.3)	542 (24.9)
Oregon		11 (5.0)	546 (15.5)	74 (7.9)	539 (7.4)	15 (6.2)	528 (15.3)
North Carolina	r	9 (4.3)	490 (6.5)	84 (5.9)	511 (6.4)	6 (4.3)	532 (16.2)
Korea, Rep. of		7 (2.2)	555 (12.1)	76 (3.7)	550 (2.7)	17 (3.2)	542 (5.5)
Chinese Taipei		5 (2.1)	567 (14.5)	78 (3.4)	571 (5.0)	17 (2.9)	562 (9.3)
Russian Federation		1 (0.9)	~ ~	46 (4.6)	539 (8.3)	52 (4.6)	521 (7.6)
International Avg. (All Countries)		18 (0.5)	498 (2.6)	63 (0.6)	487 (1.0)	20 (0.5)	476 (2.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

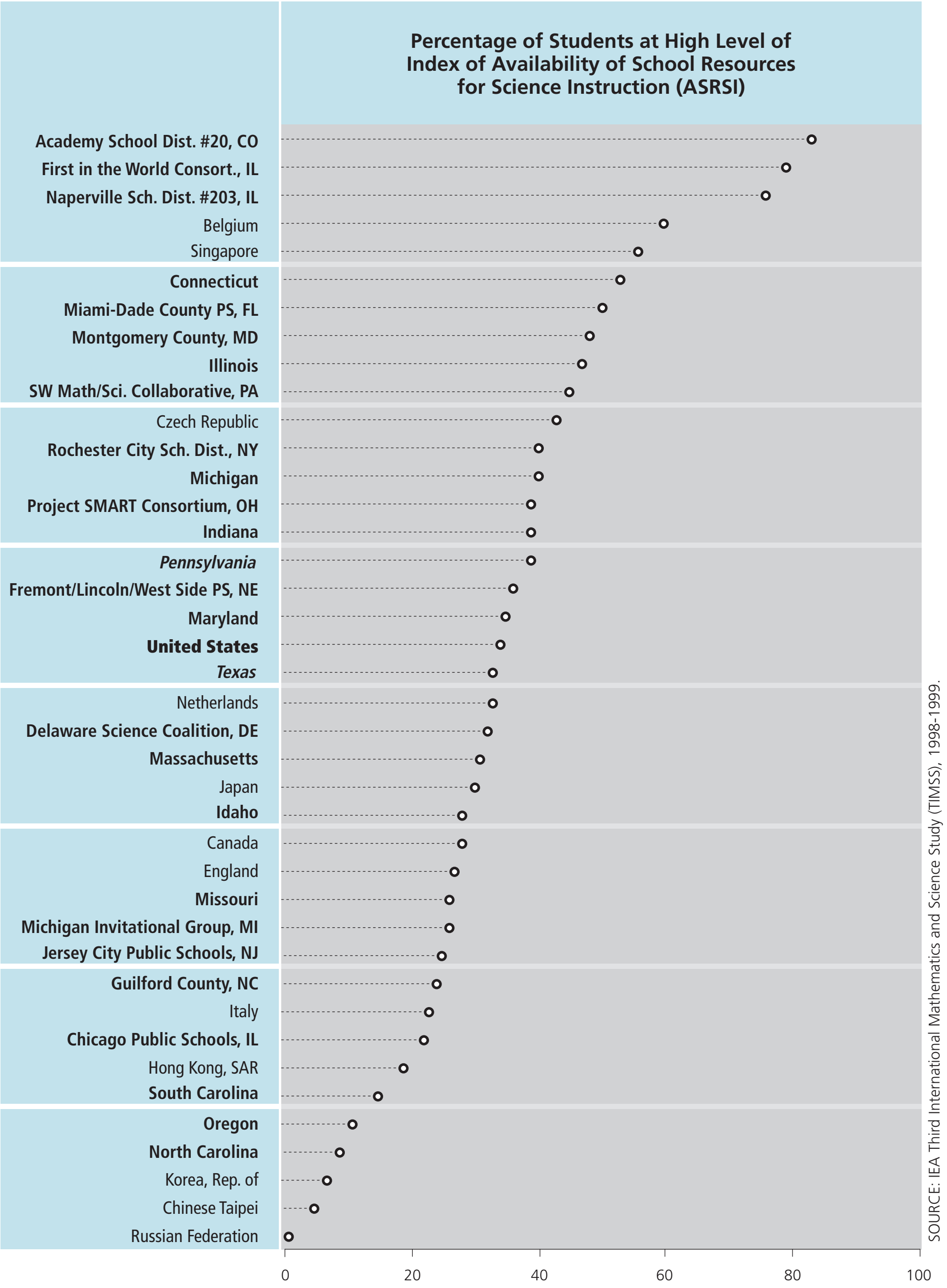
States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students.

Index of Availability of School Resources for Science Instruction (ASRSI)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

What Is the Role of the School Principal?

To better understand the roles and responsibilities of schools across countries, TIMSS asked school principals how much time per month they spend on various school-related activities. Specifically, they were asked how much time they spend on instructional leadership activities, including discussing educational objectives with teachers, initiating curriculum revisions and planning, training teachers, and engaging in professional development activities. They were also asked how much time they spend talking with parents, counseling and disciplining students, and responding to requests from local, regional, or national education officials. Further, they responded to questions about how much time they spend on administrative duties, including hiring teachers, representing the school in the community and at official meetings, and doing internal tasks (e.g., regulations, school budget, timetable). Finally, they were asked how much time they spend teaching.

The results presented in Exhibit 7.3 show that principals reported spending per month, on average across all the TIMSS 1999 countries, 51 hours on administrative duties, 35 hours communicating with various constituents, 33 hours on instructional leadership activities, and 16 hours teaching.[4] Compared with the international profile, principals in the United States reported spending more time communicating with students, parents, and education officials (over 50 hours per month, on average), and very little time teaching. Reports from principals in the Benchmarking jurisdictions generally resembled those of the United States overall. It is interesting to note that principals in Jersey City and Rochester reported spending 72 hours per month communicating with students, parents, and education officials, while principals in Indiana and the Michigan Invitational Group reported spending 74 hours per month on administrative duties.

A number of the comparison countries, such as Canada, Chinese Taipei, Hong Kong, and Singapore, have patterns of principals' use of time similar to that of the United States. For example, unlike in most European countries (e.g., the Czech Republic and Russian Federation among comparison countries), principals in these countries spend relatively little time teaching, and most of it on administrative duties, communicating with constituents, and engaging in instructional leadership activities.

---

[4] Activities reported by principals are not necessarily exclusive; principals may have reported engaging in more than one activity at the same time.

Exhibit 7.3 Time Principal Spends on Various School-Related Activities

8th Grade Science

	Average Total Hours Per Month Spent on Activities[1]			
	Instructional Leadership Activities[2]	Communicating with Students, Parents, and Education Officials[3]	Administrative Duties[4]	Teaching (including preparation)
Countries				
United States	r 34 (1.9)	r 52 (2.4)	r 56 (3.2)	r 3 (0.6)
Belgium (Flemish)	29 (2.3)	27 (2.1)	56 (2.5)	0 (0.1)
Canada	25 (1.1)	54 (1.4)	54 (2.1)	5 (0.9)
Chinese Taipei	24 (1.4)	34 (1.7)	86 (4.1)	4 (0.6)
Czech Republic	32 (1.9)	33 (1.8)	44 (2.4)	36 (1.8)
England	– –	– –	– –	– –
Hong Kong, SAR	r 43 (3.2)	r 29 (1.8)	r 75 (4.2)	r 3 (0.6)
Italy	36 (1.4)	44 (2.1)	45 (1.7)	– –
Japan	33 (2.0)	19 (1.3)	69 (3.6)	1 (0.8)
Korea, Rep. of	30 (2.1)	22 (1.6)	46 (3.6)	3 (0.5)
Netherlands	r 42 (4.0)	r 20 (2.0)	r 49 (5.6)	r 7 (1.7)
Russian Federation	r 44 (1.9)	r 33 (1.7)	r 65 (3.1)	r 46 (2.1)
Singapore	45 (2.2)	46 (1.9)	56 (3.1)	3 (0.6)
States				
Connecticut	s 38 (5.6)	s 55 (4.9)	s 51 (6.0)	s 1 (0.4)
Idaho	r 33 (2.2)	r 41 (3.3)	r 53 (6.1)	r 2 (0.9)
Illinois	r 36 (2.1)	r 49 (3.5)	r 61 (4.9)	r 2 (1.0)
Indiana	37 (3.9)	53 (5.8)	74 (6.0)	3 (1.0)
Maryland	r 38 (2.8)	r 60 (4.0)	r 56 (3.9)	r 1 (0.3)
Massachusetts	s 32 (3.1)	s 48 (4.1)	s 56 (6.6)	s 1 (0.4)
Michigan	35 (2.8)	53 (4.8)	61 (5.2)	3 (1.4)
Missouri	34 (3.3)	55 (4.9)	57 (4.9)	1 (0.5)
North Carolina	r 43 (3.7)	r 66 (6.5)	r 54 (5.0)	r 2 (0.8)
Oregon	38 (4.3)	51 (5.1)	58 (5.2)	2 (0.7)
Pennsylvania	r 27 (2.1)	r 57 (4.1)	r 59 (6.0)	r 2 (0.6)
South Carolina	r 35 (3.6)	r 62 (4.8)	r 53 (5.3)	r 2 (1.1)
Texas	s 35 (4.5)	s 57 (5.3)	s 64 (6.0)	s 2 (0.6)
Districts and Consortia				
Academy School Dist. #20, CO	25 (0.1)	45 (0.1)	46 (0.1)	1 (0.0)
Chicago Public Schools, IL	s 46 (9.0)	s 51 (5.5)	s 58 (8.9)	s 2 (0.8)
Delaware Science Coalition, DE	s 37 (1.2)	s 60 (1.3)	s 53 (2.4)	s 0 (0.0)
First in the World Consort., IL	r 32 (0.5)	r 48 (0.3)	r 47 (0.9)	r 1 (0.1)
Fremont/Lincoln/WestSide PS, NE	s 27 (0.3)	s 56 (0.5)	s 42 (0.5)	s 1 (0.1)
Guilford County, NC	r 41 (0.4)	r 65 (0.5)	r 56 (0.7)	r 1 (0.0)
Jersey City Public Schools, NJ	r 34 (0.7)	r 72 (0.6)	r 36 (0.7)	r 3 (0.1)
Miami-Dade County PS, FL	x x	x x	x x	x x
Michigan Invitational Group, MI	31 (0.5)	63 (1.0)	74 (1.4)	1 (0.0)
Montgomery County, MD	s 35 (6.2)	s 46 (4.3)	s 48 (6.4)	s 1 (0.4)
Naperville Sch. Dist. #203, IL	36 (0.7)	37 (0.7)	67 (0.8)	0 (0.0)
Project SMART Consortium, OH	r 31 (0.6)	r 58 (1.0)	r 54 (1.2)	r 1 (0.1)
Rochester City Sch. Dist., NY	r 35 (0.4)	r 72 (0.8)	r 51 (0.7)	r 8 (0.4)
SW Math/Sci. Collaborative, PA	33 (3.6)	62 (5.8)	40 (4.6)	4 (1.6)
International Avg. (All Countries)	33 (0.3)	35 (0.3)	51 (0.5)	16 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

[1] Total hours reported for activities in each category averaged across schools. Activities are not necessarily exclusive; principals may have reported engaging in more than one activity at the same time.

[2] Includes discussing educational objectives with teachers; initiating curriculum revision and/or planning; training teachers; and professional development activities.

[3] Includes talking with parents, counseling and disciplining of students and responding to requests from local, regional, or national education officials.

[4] Includes hiring teachers; representing the school in the community; representing the school at official meetings; internal administrative tasks (e.g., regulations, school budget, timetable).

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An “r” indicates school response data available for 70-84% of students. An “s” indicates school response data available for 50-69% of students. An “x” indicates school response data available for <50% of students.

What Are the Schools' Expectations of Parents?

Schools' expectations for parental involvement are shown in Exhibit 7.4. Clearly schools expect help from parents. On average across all the TIMSS 1999 countries, 85 percent of the students attended schools expecting parents to ensure that their children complete their homework, and 79 percent attended schools expecting parents to volunteer for school projects or field trips. About half the students were in schools expecting parents to help raise funds and to serve on committees. Only 28 percent were in schools expecting parents to help as aides in the classroom.

In the United States, almost all students were in schools that expected parents to ensure that their children completed their homework and to volunteer for school projects, programs, or field trips. Parents generally were not often expected to serve as teacher aides (with the notable exception of the Chicago Public Schools, where 34 percent of students were in such schools), but were more often expected to serve on committees and to raise funds for the school. Schools in the Benchmarking jurisdictions generally resembled those in the United States overall, with few major differences.

Exhibit 7.4 Schools' Expectations for Parental Involvement

	Percentage of Students Whose Schools Reported That They Expect Parents to Be Involved in the School-Related Activity				
	Be Sure Child Completes Homework	Serve as Teacher Aides in Classroom	Volunteer for School Projects, Programs, or Field Trips	Raise Funds for the School	Serve on Committees[1]
Countries					
United States	r 99 (0.7)	r 15 (3.0)	r 94 (1.7)	r 55 (4.7)	r 68 (4.1)
Belgium (Flemish)	94 (2.1)	19 (3.7)	39 (4.3)	9 (2.7)	10 (2.7)
Canada	99 (0.6)	15 (1.7)	82 (2.2)	52 (3.4)	55 (2.7)
Chinese Taipei	97 (1.3)	58 (4.2)	90 (2.5)	41 (4.2)	56 (4.4)
Czech Republic	91 (3.1)	7 (2.7)	80 (3.8)	32 (4.7)	35 (4.9)
England	– –	– –	– –	– –	– –
Hong Kong, SAR	96 (1.8)	30 (4.2)	77 (3.8)	60 (4.6)	21 (3.7)
Italy	91 (2.3)	9 (2.2)	70 (3.4)	25 (3.1)	42 (3.7)
Japan	43 (4.4)	5 (2.0)	81 (2.8)	6 (2.0)	8 (2.2)
Korea, Rep. of	64 (3.9)	33 (4.1)	71 (3.8)	31 (3.8)	44 (4.2)
Netherlands	r 81 (5.6)	r 46 (6.2)	r 61 (6.2)	r 16 (5.2)	r 46 (6.5)
Russian Federation	78 (3.1)	36 (3.3)	91 (1.7)	59 (2.8)	59 (4.1)
Singapore	95 (1.8)	6 (2.2)	44 (4.5)	51 (4.3)	41 (4.3)
States					
Connecticut	s 100 (0.0)	s 7 (4.4)	s 83 (6.6)	s 54 (8.6)	s 42 (8.9)
Idaho	r 97 (0.3)	r 7 (4.2)	r 86 (5.3)	r 20 (6.9)	r 43 (8.8)
Illinois	97 (2.5)	13 (4.4)	85 (6.5)	41 (6.8)	47 (6.9)
Indiana	100 (0.0)	8 (4.1)	87 (4.3)	50 (7.6)	42 (6.9)
Maryland	r 95 (3.5)	r 16 (5.4)	r 93 (4.0)	r 68 (7.8)	r 60 (7.8)
Massachusetts	s 100 (0.0)	s 8 (4.5)	s 91 (5.3)	s 65 (7.9)	s 86 (6.2)
Michigan	98 (1.8)	13 (5.0)	98 (1.6)	47 (7.6)	63 (6.6)
Missouri	96 (3.1)	5 (3.5)	73 (7.7)	33 (8.2)	50 (8.5)
North Carolina	r 100 (0.0)	r 22 (7.5)	r 95 (3.2)	r 76 (7.4)	r 61 (7.8)
Oregon	98 (2.3)	22 (8.0)	91 (3.4)	58 (7.6)	72 (6.1)
Pennsylvania	100 (0.0)	14 (6.3)	84 (5.3)	52 (6.5)	34 (6.2)
South Carolina	100 (0.0)	27 (7.5)	100 (0.0)	77 (7.2)	91 (4.4)
Texas	r 97 (2.7)	r 9 (5.1)	r 94 (3.9)	r 36 (8.7)	r 65 (6.9)
Districts and Consortia					
Academy School Dist. #20, CO	100 (0.0)	0 (0.0)	100 (0.0)	46 (0.4)	75 (0.3)
Chicago Public Schools, IL	r 100 (0.0)	r 34 (8.8)	r 94 (6.0)	r 68 (11.8)	r 80 (8.9)
Delaware Science Coalition, DE	r 98 (0.1)	r 9 (0.5)	r 90 (0.5)	r 53 (1.9)	r 60 (2.0)
First in the World Consort., IL	r 100 (0.0)	r 20 (1.5)	r 98 (0.1)	r 56 (1.2)	r 37 (1.3)
Fremont/Lincoln/WestSide PS, NE	r 100 (0.0)	r 0 (0.0)	r 72 (1.9)	r 33 (1.2)	r 48 (1.6)
Guilford County, NC	r 100 (0.0)	s 0 (0.0)	r 100 (0.0)	r 88 (1.0)	r 77 (0.7)
Jersey City Public Schools, NJ	100 (0.0)	6 (0.2)	90 (0.6)	54 (1.4)	77 (0.8)
Miami-Dade County PS, FL	x x	x x	x x	x x	x x
Michigan Invitational Group, MI	85 (1.5)	4 (0.3)	73 (1.2)	34 (1.3)	76 (1.4)
Montgomery County, MD	s 100 (0.0)	s 20 (11.3)	s 100 (0.0)	s 88 (2.3)	s 59 (12.3)
Naperville Sch. Dist. #203, IL	100 (0.0)	0 (0.0)	81 (0.6)	36 (1.8)	36 (1.8)
Project SMART Consortium, OH	93 (1.0)	14 (0.5)	80 (1.4)	45 (1.4)	52 (1.4)
Rochester City Sch. Dist., NY	r 100 (0.0)	r 19 (1.3)	r 90 (0.9)	r 57 (1.6)	r 100 (0.0)
SW Math/Sci. Collaborative, PA	100 (0.0)	7 (4.0)	88 (6.2)	48 (8.0)	41 (8.2)
International Avg. (All Countries)	85 (0.5)	28 (0.6)	79 (0.5)	51 (0.6)	47 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

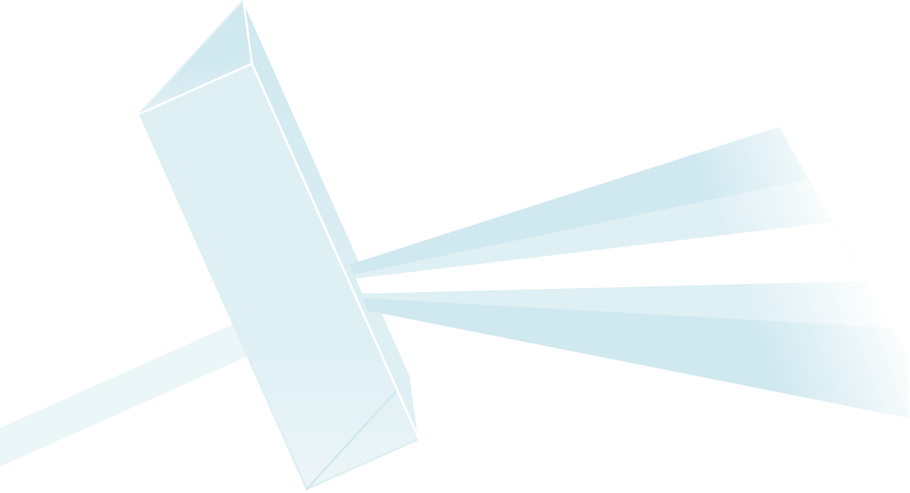
[1] Serve on committees which select school personnel or review school finances.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.



How Serious Are School Attendance Problems?

In some countries, schools are confronted with high rates of absenteeism, which can influence instructional continuity and reduce the time for learning. In general, research has shown that greater truancy is related to less serious attitudes towards school and lower academic achievement. To examine this issue, TIMSS developed an index of good school and class attendance (SCA) based on schools' responses to three questions about the seriousness of students' absenteeism, arriving late at school, and skipping class. The high index level indicates that schools reported that all three types of behavior are not a problem. The low level indicates that two or more are a serious problem, or that two are minor problems and one a serious problem. The medium category includes all other combinations of responses.

The results of the index are presented in Exhibit 7.5. Sixty percent of students on average across all the TIMSS 1999 countries were in the medium category, where principals had judged their schools to have a moderate attendance problem. Exactly one-fifth of the students were in schools at the high level of the index, and another 19 percent were in schools at the low level. Although countries varied considerably, there was a modest positive relationship between good attendance and science achievement on average across countries.

The results for the United States resemble the international averages, and also show a positive relationship between attendance and science achievement. Across the Benchmarking entities, the situation varied considerably. Participants with the highest percentages of students in schools with good attendance included Naperville and the Academy School District, with more than 40 percent of the students in this category. Jurisdictions with less than 10 percent of students in this category included Pennsylvania, Jersey City, Oregon, the Delaware Science Coalition, and Rochester.

The information used to compute this index appears in Exhibit 7.6, together with data showing the percentages of students in schools where the behavior occurs at least weekly. Arriving late and absenteeism were more common in the United States than in the TIMSS 1999 countries generally, but were not usually considered to be serious problems. Among Benchmarking participants, Naperville had the fewest students in schools that reported attendance problems. In contrast, Rochester reported the most problems, with almost all students in schools where tardiness, absenteeism, and skipping class are frequent occurrences and sometimes constitute serious problems.

Exhibit 7.5 Index of Good School and Class Attendance (SCA)

Index of Good School and Class Attendance

Index based on schools' responses to three questions about the seriousness of attendance problems in school: arriving late at school; absenteeism; skipping class (see exhibit 7.6). High level indicates that all three behaviors are reported to be not a problem. Low level indicates that two or more behaviors are reported to be a serious problem, or two behaviors are reported to be minor problems and the third a serious problem. Medium level includes all other possible combinations of responses.

		High SCA		**Medium** SCA		**Low** SCA	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Naperville Sch. Dist. #203, IL		55 (1.5)	576 (5.4)	45 (1.5)	593 (5.7)	0 (0.0)	~ ~
Belgium (Flemish)		52 (4.4)	550 (5.2)	45 (4.5)	520 (6.6)	3 (1.0)	539 (10.1)
Academy School Dist. #20, CO		42 (0.4)	551 (4.5)	58 (0.4)	565 (2.9)	0 (0.0)	~ ~
Czech Republic		36 (5.8)	544 (6.7)	56 (6.0)	538 (5.6)	8 (2.3)	555 (17.7)
Michigan Invitational Group, MI		34 (1.4)	567 (9.2)	66 (1.4)	564 (8.1)	0 (0.0)	~ ~
Italy		33 (3.3)	508 (5.0)	58 (3.6)	494 (5.4)	9 (2.4)	442 (14.3)
Singapore		32 (4.1)	599 (15.4)	64 (4.0)	553 (8.9)	3 (1.6)	552 (22.5)
Korea, Rep. of		31 (3.7)	547 (3.7)	61 (4.0)	549 (3.2)	9 (2.4)	557 (7.5)
Netherlands	r	30 (7.3)	531 (10.2)	46 (7.3)	560 (6.2)	24 (7.5)	519 (28.3)
First in the World Consort., IL	r	28 (1.4)	577 (14.5)	72 (1.4)	551 (6.9)	0 (0.0)	~ ~
Chinese Taipei		28 (3.7)	591 (8.3)	61 (3.6)	558 (4.1)	11 (2.7)	576 (9.1)
Michigan	r	28 (6.7)	563 (11.8)	69 (6.2)	554 (9.7)	3 (2.5)	510 (95.6)
Chicago Public Schools, IL	s	27 (13.5)	484 (20.2)	65 (13.2)	431 (11.2)	8 (1.2)	436 (15.9)
Indiana		27 (7.8)	564 (11.4)	66 (8.4)	525 (8.7)	7 (3.7)	525 (8.2)
Hong Kong, SAR		25 (3.9)	540 (7.9)	68 (4.3)	531 (5.6)	7 (2.5)	500 (10.8)
Project SMART Consortium, OH	s	25 (1.2)	553 (22.6)	71 (1.2)	530 (11.0)	4 (0.2)	504 (12.3)
Illinois		22 (6.5)	534 (13.5)	73 (6.7)	521 (7.0)	5 (0.4)	555 (5.7)
Connecticut	s	22 (6.6)	559 (30.4)	78 (6.6)	530 (13.0)	0 (0.0)	~ ~
United States	r	19 (3.0)	553 (10.2)	68 (3.4)	512 (6.5)	13 (2.5)	480 (11.8)
Fremont/Lincoln/WestSide PS, NE	s	18 (0.6)	526 (9.2)	69 (1.5)	499 (7.9)	13 (1.5)	577 (22.1)
Canada		18 (2.2)	536 (5.7)	73 (3.0)	533 (2.5)	9 (2.0)	535 (11.8)
Texas	s	15 (7.0)	538 (20.2)	81 (7.3)	510 (13.2)	4 (2.8)	430 (18.9)
Montgomery County, MD	s	15 (11.0)	558 (10.3)	85 (11.0)	523 (5.2)	0 (0.0)	~ ~
Massachusetts	s	14 (5.1)	559 (11.9)	74 (6.2)	536 (9.8)	11 (5.4)	536 (10.6)
Idaho	r	14 (6.7)	537 (10.9)	78 (7.6)	528 (7.4)	8 (3.6)	510 (25.8)
SW Math/Sci. Collaborative, PA		13 (3.6)	563 (8.7)	78 (6.2)	551 (8.0)	9 (4.6)	463 (19.3)
Guilford County, NC	r	13 (0.6)	580 (14.0)	79 (1.0)	538 (9.8)	8 (0.9)	459 (39.4)
South Carolina	r	11 (4.0)	490 (20.0)	75 (5.4)	516 (6.6)	13 (4.0)	489 (29.4)
Maryland	r	11 (4.5)	534 (10.4)	80 (6.1)	504 (9.2)	10 (5.1)	481 (24.6)
Russian Federation		10 (1.7)	538 (16.1)	70 (3.8)	535 (7.4)	20 (3.4)	505 (8.5)
Missouri		10 (5.0)	553 (8.2)	80 (7.0)	527 (8.0)	10 (5.1)	451 (31.4)
North Carolina	r	10 (4.2)	513 (14.6)	84 (5.7)	513 (5.6)	6 (4.0)	454 (9.5)
Pennsylvania		9 (5.1)	538 (11.5)	83 (6.6)	540 (6.1)	8 (4.1)	474 (11.2)
Japan		7 (2.4)	560 (5.0)	47 (4.1)	551 (4.1)	46 (3.9)	546 (2.7)
Jersey City Public Schools, NJ	r	7 (0.3)	463 (15.6)	90 (0.4)	437 (11.9)	3 (0.1)	409 (13.2)
Oregon		4 (3.0)	500 (9.9)	84 (5.9)	537 (7.0)	12 (4.8)	521 (15.4)
Delaware Science Coalition, DE	r	0 (0.0)	~ ~	88 (2.0)	488 (10.0)	12 (2.0)	519 (35.7)
Rochester City Sch. Dist., NY	s	0 (0.0)	~ ~	50 (1.5)	463 (13.4)	50 (1.5)	431 (13.0)
Miami-Dade County PS, FL		x x	x x	x x	x x	x x	x x
England		– –	– –	– –	– –	– –	– –
International Avg. (All Countries)		20 (0.6)	498 (2.5)	60 (0.7)	487 (1.0)	19 (0.5)	474 (2.0)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

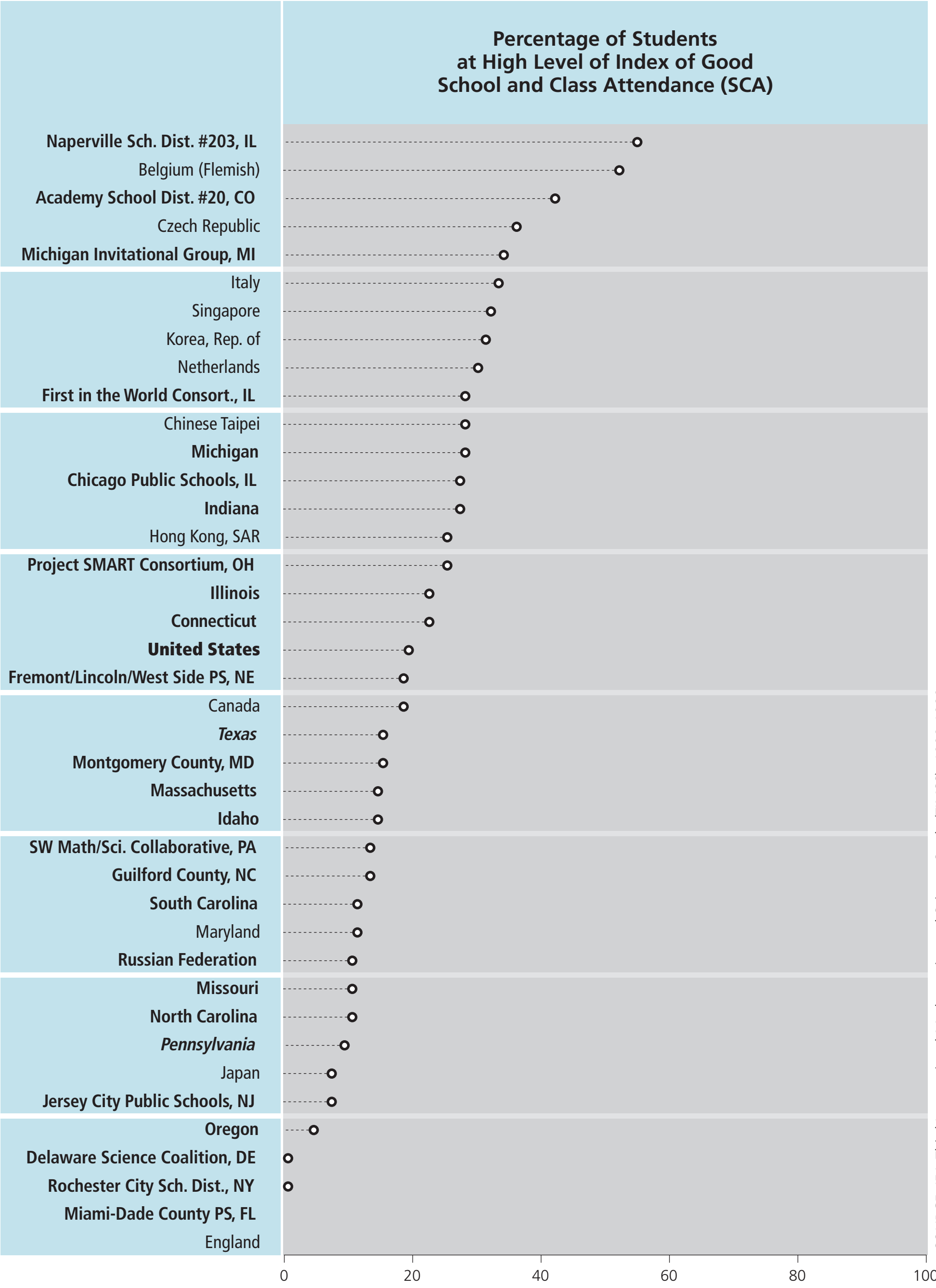
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit 7.5
(Continued)

Index of Good School and Class Attendance (SCA)



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 7.6 Frequency and Seriousness of Student Attendance Problems

8th Grade Science

	Percentage of Students Whose Schools Reported the Behavior					
	Arriving Late		Absenteeism		Skipping Class	
	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem
Countries						
United States	r 71 (3.7)	r 12 (2.3)	r 60 (4.2)	r 12 (2.7)	r 29 (3.6)	r 4 (1.8)
Belgium (Flemish)	44 (4.7)	3 (1.4)	11 (2.4)	4 (1.8)	4 (1.3)	2 (1.0)
Canada	58 (2.7)	7 (1.7)	45 (3.1)	7 (1.6)	22 (2.3)	3 (1.0)
Chinese Taipei	43 (4.1)	2 (1.1)	32 (4.0)	10 (2.7)	30 (3.8)	11 (2.8)
Czech Republic	21 (3.8)	0 (0.3)	9 (2.8)	8 (2.5)	5 (2.2)	8 (2.4)
England	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	r 61 (4.8)	9 (2.8)	r 34 (4.5)	3 (1.6)	r 10 (2.8)	r 1 (0.9)
Italy	32 (3.6)	4 (1.6)	11 (2.2)	9 (2.3)	8 (2.2)	7 (2.0)
Japan	55 (4.1)	20 (3.4)	63 (4.1)	76 (3.9)	14 (3.2)	27 (3.8)
Korea, Rep. of	32 (4.0)	1 (1.0)	31 (4.1)	12 (2.9)	21 (3.6)	5 (1.8)
Netherlands	r 76 (4.9)	r 18 (6.8)	r 35 (5.9)	r 12 (6.4)	r 44 (6.5)	r 15 (7.1)
Russian Federation	41 (3.8)	14 (3.5)	22 (2.9)	12 (2.2)	32 (4.2)	10 (2.2)
Singapore	51 (4.8)	3 (1.6)	40 (4.4)	3 (1.5)	23 (4.0)	0 (0.0)
States						
Connecticut	s 67 (9.4)	s 0 (0.0)	s 48 (9.5)	s 4 (0.5)	s 20 (6.7)	s 0 (0.0)
Idaho	r 72 (8.9)	r 5 (2.7)	r 67 (8.5)	r 8 (3.6)	r 31 (7.3)	r 1 (0.1)
Illinois	57 (8.4)	5 (3.0)	42 (7.4)	7 (1.2)	r 9 (4.0)	0 (0.0)
Indiana	64 (7.9)	7 (3.5)	55 (7.9)	9 (4.2)	20 (4.5)	0 (0.0)
Maryland	r 63 (7.1)	r 10 (5.1)	r 51 (6.9)	r 10 (5.1)	r 21 (6.0)	r 0 (0.0)
Massachusetts	s 59 (8.9)	s 16 (7.5)	s 62 (7.6)	s 14 (6.1)	s 17 (6.6)	s 0 (0.0)
Michigan	48 (7.1)	r 1 (1.0)	37 (7.3)	r 5 (3.4)	11 (4.5)	r 0 (0.0)
Missouri	76 (6.0)	2 (1.7)	69 (6.7)	13 (5.6)	33 (6.5)	r 9 (5.0)
North Carolina	r 54 (8.3)	r 3 (0.2)	r 52 (9.0)	r 11 (5.0)	r 16 (6.2)	r 0 (0.0)
Oregon	81 (6.5)	r 8 (3.0)	75 (7.6)	19 (5.3)	43 (8.1)	5 (1.8)
Pennsylvania	73 (7.2)	8 (4.1)	50 (6.7)	8 (4.1)	17 (5.0)	1 (0.0)
South Carolina	r 73 (6.5)	r 10 (4.9)	r 67 (7.8)	r 20 (5.1)	16 (4.4)	r 0 (0.0)
Texas	r 81 (7.3)	s 4 (2.8)	r 68 (7.6)	s 1 (1.4)	r 39 (6.1)	s 0 (0.0)
Districts and Consortia						
Academy School Dist. #20, CO	54 (0.4)	0 (0.0)	29 (0.4)	0 (0.0)	46 (0.4)	0 (0.0)
Chicago Public Schools, IL	s 66 (8.3)	s 8 (1.2)	s 49 (11.4)	s 10 (7.8)	s 14 (6.1)	r 0 (0.0)
Delaware Science Coalition, DE	r 84 (2.0)	r 0 (0.0)	r 90 (0.6)	r 12 (2.0)	s 54 (1.7)	r 0 (0.0)
First in the World Consort., IL	r 62 (1.4)	r 0 (0.0)	r 15 (0.4)	r 0 (0.0)	r 0 (0.0)	r 0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r 68 (1.1)	s 0 (0.0)	r 58 (1.4)	s 13 (1.5)	r 48 (1.7)	s 0 (0.0)
Guilford County, NC	r 77 (0.9)	r 0 (0.0)	r 88 (0.6)	r 8 (0.9)	r 36 (1.1)	r 0 (0.0)
Jersey City Public Schools, NJ	66 (1.0)	r 12 (0.8)	50 (1.4)	r 0 (0.0)	0 (0.0)	r 0 (0.0)
Miami-Dade County PS, FL	x x	x x	x x	x x	x x	x x
Michigan Invitational Group, MI	48 (1.5)	9 (0.8)	40 (1.6)	0 (0.0)	31 (1.5)	0 (0.0)
Montgomery County, MD	s 83 (9.6)	s 0 (0.0)	s 61 (12.2)	s 0 (0.0)	s 12 (7.2)	s 0 (0.0)
Naperville Sch. Dist. #203, IL	39 (1.9)	0 (0.0)	15 (2.1)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	r 73 (1.1)	s 4 (0.2)	r 47 (1.6)	s 4 (0.2)	r 33 (1.6)	s 0 (0.0)
Rochester City Sch. Dist., NY	r 100 (0.0)	s 19 (0.6)	r 100 (0.0)	s 19 (0.6)	r 84 (0.5)	s 30 (1.5)
SW Math/Sci. Collaborative, PA	68 (7.7)	9 (4.6)	62 (6.2)	7 (4.3)	26 (8.7)	3 (2.9)
International Avg. (All Countries)	49 (0.6)	11 (0.4)	38 (0.6)	17 (0.5)	27 (0.6)	13 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

How Safe and Orderly Are Schools?

Discipline that maintains an orderly atmosphere conducive to learning is very important to school quality, and research indicates that urban schools have conditions less conducive to learning than non-urban schools.[5] For example, urban schools report more crime against students and teachers at school and that physical conflict among students is a serious or moderate problem. Among the Benchmarking participants there was considerable variation in principals' reports about the seriousness of a variety of potential discipline problems.

The frequency and seriousness of student behavior threatening an orderly school environment are presented in Exhibit 7.7. The three types of behavior are violating the dress code, creating a classroom disturbance, and cheating. Violation of dress code is likely to reflect, at least partially, whether there is a uniform requirement. For many countries, violating the dress code was not reported to be a serious problem; on average internationally only six percent of the students were in schools where it was a serious problem. Dress code violations were more frequently reported in the United States, where 42 percent of students were in schools where this occurs at least weekly, compared with 24 percent internationally. This was also a frequent problem in Texas and in Rochester, with 79 and 59 percent of students, respectively, in such schools.

Classroom disturbance was a more frequent problem in schools in the United States, as well as a more serious one. More than two-thirds of U.S. eighth-grade students were in schools where disturbances occur at least weekly, and 11 percent where these are a serious problem. Benchmarking jurisdictions where classroom disturbances were both more frequent and more serious than in the United States generally included Maryland, Missouri, North Carolina, Pennsylvania, the Delaware Science Coalition, Guilford County, the Michigan Invitational Group, Montgomery County, and Rochester.

The frequency and seriousness of student behavior threatening a safe school environment are shown in Exhibit 7.8. The five types of behavior are vandalism, theft, physical injury to other students, intimidation or verbal abuse of other students, and intimidation or verbal abuse of teachers or staff. As in other reports of student behavior, cross-national comparisons are difficult because of differing perceptions of what constitutes a serious problem. However, with only a few exceptions, the overwhelming majority of students attend schools judged to have few serious problems. The incidence of such student behavior was

---

[5] Mayer, D.P., Mullens, J.E., and Moore, M.T. (2000), *Monitoring School Quality: An Indicators Report*, NCES 2001-030, Washington, DC: National Center for Education Statistics; Kaufman, P., Chen, X., Choy, S.P., Ruddy, S.A., Miller, A.K., Fleury, J.K., Chandler, K.A., Rand, M.R., Klaus, P., and Planty, M.G. (2000), *Indicators of School Crime and Safety, 2000*, NCES 2001-017/NCJ-184176, Washington, DC: U.S. Departments of Education and Justice.

generally low in most countries. The exception was intimidation or verbal abuse of other students. Some countries had relatively high percentages of students in schools where this occurs at least weekly; in Canada, the Netherlands, and the United States, more than 40 percent of the students were in such schools. Among Benchmarking participants, intimidation or verbal abuse of other students was a frequent and serious problem in Idaho, Maryland, Oregon, Pennsylvania, the Delaware Science Coalition, the Fremont/Lincoln/Westside Public Schools, the Project SMART Consortium, and Rochester. Vandalism was a frequent and serious problem in Rochester.

Exhibit 7.7 Frequency and Seriousness of Student Behavior Threatening an Orderly School Environment

	Percentage of Students Whose Schools Reported the Behavior					
	Violating Dress Code		**Classroom Disturbance**		**Cheating**	
	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem
Countries						
United States	r 42 (4.0)	r 3 (1.2)	r 69 (4.3)	r 11 (2.6)	r 12 (2.8)	r 1 (0.0)
Belgium (Flemish)	6 (2.1)	0 (0.0)	40 (5.4)	7 (2.5)	14 (2.7)	1 (0.0)
Canada	22 (1.8)	2 (0.8)	60 (2.6)	21 (2.3)	4 (1.4)	2 (0.9)
Chinese Taipei	41 (4.1)	3 (1.5)	30 (3.8)	4 (1.6)	9 (2.1)	8 (2.3)
Czech Republic	3 (1.7)	0 (0.0)	63 (4.7)	21 (4.4)	9 (4.3)	11 (3.5)
England	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	r 42 (4.6)	r 7 (2.5)	36 (4.7)	r 9 (2.9)	4 (1.7)	r 4 (1.9)
Italy	– –	– –	47 (4.0)	32 (3.6)	13 (2.7)	5 (1.4)
Japan	30 (4.0)	18 (3.5)	5 (1.5)	23 (3.7)	2 (1.1)	13 (2.8)
Korea, Rep. of	37 (4.3)	3 (1.4)	43 (4.2)	7 (1.8)	3 (1.3)	8 (2.5)
Netherlands	r 10 (4.2)	r 0 (0.0)	r 76 (5.5)	r 14 (5.4)	r 60 (6.5)	r 1 (0.8)
Russian Federation	7 (2.2)	0 (0.0)	13 (2.8)	4 (1.6)	1 (0.5)	2 (1.2)
Singapore	36 (4.8)	2 (1.3)	32 (3.9)	3 (1.7)	3 (1.4)	0 (0.0)
States						
Connecticut	s 22 (7.5)	s 0 (0.0)	s 71 (10.3)	s 11 (5.8)	s 8 (4.9)	s 7 (4.6)
Idaho	r 21 (8.2)	r 0 (0.0)	r 76 (6.8)	r 8 (3.9)	r 15 (5.4)	r 0 (0.0)
Illinois	16 (5.9)	2 (1.1)	65 (8.0)	6 (3.4)	10 (3.9)	0 (0.0)
Indiana	19 (6.2)	3 (0.2)	70 (5.5)	11 (4.8)	12 (5.0)	1 (1.2)
Maryland	r 36 (7.4)	r 4 (3.0)	r 84 (5.8)	r 26 (7.9)	r 9 (4.3)	r 0 (0.0)
Massachusetts	s 15 (5.5)	s 0 (0.0)	s 73 (8.4)	s 11 (4.4)	s 8 (4.8)	s 3 (2.6)
Michigan	16 (6.2)	r 2 (0.2)	68 (6.7)	r 7 (3.6)	5 (2.8)	r 0 (0.0)
Missouri	33 (7.6)	r 0 (0.0)	83 (5.1)	r 13 (4.7)	12 (4.1)	r 0 (0.0)
North Carolina	r 31 (8.6)	r 0 (0.0)	r 86 (5.7)	r 15 (6.3)	r 8 (4.4)	r 0 (0.0)
Oregon	21 (6.3)	0 (0.0)	77 (6.3)	6 (3.7)	4 (2.9)	0 (0.0)
Pennsylvania	34 (5.2)	6 (5.9)	82 (4.7)	15 (7.5)	5 (2.2)	1 (0.1)
South Carolina	r 47 (8.8)	r 5 (3.3)	86 (6.5)	r 10 (4.6)	13 (5.8)	r 1 (1.4)
Texas	r 79 (3.7)	s 11 (6.6)	r 79 (6.0)	s 8 (5.2)	r 12 (6.1)	s 0 (0.0)
Districts and Consortia						
Academy School Dist. #20, CO	0 (0.0)	0 (0.0)	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	r 40 (9.7)	r 10 (7.5)	s 62 (9.0)	s 0 (0.0)	s 19 (10.2)	s 0 (0.0)
Delaware Science Coalition, DE	r 39 (2.0)	r 6 (0.5)	r 96 (0.4)	r 23 (1.8)	r 18 (0.8)	r 0 (0.0)
First in the World Consort., IL	r 0 (0.0)	r 0 (0.0)	r 44 (1.1)	r 0 (0.1)	r 0 (0.1)	r 0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r 43 (1.8)	s 0 (0.0)	r 65 (1.3)	s 9 (0.5)	r 13 (0.9)	s 0 (0.0)
Guilford County, NC	r 42 (1.2)	r 0 (0.0)	r 88 (1.0)	r 17 (0.9)	r 19 (1.2)	s 0 (0.0)
Jersey City Public Schools, NJ	r 19 (1.1)	r 6 (0.9)	44 (1.6)	r 9 (0.8)	11 (1.0)	r 0 (0.0)
Miami-Dade County PS, FL	x x	x x	x x	x x	x x	x x
Michigan Invitational Group, MI	31 (1.5)	0 (0.0)	84 (1.4)	15 (1.5)	25 (1.2)	2 (0.1)
Montgomery County, MD	s 38 (12.6)	s 0 (0.0)	s 86 (9.8)	s 13 (8.1)	s 7 (1.1)	s 0 (0.0)
Naperville Sch. Dist. #203, IL	0 (0.0)	0 (0.0)	15 (2.1)	0 (0.0)	21 (1.0)	0 (0.0)
Project SMART Consortium, OH	r 27 (1.3)	s 0 (0.0)	r 65 (1.4)	s 14 (0.8)	r 0 (0.0)	s 0 (0.0)
Rochester City Sch. Dist., NY	r 59 (1.5)	s 0 (0.0)	r 100 (0.0)	s 50 (1.7)	s 0 (0.0)	s 0 (0.0)
SW Math/Sci. Collaborative, PA	47 (9.1)	2 (2.1)	67 (7.2)	11 (5.4)	7 (2.9)	0 (0.0)
International Avg. (All Countries)	24 (0.6)	6 (0.3)	39 (0.6)	13 (0.5)	11 (0.4)	7 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit 7.8

Frequency and Seriousness of Student Behavior Threatening a Safe School Environment

8th Grade Science

	Percentage of Students Whose Schools Reported the Behavior					
	Vandalism		Theft		Physical Injury to Other Students	
	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem
Countries						
United States	r 11 (2.3)	r 1 (0.8)	r 10 (2.5)	r 2 (1.1)	r 10 (2.4)	r 3 (1.8)
Belgium (Flemish)	8 (2.4)	9 (2.6)	7 (2.2)	9 (2.5)	8 (1.9)	6 (2.1)
Canada	15 (1.5)	6 (2.0)	7 (1.4)	6 (1.9)	6 (1.8)	4 (1.5)
Chinese Taipei	14 (3.1)	11 (2.5)	7 (2.2)	16 (2.9)	8 (2.3)	21 (3.2)
Czech Republic	13 (2.7)	21 (3.6)	3 (1.9)	17 (3.8)	2 (1.7)	17 (3.7)
England	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	18 (3.7)	r 6 (2.3)	8 (2.6)	r 5 (2.2)	5 (2.1)	r 3 (1.6)
Italy	7 (1.9)	18 (2.8)	4 (1.4)	16 (2.8)	9 (2.1)	19 (3.0)
Japan	3 (1.3)	23 (3.5)	1 (0.9)	25 (3.7)	1 (0.9)	22 (3.6)
Korea, Rep. of	12 (2.8)	10 (2.5)	9 (2.5)	13 (3.0)	10 (2.6)	9 (2.6)
Netherlands	r 45 (7.6)	r 28 (7.4)	r 22 (5.9)	r 19 (6.4)	r 2 (1.3)	r 4 (2.0)
Russian Federation	0 (0.4)	3 (1.5)	1 (0.5)	6 (2.0)	2 (1.1)	4 (1.3)
Singapore	5 (1.8)	2 (1.3)	5 (2.0)	2 (1.4)	1 (0.7)	0 (0.0)
States						
Connecticut	s 12 (6.0)	s 0 (0.0)	s 12 (6.0)	s 0 (0.0)	s 25 (8.2)	s 13 (6.1)
Idaho	r 15 (5.6)	r 0 (0.0)	r 17 (5.9)	r 4 (3.2)	r 25 (8.2)	r 0 (0.0)
Illinois	3 (0.9)	2 (0.1)	5 (2.4)	0 (0.0)	9 (3.8)	4 (3.0)
Indiana	2 (0.1)	0 (0.0)	6 (3.7)	2 (2.2)	8 (4.0)	2 (2.2)
Maryland	r 7 (3.7)	r 3 (0.2)	r 6 (3.4)	r 0 (0.0)	r 33 (8.3)	r 9 (5.1)
Massachusetts	s 6 (3.5)	s 0 (0.0)	s 6 (3.8)	s 3 (2.4)	s 9 (4.5)	s 0 (0.0)
Michigan	6 (3.2)	r 2 (0.2)	3 (2.1)	r 2 (0.1)	6 (2.7)	r 4 (2.7)
Missouri	9 (5.0)	r 2 (2.2)	7 (3.9)	r 7 (3.9)	8 (4.9)	r 5 (3.6)
North Carolina	r 20 (7.3)	r 0 (0.0)	r 20 (7.1)	r 3 (2.5)	r 8 (4.4)	r 0 (0.0)
Oregon	7 (3.9)	2 (1.7)	12 (4.9)	0 (0.0)	7 (4.4)	2 (2.3)
Pennsylvania	7 (2.9)	r 1 (0.9)	6 (2.9)	r 2 (1.8)	9 (3.6)	5 (3.1)
South Carolina	5 (3.6)	r 0 (0.0)	18 (5.9)	r 0 (0.0)	8 (4.6)	r 3 (2.5)
Texas	r 12 (6.2)	s 0 (0.0)	r 16 (7.3)	s 0 (0.0)	r 9 (5.1)	s 0 (0.0)
Districts and Consortia						
Academy School Dist. #20, CO	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	r 0 (0.0)
Chicago Public Schools, IL	s 6 (1.0)	s 0 (0.0)	s 6 (1.0)	s 0 (0.0)	s 6 (1.0)	s 0 (0.0)
Delaware Science Coalition, DE	r 6 (0.5)	r 6 (0.5)	r 5 (2.1)	r 0 (0.0)	s 28 (2.6)	r 6 (0.5)
First in the World Consort., IL	r 13 (0.4)	r 0 (0.0)	r 13 (0.4)	r 0 (0.0)	r 0 (0.0)	r 0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r 0 (0.0)	s 0 (0.0)	r 25 (1.4)	s 0 (0.0)	r 25 (1.4)	s 13 (1.5)
Guilford County, NC	r 0 (0.0)	r 0 (0.0)	r 0 (0.0)	s 0 (0.0)	r 7 (0.4)	s 0 (0.0)
Jersey City Public Schools, NJ	11 (0.9)	r 0 (0.0)	0 (0.0)	r 6 (0.4)	10 (0.3)	r 9 (0.8)
Miami-Dade County PS, FL	x x	x x	x x	x x	x x	x x
Michigan Invitational Group, MI	19 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	11 (0.8)	0 (0.0)
Montgomery County, MD	s 12 (7.2)	s 0 (0.0)	s 7 (1.1)	s 0 (0.0)	s 0 (0.0)	s 0 (0.0)
Naperville Sch. Dist. #203, IL	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	r 16 (1.2)	s 0 (0.0)	r 23 (1.5)	s 0 (0.0)	r 16 (0.8)	s 10 (0.8)
Rochester City Sch. Dist., NY	r 60 (1.6)	s 36 (1.7)	r 19 (1.8)	s 0 (0.0)	r 30 (1.3)	s 0 (0.0)
SW Math/Sci. Collaborative, PA	14 (5.8)	4 (0.4)	14 (4.7)	4 (0.4)	17 (6.7)	2 (2.1)
International Avg. (All Countries)	11 (0.4)	13 (0.5)	6 (0.3)	12 (0.5)	6 (0.3)	10 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

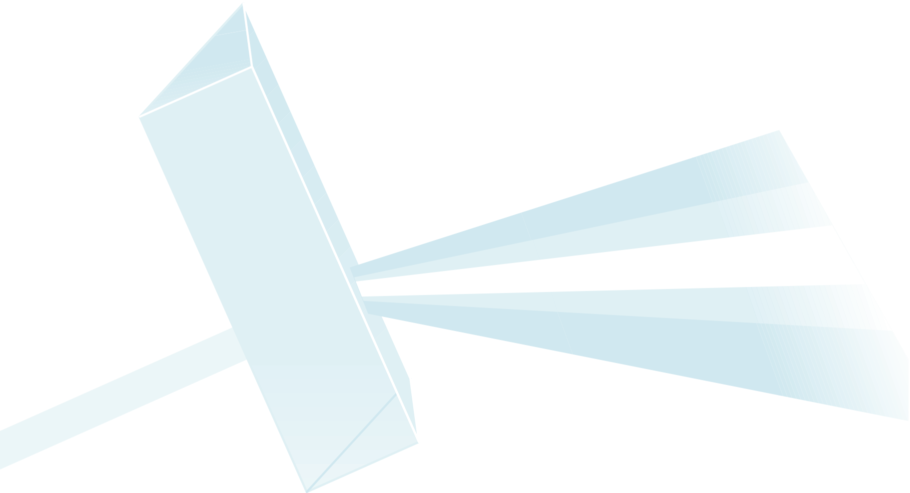
An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit 7.8
(Continued)

Frequency and Seriousness of Student Behavior Threatening a Safe School Environment

	Percentage of Students Whose Schools Reported the Behavior			
	Intimidation or Verbal Abuse of Other Students		Intimidation or Verbal Abuse of Teachers or Staff	
	Occurs at Least Weekly	Is a Serious Problem	Occurs at Least Weekly	Is a Serious Problem
Countries				
United States	r 46 (4.3)	r 16 (3.6)	r 7 (2.0)	r 3 (1.5)
Belgium (Flemish)	23 (3.4)	15 (3.7)	5 (1.5)	3 (1.2)
Canada	42 (3.0)	22 (2.5)	4 (1.2)	3 (1.1)
Chinese Taipei	11 (2.7)	18 (3.1)	1 (1.0)	17 (3.0)
Czech Republic	5 (1.5)	17 (3.6)	0 (0.0)	9 (2.6)
England	– –	– –	– –	– –
Hong Kong, SAR	r 8 (2.7)	r 4 (1.8)	r 3 (1.5)	r 2 (1.3)
Italy	14 (2.3)	23 (3.0)	4 (1.7)	13 (2.7)
Japan	3 (1.5)	25 (3.8)	2 (1.2)	23 (3.7)
Korea, Rep. of	12 (2.9)	12 (2.8)	8 (2.3)	9 (2.5)
Netherlands	r 49 (7.3)	r 23 (6.9)	r 17 (6.6)	r 16 (6.4)
Russian Federation	3 (1.3)	7 (2.1)	1 (0.5)	1 (0.6)
Singapore	7 (2.3)	2 (1.2)	1 (0.7)	1 (0.9)
States				
Connecticut	s 53 (11.3)	s 14 (6.2)	s 5 (3.9)	s 6 (4.5)
Idaho	r 62 (9.7)	r 29 (7.3)	r 13 (3.5)	r 2 (0.1)
Illinois	42 (7.2)	11 (4.6)	6 (3.3)	3 (2.6)
Indiana	35 (7.1)	7 (2.0)	2 (0.1)	0 (0.0)
Maryland	r 66 (7.1)	r 25 (7.3)	r 36 (6.5)	r 16 (6.1)
Massachusetts	s 52 (9.2)	s 15 (7.2)	s 9 (4.4)	s 4 (2.7)
Michigan	46 (5.1)	r 16 (5.4)	0 (0.0)	r 2 (0.1)
Missouri	49 (7.7)	r 13 (3.9)	21 (5.9)	r 5 (3.4)
North Carolina	r 49 (6.8)	r 18 (5.8)	r 12 (5.1)	r 0 (0.1)
Oregon	67 (7.8)	23 (7.9)	4 (2.7)	2 (2.3)
Pennsylvania	53 (8.2)	21 (7.3)	13 (4.0)	9 (4.9)
South Carolina	47 (8.9)	r 9 (4.3)	8 (4.6)	r 3 (2.5)
Texas	r 43 (5.1)	s 12 (6.3)	r 2 (2.5)	s 0 (0.0)
Districts and Consortia				
Academy School Dist. #20, CO	25 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	s 30 (12.5)	s 0 (0.0)	s 0 (0.0)	s 0 (0.0)
Delaware Science Coalition, DE	r 83 (0.9)	r 13 (0.7)	r 16 (1.9)	r 10 (0.6)
First in the World Consort., IL	r 37 (1.0)	r 0 (0.1)	r 0 (0.1)	r 0 (0.1)
Fremont/Lincoln/WestSide PS, NE	r 51 (1.6)	s 24 (1.1)	r 43 (1.8)	s 0 (0.0)
Guilford County, NC	r 46 (1.2)	s 6 (0.5)	r 9 (0.4)	s 10 (0.5)
Jersey City Public Schools, NJ	36 (1.3)	r 19 (1.0)	35 (1.3)	r 9 (0.8)
Miami-Dade County PS, FL	x x	x x	x x	x x
Michigan Invitational Group, MI	50 (1.5)	14 (0.7)	12 (0.8)	0 (0.0)
Montgomery County, MD	s 48 (8.8)	s 23 (11.1)	s 28 (14.9)	x x
Naperville Sch. Dist. #203, IL	21 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	r 61 (1.6)	s 26 (1.0)	r 16 (0.8)	s 18 (0.9)
Rochester City Sch. Dist., NY	r 100 (0.0)	s 36 (1.7)	r 50 (1.7)	s 0 (0.0)
SW Math/Sci. Collaborative, PA	52 (9.4)	14 (6.3)	22 (7.7)	4 (3.3)
International Avg. (All Countries)	16 (0.5)	14 (0.5)	4 (0.3)	9 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.



REFERENCE 1

Students’ Backgrounds and Attitudes Towards Science

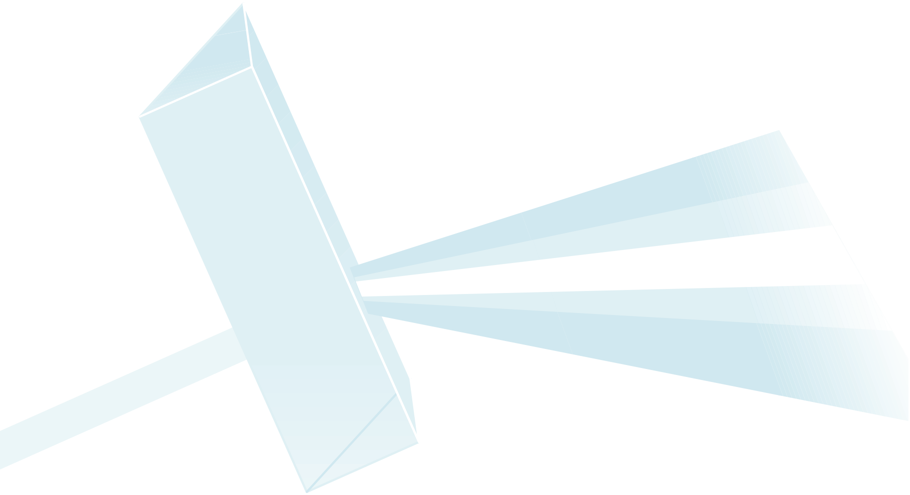


Exhibit R1.1 Educational Aids in the Home: Dictionary, Study Desk/Table, and Computer

	Have All Three Educational Aids		Do Not Have All Three Educational Aids		Percentage of Students		
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Have Dictionary	Have Study Desk/Table for Own Use	Have Computer
Countries							
United States	74 (1.3)	535 (3.9)	26 (1.3)	469 (5.8)	97 (0.3)	90 (0.5)	80 (1.2)
Belgium (Flemish)	82 (1.2)	541 (2.7)	18 (1.2)	507 (6.9)	98 (0.7)	96 (0.6)	86 (1.0)
Canada	78 (0.8)	539 (2.2)	22 (0.8)	513 (3.6)	98 (0.2)	91 (0.6)	85 (0.8)
Chinese Taipei	61 (1.1)	588 (4.2)	39 (1.1)	541 (5.5)	98 (0.2)	94 (0.4)	63 (1.0)
Czech Republic	43 (1.2)	563 (4.1)	57 (1.2)	522 (4.8)	94 (0.8)	91 (0.7)	47 (1.2)
England	79 (0.9)	550 (4.8)	21 (0.9)	501 (7.3)	98 (0.3)	92 (0.6)	85 (0.8)
Hong Kong, SAR	57 (1.3)	537 (3.8)	43 (1.3)	522 (4.5)	99 (0.1)	75 (0.9)	72 (1.3)
Italy	59 (1.1)	506 (4.5)	41 (1.1)	476 (4.8)	98 (0.3)	93 (0.6)	63 (1.0)
Japan	52 (1.0)	564 (2.8)	48 (1.0)	536 (2.7)	99 (0.1)	97 (0.2)	52 (0.9)
Korea, Rep. of	65 (0.9)	563 (3.0)	35 (0.9)	523 (3.2)	99 (0.2)	96 (0.2)	67 (0.9)
Netherlands	94 (1.0)	548 (6.7)	6 (1.0)	499 (16.2)	100 (0.2)	99 (0.2)	96 (1.0)
Russian Federation	19 (1.2)	540 (7.6)	81 (1.2)	528 (6.7)	88 (1.3)	92 (0.8)	22 (1.2)
Singapore	75 (1.4)	582 (7.6)	25 (1.4)	524 (9.7)	99 (0.2)	92 (0.5)	80 (1.3)
States							
Connecticut	82 (2.0)	541 (9.7)	18 (2.0)	478 (11.9)	97 (0.3)	92 (0.9)	88 (1.7)
Idaho	75 (2.3)	540 (5.4)	25 (2.3)	491 (9.1)	94 (0.9)	90 (0.9)	82 (2.1)
Illinois	75 (2.1)	535 (6.8)	25 (2.1)	477 (6.2)	98 (0.5)	91 (0.8)	80 (2.1)
Indiana	74 (2.0)	545 (6.8)	26 (2.0)	504 (8.9)	97 (0.4)	90 (1.2)	81 (1.5)
Maryland	80 (1.6)	518 (6.9)	20 (1.6)	462 (9.6)	98 (0.3)	91 (0.9)	86 (1.4)
Massachusetts	82 (1.8)	544 (7.2)	18 (1.8)	485 (7.0)	98 (0.3)	93 (0.7)	87 (1.6)
Michigan	79 (1.9)	557 (7.0)	21 (1.9)	502 (12.6)	98 (0.3)	90 (0.9)	85 (1.7)
Missouri	69 (2.0)	538 (6.2)	31 (2.0)	493 (7.6)	96 (0.6)	90 (0.6)	76 (1.8)
North Carolina	68 (2.0)	524 (5.6)	32 (2.0)	474 (7.8)	97 (0.4)	89 (0.9)	74 (1.8)
Oregon	79 (2.0)	548 (5.1)	21 (2.0)	496 (9.5)	97 (0.6)	91 (1.0)	86 (1.7)
Pennsylvania	78 (2.4)	540 (5.1)	22 (2.4)	494 (10.1)	98 (0.7)	91 (1.1)	83 (2.0)
South Carolina	67 (2.2)	529 (6.5)	33 (2.2)	476 (7.8)	97 (0.4)	89 (1.0)	75 (2.2)
Texas	65 (3.6)	542 (7.3)	35 (3.6)	455 (12.2)	95 (0.7)	86 (1.7)	73 (3.3)
Districts and Consortia							
Academy School Dist. #20, CO	92 (0.8)	562 (2.3)	8 (0.8)	525 (12.1)	99 (0.3)	96 (0.6)	96 (0.5)
Chicago Public Schools, IL	54 (1.9)	465 (10.3)	46 (1.9)	433 (9.7)	98 (0.5)	85 (1.5)	61 (1.7)
Delaware Science Coalition, DE	76 (2.1)	516 (8.5)	24 (2.1)	460 (7.9)	97 (0.6)	90 (1.1)	82 (1.6)
First in the World Consort., IL	91 (1.2)	568 (4.8)	9 (1.2)	536 (17.4)	98 (0.3)	95 (1.2)	96 (0.6)
Fremont/Lincoln/WestSide PS, NE	77 (1.8)	527 (5.9)	23 (1.8)	462 (8.7)	96 (0.9)	92 (1.0)	81 (1.6)
Guilford County, NC	76 (1.8)	549 (6.6)	24 (1.8)	486 (9.3)	98 (0.5)	92 (1.1)	81 (1.6)
Jersey City Public Schools, NJ	49 (2.8)	463 (11.6)	51 (2.8)	421 (7.4)	96 (0.7)	81 (1.4)	58 (2.3)
Miami-Dade County PS, FL	58 (3.0)	451 (11.1)	42 (3.0)	395 (10.6)	95 (0.8)	84 (1.4)	66 (2.8)
Michigan Invitational Group, MI	82 (1.2)	570 (5.9)	18 (1.2)	542 (12.2)	97 (0.5)	91 (1.0)	89 (1.6)
Montgomery County, MD	86 (1.9)	542 (4.8)	14 (1.9)	469 (10.5)	99 (0.4)	93 (0.9)	91 (1.4)
Naperville Sch. Dist. #203, IL	96 (0.6)	585 (4.1)	4 (0.6)	566 (16.2)	99 (0.3)	97 (0.5)	98 (0.4)
Project SMART Consortium, OH	76 (1.5)	550 (8.7)	24 (1.5)	507 (8.0)	98 (0.6)	91 (1.1)	83 (1.2)
Rochester City Sch. Dist., NY	52 (2.5)	464 (9.9)	48 (2.5)	444 (7.6)	94 (0.7)	83 (1.4)	61 (2.3)
SW Math/Sci. Collaborative, PA	75 (2.1)	557 (6.6)	25 (2.1)	502 (11.0)	98 (0.4)	90 (0.9)	82 (1.9)
International Avg. (All Countries)	41 (0.2)	515 (1.2)	59 (0.2)	471 (0.9)	90 (0.1)	86 (0.1)	45 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit R1.2 Number of Books in the Home

	Three or More Bookcases (More Than 200 Books)		About Two Bookcases (101-200 Books)		About One Bookcase (26-100 Books)		About One Shelf (11-25 Books)		None or Very Few (0-10 Books)	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries										
United States	28 (1.2)	557 (4.5)	22 (0.6)	538 (4.6)	29 (0.8)	508 (3.9)	14 (0.7)	468 (7.0)	8 (0.6)	442 (6.0)
Belgium (Flemish)	14 (0.8)	561 (4.9)	14 (0.6)	557 (5.7)	31 (1.3)	542 (4.2)	21 (0.7)	522 (5.8)	19 (1.3)	504 (5.4)
Canada	31 (0.9)	553 (4.0)	24 (0.8)	541 (3.3)	28 (0.7)	527 (3.4)	11 (0.5)	498 (5.1)	5 (0.3)	495 (12.4)
Chinese Taipei	16 (0.8)	616 (6.1)	12 (0.5)	603 (7.3)	31 (0.7)	579 (6.0)	23 (0.7)	554 (4.7)	17 (0.9)	507 (4.4)
Czech Republic	28 (1.4)	565 (5.5)	30 (1.4)	548 (5.8)	34 (1.1)	523 (4.8)	7 (0.8)	493 (7.6)	1 (0.2)	~ ~
England	26 (1.2)	593 (6.7)	23 (0.8)	550 (7.3)	32 (1.1)	526 (4.7)	13 (0.8)	483 (6.4)	7 (0.7)	472 (11.5)
Hong Kong, SAR	8 (0.5)	548 (6.4)	10 (0.5)	534 (6.0)	27 (0.7)	537 (4.9)	27 (0.7)	530 (4.8)	28 (0.9)	517 (4.2)
Italy	20 (0.9)	523 (7.5)	15 (0.7)	518 (5.9)	28 (0.9)	497 (4.4)	25 (0.9)	471 (5.6)	12 (0.8)	453 (7.2)
Japan	18 (0.7)	577 (5.3)	18 (0.6)	567 (5.0)	31 (0.7)	548 (2.6)	19 (0.6)	541 (4.6)	14 (0.6)	518 (5.1)
Korea, Rep. of	20 (0.8)	589 (3.8)	23 (0.6)	562 (4.6)	36 (0.7)	544 (2.1)	10 (0.5)	510 (4.9)	10 (0.4)	490 (5.6)
Netherlands	24 (1.8)	575 (9.3)	23 (1.2)	554 (6.9)	31 (1.1)	546 (7.2)	15 (1.4)	508 (12.1)	8 (1.4)	499 (12.3)
Russian Federation	23 (1.5)	555 (6.0)	29 (1.1)	541 (7.1)	31 (1.3)	521 (7.7)	13 (1.0)	495 (8.9)	4 (0.5)	470 (20.8)
Singapore	12 (0.6)	599 (11.4)	14 (0.7)	599 (10.3)	40 (1.1)	579 (7.2)	22 (1.0)	540 (8.8)	12 (0.8)	516 (8.8)
States										
Connecticut	35 (2.7)	565 (10.0)	23 (0.9)	539 (10.5)	25 (1.3)	523 (8.9)	10 (1.4)	472 (13.8)	8 (1.4)	445 (14.7)
Idaho	32 (1.6)	553 (6.3)	23 (1.1)	542 (7.1)	27 (1.4)	520 (5.6)	11 (1.2)	485 (10.5)	7 (1.0)	439 (9.6)
Illinois	29 (2.5)	555 (8.7)	23 (0.9)	536 (6.6)	30 (1.6)	511 (7.4)	12 (1.1)	472 (8.8)	6 (0.8)	446 (9.5)
Indiana	30 (2.2)	569 (8.0)	23 (1.0)	546 (6.4)	28 (1.2)	525 (6.6)	11 (1.3)	495 (8.6)	8 (1.0)	456 (12.3)
Maryland	31 (1.8)	547 (6.7)	23 (0.8)	522 (6.2)	27 (1.0)	491 (7.9)	13 (0.8)	459 (11.5)	7 (0.8)	432 (11.5)
Massachusetts	32 (1.9)	571 (8.9)	23 (1.1)	540 (6.5)	27 (1.1)	522 (6.4)	11 (1.1)	490 (8.4)	7 (1.1)	456 (11.3)
Michigan	36 (1.9)	578 (8.1)	24 (1.0)	557 (6.8)	26 (0.9)	528 (8.6)	10 (1.1)	485 (13.9)	5 (0.7)	471 (15.3)
Missouri	26 (1.6)	550 (6.7)	21 (1.3)	542 (6.6)	31 (1.2)	521 (6.7)	13 (0.8)	487 (11.5)	10 (0.8)	471 (12.6)
North Carolina	23 (1.8)	539 (7.4)	24 (0.9)	531 (7.2)	32 (1.3)	502 (6.9)	15 (1.1)	469 (7.8)	7 (0.7)	439 (8.1)
Oregon	33 (2.1)	576 (7.9)	23 (1.0)	548 (5.3)	27 (1.1)	522 (5.5)	10 (1.4)	486 (11.5)	6 (0.8)	441 (14.2)
Pennsylvania	28 (2.2)	560 (8.1)	25 (0.8)	545 (4.6)	30 (1.7)	515 (7.6)	11 (1.0)	485 (9.4)	6 (0.7)	473 (8.5)
South Carolina	23 (1.3)	554 (8.8)	21 (1.1)	539 (7.5)	30 (1.1)	508 (5.8)	16 (0.9)	465 (9.0)	9 (0.9)	430 (9.0)
Texas	20 (2.1)	571 (7.1)	19 (1.5)	546 (8.4)	30 (1.6)	517 (9.6)	16 (1.4)	458 (11.3)	15 (2.1)	433 (12.0)
Districts and Consortia										
Academy School Dist. #20, CO	46 (1.2)	576 (2.4)	25 (1.2)	558 (5.1)	21 (1.1)	545 (5.7)	5 (0.5)	529 (12.8)	3 (0.5)	476 (18.3)
Chicago Public Schools, IL	17 (2.6)	472 (14.2)	18 (1.6)	469 (11.6)	35 (1.8)	455 (11.5)	21 (1.8)	426 (8.2)	10 (1.2)	415 (13.6)
Delaware Science Coalition, DE	28 (2.1)	549 (9.1)	21 (1.5)	520 (10.7)	27 (1.5)	498 (6.8)	14 (1.3)	454 (10.1)	10 (1.3)	416 (11.5)
First in the World Consort., IL	41 (2.2)	578 (7.8)	28 (2.0)	572 (7.3)	23 (1.7)	559 (9.0)	5 (0.9)	505 (12.8)	3 (0.9)	495 (14.5)
Fremont/Lincoln/WestSide PS, NE	32 (1.7)	534 (7.8)	23 (1.0)	538 (7.9)	27 (2.2)	504 (7.2)	8 (0.8)	462 (10.6)	10 (1.2)	450 (12.6)
Guilford County, NC	29 (2.3)	580 (6.1)	25 (1.1)	541 (8.9)	29 (1.7)	517 (9.4)	12 (1.8)	480 (12.5)	5 (0.9)	470 (16.0)
Jersey City Public Schools, NJ	12 (1.4)	474 (18.6)	16 (1.3)	465 (15.7)	33 (1.9)	456 (8.1)	23 (1.8)	427 (9.8)	16 (1.8)	383 (9.3)
Miami-Dade County PS, FL	14 (2.6)	480 (24.2)	14 (1.3)	471 (9.5)	31 (1.2)	436 (10.4)	25 (2.1)	405 (11.0)	17 (1.8)	373 (15.9)
Michigan Invitational Group, MI	37 (2.7)	581 (8.7)	26 (2.0)	568 (6.5)	27 (1.8)	550 (8.0)	6 (0.8)	559 (13.8)	4 (0.7)	499 (21.4)
Montgomery County, MD	41 (2.3)	565 (6.3)	21 (1.8)	541 (8.8)	24 (1.2)	515 (6.3)	8 (1.2)	459 (11.6)	6 (0.9)	450 (11.4)
Naperville Sch. Dist. #203, IL	49 (1.4)	597 (5.2)	28 (1.2)	584 (5.6)	18 (1.1)	564 (7.0)	4 (0.5)	544 (9.3)	1 (0.3)	~ ~
Project SMART Consortium, OH	26 (2.3)	564 (12.6)	24 (1.3)	552 (9.2)	32 (1.3)	539 (8.4)	11 (1.4)	512 (7.9)	8 (0.9)	453 (12.9)
Rochester City Sch. Dist., NY	17 (2.1)	490 (15.9)	15 (1.0)	475 (13.6)	28 (1.6)	464 (8.2)	21 (1.9)	431 (7.6)	19 (1.5)	418 (11.6)
SW Math/Sci. Collaborative, PA	28 (2.5)	576 (8.2)	23 (1.2)	562 (6.3)	31 (1.9)	531 (6.9)	11 (1.3)	504 (13.0)	6 (1.3)	459 (14.8)
International Avg. (All Countries)	18 (0.2)	517 (1.6)	16 (0.1)	511 (1.2)	29 (0.2)	493 (1.0)	22 (0.1)	464 (1.0)	14 (0.2)	441 (1.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Exhibit R1.3 Highest Level of Education of Either Parent*

	Finished University¹		Finished Upper Secondary School But Not University²		Finished Primary School But Not Upper Secondary School³		Did Not Finish Primary School⁴		Do Not Know	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries										
United States	35 (1.7)	551 (4.6)	46 (1.3)	510 (4.9)	5 (0.4)	461 (9.7)	1 (0.2)	~ ~	13 (0.7)	476 (7.3)
Belgium (Flemish)	16 (1.0)	564 (6.0)	45 (0.9)	546 (4.5)	10 (0.7)	516 (7.0)	0 (0.1)	~ ~	29 (1.0)	513 (3.2)
Canada	45 (1.3)	548 (2.8)	34 (1.0)	532 (2.6)	6 (0.5)	509 (9.8)	0 (0.1)	~ ~	15 (0.7)	504 (4.5)
Chinese Taipei	15 (1.0)	612 (5.9)	64 (0.8)	571 (4.5)	14 (0.7)	542 (5.7)	1 (0.1)	~ ~	7 (0.4)	524 (7.5)
Czech Republic	22 (1.2)	577 (5.7)	46 (1.3)	546 (4.8)	21 (1.2)	520 (6.4)	0 (0.0)	~ ~	11 (0.9)	503 (8.8)
England	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	7 (0.7)	553 (7.8)	38 (1.0)	536 (4.0)	32 (0.9)	533 (4.2)	9 (0.7)	508 (6.5)	13 (0.6)	515 (6.2)
Italy	10 (0.8)	529 (8.8)	45 (1.3)	514 (4.0)	40 (1.5)	466 (4.6)	2 (0.3)	~ ~	3 (0.4)	472 (11.6)
Japan	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Korea, Rep. of	25 (1.0)	583 (3.5)	48 (0.8)	547 (4.1)	14 (0.5)	528 (5.9)	5 (0.4)	528 (7.8)	8 (0.4)	508 (4.9)
Netherlands	12 (1.1)	571 (9.6)	53 (2.4)	558 (6.4)	7 (1.0)	519 (12.0)	1 (0.5)	~ ~	27 (2.1)	521 (9.6)
Russian Federation	33 (1.4)	554 (7.4)	47 (1.2)	527 (6.5)	5 (0.5)	490 (15.7)	1 (0.2)	~ ~	14 (0.9)	503 (7.8)
Singapore	11 (1.0)	634 (9.0)	51 (1.0)	575 (7.2)	23 (1.0)	542 (10.2)	4 (0.3)	532 (12.2)	12 (0.6)	544 (9.7)
States										
Connecticut	41 (2.8)	558 (12.2)	42 (2.1)	518 (8.4)	4 (0.7)	463 (15.5)	0 (0.2)	~ ~	13 (0.9)	503 (13.0)
Idaho	31 (2.1)	552 (6.6)	46 (1.9)	531 (5.8)	6 (1.0)	471 (13.7)	1 (0.2)	~ ~	16 (0.7)	496 (9.5)
Illinois	34 (2.8)	555 (8.8)	47 (2.1)	513 (6.6)	5 (0.8)	453 (9.3)	0 (0.2)	~ ~	14 (1.1)	489 (9.0)
Indiana	36 (2.8)	567 (8.4)	48 (2.9)	525 (6.2)	5 (0.8)	477 (11.5)	0 (0.1)	~ ~	11 (1.1)	497 (12.6)
Maryland	39 (2.0)	534 (7.9)	43 (1.8)	498 (7.2)	4 (0.5)	446 (16.0)	0 (0.1)	~ ~	14 (0.8)	472 (9.8)
Massachusetts	38 (2.2)	561 (8.0)	43 (1.3)	526 (7.2)	4 (0.7)	472 (12.9)	1 (0.2)	~ ~	14 (1.0)	503 (10.0)
Michigan	40 (3.2)	574 (8.5)	47 (2.7)	536 (8.0)	2 (0.4)	~ ~	0 (0.0)	~ ~	11 (0.9)	502 (13.9)
Missouri	29 (1.7)	551 (9.5)	50 (1.9)	518 (6.4)	6 (1.1)	505 (14.8)	0 (0.1)	~ ~	14 (0.9)	496 (8.2)
North Carolina	25 (3.1)	538 (9.9)	59 (4.1)	505 (9.5)	5 (0.3)	460 (27.5)	0 (0.1)	~ ~	10 (0.9)	477 (6.7)
Oregon	39 (2.5)	572 (6.9)	46 (2.3)	528 (5.8)	5 (0.6)	454 (20.4)	1 (0.2)	~ ~	9 (0.7)	491 (13.3)
Pennsylvania	34 (2.4)	552 (7.9)	49 (2.0)	523 (5.5)	3 (0.5)	477 (15.9)	0 (0.2)	~ ~	14 (1.1)	505 (9.0)
South Carolina	30 (2.1)	543 (8.1)	52 (1.9)	504 (6.8)	6 (0.7)	480 (8.8)	0 (0.0)	~ ~	12 (1.1)	483 (10.7)
Texas	37 (2.3)	555 (6.0)	38 (0.9)	503 (19.5)	9 (1.4)	464 (11.5)	1 (0.4)	~ ~	15 (1.4)	464 (26.5)
Districts and Consortia										
Academy School Dist. #20, CO	59 (1.7)	574 (2.9)	28 (1.3)	543 (5.4)	1 (0.2)	~ ~	0 (0.1)	~ ~	12 (1.0)	531 (5.8)
Chicago Public Schools, IL	24 (3.3)	463 (17.2)	47 (2.3)	457 (9.2)	11 (1.6)	436 (12.2)	2 (0.6)	~ ~	17 (1.4)	420 (12.5)
Delaware Science Coalition, DE	35 (2.6)	534 (11.7)	48 (2.0)	494 (7.3)	4 (0.7)	450 (15.3)	1 (0.4)	~ ~	12 (1.1)	465 (13.9)
First in the World Consort., IL	58 (4.0)	584 (9.4)	28 (2.4)	554 (7.7)	3 (0.7)	510 (27.0)	1 (0.4)	~ ~	11 (1.4)	514 (10.0)
Fremont/Lincoln/WestSide PS, NE	39 (2.1)	537 (7.4)	40 (2.5)	514 (8.0)	4 (0.8)	442 (19.4)	0 (0.1)	~ ~	17 (2.2)	468 (12.3)
Guilford County, NC	39 (3.4)	570 (11.3)	49 (2.9)	514 (9.0)	4 (0.7)	473 (14.7)	0 (0.2)	~ ~	9 (1.0)	511 (13.3)
Jersey City Public Schools, NJ	23 (2.0)	452 (17.8)	48 (2.0)	452 (9.3)	9 (0.9)	418 (10.5)	1 (0.4)	~ ~	19 (1.3)	421 (10.7)
Miami-Dade County PS, FL	28 (2.5)	454 (16.2)	42 (1.7)	438 (8.7)	8 (0.7)	391 (10.4)	1 (0.2)	~ ~	21 (1.4)	391 (11.8)
Michigan Invitational Group, MI	41 (2.7)	581 (11.5)	47 (2.0)	562 (6.6)	1 (0.3)	~ ~	0 (0.2)	~ ~	11 (1.3)	528 (9.9)
Montgomery County, MD	54 (2.6)	562 (5.3)	27 (1.9)	506 (5.7)	4 (0.9)	458 (17.4)	1 (0.2)	~ ~	14 (1.2)	500 (8.6)
Naperville Sch. Dist. #203, IL	71 (1.6)	594 (5.5)	19 (1.3)	564 (4.7)	1 (0.2)	~ ~	0 (0.2)	~ ~	9 (0.9)	550 (10.4)
Project SMART Consortium, OH	36 (2.5)	563 (9.3)	46 (2.1)	538 (9.2)	3 (0.7)	483 (13.6)	0 (0.2)	~ ~	14 (1.4)	497 (10.6)
Rochester City Sch. Dist., NY	22 (1.7)	468 (15.8)	48 (2.1)	455 (10.8)	8 (0.9)	441 (14.2)	1 (0.2)	~ ~	21 (2.0)	445 (7.8)
SW Math/Sci. Collaborative, PA	37 (2.8)	570 (9.1)	48 (2.3)	535 (7.0)	3 (0.5)	485 (17.9)	0 (0.0)	~ ~	13 (0.9)	508 (9.6)
International Avg. (All Countries)	20 (0.2)	524 (1.3)	41 (0.2)	492 (0.8)	21 (0.2)	460 (1.5)	6 (0.1)	411 (4.9)	12 (0.1)	462 (1.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Response categories were defined by each country to conform to their own educational system and may not be strictly comparable across countries. See Reference Exhibit R1.4 for country modifications to the definitions of educational levels.

[1] In most countries, defined as completion of at least a 4-year degree program at a university or an equivalent institute of higher education.

[2] Finished upper secondary school with or without some tertiary education not equivalent to a university degree. In most countries, finished secondary corresponds to completion of an upper-secondary track terminating after 11 to 13 years of schooling (ISCED level 3 vocational, apprenticeship or academic tracks).

[3] Finished primary school or attended some secondary school not equivalent to completion of upper secondary.

[4] Some primary school or did not go to school.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.

Exhibit R1.4

Country Modifications to the Definitions of Educational Levels for Parents' Education or Students' Expectations for Finishing School*

8th Grade Science

	Finished University	Finished Upper Secondary School But Not University	
		Post-Secondary Level	Upper-Secondary Level[1]
Internationally Defined Level	Finished University	Some Vocational-Technical Education After Secondary School or Some University	Finished Secondary School
United States (P) ‡	Completed Bachelor's Degree at College or University	Some Vocational-Technical Education After Secondary School or Some Community College, College or University Courses	Finish High School
United States (S) §	Finish community college, college or university	Some Vocational-Technical Education After Secondary School or Some Community College, College or University Courses	Finish High School
Australia §	▨	▨	▨
Belgium (Flemish) §	▨	Post-Secondary Tertiary Higher Education Outside University or Some Years of University	Finish Higher Secondary School
Canada	Finish University or College	Some Vocational-Technical Education After Secondary School or Some University or College	▨
Chile	▨	▨	▨
Cyprus §	University Degree	▨	Finish Upper Secondary
Czech Republic (P) §‡	Finish University (4-5 years university study)	Some Vocational-Technical Education After Secondary School or Some University	Vocational Training or Secondary With Maturita
Czech Republic (S)	Finish University (4-5 years university study)	Medium-cycle higher education or bachelor studies (3 years university study or special higher education)	Vocational Training or Secondary With Maturita
Finland	▨	▨	Finish secondary school (about 12 years)
Hungary §	University or College Degree	Not Included	Apprenticeship (3-year trade school) or Final Exam in Secondary School (4-year academic/vocational)
Indonesia	Completed University Degree (Sarjana 1/2/3)	Academy (3 years or less of higher education outside university - Diploma D1/D2/D3) or Some University (Did Not Complete Degree)	Finish Secondary (SMP, SMA, SMEA, STM, etc.)
Italy §	Finish University (Laurea o Dottorato di Ricerca 4-6 Year)	Vocational/Professional Course After Secondary Diploma or Some University (2-3 Year Short-Course Diploma)	Finish Secondary School With Maturita (Classical/Technical) or Vocational Training Diploma
Japan (S) [3]	University or Graduate School	Vocational/Technical Education After Secondary or 2-year college	Upper secondary
Korea, Rep. of §	▨	▨	▨
Latvia (LSS) §	Higher Education (5 years)	Vocational School (Post-Secondary) or Technikum (3 years) or Some Higher Education	Finish Secondary or Vocational School (11 years)
Lithuania §	University or Other Higher Education	Vocational or Agricultural School or College (Technical, Art, Music)	▨
Netherlands	University With Diploma	Vocational/Technical Education After Secondary (bv.heao, hts, pedagogical academy) or Some Years At University (Without Diploma)	Finish Secondary School With Diploma
New Zealand (P) ‡	University or Teachers' College (College of Education)	Vocational/Polytechnic Education After Secondary School or Some University	Complete Form 6 or Form 7
New Zealand (S) §	University, College of Education (teacher training) or degree or national diploma course at polytech	Certificate course at polytech (e.g, trade certificate) or some university	Finish secondary school (complete Form 6 or Form 7)
Philippines §	Finish College/University	Some Vocational/Technical Education After High School or Some College/University	Finish High School
Romania §	Finish University (facultate)	Post-Secondary Technical School or Did Not Complete University	Finish Senior Secondary (liceu)
Singapore §	▨	Finish JC/Pre-U or Polytechnic or Some Other Vocational/Technical Education After Secondary (e.g., ITE, VITB)' [includes GCE 'A' level, which is 2 years additional schooling beyond completion of secondary.]	Finish Secondary School
Slovenia (S) §‡	▨	▨	Finish gymnasium or secondary school
South Africa §	▨	Finish Technikon or Some University	Finish Secondary
Thailand §	Graduate level (Finish Tertiary Education, 4 years)	Diploma/Undergraduate Level (higher certificate, 2 years)	Finish Academic or Vocational/Technical Upper-Secondary Track
Tunisia	Bachelor's Degree (BA)	▨	▨

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

▨ National educational level is the same as the internationally-defined level

---

* Educational levels were translated and defined in most countries to be comparable to the internationally-defined levels. Countries that used modified response options to conform to their national education systems are indicated to aid in the interpretation of the reporting categories in Exhibits 4.5 and R1.3. National modifications pertain to both the parents' education and student's expectations questions unless otherwise indicated.

[1] Upper-secondary corresponds to ISCED level 3 tracks terminating after 11 to 13 years in most countries. (Education at a Glance, OECD, 1995.)

[2] Primary school or lower educational levels were included only in the parents' education question.

[3] Japan administered the question pertaining to students' expectations but not the question pertaining to parents' education.

§ Some educational levels modified from 1995.

‡ Educational levels differ for the parent's education (P) question and the students' expectations (S) question.

Exhibit R1.4
(Continued)

Country Modifications to the Definitions of Educational Levels for Parents' Education or Students' Expectations for Finishing School*

8th Grade Science

Finished Primary School But Not Upper Secondary School		Did Not Finish Primary School²	
Lower-Secondary Level	**Primary Level²**		
Finished Some Secondary School	Finished Primary School	Some Primary School or Did Not Go to School	**Internationally Defined Level**
Some High School	Finish Elementary School	Finish elementary school or did not go to school	United States (P)
Some High School	▨	▨	United States (S)
▨	▨	Less Than Year 6 in Primary School	Australia
Finish Lower Secondary School	Finish Basic School	Some Years of Basic School or Did Not Go to School	Belgium (Flemish)
▨	▨	▨	Canada
▨	Finish Primary School (grade 8)	▨	Chile
Finish Lower Secondary (Gymnasium - grade 9)	▨	▨	Cyprus
Vocational Training or Secondary School Without Maturita	▨	Not Included	Czech Republic (P)
Vocational Training or Secondary School Without Maturita	▨	▨	Czech Republic (S)
Some Secondary School (10 - 11 years)	Finish Primary School (about 9 years)	Did Not Go to School, Primary School or Part of Lower Secondary (< 9 years)	Finland
Finish General School (grade 8)	Some General School	Not Included	Hungary
▨	Finish Primary School (SD)	▨	Indonesia
Finish Middle School	▨	▨	Italy
Lower Secondary	▨	▨	Japan (S)
Some High School	Finish Middle School	Some middle school or did not go to school	Korea, Rep. of
▨	▨	▨	Latvia (LSS)
▨	Finish Basic School (grade 10)	Some Basic School or Did Not Go to School	Lithuania
Some Years of Secondary School (mavo, havo, vwo) without Diploma	Finish Primary School (grade 8)	▨	Netherlands
▨	▨	▨	New Zealand (P)
▨	▨	▨	New Zealand (S)
Some High School	Finish Elementary School	Some Elementary School or Did Not Go to School	Philippines
Did Not Complete Senior Secondary	Finish Junior Secondary (Gymnasium - grade 8)	Did Not Finish Grade 8 or Did Not Go to School	Romania
▨	▨	▨	Singapore
▨	▨	▨	Slovenia (S)
▨	▨	▨	South Africa
Finish Lower Secondary School	Finish Upper Primary School	Finish Lower Primary School or Did Not Go to School	Thailand
▨	▨	▨	Tunisia

▨ National educational level is the same as the internationally-defined level

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit R1.5 Students' Perception of the Importance of Various Activities

	Percentage of Students Agreeing That It Is Important to Do Each Activity				
	Do Well in Science	Do Well in Mathematics	Do Well in Language	Have Time to Have Fun	Be Good at Sports
Countries					
United States	96 (0.3)	97 (0.3)	96 (0.3)	99 (0.2)	84 (0.6)
Belgium (Flemish)	91 (0.8)	98 (0.3)	96 (0.4)	98 (0.4)	77 (0.9)
Canada	95 (0.4)	98 (0.2)	97 (0.5)	99 (0.2)	82 (0.6)
Chinese Taipei	89 (0.5)	89 (0.5)	89 (0.5)	99 (0.1)	94 (0.3)
Czech Republic	93 (0.6)	98 (0.3)	97 (0.4)	97 (0.4)	82 (1.0)
England	97 (0.3)	99 (0.2)	99 (0.2)	98 (0.3)	79 (0.9)
Hong Kong, SAR	86 (0.7)	95 (0.4)	96 (0.4)	97 (0.3)	84 (0.6)
Italy	94 (0.5)	97 (0.4)	97 (0.3)	98 (0.3)	89 (0.6)
Japan	83 (0.7)	88 (0.5)	89 (0.6)	99 (0.2)	82 (0.6)
Korea, Rep. of	87 (0.5)	90 (0.4)	89 (0.4)	92 (0.3)	88 (0.5)
Netherlands	94 (0.9)	98 (0.3)	99 (0.3)	98 (0.3)	76 (1.5)
Russian Federation	96 (0.3)	97 (0.4)	97 (0.4)	98 (0.3)	90 (0.6)
Singapore	98 (0.2)	99 (0.2)	100 (0.1)	93 (0.6)	90 (0.5)
States					
Connecticut	96 (0.6)	97 (0.5)	97 (0.4)	99 (0.3)	82 (1.0)
Idaho	94 (0.5)	96 (0.4)	95 (0.6)	99 (0.2)	86 (0.8)
Illinois	96 (0.5)	98 (0.3)	97 (0.4)	99 (0.2)	83 (1.0)
Indiana	96 (0.5)	97 (0.4)	96 (0.6)	99 (0.2)	82 (0.8)
Maryland	95 (0.5)	97 (0.4)	96 (0.4)	98 (0.3)	84 (0.8)
Massachusetts	96 (0.5)	97 (0.4)	96 (0.5)	99 (0.2)	82 (0.9)
Michigan	96 (0.4)	97 (0.4)	96 (0.5)	99 (0.2)	84 (1.2)
Missouri	95 (0.6)	97 (0.5)	95 (0.5)	98 (0.4)	85 (1.0)
North Carolina	97 (0.4)	99 (0.2)	99 (0.3)	99 (0.2)	87 (0.6)
Oregon	95 (0.7)	97 (0.5)	95 (0.6)	98 (0.3)	84 (1.2)
Pennsylvania	94 (0.7)	96 (1.0)	95 (0.9)	99 (0.3)	83 (0.9)
South Carolina	97 (0.4)	98 (0.4)	97 (0.3)	98 (0.3)	84 (0.8)
Texas	95 (0.6)	97 (0.4)	95 (0.5)	98 (0.7)	85 (1.1)
Districts and Consortia					
Academy School Dist. #20, CO	95 (0.6)	97 (0.4)	95 (0.6)	99 (0.3)	85 (1.0)
Chicago Public Schools, IL	95 (0.7)	99 (0.4)	97 (0.9)	95 (1.1)	83 (1.3)
Delaware Science Coalition, DE	94 (0.8)	97 (0.4)	96 (0.4)	98 (0.4)	85 (1.1)
First in the World Consort., IL	96 (0.8)	97 (0.8)	97 (0.7)	100 (0.2)	81 (1.2)
Fremont/Lincoln/WestSide PS, NE	93 (0.4)	95 (0.4)	94 (0.5)	99 (0.3)	82 (1.2)
Guilford County, NC	98 (0.3)	99 (0.4)	99 (0.4)	99 (0.4)	84 (1.5)
Jersey City Public Schools, NJ	98 (0.3)	99 (0.3)	99 (0.4)	96 (0.8)	84 (1.2)
Miami-Dade County PS, FL	97 (0.8)	97 (0.7)	98 (0.6)	97 (0.6)	85 (1.2)
Michigan Invitational Group, MI	95 (0.7)	97 (0.6)	97 (0.5)	100 (0.2)	82 (1.5)
Montgomery County, MD	94 (0.8)	97 (0.8)	96 (0.8)	99 (0.3)	83 (1.1)
Naperville Sch. Dist. #203, IL	96 (0.4)	97 (0.3)	96 (0.4)	99 (0.3)	84 (0.9)
Project SMART Consortium, OH	96 (0.6)	98 (0.5)	97 (0.4)	99 (0.3)	85 (0.8)
Rochester City Sch. Dist., NY	98 (0.7)	99 (0.5)	98 (0.5)	98 (0.4)	85 (1.7)
SW Math/Sci. Collaborative, PA	96 (0.7)	98 (0.5)	95 (0.6)	99 (0.3)	83 (1.3)
International Avg. (All Countries)	92 (0.1)	96 (0.1)	96 (0.1)	92 (0.1)	87 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit R1.6

Students' Perception of Their Mothers' View of the Importance of Various Activities

	Percentage of Students Agreeing That Their Mothers Think It Is Important to Do Each Activity				
	Do Well in Science	Do Well in Mathematics	Do Well in Language	Have Time to Have Fun	Be Good at Sports
Countries					
United States	98 (0.2)	98 (0.2)	98 (0.2)	93 (0.4)	76 (0.6)
Belgium (Flemish)	92 (0.6)	97 (0.4)	97 (0.5)	96 (0.5)	66 (1.6)
Canada	98 (0.3)	99 (0.1)	99 (0.2)	96 (0.4)	76 (0.8)
Chinese Taipei	95 (0.4)	95 (0.5)	93 (0.4)	95 (0.3)	91 (0.4)
Czech Republic	96 (0.5)	99 (0.2)	99 (0.3)	90 (0.7)	72 (1.1)
England	98 (0.3)	99 (0.2)	99 (0.2)	94 (0.5)	74 (1.0)
Hong Kong, SAR	87 (0.7)	96 (0.3)	97 (0.3)	82 (0.7)	73 (0.9)
Italy	97 (0.3)	99 (0.3)	99 (0.2)	95 (0.4)	84 (0.8)
Japan	87 (0.6)	92 (0.5)	92 (0.5)	94 (0.4)	82 (0.6)
Korea, Rep. of	90 (0.4)	95 (0.3)	92 (0.4)	66 (0.7)	78 (0.6)
Netherlands	94 (0.8)	98 (0.3)	98 (0.3)	97 (0.5)	59 (1.9)
Russian Federation	96 (0.4)	96 (0.4)	97 (0.4)	92 (0.4)	86 (0.7)
Singapore	98 (0.2)	99 (0.2)	98 (0.2)	76 (0.9)	80 (0.7)
States					
Connecticut	98 (0.4)	98 (0.3)	98 (0.3)	93 (0.7)	75 (1.2)
Idaho	97 (0.5)	98 (0.4)	97 (0.4)	94 (0.5)	82 (1.2)
Illinois	97 (0.4)	99 (0.2)	98 (0.3)	92 (0.9)	74 (1.2)
Indiana	98 (0.5)	99 (0.4)	98 (0.4)	95 (0.5)	74 (0.8)
Maryland	97 (0.3)	98 (0.3)	98 (0.3)	93 (0.4)	76 (1.1)
Massachusetts	98 (0.3)	98 (0.3)	98 (0.3)	93 (0.6)	73 (0.9)
Michigan	98 (0.4)	98 (0.3)	98 (0.3)	94 (0.4)	76 (1.5)
Missouri	98 (0.4)	98 (0.4)	98 (0.4)	93 (0.6)	78 (1.1)
North Carolina	98 (0.2)	99 (0.3)	99 (0.3)	94 (0.6)	80 (0.9)
Oregon	97 (0.5)	98 (0.4)	97 (0.5)	93 (0.6)	78 (1.4)
Pennsylvania	98 (0.9)	98 (0.6)	98 (0.7)	94 (0.5)	77 (1.3)
South Carolina	98 (0.4)	98 (0.4)	98 (0.3)	93 (0.8)	76 (1.3)
Texas	97 (0.5)	97 (0.4)	97 (0.5)	91 (1.1)	80 (1.3)
Districts and Consortia					
Academy School Dist. #20, CO	98 (0.4)	98 (0.3)	97 (0.4)	94 (0.7)	77 (1.1)
Chicago Public Schools, IL	96 (0.9)	98 (0.5)	97 (0.8)	85 (1.2)	72 (1.8)
Delaware Science Coalition, DE	96 (0.9)	97 (0.6)	97 (0.5)	90 (0.7)	77 (1.1)
First in the World Consort., IL	98 (0.4)	99 (0.4)	98 (0.5)	94 (0.6)	66 (2.3)
Fremont/Lincoln/WestSide PS, NE	97 (1.0)	97 (0.5)	97 (1.0)	95 (1.2)	71 (1.8)
Guilford County, NC	99 (0.3)	99 (0.3)	99 (0.3)	94 (0.6)	77 (1.4)
Jersey City Public Schools, NJ	98 (0.4)	99 (0.3)	98 (0.3)	88 (1.3)	78 (1.2)
Miami-Dade County PS, FL	98 (0.4)	97 (0.6)	98 (0.5)	88 (1.3)	79 (1.9)
Michigan Invitational Group, MI	98 (0.4)	99 (0.4)	98 (0.4)	94 (0.8)	75 (1.4)
Montgomery County, MD	97 (0.8)	98 (0.6)	98 (0.6)	92 (0.8)	74 (1.1)
Naperville Sch. Dist. #203, IL	99 (0.3)	99 (0.2)	99 (0.3)	95 (0.6)	75 (1.5)
Project SMART Consortium, OH	98 (0.5)	97 (0.5)	98 (0.4)	94 (0.8)	77 (1.8)
Rochester City Sch. Dist., NY	96 (0.7)	97 (0.7)	97 (0.8)	91 (1.0)	79 (1.9)
SW Math/Sci. Collaborative, PA	98 (0.4)	98 (0.3)	98 (0.3)	93 (0.7)	77 (1.5)
International Avg. (All Countries)	93 (0.1)	96 (0.1)	96 (0.1)	85 (0.1)	81 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

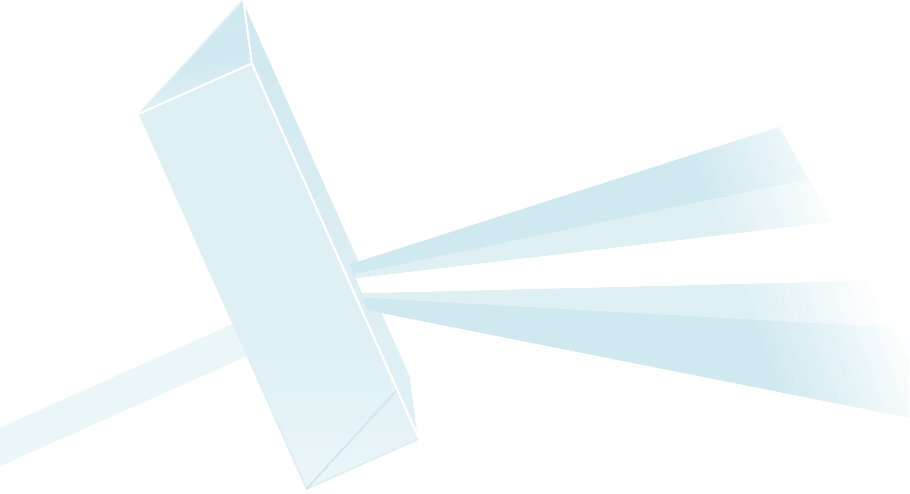


Exhibit R1.7

Students' Perception of Their Friends' View of the Importance of Various Activities

8th Grade Science

	Percentage of Students Agreeing That Their Friends Think It Is Important to Do Each Activity				
	Do Well in Science	Do Well in Mathematics	Do Well in Language	Have Time to Have Fun	Be Good at Sports
Countries					
United States	72 (0.8)	79 (0.8)	76 (1.0)	98 (0.2)	86 (0.5)
Belgium (Flemish)	66 (1.2)	81 (1.1)	77 (1.4)	98 (0.5)	76 (1.1)
Canada	72 (0.9)	84 (0.6)	82 (0.7)	99 (0.1)	84 (0.9)
Chinese Taipei	82 (0.7)	84 (0.7)	84 (0.6)	98 (0.2)	94 (0.4)
Czech Republic	68 (1.0)	84 (0.9)	83 (0.8)	97 (0.4)	83 (0.9)
England	84 (1.0)	90 (0.8)	90 (0.7)	99 (0.2)	80 (1.0)
Hong Kong, SAR	66 (1.0)	84 (0.7)	87 (0.8)	96 (0.3)	83 (0.8)
Italy	66 (1.3)	80 (0.9)	84 (0.7)	98 (0.3)	94 (0.5)
Japan	78 (0.8)	85 (0.6)	85 (0.8)	99 (0.2)	80 (0.7)
Korea, Rep. of	72 (0.8)	77 (0.7)	73 (0.8)	93 (0.3)	80 (0.8)
Netherlands	79 (1.2)	88 (1.0)	90 (0.9)	98 (0.4)	70 (1.9)
Russian Federation	83 (0.7)	89 (0.6)	89 (0.6)	97 (0.4)	87 (0.8)
Singapore	94 (0.6)	96 (0.3)	97 (0.3)	93 (0.6)	88 (0.6)
States					
Connecticut	71 (2.1)	78 (1.5)	76 (1.7)	98 (0.4)	84 (1.1)
Idaho	71 (2.2)	77 (1.8)	74 (1.5)	98 (0.4)	87 (1.1)
Illinois	70 (2.1)	80 (1.7)	75 (2.0)	98 (0.3)	86 (1.1)
Indiana	73 (1.5)	79 (1.3)	76 (1.3)	99 (0.3)	86 (0.9)
Maryland	69 (1.3)	76 (1.1)	75 (1.2)	98 (0.3)	85 (0.9)
Massachusetts	69 (1.8)	74 (1.5)	72 (1.4)	99 (0.2)	85 (0.9)
Michigan	75 (1.3)	79 (1.0)	75 (1.4)	98 (0.3)	87 (1.0)
Missouri	71 (1.4)	76 (1.3)	73 (1.3)	98 (0.4)	85 (1.2)
North Carolina	78 (1.5)	85 (1.3)	84 (1.3)	99 (0.2)	89 (1.0)
Oregon	70 (1.9)	76 (1.6)	74 (1.7)	98 (0.3)	87 (1.1)
Pennsylvania	70 (1.2)	77 (1.2)	74 (1.2)	99 (0.3)	87 (0.8)
South Carolina	74 (1.3)	83 (1.0)	82 (0.8)	98 (0.4)	87 (0.8)
Texas	70 (1.7)	77 (1.3)	74 (1.5)	98 (0.6)	87 (1.0)
Districts and Consortia					
Academy School Dist. #20, CO	74 (1.2)	77 (1.1)	75 (1.2)	99 (0.3)	86 (0.9)
Chicago Public Schools, IL	65 (2.4)	88 (1.3)	78 (2.2)	96 (0.9)	85 (1.2)
Delaware Science Coalition, DE	67 (1.8)	73 (1.6)	74 (1.3)	98 (0.6)	87 (1.1)
First in the World Consort., IL	71 (1.4)	77 (1.8)	74 (1.7)	99 (0.5)	82 (1.3)
Fremont/Lincoln/WestSide PS, NE	69 (1.1)	75 (1.4)	70 (1.1)	97 (1.1)	83 (1.6)
Guilford County, NC	82 (1.5)	88 (1.3)	87 (1.3)	99 (0.3)	87 (1.2)
Jersey City Public Schools, NJ	76 (1.6)	89 (1.3)	88 (1.2)	97 (0.7)	88 (1.0)
Miami-Dade County PS, FL	73 (1.4)	80 (1.4)	80 (1.0)	97 (0.5)	84 (1.1)
Michigan Invitational Group, MI	72 (1.8)	76 (1.6)	73 (1.4)	98 (0.8)	83 (1.8)
Montgomery County, MD	69 (1.8)	78 (1.6)	75 (1.6)	99 (0.4)	85 (1.1)
Naperville Sch. Dist. #203, IL	79 (1.2)	84 (1.1)	82 (1.1)	99 (0.3)	83 (1.0)
Project SMART Consortium, OH	73 (1.3)	76 (1.2)	74 (1.5)	99 (0.3)	85 (1.1)
Rochester City Sch. Dist., NY	79 (1.5)	82 (1.5)	79 (1.6)	97 (0.8)	85 (1.6)
SW Math/Sci. Collaborative, PA	72 (1.4)	79 (1.2)	75 (1.0)	99 (0.2)	86 (1.6)
International Avg. (All Countries)	77 (0.2)	86 (0.1)	86 (0.1)	92 (0.1)	85 (0.1)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit R1.8 Why Students Need to Do Well in the Sciences*

8th Grade Science

		Percentage of Students Reporting								
		To Get Desired Job			To Please Parents			To Get Into Desired Secondary School or University		
		Strongly Agree	Agree	Disagree/ Strongly Disagree	Strongly Agree	Agree	Disagree/ Strongly Disagree	Strongly Agree	Agree	Disagree/ Strongly Disagree
General/Integrated Science										
G Countries	United States	28 (0.8)	31 (0.7)	40 (0.7)	32 (0.7)	47 (0.6)	21 (0.5)	46 (0.9)	40 (0.6)	14 (0.6)
	Canada	27 (0.7)	33 (0.8)	40 (0.8)	22 (1.0)	46 (1.0)	32 (0.7)	42 (0.8)	40 (0.6)	18 (0.7)
	Chinese Taipei [a]	26 (0.7)	45 (0.7)	30 (0.8)	28 (0.8)	50 (0.8)	22 (0.6)	37 (0.9)	48 (0.7)	15 (0.6)
	England	28 (1.1)	31 (1.0)	41 (1.4)	20 (1.0)	42 (1.2)	38 (1.2)	37 (1.3)	38 (1.3)	25 (1.0)
	Hong Kong, SAR	20 (0.7)	44 (0.8)	37 (0.9)	22 (0.7)	53 (0.7)	24 (0.7)	24 (0.8)	47 (0.9)	29 (0.9)
	Italy	19 (0.7)	36 (1.0)	44 (1.2)	25 (0.9)	51 (1.0)	24 (1.0)	24 (0.8)	43 (1.0)	33 (1.1)
	Japan	11 (0.5)	31 (0.8)	58 (1.0)	6 (0.4)	24 (0.6)	70 (0.7)	29 (0.8)	54 (0.7)	16 (0.8)
	Korea, Rep. of	13 (0.5)	31 (0.5)	57 (0.8)	13 (0.5)	49 (0.6)	38 (0.7)	29 (0.7)	54 (0.7)	17 (0.5)
	Singapore	35 (1.1)	40 (0.7)	25 (1.1)	28 (0.7)	46 (0.6)	26 (0.6)	50 (1.3)	42 (1.0)	7 (0.7)
States	Connecticut	25 (1.2)	32 (1.2)	43 (1.1)	30 (1.1)	50 (1.3)	20 (1.1)	44 (1.4)	43 (1.3)	13 (1.2)
	Idaho	27 (1.2)	35 (1.3)	39 (1.7)	32 (1.2)	50 (1.4)	18 (1.2)	43 (1.6)	42 (1.3)	15 (1.0)
	Illinois	27 (1.2)	30 (1.1)	43 (1.3)	28 (1.0)	50 (1.2)	22 (1.1)	45 (1.0)	40 (1.0)	15 (1.1)
	Indiana	30 (1.5)	34 (1.4)	36 (1.4)	32 (1.6)	51 (1.4)	17 (1.1)	47 (2.4)	41 (2.0)	12 (0.9)
	Maryland	31 (1.0)	32 (1.0)	37 (1.3)	34 (1.0)	47 (0.9)	19 (1.0)	47 (1.4)	40 (1.0)	13 (0.9)
	Massachusetts	25 (1.0)	31 (1.0)	44 (1.5)	31 (0.8)	47 (0.9)	22 (1.0)	42 (1.1)	43 (1.1)	15 (0.9)
	Michigan	28 (1.2)	35 (1.0)	37 (1.1)	31 (1.2)	49 (1.3)	20 (1.3)	46 (1.4)	42 (1.3)	11 (1.0)
	Missouri	30 (1.1)	33 (1.1)	38 (1.4)	35 (1.0)	46 (1.1)	19 (1.0)	46 (1.5)	40 (1.2)	14 (0.9)
	North Carolina	34 (1.1)	32 (1.1)	34 (0.9)	39 (1.3)	44 (1.3)	17 (1.0)	54 (1.8)	35 (1.6)	11 (0.8)
	Oregon	24 (1.4)	34 (1.6)	42 (1.8)	30 (1.1)	50 (1.5)	20 (1.4)	40 (1.6)	45 (1.4)	15 (1.1)
	Pennsylvania	23 (0.9)	34 (1.0)	43 (1.4)	29 (1.6)	49 (1.0)	22 (1.3)	40 (1.6)	44 (1.3)	17 (0.9)
	South Carolina	33 (1.1)	32 (1.2)	35 (1.2)	35 (0.9)	46 (1.2)	19 (1.2)	52 (1.4)	37 (1.2)	11 (0.8)
	Texas	30 (1.3)	34 (1.0)	36 (1.4)	32 (1.8)	47 (1.3)	21 (1.3)	46 (2.0)	40 (1.3)	13 (1.1)
Districts	Academy School Dist. #20, CO	29 (1.4)	35 (1.3)	37 (1.5)	35 (1.4)	49 (1.7)	16 (1.3)	50 (1.5)	41 (1.3)	9 (0.9)
	Chicago Public Schools, IL	22 (1.5)	29 (2.1)	48 (1.9)	21 (1.9)	45 (1.8)	35 (1.2)	37 (2.3)	43 (1.8)	20 (1.4)
	Delaware Science Coalition, DE	29 (1.4)	30 (1.5)	42 (2.2)	31 (1.3)	46 (1.7)	23 (1.6)	45 (1.8)	39 (1.3)	16 (1.7)
	First in the World Consort., IL	27 (1.7)	33 (0.9)	40 (1.7)	28 (1.8)	49 (1.4)	23 (1.1)	46 (2.2)	44 (2.4)	10 (1.5)
	Fremont/Lincoln/WestSide PS, NE	25 (1.1)	38 (2.0)	37 (1.6)	30 (1.3)	49 (1.7)	21 (1.5)	41 (2.0)	47 (2.1)	12 (1.7)
	Guilford County, NC	29 (1.4)	32 (1.7)	39 (2.2)	37 (1.4)	45 (1.6)	18 (1.6)	54 (2.3)	38 (1.7)	8 (1.1)
	Jersey City Public Schools, NJ	25 (1.6)	27 (1.3)	48 (2.0)	31 (1.5)	43 (1.4)	25 (1.3)	45 (2.0)	39 (2.0)	16 (1.4)
	Miami-Dade County PS, FL	36 (1.8)	31 (0.9)	33 (2.0)	34 (1.8)	44 (1.3)	22 (1.2)	51 (2.4)	35 (1.6)	13 (1.3)
	Michigan Invitational Group, MI	26 (1.8)	37 (1.3)	37 (2.1)	28 (1.7)	50 (1.8)	22 (1.4)	45 (2.6)	44 (2.0)	10 (1.3)
	Montgomery County, MD	29 (1.6)	32 (1.6)	39 (1.5)	34 (1.6)	48 (1.9)	17 (1.1)	46 (1.9)	42 (1.6)	12 (1.2)
	Naperville Sch. Dist. #203, IL	28 (1.5)	31 (1.2)	41 (1.6)	33 (1.0)	50 (1.2)	17 (1.1)	49 (1.7)	42 (1.8)	9 (0.7)
	Project SMART Consortium, OH	26 (1.5)	33 (1.3)	41 (1.8)	31 (1.2)	50 (1.6)	19 (1.1)	43 (1.8)	43 (1.4)	14 (1.4)
	Rochester City Sch. Dist., NY	s 38 (1.9)	30 (2.2)	33 (1.9)	s 34 (2.1)	40 (2.1)	26 (2.3)	s 50 (1.6)	39 (1.4)	11 (1.1)
	SW Math/Sci. Collaborative, PA	23 (1.5)	35 (1.4)	42 (2.0)	29 (1.1)	52 (1.2)	18 (1.3)	42 (1.8)	43 (1.4)	15 (1.2)
	International Avg. (All General Science Countries)	33 (0.2)	36 (0.2)	31 (0.2)	32 (0.2)	43 (0.2)	26 (0.2)	42 (0.2)	40 (0.2)	18 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Why Students Need to Do Well in the Sciences*

	Percentage of Students Reporting								
	To Get Desired Job			To Please Parents			To Get Into Desired Secondary School or University		
	Strongly Agree	Agree	Disagree/ Strongly Disagree	Strongly Agree	Agree	Disagree/ Strongly Disagree	Strongly Agree	Agree	Disagree/ Strongly Disagree
Earth Science									
Belgium (Flemish)	3 (0.8)	12 (0.6)	85 (0.8)	14 (0.7)	55 (0.8)	31 (0.9)	4 (0.8)	17 (0.8)	78 (1.0)
Czech Republic	19 (1.3)	31 (1.3)	50 (1.5)	25 (1.2)	56 (1.2)	20 (1.0)	25 (1.4)	40 (1.2)	35 (1.3)
Netherlands	6 (0.9)	17 (1.5)	77 (1.3)	10 (0.7)	40 (1.3)	50 (1.4)	6 (0.7)	23 (1.0)	71 (1.3)
Russian Federation	20 (0.8)	32 (1.1)	48 (1.2)	17 (0.8)	41 (0.9)	42 (1.2)	27 (0.8)	49 (1.0)	24 (0.8)
International Avg. (All Separate Science Countries)	18 (0.3)	31 (0.4)	51 (0.4)	18 (0.3)	42 (0.3)	40 (0.4)	22 (0.3)	39 (0.3)	39 (0.4)
Biology									
Belgium (Flemish)	8 (0.8)	17 (0.6)	75 (1.1)	12 (1.1)	55 (0.8)	33 (1.2)	8 (0.8)	23 (0.8)	69 (1.1)
Czech Republic	19 (1.2)	30 (1.1)	52 (1.5)	19 (1.1)	58 (1.1)	23 (0.9)	27 (1.3)	41 (1.2)	33 (1.4)
Netherlands	12 (0.9)	23 (1.4)	65 (1.9)	9 (1.0)	38 (1.6)	53 (1.4)	14 (1.0)	28 (1.9)	58 (2.3)
Russian Federation	23 (0.9)	31 (0.9)	46 (1.2)	16 (0.9)	41 (0.9)	44 (1.2)	27 (0.9)	50 (1.0)	23 (0.9)
International Avg. (All Separate Science Countries)	20 (0.3)	32 (0.3)	48 (0.4)	16 (0.2)	40 (0.3)	44 (0.3)	25 (0.3)	41 (0.3)	34 (0.3)
Physics									
Belgium (Flemish)	5 (0.6)	20 (1.3)	75 (1.4)	16 (1.1)	57 (1.4)	27 (1.2)	7 (0.7)	28 (1.4)	65 (1.6)
Czech Republic	20 (1.4)	32 (1.2)	48 (1.4)	26 (1.3)	55 (1.2)	20 (1.0)	28 (1.3)	39 (1.1)	34 (1.4)
Netherlands [b]	9 (0.8)	23 (1.3)	68 (1.6)	9 (0.8)	39 (1.5)	52 (1.6)	10 (0.8)	26 (1.6)	64 (1.8)
Russian Federation	25 (0.8)	35 (1.2)	39 (1.2)	20 (0.9)	41 (1.1)	39 (1.5)	32 (1.1)	48 (1.1)	21 (1.0)
International Avg. (All Separate Science Countries)	22 (0.3)	33 (0.3)	45 (0.4)	19 (0.3)	40 (0.3)	41 (0.3)	25 (0.3)	41 (0.3)	34 (0.3)
Chemistry									
Belgium (Flemish)	– –	– –	– –	– –	– –	– –	– –	– –	– –
Czech Republic	19 (1.1)	30 (1.2)	51 (1.3)	23 (1.1)	56 (1.1)	21 (1.1)	26 (1.3)	40 (1.1)	34 (1.3)
Netherlands	– –	– –	– –	– –	– –	– –	– –	– –	– –
Russian Federation	24 (0.9)	32 (1.0)	44 (1.1)	17 (0.9)	41 (1.1)	42 (1.4)	29 (0.9)	49 (1.1)	23 (0.8)
International Avg. (All Separate Science Countries)	21 (0.3)	34 (0.3)	45 (0.4)	18 (0.3)	39 (0.3)	43 (0.3)	26 (0.3)	43 (0.3)	31 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit R1.9 Students' Daily Out-of-School Study Time

8th Grade Science

	Average Hours Spent Each Day Studying or Doing Homework[1]				Percentage of Students Reporting Spending Some Time Studying All Three Subjects: Science, Mathematics, and Other
	Science	Mathematics	Other School Subjects	Total	
Countries					
United States	0.6 (0.01)	0.8 (0.02)	0.9 (0.02)	2.1 (0.04)	72 (1.6)
Belgium (Flemish)	0.8 (0.03)	1.1 (0.03)	1.4 (0.04)	2.9 (0.05)	86 (1.2)
Canada	0.6 (0.01)	0.8 (0.02)	1.0 (0.02)	2.2 (0.04)	78 (1.0)
Chinese Taipei	0.6 (0.02)	0.7 (0.02)	1.0 (0.02)	2.0 (0.05)	55 (1.3)
Czech Republic	0.6 (0.02)	0.7 (0.02)	0.7 (0.02)	1.9 (0.04)	74 (1.4)
England	– –	– –	– –	– –	– –
Hong Kong, SAR	0.5 (0.01)	0.7 (0.02)	0.7 (0.02)	1.6 (0.04)	53 (1.3)
Italy	1.0 (0.02)	1.3 (0.03)	1.9 (0.03)	3.6 (0.04)	91 (0.8)
Japan	0.4 (0.01)	0.6 (0.01)	0.8 (0.02)	1.7 (0.04)	59 (1.4)
Korea, Rep. of	0.4 (0.01)	0.6 (0.02)	0.7 (0.02)	1.6 (0.03)	50 (0.9)
Netherlands	0.6 (0.02)	0.6 (0.02)	1.0 (0.02)	2.2 (0.04)	89 (1.1)
Russian Federation	1.5 (0.03)	1.1 (0.03)	1.2 (0.04)	3.1 (0.05)	89 (0.7)
Singapore	1.2 (0.02)	1.3 (0.02)	1.7 (0.03)	3.5 (0.04)	90 (0.8)
States					
Connecticut	0.7 (0.02)	0.8 (0.02)	1.0 (0.02)	2.2 (0.05)	83 (1.8)
Idaho	0.6 (0.02)	0.7 (0.02)	0.8 (0.02)	1.9 (0.04)	65 (2.7)
Illinois	0.6 (0.02)	0.8 (0.02)	1.0 (0.03)	2.2 (0.05)	77 (1.6)
Indiana	0.5 (0.02)	0.7 (0.03)	0.8 (0.03)	1.9 (0.06)	70 (2.2)
Maryland	0.6 (0.02)	0.8 (0.02)	0.9 (0.02)	2.0 (0.04)	76 (1.4)
Massachusetts	0.7 (0.02)	0.8 (0.02)	1.0 (0.03)	2.3 (0.06)	84 (1.4)
Michigan	0.6 (0.02)	0.8 (0.03)	0.9 (0.03)	2.0 (0.05)	75 (1.6)
Missouri	0.5 (0.02)	0.7 (0.03)	0.8 (0.03)	1.9 (0.06)	65 (1.9)
North Carolina	0.6 (0.02)	0.8 (0.02)	0.9 (0.03)	2.1 (0.05)	74 (2.1)
Oregon	0.5 (0.03)	0.8 (0.02)	0.9 (0.03)	2.0 (0.04)	68 (2.2)
Pennsylvania	0.6 (0.02)	0.7 (0.03)	0.8 (0.03)	1.9 (0.07)	72 (1.9)
South Carolina	0.6 (0.02)	0.8 (0.02)	0.9 (0.03)	2.0 (0.05)	73 (1.6)
Texas	0.5 (0.03)	0.8 (0.04)	0.8 (0.03)	1.8 (0.07)	60 (2.3)
Districts and Consortia					
Academy School Dist. #20, CO	0.8 (0.03)	1.0 (0.03)	1.1 (0.03)	2.5 (0.05)	86 (0.8)
Chicago Public Schools, IL	0.8 (0.03)	1.2 (0.06)	1.3 (0.03)	2.7 (0.07)	79 (2.0)
Delaware Science Coalition, DE	0.6 (0.03)	0.7 (0.03)	0.8 (0.03)	1.9 (0.04)	70 (2.2)
First in the World Consort., IL	0.6 (0.03)	0.8 (0.02)	1.1 (0.05)	2.3 (0.07)	84 (1.7)
Fremont/Lincoln/WestSide PS, NE	0.5 (0.03)	0.7 (0.05)	0.9 (0.04)	1.8 (0.09)	65 (1.5)
Guilford County, NC	0.6 (0.02)	0.9 (0.03)	0.9 (0.03)	2.3 (0.05)	82 (1.6)
Jersey City Public Schools, NJ	0.8 (0.03)	1.1 (0.05)	1.3 (0.05)	2.7 (0.09)	76 (2.5)
Miami-Dade County PS, FL	0.7 (0.04)	0.9 (0.03)	0.9 (0.04)	2.2 (0.08)	69 (2.3)
Michigan Invitational Group, MI	0.6 (0.01)	0.7 (0.03)	0.8 (0.03)	2.0 (0.06)	76 (1.5)
Montgomery County, MD	0.7 (0.03)	0.9 (0.04)	1.0 (0.03)	2.4 (0.04)	81 (1.4)
Naperville Sch. Dist. #203, IL	0.6 (0.02)	0.8 (0.02)	1.0 (0.03)	2.3 (0.04)	85 (1.4)
Project SMART Consortium, OH	0.5 (0.02)	0.6 (0.02)	0.8 (0.03)	1.8 (0.04)	71 (1.8)
Rochester City Sch. Dist., NY	0.7 (0.04)	0.8 (0.05)	0.9 (0.05)	2.1 (0.07)	74 (2.4)
SW Math/Sci. Collaborative, PA	0.5 (0.02)	0.7 (0.03)	0.8 (0.02)	1.9 (0.05)	72 (2.1)
International Avg. (All Countries)	1.0 (0.00)	1.1 (0.00)	1.3 (0.01)	2.8 (0.01)	80 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

[1] Average hours based on: No time=0; less than 1 hour=.5; 1-2 hours=1.5; 3-5 hours=4; more than 5 hours=7.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

Exhibit R1.10 Students' Daily Leisure Time*

	Average Hours Spent Each Day[1]					
	Watching Television or Videos	Playing Computer Games	Playing or Talking With Friends	Doing Jobs at Home	Playing Sports	Reading a Book for Enjoyment
Countries						
United States	2.5 (0.06)	0.9 (0.02)	2.4 (0.05)	1.1 (0.03)	1.9 (0.03)	0.6 (0.02)
Belgium (Flemish)	2.1 (0.04)	0.9 (0.04)	1.8 (0.05)	1.0 (0.04)	1.8 (0.07)	0.6 (0.02)
Canada	2.2 (0.03)	0.8 (0.02)	2.1 (0.04)	1.1 (0.03)	1.9 (0.03)	0.7 (0.04)
Chinese Taipei	2.0 (0.04)	0.9 (0.03)	1.3 (0.03)	1.0 (0.02)	1.2 (0.02)	0.9 (0.02)
Czech Republic	2.3 (0.05)	0.9 (0.06)	3.0 (0.07)	1.2 (0.03)	2.0 (0.05)	1.0 (0.04)
England	2.6 (0.05)	1.2 (0.04)	2.5 (0.08)	0.8 (0.02)	1.6 (0.04)	0.6 (0.02)
Hong Kong, SAR	2.4 (0.04)	1.0 (0.03)	1.3 (0.04)	0.6 (0.01)	1.0 (0.03)	0.8 (0.02)
Italy	1.8 (0.03)	1.0 (0.03)	2.7 (0.05)	1.1 (0.03)	1.7 (0.03)	0.7 (0.02)
Japan	3.1 (0.05)	0.9 (0.03)	1.8 (0.04)	0.5 (0.02)	1.1 (0.03)	0.8 (0.02)
Korea, Rep. of	2.9 (0.04)	0.8 (0.03)	1.3 (0.03)	0.6 (0.01)	0.6 (0.02)	0.6 (0.01)
Netherlands	2.4 (0.10)	0.9 (0.04)	2.6 (0.09)	0.8 (0.04)	1.8 (0.06)	0.7 (0.04)
Russian Federation	2.6 (0.05)	0.7 (0.03)	3.0 (0.05)	1.5 (0.03)	1.3 (0.03)	1.2 (0.03)
Singapore	2.4 (0.04)	1.1 (0.03)	1.5 (0.04)	0.9 (0.02)	1.5 (0.04)	1.0 (0.02)
States						
Connecticut	2.4 (0.09)	0.9 (0.04)	2.6 (0.08)	1.0 (0.06)	2.0 (0.05)	0.6 (0.03)
Idaho	2.1 (0.08)	0.8 (0.02)	2.2 (0.07)	1.2 (0.05)	2.0 (0.08)	0.7 (0.03)
Illinois	2.6 (0.09)	0.9 (0.05)	2.5 (0.09)	1.1 (0.05)	1.9 (0.04)	0.7 (0.03)
Indiana	2.4 (0.07)	0.9 (0.04)	2.4 (0.09)	1.1 (0.04)	1.9 (0.07)	0.6 (0.04)
Maryland	3.0 (0.10)	1.1 (0.04)	2.8 (0.07)	1.1 (0.04)	2.0 (0.05)	0.6 (0.02)
Massachusetts	2.3 (0.07)	1.0 (0.03)	2.6 (0.08)	0.9 (0.03)	1.9 (0.04)	0.5 (0.03)
Michigan	2.2 (0.09)	0.8 (0.04)	2.3 (0.08)	1.0 (0.06)	2.0 (0.06)	0.6 (0.03)
Missouri	2.6 (0.08)	0.9 (0.04)	2.7 (0.09)	1.3 (0.05)	1.9 (0.04)	0.5 (0.02)
North Carolina	2.9 (0.09)	0.9 (0.04)	2.5 (0.06)	1.3 (0.03)	1.9 (0.05)	0.6 (0.02)
Oregon	2.0 (0.06)	0.8 (0.04)	2.3 (0.06)	1.1 (0.04)	2.0 (0.05)	0.7 (0.03)
Pennsylvania	2.4 (0.09)	0.9 (0.04)	2.7 (0.09)	1.0 (0.04)	2.0 (0.04)	0.5 (0.03)
South Carolina	2.9 (0.09)	1.0 (0.05)	2.5 (0.06)	1.2 (0.05)	2.0 (0.06)	0.7 (0.03)
Texas	2.6 (0.09)	0.9 (0.05)	2.3 (0.09)	1.2 (0.06)	1.8 (0.06)	0.6 (0.03)
Districts and Consortia						
Academy School Dist. #20, CO	2.1 (0.06)	0.9 (0.05)	2.1 (0.05)	0.9 (0.02)	2.0 (0.05)	0.7 (0.03)
Chicago Public Schools, IL	3.3 (0.13)	1.0 (0.09)	2.7 (0.13)	1.7 (0.10)	2.0 (0.08)	1.2 (0.12)
Delaware Science Coalition, DE	2.8 (0.10)	1.0 (0.06)	2.8 (0.11)	1.1 (0.05)	2.0 (0.06)	0.6 (0.03)
First in the World Consort., IL	1.9 (0.06)	0.7 (0.05)	2.1 (0.09)	0.7 (0.02)	1.7 (0.07)	0.7 (0.04)
Fremont/Lincoln/WestSide PS, NE	2.5 (0.08)	0.9 (0.08)	2.8 (0.09)	1.0 (0.04)	2.0 (0.08)	0.7 (0.05)
Guilford County, NC	2.8 (0.08)	0.9 (0.05)	2.5 (0.08)	1.1 (0.04)	1.9 (0.07)	0.7 (0.04)
Jersey City Public Schools, NJ	3.2 (0.09)	1.0 (0.06)	2.8 (0.10)	1.4 (0.05)	1.9 (0.07)	0.9 (0.05)
Miami-Dade County PS, FL	3.1 (0.12)	1.1 (0.07)	2.5 (0.11)	1.4 (0.06)	2.1 (0.12)	0.9 (0.08)
Michigan Invitational Group, MI	2.0 (0.08)	0.8 (0.05)	2.3 (0.10)	1.0 (0.04)	1.9 (0.08)	0.6 (0.04)
Montgomery County, MD	2.5 (0.08)	0.9 (0.05)	2.3 (0.08)	0.9 (0.04)	1.8 (0.05)	0.7 (0.02)
Naperville Sch. Dist. #203, IL	1.8 (0.05)	0.7 (0.03)	2.0 (0.05)	0.7 (0.03)	2.0 (0.05)	0.8 (0.03)
Project SMART Consortium, OH	2.5 (0.08)	0.9 (0.06)	2.9 (0.10)	1.0 (0.05)	2.2 (0.09)	0.5 (0.03)
Rochester City Sch. Dist., NY	3.6 (0.11)	1.2 (0.08)	2.9 (0.10)	1.5 (0.07)	1.9 (0.07)	0.7 (0.05)
SW Math/Sci. Collaborative, PA	2.4 (0.07)	0.9 (0.04)	2.5 (0.10)	0.9 (0.04)	2.0 (0.06)	0.5 (0.03)
International Avg. (All Countries)	2.3 (0.01)	0.8 (0.01)	1.9 (0.01)	1.4 (0.01)	1.5 (0.01)	1.0 (0.00)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Activities are not necessarily exclusive; students may have reported engaging in more than one activity at the same time.

[1] Average hours based on: No time=0; less than 1 hour=.5; 1-2 hours=1.5; 3-5 hours=4; more than 5 hours=7.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit R1.11 Students' Reports That Science Is Not One of Their Strengths*

8th Grade Science

Percentage of Students Reporting Agree or Strongly Agree

Participants with General/ Integrated Science

Countries	
United States	35 (0.9)
Canada	43 (0.8)
Chinese Taipei [a]	50 (1.1)
England	36 (1.1)
Hong Kong, SAR	55 (1.1)
Italy	36 (1.1)
Japan	53 (0.9)
Korea, Rep. of	55 (1.1)
Singapore	41 (1.2)
States	
Connecticut	34 (1.9)
Idaho	40 (1.8)
Illinois	35 (1.3)
Indiana	34 (2.1)
Maryland	37 (1.6)
Massachusetts	36 (2.0)
Michigan	33 (1.3)
Missouri	39 (1.9)
North Carolina	32 (1.7)
Oregon	39 (1.9)
Pennsylvania	38 (1.5)
South Carolina	37 (2.1)
Texas	35 (2.5)
Districts and Consortia	
Academy School Dist. #20, CO	37 (1.3)
Chicago Public Schools, IL	34 (2.0)
Delaware Science Coalition, DE	35 (2.7)
First in the World Consort., IL	32 (2.1)
Fremont/Lincoln/WestSide PS, NE	44 (3.5)
Guilford County, NC	32 (2.5)
Jersey City Public Schools, NJ	41 (1.6)
Miami-Dade County PS, FL	39 (2.0)
Michigan Invitational Group, MI	32 (2.6)
Montgomery County, MD	33 (2.4)
Naperville Sch. Dist. #203, IL	35 (1.8)
Project SMART Consortium, OH	34 (2.3)
Rochester City Sch. Dist., NY	38 (2.1)
SW Math/Sci. Collaborative, PA	36 (2.4)
International Avg. (All General Science Countries)	44 (0.2)

Countries with Separate Science Subjects

	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	50 (1.1)	44 (1.5)	49 (2.3)	– –
Czech Republic	33 (1.3)	29 (1.2)	45 (1.5)	45 (1.8)
Netherlands [b]	38 (1.4)	34 (1.2)	44 (2.1)	– –
Russian Federation	24 (1.0)	15 (1.0)	29 (1.1)	38 (1.7)
International Avg. (All Separate Science Countries)	39 (0.4)	34 (0.3)	47 (0.4)	49 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data in physics panel pertain to physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

Exhibit R1.12 Students' Liking the Sciences*

Percentage of Students Reporting Like or Like A Lot

Participants with General/ Integrated Science

Countries	
United States	73 (0.8)
Canada	70 (1.0)
Chinese Taipei [a]	69 (0.9)
England	83 (0.9)
Hong Kong, SAR	76 (1.1)
Italy	72 (1.2)
Japan	55 (1.1)
Korea, Rep. of	52 (1.2)
Singapore	86 (1.1)
States	
Connecticut	73 (2.0)
Idaho	67 (2.2)
Illinois	73 (1.3)
Indiana	73 (2.0)
Maryland	72 (1.7)
Massachusetts	73 (2.0)
Michigan	73 (1.7)
Missouri	70 (1.7)
North Carolina	80 (1.2)
Oregon	69 (2.2)
Pennsylvania	71 (1.5)
South Carolina	73 (2.0)
Texas	74 (1.2)
Districts and Consortia	
Academy School Dist. #20, CO	70 (1.3)
Chicago Public Schools, IL	75 (3.1)
Delaware Science Coalition, DE	73 (1.7)
First in the World Consort., IL	73 (2.0)
Fremont/Lincoln/WestSide PS, NE	67 (2.3)
Guilford County, NC	77 (1.6)
Jersey City Public Schools, NJ	77 (1.4)
Miami-Dade County PS, FL	79 (2.9)
Michigan Invitational Group, MI	75 (2.3)
Montgomery County, MD	71 (2.6)
Naperville Sch. Dist. #203, IL	69 (1.5)
Project SMART Consortium, OH	71 (2.1)
Rochester City Sch. Dist., NY	81 (1.7)
SW Math/Sci. Collaborative, PA	73 (2.3)
International Avg. (All General Science Countries)	79 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries with Separate Science Subjects

	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	51 (1.6)	67 (1.1)	57 (2.3)	– –
Czech Republic	72 (1.6)	78 (1.6)	54 (2.1)	58 (2.1)
Netherlands	– –	– –	– –	– –
Russian Federation	81 (1.2)	92 (0.6)	78 (1.1)	75 (1.3)
International Avg. (All Separate Science Countries)	69 (0.4)	76 (0.3)	61 (0.4)	62 (0.4)

Background data provided by students.

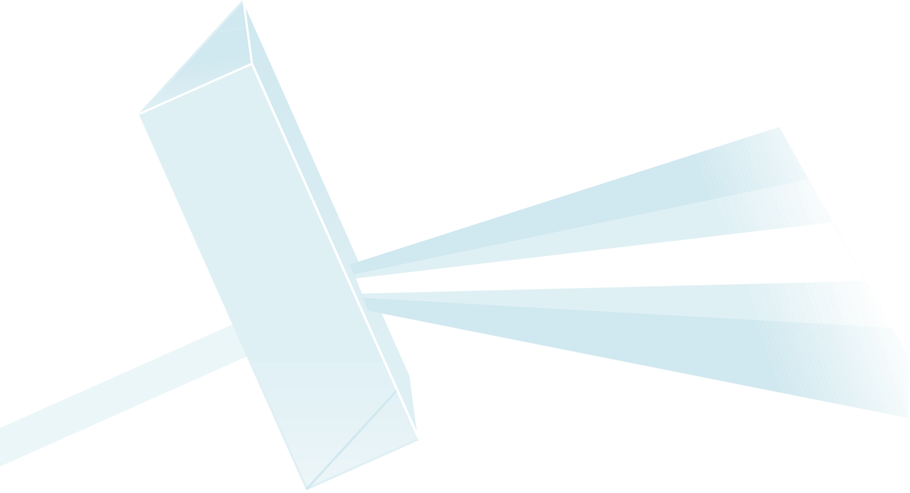
* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.



REFERENCE 2

The Science Curriculum

Exhibit R2.1 Organization of Science Instruction

8th Grade Science

	Percentage of Students Whose Schools Reported Various Organizational Approaches in Science Instruction to Accommodate Students with Different Abilities or Interests in Science				
	All Classes Study Similar Content but at Different Levels of Difficulty	Students Are Grouped by Ability within Classes	Enrichment Science Is Offered	Remedial Science Is Offered	Different Classes Study Different Content
Countries					
United States	r 52 (4.6)	r 17 (3.4)	r 34 (4.0)	r 17 (3.4)	r 12 (2.7)
Belgium (Flemish)	57 (4.4)	11 (2.1)	19 (3.1)	37 (4.4)	58 (3.9)
Canada	x x	x x	x x	x x	x x
Chinese Taipei	49 (4.0)	23 (3.6)	83 (3.2)	78 (3.7)	16 (3.2)
Czech Republic	69 (4.6)	27 (4.4)	32 (4.3)	37 (5.2)	6 (2.9)
England	r 66 (4.6)	r 48 (4.5)	r 38 (5.0)	r 45 (4.9)	r 0 (0.0)
Hong Kong, SAR	47 (4.9)	10 (2.9)	49 (4.2)	21 (3.2)	r 2 (1.2)
Italy	0 (0.0)	0 (0.0)	38 (4.0)	45 (4.1)	0 (0.0)
Japan	23 (3.7)	7 (2.4)	28 (3.2)	58 (4.5)	4 (1.8)
Korea, Rep. of	24 (3.7)	39 (4.3)	21 (3.3)	17 (3.0)	16 (2.8)
Netherlands	r 62 (6.2)	r 32 (6.8)	r 77 (6.3)	r 38 (6.4)	r 61 (6.6)
Russian Federation	31 (4.0)	49 (4.0)	91 (2.6)	50 (3.6)	21 (3.5)
Singapore	0 (0.0)	0 (0.0)	81 (3.3)	97 (0.8)	83 (3.5)
States					
Connecticut	s 53 (9.2)	s 21 (8.1)	s 20 (8.1)	s 19 (8.5)	s 15 (7.6)
Idaho	r 57 (8.5)	r 11 (4.5)	r 3 (2.8)	r 10 (5.4)	r 7 (5.1)
Illinois	38 (7.9)	10 (3.5)	21 (6.4)	9 (4.2)	8 (3.8)
Indiana	59 (6.3)	10 (4.4)	25 (5.3)	7 (3.8)	13 (5.0)
Maryland	r 81 (5.4)	r 43 (8.3)	r 45 (6.4)	r 25 (6.4)	r 26 (6.6)
Massachusetts	s 54 (8.2)	s 20 (6.3)	s 19 (7.7)	s 22 (7.5)	s 3 (2.9)
Michigan	55 (9.3)	9 (3.7)	11 (5.3)	18 (6.6)	4 (2.6)
Missouri	44 (7.2)	2 (0.1)	22 (5.6)	14 (4.2)	2 (2.1)
North Carolina	r 75 (6.5)	r 16 (5.0)	r 25 (6.1)	r 11 (5.4)	r 9 (5.1)
Oregon	57 (9.2)	21 (8.0)	21 (8.0)	2 (0.1)	9 (4.0)
Pennsylvania	52 (7.9)	23 (6.1)	35 (6.0)	16 (3.4)	25 (4.7)
South Carolina	72 (6.9)	28 (7.0)	44 (9.1)	13 (4.9)	27 (5.8)
Texas	r 73 (7.7)	r 31 (8.7)	r 72 (8.4)	r 17 (6.2)	r 22 (7.5)
Districts and Consortia					
Academy School Dist. #20, CO	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	s 81 (8.8)	s 34 (11.0)	s 23 (11.2)	s 0 (0.0)	s 10 (6.1)
Delaware Science Coalition, DE	r 39 (2.2)	r 19 (0.9)	r 38 (2.0)	r 27 (2.3)	r 22 (1.0)
First in the World Consort., IL	r 56 (1.3)	r 8 (0.6)	r 15 (1.0)	r 0 (0.0)	r 0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r 100 (0.0)	r 30 (2.1)	r 79 (0.7)	r 7 (0.2)	s 63 (1.9)
Guilford County, NC	r 73 (0.9)	r 28 (1.0)	r 18 (1.1)	r 0 (0.0)	r 0 (0.0)
Jersey City Public Schools, NJ	38 (1.6)	10 (0.6)	5 (2.1)	8 (2.0)	0 (0.0)
Miami-Dade County PS, FL	x x	s 40 (14.2)	s 100 (0.0)	s 17 (9.7)	s 25 (11.6)
Michigan Invitational Group, MI	37 (1.3)	14 (1.1)	15 (1.5)	9 (0.3)	0 (0.0)
Montgomery County, MD	s 81 (8.0)	s 56 (7.6)	s 61 (12.9)	s 17 (9.3)	s 16 (11.6)
Naperville Sch. Dist. #203, IL	0 (0.0)	0 (0.0)	24 (1.5)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	45 (1.4)	17 (1.0)	53 (1.5)	16 (1.0)	25 (1.4)
Rochester City Sch. Dist., NY	r 100 (0.0)	r 19 (1.3)	r 100 (0.0)	r 19 (1.3)	r 46 (1.6)
SW Math/Sci. Collaborative, PA	57 (8.9)	17 (7.5)	31 (9.6)	18 (6.0)	17 (7.6)
International Avg. (All Countries)	54 (0.7)	28 (0.6)	50 (0.6)	53 (0.7)	14 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit R2.2

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Earth Science

	Earth's physical features (layers, landforms, bodies of water, rocks, soil)	Earth's atmosphere (layers, composition, temperature, pressure)	Earth processes and history (weather and climate, physical cycles,plate tectonics, fossils)	Earth in the solar system and the universe (interactions between earth, sun, and moon, relationship to planets and stars)
Countries				
United States	●	●	●	●
Belgium (Flemish)	◉	◉	◉	⊙
Canada	●	◉	●	●
Chinese Taipei	○	○	○	●
Czech Republic	●	●	●	●
England	●	●	○	●
Hong Kong, SAR	○	○	○	●
Italy	●	○	●	●
Japan	●	●	●	●
Korea, Rep. of	●	●	●	●
Netherlands	◉	○	◉	○
Russian Federation	●	●	●	●
Singapore	●	●	●	●
States				
Connecticut	●	●	●	●
Idaho	●	●	●	●
Illinois	●	●	●	●
Indiana	●	○	●	●
Maryland	●	●	●	●
Massachusetts	●	●	●	●
Michigan	●	●	●	●
Missouri	●	●	●	●
North Carolina	●	●	●	●
Oregon	●	○	●	●
Pennsylvania [1]	–	–	–	–
South Carolina	●	●	●	●
Texas	●	●	●	●
Districts and Consortia				
Academy School Dist. #20, CO	–	–	–	–
Chicago Public Schools, IL	●	●	●	●
Delaware Science Coalition, DE	●	●	●	●
First in the World Consort., IL	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	●	●
Guilford County, NC	●	●	●	●
Jersey City Public Schools, NJ	●	●	●	●
Miami-Dade County PS, FL	●	●	●	●
Michigan Invitational Group, MI	●	●	●	●
Montgomery County, MD	●	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●	●
Project SMART Consortium, OH	●	●	●	●
Rochester City Sch. Dist., NY	●	●	●	●
SW Math/Sci. Collaborative, PA	–	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track-about 25%)
◌	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.3

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Biology

	Human body – structure and function of organs and systems	Human bodily processes (metabolism, respiration, digestion)	Human nutrition, health, and disease	Biology of plant and animal life (diversity, structure, life processes, life cycles)	Photosynthesis	Interactions of living things (biomes and ecosystems, interdependence)	Reproduction, genetics, evolution, and speciation
Countries							
United States	●	●	●	●	●	●	●
Belgium (Flemish)	●	●	●	◉	●	◉	●
Canada	●	●	●	●	●	●	○
Chinese Taipei	●	●	○	●	●	●	●
Czech Republic	●	●	●	●	●	●	◉
England	○	●	●	●	●	●	⊙
Hong Kong, SAR	●	●	●	●	●	●	●
Italy	●	●	●	●	●	●	●
Japan	●	●	○	●	●	○	○
Korea, Rep. of	●	●	●	●	●	○	○
Netherlands	◉	◉	●	◉	●	◉	●
Russian Federation	○	○	○	●	●	○	○
Singapore	●	●	●	●	●	●	●
States							
Connecticut	●	●	●	●	●	●	●
Idaho	●	●	●	●	●	●	●
Illinois	●	●	●	●	●	●	●
Indiana	●	●	●	●	●	●	●
Maryland	●	●	●	●	●	●	●
Massachusetts	○	○	○	●	●	●	●
Michigan	●	●	●	●	●	●	●
Missouri	○	○	○	●	●	●	●
North Carolina	●	●	●	●	●	●	●
Oregon	●	○	○	●	●	●	●
Pennsylvania [1]	–	–	–	–	–	–	–
South Carolina	●	●	◉	●	●	●	◉
Texas	●	●	●	●	●	●	●
Districts and Consortia							
Academy School Dist. #20, CO	–	–	–	–	–	–	–
Chicago Public Schools, IL	●	●	●	●	●	●	●
Delaware Science Coalition, DE	◉	●	●	●	●	●	●
First in the World Consort., IL	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	●	●	●	●	●
Guilford County, NC	●	●	●	●	●	●	●
Jersey City Public Schools, NJ	●	●	●	●	●	●	●
Miami-Dade County PS, FL	●	●	●	●	●	●	●
Michigan Invitational Group, MI	●	●	●	●	●	●	●
Montgomery County, MD	●	●	●	●	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●	●	●	●	●
Project SMART Consortium, OH	●	●	●	●	●	●	●
Rochester City Sch. Dist., NY	●	●	○	●	●	●	·
SW Math/Sci. Collaborative, PA	–	–	–	–	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track- about 25%)
·	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.4

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Physics

	Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)	Subatomic particles (protons, electrons, neutrons)	Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	Heat and temperature	Gas laws (relationship between temperature/pressure/volume)	Wave phenomena, sound, and vibration	Light (reflection, refraction, light and color)	Electricity and magnetism (circuits, conductivity, magnets)	Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	Buoyancy
Countries										
United States	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	●	○	●	○	○	○	●	●	○	○
Canada	●	○	◉	●	○	◉	◉	◉	◉	◉
Chinese Taipei	●	●	○	●	●	●	●	●	○	●
Czech Republic	●	●	●	●	●	○	●	●	●	●
England	●	○	●	●	○	●	●	●	●	●
Hong Kong, SAR	●	○	●	●	○	○	●	●	●	○
Italy	●	○	●	●	○	●	●	●	●	○
Japan	●	○	○	●	○	●	●	●	●	●
Korea, Rep. of	●	○	●	●	●	○	●	●	●	○
Netherlands	●	○	⊙	●	○	⊙	◉	○	○	○
Russian Federation	●	●	●	●	○	○	○	●	●	●
Singapore	●	●	●	●	○	○	●	●	●	○
States										
Connecticut	●	●	●	⊙	⊙	●	●	●	●	●
Idaho	●	·	●	●	⊙	⊙	⊙	●	●	●
Illinois	●	●	●	●	●	●	●	●	●	●
Indiana	●	○	●	●	●	●	●	●	●	○
Maryland	●	●	●	●	○	●	●	●	●	⊙
Massachusetts	●	●	●	●	●	●	●	●	●	●
Michigan	●	○	●	●	○	●	●	●	●	○
Missouri	●	●	●	●	◉	◉	●	●	●	●
North Carolina	●	●	●	●	●	●	●	●	●	●
Oregon	●	○	●	●	●	○	○	●	○	●
Pennsylvania [1]	–	–	–	–	–	–	–	–	–	–
South Carolina	●	●	●	●	○	●	●	●	●	●
Texas	●	●	●	●	●	●	●	●	●	○
Districts and Consortia										
Academy School Dist. #20, CO	–	–	–	–	–	–	–	–	–	–
Chicago Public Schools, IL	●	●	●	●	◉	◉	◉	●	◉	●
Delaware Science Coalition, DE	●	○	●	●	○	○	○	●	●	◉
First in the World Consort., IL	●	●	●	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	●	●	◉	●	●	●	●	◉
Guilford County, NC	●	●	●	●	●	●	●	●	●	●
Jersey City Public Schools, NJ	●	●	●	●	●	●	●	●	●	●
Miami-Dade County PS, FL	●	●	●	●	◉	●	●	●	●	●
Michigan Invitational Group, MI	●	●	●	●	◉	◉	●	●	●	◉
Montgomery County, MD	●	●	●	●	●	●	●	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●	●	·	●	●	●	●	●
Project SMART Consortium, OH	●	○	●	●	○	●	●	●	●	●
Rochester City Sch. Dist., NY	●	●	●	●	○	●	●	●	●	·
SW Math/Sci. Collaborative, PA	–	–	–	–	–	–	–	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track-about 25%)
·	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.5

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Chemistry

	Classification of matter (elements, compounds, solutions, mixtures)	Structure of matter (atoms, ions, molecules, crystals)	Formation of solutions (solvents, solutes, soluble/insoluble substances)	Acids, bases, and salts	Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	Energy and chemical change (exothermic and endothermic reactions, reaction rates)	Chemical bonding and compound formation (ionic, covalent)	Chemical equations	Atomic structure	Atomic number and atomic mass	Periodic table	Valency
Countries												
United States	●	●	●	●	●	○	○	○	●	○	⊙	○
Belgium (Flemish)	○	○	○	○	○	○	○	○	○	○	○	○
Canada	●	○	●	◌	○	○	○	○	○	○	○	○
Chinese Taipei	●	●	●	●	●	●	○	●	◉	◉	○	○
Czech Republic	●	●	●	◉	●	◉	●	●	●	●	●	●
England	●	●	●	●	●	○	○	⊙	◌	◌	◌	⊙
Hong Kong, SAR	●	●	●	●	○	●	○	○	○	○	○	○
Italy	●	●	○	○	●	○	○	○	○	○	○	○
Japan	●	●	●	●	●	○	○	●	○	○	○	○
Korea, Rep. of	●	●	●	●	●	○	○	●	○	○	○	○
Netherlands	⊙	⊙	○	◉	○	○	○	○	○	○	○	○
Russian Federation	●	●	●	●	●	●	●	●	●	●	●	●
Singapore	●	●	●	●	●	○	○	◌	●	○	●	○
States												
Connecticut	●	●	⊙	●	●	⊙	●	⊙	●	●	●	⊙
Idaho	●	●	●	⊙	●	●	⊙	⊙	◉	◉	⊙	⊙
Illinois	●	●	●	●	◉	◉	●	●	●	●	●	●
Indiana	●	●	●	●	●	●	○	○	○	○	○	○
Maryland	●	○	⊙	⊙	◌	◌	○	○	●	○	○	○
Massachusetts	●	●	○	●	●	●	○	○	○	○	○	○
Michigan	●	●	○	○	●	○	○	○	○	○	○	○
Missouri	●	●	◉	◉	◉	●	◉	◉	◉	◉	◉	◉
North Carolina	●	●	●	●	●	●	○	○	●	●	●	○
Oregon	●	○	○	○	○	○	○	○	○	○	○	○
Pennsylvania [1]	–	–	–	–	–	–	–	–	–	–	–	–
South Carolina	●	◉	●	●	◉	◉	◉	◉	●	●	●	○
Texas	●	●	●	●	●	●	●	●	●	●	●	●
Districts and Consortia												
Academy School Dist. #20, CO	–	–	–	–	–	–	–	–	–	–	–	–
Chicago Public Schools, IL	●	●	●	●	●	⊙	⊙	⊙	◉	◉	◉	⊙
Delaware Science Coalition, DE	●	◉	◉	●	◉	◉	○	○	○	○	◌	○
First in the World Consort., IL	●	●	●	●	●	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	●	◉	◉	◉	◉	○	●	◉	○	○
Guilford County, NC	●	●	●	●	●	●	○	○	●	●	●	●
Jersey City Public Schools, NJ	●	●	●	●	●	●	●	●	●	●	●	●
Miami-Dade County PS, FL	●	●	●	●	●	●	●	●	●	●	●	○
Michigan Invitational Group, MI	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉
Montgomery County, MD	●	●	●	●	●	●	●	●	●	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●	●	●	●	◉	●	●	●	●	●
Project SMART Consortium, OH	●	●	●	●	●	○	○	○	○	○	○	○
Rochester City Sch. Dist., NY	●	○	◌	●	●	●	○	○	●	○	○	○
SW Math/Sci. Collaborative, PA	–	–	–	–	–	–	–	–	–	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track-about 25%)
◌	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.6

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Environmental and Resource Issues

	Pollution (acid rain, global warming, ozone layer, water pollution)	Conservation of natural resources (land, water, forests, energy sources)	Food supply and production, population, and environmental effects of natural and man-made events
Countries			
United States	●	●	●
Belgium (Flemish)	●	●	◉
Canada	●	●	●
Chinese Taipei	○	●	●
Czech Republic	◉	●	◉
England	●	●	●
Hong Kong, SAR	◉	◉	◉
Italy	●	●	●
Japan	○	○	○
Korea, Rep. of	○	○	○
Netherlands	●	●	●
Russian Federation	●	●	●
Singapore	●	●	●
States			
Connecticut	●	●	●
Idaho	●	●	●
Illinois	●	●	●
Indiana	●	●	●
Maryland	●	●	●
Massachusetts	●	●	●
Michigan	●	●	●
Missouri	●	●	●
North Carolina	●	●	●
Oregon	○	○	●
Pennsylvania [1]	–	–	–
South Carolina	●	●	●
Texas	●	●	●
Districts and Consortia			
Academy School Dist. #20, CO	–	–	–
Chicago Public Schools, IL	●	●	◉
Delaware Science Coalition, DE	●	●	◉
First in the World Consort., IL	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	●
Guilford County, NC	●	●	●
Jersey City Public Schools, NJ	●	●	●
Miami-Dade County PS, FL	●	●	●
Michigan Invitational Group, MI	●	●	●
Montgomery County, MD	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●
Project SMART Consortium, OH	●	●	●
Rochester City Sch. Dist., NY	·	●	·
SW Math/Sci. Collaborative, PA	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track- about 25%)
·	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.7

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade – Scientific Inquiry and the Nature of Science

8th Grade Science

	Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	Experimental design (experimental control, materials and procedures)	Scientific measurements (reliability, replication, experimental error, accuracy, scales)	Using scientific apparatus and conducting routine experimental operations	Gathering, organizing, and representing data (units, tables, charts, graphs)	Describing and interpreting data
Countries						
United States	●	●	●	●	●	●
Belgium (Flemish)	●	◉	●	●	●	●
Canada	●	●	◉	◉	●	●
Chinese Taipei	●	○	●	●	●	●
Czech Republic	○	○	○	●	●	●
England	●	●	●	●	●	●
Hong Kong, SAR	◉	◉	○	●	●	◉
Italy	●	●	●	○	●	●
Japan	●	●	○	●	●	●
Korea, Rep. of	○	○	○	●	●	●
Netherlands	○	◉	⊙	◉	●	●
Russian Federation	○	○	○	●	●	○
Singapore	●	◉	●	●	●	●
States						
Connecticut	●	●	●	●	●	●
Idaho	●	●	●	●	●	●
Illinois	●	●	●	●	●	●
Indiana	●	●	●	●	●	●
Maryland	●	●	●	●	●	●
Massachusetts	●	●	●	●	●	●
Michigan	●	●	●	●	●	●
Missouri	●	◉	◉	●	●	●
North Carolina	●	●	●	●	●	●
Oregon	●	●	●	●	●	●
Pennsylvania [1]	–	–	–	–	–	–
South Carolina	●	●	○	●	●	●
Texas	●	●	●	●	●	●
Districts and Consortia						
Academy School Dist. #20, CO	–	–	–	–	–	–
Chicago Public Schools, IL	●	●	◉	◉	●	◉
Delaware Science Coalition, DE	●	●	●	●	●	●
First in the World Consort., IL	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	●	●	⊙	●	●	●
Guilford County, NC	●	●	●	●	●	●
Jersey City Public Schools, NJ	●	●	●	●	●	●
Miami-Dade County PS, FL	●	●	●	●	●	●
Michigan Invitational Group, MI	●	●	◉	●	●	●
Montgomery County, MD	●	●	●	●	●	●
Naperville Sch. Dist. #203, IL	●	●	●	●	●	●
Project SMART Consortium, OH	●	●	●	●	●	●
Rochester City Sch. Dist., NY	●	●	○	●	●	●
SW Math/Sci. Collaborative, PA	–	–	–	–	–	–

●	All or almost all students (at least 90%)
◉	About half of the students
⊙	Only the more able students (top track-about 25%)
·	Only the most advanced students (10% or less)
○	Not included in curriculum
–	Data not available

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by coordinators from participating jurisdictions.

---

[1] Pennsylvania: Due to the variation across the state, a representative response cannot be provided for these questions.

Exhibit R2.8 When Earth Science Topics Are Taught*

8th Grade Science

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year¹			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	20 (3.1)	12 (2.6)	26 (3.4)	20 (2.1)	11 (2.3)	11 (2.4)
Belgium (Flemish)	r	4 (1.8)	12 (2.4)	2 (1.3)	10 (2.7)	12 (2.8)	60 (4.1)
Canada	s	17 (2.6)	12 (2.5)	21 (2.8)	22 (2.8)	14 (2.8)	16 (2.6)
Chinese Taipei		– –	– –	– –	– –	– –	– –
Czech Republic		45 (6.3)	11 (3.4)	6 (1.9)	23 (4.2)	13 (3.7)	2 (1.2)
England	s	22 (4.2)	13 (3.6)	0 (0.0)	24 (4.2)	14 (4.0)	27 (3.5)
Hong Kong, SAR	s	1 (0.1)	0 (0.0)	2 (1.6)	7 (2.9)	1 (0.1)	88 (3.6)
Italy		5 (1.7)	8 (2.1)	18 (3.2)	28 (3.4)	22 (3.1)	19 (2.8)
Japan		0 (0.0)	3 (1.6)	3 (1.8)	6 (1.9)	28 (3.7)	61 (4.0)
Korea, Rep. of		4 (1.6)	13 (3.0)	12 (2.8)	22 (3.4)	41 (4.0)	8 (2.1)
Netherlands		0 (0.0)	1 (0.8)	10 (3.5)	59 (6.0)	14 (3.8)	17 (4.7)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore		x x	x x	x x	x x	x x	x x
States							
Connecticut	s	38 (7.4)	6 (2.2)	13 (5.2)	17 (5.9)	8 (4.0)	18 (6.6)
Idaho	s	18 (7.5)	0 (0.1)	20 (4.1)	9 (3.5)	3 (2.0)	50 (7.3)
Illinois	r	26 (5.4)	16 (5.5)	19 (5.6)	18 (5.2)	2 (1.3)	19 (6.8)
Indiana	r	31 (7.7)	18 (4.2)	19 (4.5)	14 (4.1)	8 (3.5)	9 (3.6)
Maryland	s	26 (7.2)	8 (3.6)	17 (4.1)	17 (4.5)	15 (5.4)	17 (4.3)
Massachusetts	r	18 (5.1)	12 (5.0)	25 (5.6)	18 (4.8)	10 (4.0)	18 (4.8)
Michigan	r	30 (5.0)	16 (4.6)	12 (3.5)	14 (3.2)	18 (4.5)	11 (3.9)
Missouri	r	11 (4.9)	7 (3.2)	22 (4.5)	29 (5.7)	24 (6.1)	7 (2.9)
North Carolina		6 (3.4)	15 (5.4)	21 (4.8)	22 (5.1)	29 (3.9)	6 (0.9)
Oregon		15 (5.2)	5 (2.5)	37 (8.4)	26 (7.0)	6 (3.2)	11 (4.3)
Pennsylvania	r	29 (6.4)	4 (1.8)	38 (6.2)	7 (2.2)	2 (1.1)	19 (3.7)
South Carolina		7 (4.0)	4 (2.9)	43 (6.1)	41 (7.6)	2 (1.6)	3 (1.3)
Texas	r	1 (0.9)	1 (1.2)	49 (5.7)	37 (5.2)	6 (2.7)	7 (3.2)
Districts and Consortia							
Academy School Dist. #20, CO		64 (0.4)	0 (0.0)	0 (0.0)	26 (0.4)	0 (0.0)	10 (0.2)
Chicago Public Schools, IL	r	33 (10.9)	7 (5.1)	20 (3.8)	19 (10.1)	6 (4.5)	15 (5.8)
Delaware Science Coalition, DE	s	0 (0.0)	0 (0.0)	65 (5.9)	13 (3.7)	8 (4.5)	13 (4.8)
First in the World Consort., IL		72 (6.7)	5 (1.7)	0 (0.0)	7 (1.1)	3 (0.4)	14 (7.8)
Fremont/Lincoln/WestSide PS, NE	r	13 (8.0)	51 (10.3)	1 (0.4)	25 (1.5)	6 (6.3)	3 (2.4)
Guilford County, NC		0 (0.0)	6 (0.9)	25 (5.1)	22 (4.0)	40 (5.5)	7 (3.1)
Jersey City Public Schools, NJ	r	86 (4.1)	0 (0.0)	0 (0.0)	11 (4.2)	4 (0.4)	0 (0.0)
Miami-Dade County PS, FL	s	21 (6.8)	16 (6.8)	10 (4.6)	34 (6.8)	15 (5.2)	4 (2.9)
Michigan Invitational Group, MI	r	22 (2.2)	2 (1.5)	45 (5.6)	16 (5.9)	9 (3.2)	6 (1.8)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		2 (0.6)	40 (4.8)	0 (0.0)	28 (2.8)	29 (4.0)	0 (0.0)
Project SMART Consortium, OH	r	15 (1.7)	16 (2.2)	23 (3.8)	27 (4.0)	6 (3.1)	12 (3.5)
Rochester City Sch. Dist., NY	s	10 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	3 (2.8)	87 (2.7)
SW Math/Sci. Collaborative, PA		34 (5.5)	8 (2.2)	14 (5.9)	12 (3.9)	5 (2.9)	26 (6.1)
International Avg. (All Countries)		13 (0.5)	10 (0.5)	10 (0.5)	23 (0.7)	12 (0.5)	31 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for earth science are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.20.

[1] For each topic in Exhibit 5.20, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R2.9 When Biology Topics Are Taught*

8th Grade Science

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year¹			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	45 (3.7)	10 (2.1)	9 (2.0)	17 (2.6)	9 (2.2)	10 (2.0)
Belgium (Flemish)		0 (0.0)	7 (2.0)	27 (4.3)	39 (4.4)	25 (4.2)	2 (1.3)
Canada	s	1 (0.5)	6 (1.8)	10 (2.1)	26 (4.1)	10 (3.4)	47 (3.3)
Chinese Taipei		– –	– –	– –	– –	– –	– –
Czech Republic		8 (2.4)	2 (0.8)	25 (4.6)	26 (2.8)	33 (5.3)	6 (1.8)
England	s	9 (3.1)	8 (2.7)	16 (3.5)	42 (4.8)	19 (3.9)	6 (1.7)
Hong Kong, SAR	r	3 (1.3)	6 (2.4)	4 (1.7)	17 (3.8)	25 (4.3)	45 (4.5)
Italy		34 (4.0)	30 (3.5)	11 (2.3)	11 (2.3)	13 (2.2)	1 (0.3)
Japan		1 (1.2)	1 (0.9)	17 (3.3)	37 (3.9)	17 (3.3)	27 (3.5)
Korea, Rep. of		4 (1.7)	1 (1.0)	13 (3.1)	39 (3.8)	21 (3.6)	20 (3.3)
Netherlands	r	0 (0.0)	1 (0.7)	2 (1.2)	96 (1.7)	1 (0.9)	0 (0.0)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore		0 (0.0)	2 (1.5)	34 (4.3)	45 (4.6)	14 (3.3)	4 (2.0)
States							
Connecticut	s	56 (7.9)	16 (7.2)	10 (3.9)	4 (2.4)	9 (4.0)	5 (2.5)
Idaho	s	57 (8.2)	7 (3.7)	3 (1.5)	7 (3.7)	3 (2.2)	24 (7.5)
Illinois	r	44 (7.8)	9 (3.9)	9 (3.7)	16 (4.3)	8 (3.5)	14 (3.9)
Indiana	r	33 (7.6)	13 (8.0)	21 (6.2)	12 (4.9)	11 (4.8)	9 (3.6)
Maryland	s	58 (7.1)	11 (4.7)	2 (2.3)	12 (4.3)	15 (5.0)	1 (1.0)
Massachusetts	r	59 (6.6)	16 (4.7)	6 (3.0)	6 (3.2)	6 (3.0)	8 (3.3)
Michigan	r	28 (5.6)	14 (3.6)	10 (3.9)	16 (3.8)	20 (5.2)	12 (4.0)
Missouri	r	31 (6.2)	8 (3.6)	6 (3.4)	28 (7.6)	13 (5.0)	14 (4.8)
North Carolina	r	51 (6.0)	21 (5.0)	1 (1.3)	5 (2.9)	10 (2.6)	12 (3.7)
Oregon	r	55 (7.1)	8 (3.5)	12 (4.5)	9 (3.7)	6 (1.6)	10 (4.0)
Pennsylvania	r	55 (5.8)	3 (1.2)	7 (2.7)	8 (2.5)	7 (3.0)	21 (3.2)
South Carolina	r	48 (7.0)	12 (5.4)	8 (3.3)	17 (5.3)	9 (3.6)	6 (3.1)
Texas	r	43 (6.5)	12 (4.2)	5 (2.9)	18 (3.8)	14 (5.5)	8 (3.6)
Districts and Consortia							
Academy School Dist. #20, CO		64 (0.4)	5 (0.2)	21 (0.4)	10 (0.4)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	r	6 (4.3)	0 (0.0)	7 (4.6)	48 (12.5)	26 (11.1)	14 (8.3)
Delaware Science Coalition, DE	s	71 (7.0)	6 (2.4)	1 (0.1)	5 (2.6)	2 (0.9)	15 (6.1)
First in the World Consort., IL		42 (4.0)	3 (0.4)	22 (4.3)	24 (9.3)	5 (5.0)	5 (1.5)
Fremont/Lincoln/WestSide PS, NE	s	5 (4.1)	21 (4.3)	28 (5.1)	29 (11.4)	14 (10.5)	3 (1.1)
Guilford County, NC	r	52 (4.8)	34 (5.4)	0 (0.0)	2 (0.4)	6 (1.0)	6 (2.8)
Jersey City Public Schools, NJ	r	72 (4.0)	4 (0.6)	0 (0.0)	7 (0.7)	8 (0.8)	9 (4.2)
Miami-Dade County PS, FL	s	39 (8.5)	15 (5.9)	10 (4.6)	18 (6.1)	13 (4.1)	5 (2.4)
Michigan Invitational Group, MI	r	41 (2.2)	11 (3.7)	2 (1.2)	17 (1.8)	5 (3.1)	24 (2.8)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		12 (0.5)	12 (0.7)	13 (3.1)	42 (5.2)	21 (4.3)	0 (0.0)
Project SMART Consortium, OH	r	46 (3.6)	12 (1.6)	11 (1.4)	15 (4.2)	8 (2.6)	8 (2.3)
Rochester City Sch. Dist., NY	r	64 (5.9)	0 (0.0)	10 (4.9)	12 (4.7)	4 (1.8)	10 (3.4)
SW Math/Sci. Collaborative, PA	r	43 (9.4)	9 (4.2)	0 (0.0)	13 (4.5)	9 (4.9)	26 (5.8)
International Avg. (All Countries)		7 (0.4)	9 (0.4)	15 (0.6)	29 (0.7)	19 (0.6)	21 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for biology are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.21.

[1] For each topic in Exhibit 5.21, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R2.10 When Physics Topics Are Taught*

8th Grade Science

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year[1]			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	5 (1.5)	7 (1.9)	21 (3.6)	37 (2.9)	12 (2.4)	18 (3.1)
Belgium (Flemish)	s	0 (0.0)	0 (0.0)	1 (0.9)	13 (3.4)	2 (1.3)	84 (3.3)
Canada	s	0 (0.2)	6 (2.0)	7 (1.7)	25 (3.0)	16 (2.8)	45 (3.2)
Chinese Taipei		5 (1.6)	5 (1.9)	12 (2.7)	34 (4.2)	26 (3.8)	19 (2.9)
Czech Republic		0 (0.0)	5 (2.3)	5 (2.1)	26 (4.9)	60 (5.0)	4 (2.1)
England	s	0 (0.2)	16 (4.2)	4 (1.8)	52 (5.3)	27 (4.4)	1 (0.5)
Hong Kong, SAR	r	1 (0.9)	2 (1.3)	12 (3.3)	21 (4.0)	37 (4.9)	28 (4.3)
Italy		4 (1.6)	14 (2.7)	7 (2.1)	20 (3.0)	32 (3.9)	24 (3.3)
Japan		0 (0.0)	12 (3.1)	1 (0.9)	7 (2.0)	73 (3.6)	6 (2.3)
Korea, Rep. of		4 (1.6)	13 (2.6)	2 (1.2)	24 (3.7)	30 (3.9)	28 (3.8)
Netherlands		0 (0.0)	1 (0.7)	0 (0.0)	98 (0.9)	1 (0.6)	0 (0.0)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore		0 (0.1)	2 (1.1)	20 (3.5)	59 (4.3)	17 (3.6)	2 (1.4)
States							
Connecticut	s	4 (3.1)	7 (3.3)	21 (6.1)	24 (7.9)	7 (4.6)	36 (8.5)
Idaho	s	2 (1.3)	1 (0.8)	25 (8.5)	29 (5.4)	3 (0.3)	41 (7.3)
Illinois	r	7 (3.7)	10 (5.1)	15 (4.6)	19 (5.1)	23 (7.1)	26 (7.7)
Indiana	r	11 (5.8)	11 (4.8)	19 (5.4)	21 (5.9)	18 (6.4)	20 (8.3)
Maryland	s	3 (1.7)	15 (4.5)	19 (6.3)	31 (7.4)	18 (4.7)	14 (4.8)
Massachusetts	r	1 (1.0)	8 (4.6)	24 (6.7)	37 (7.4)	15 (4.6)	16 (4.5)
Michigan	r	4 (2.5)	5 (2.5)	23 (4.6)	51 (6.1)	10 (3.8)	8 (3.9)
Missouri	r	11 (3.9)	7 (3.5)	14 (2.7)	31 (5.1)	23 (6.0)	14 (4.4)
North Carolina	r	1 (0.6)	12 (4.6)	18 (5.7)	40 (6.2)	13 (4.6)	16 (5.9)
Oregon	r	9 (4.9)	12 (4.5)	12 (5.0)	38 (7.3)	13 (4.7)	16 (4.8)
Pennsylvania	s	1 (0.8)	12 (8.2)	25 (5.6)	25 (4.7)	4 (1.9)	33 (7.5)
South Carolina	r	2 (0.2)	7 (2.6)	27 (6.5)	46 (6.3)	7 (3.5)	10 (3.2)
Texas	s	9 (6.1)	16 (3.5)	10 (3.8)	42 (6.7)	7 (2.7)	15 (5.1)
Districts and Consortia							
Academy School Dist. #20, CO		0 (0.0)	0 (0.0)	44 (0.6)	36 (0.6)	0 (0.0)	20 (0.4)
Chicago Public Schools, IL	r	12 (6.4)	7 (5.1)	20 (7.3)	34 (11.5)	15 (7.9)	13 (7.4)
Delaware Science Coalition, DE		x x	x x	x x	x x	x x	x x
First in the World Consort., IL		12 (1.2)	16 (6.4)	16 (2.5)	19 (2.9)	26 (9.1)	11 (1.5)
Fremont/Lincoln/WestSide PS, NE	s	0 (0.0)	30 (3.5)	10 (4.9)	12 (3.2)	33 (7.5)	16 (4.5)
Guilford County, NC	r	1 (0.1)	41 (5.5)	8 (3.4)	31 (5.6)	14 (3.6)	5 (2.4)
Jersey City Public Schools, NJ	r	0 (0.0)	5 (4.3)	19 (1.8)	62 (4.2)	9 (0.8)	5 (0.5)
Miami-Dade County PS, FL	s	5 (3.9)	0 (0.0)	47 (5.9)	31 (5.5)	2 (1.8)	15 (5.1)
Michigan Invitational Group, MI	r	5 (0.3)	6 (0.7)	26 (6.0)	29 (3.4)	18 (6.7)	16 (3.7)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		0 (0.0)	0 (0.0)	26 (2.8)	41 (5.5)	21 (4.9)	11 (0.5)
Project SMART Consortium, OH	r	3 (0.1)	12 (1.5)	25 (3.7)	37 (3.6)	9 (3.0)	14 (1.3)
Rochester City Sch. Dist., NY	r	0 (0.0)	6 (4.1)	21 (4.9)	37 (2.7)	0 (0.0)	36 (6.4)
SW Math/Sci. Collaborative, PA	r	4 (3.1)	4 (3.1)	25 (7.1)	35 (7.5)	7 (2.5)	24 (7.9)
International Avg. (All Countries)		2 (0.2)	7 (0.4)	10 (0.5)	34 (0.7)	21 (0.6)	27 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for physics are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.22.

[1] For each topic in Exhibit 5.22, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R2.11 When Chemistry Topics Are Taught*

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year¹			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	8 (1.9)	2 (0.9)	31 (3.5)	32 (3.4)	4 (1.0)	23 (3.3)
Belgium (Flemish)	s	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.9)	0 (0.0)	97 (1.9)
Canada	s	6 (2.0)	2 (0.9)	15 (2.7)	25 (3.2)	2 (0.9)	51 (3.9)
Chinese Taipei		7 (1.9)	1 (0.7)	41 (4.5)	46 (3.9)	5 (1.9)	1 (0.7)
Czech Republic		1 (0.3)	5 (2.1)	28 (4.9)	45 (5.6)	14 (3.1)	8 (3.0)
England	s	4 (2.2)	7 (2.8)	14 (3.5)	59 (5.1)	5 (2.0)	11 (3.3)
Hong Kong, SAR	r	8 (2.6)	19 (3.8)	6 (1.9)	15 (3.5)	18 (3.8)	35 (4.8)
Italy		21 (3.1)	15 (2.6)	12 (2.5)	20 (3.2)	9 (2.1)	23 (3.6)
Japan		3 (1.7)	1 (0.7)	32 (4.3)	35 (3.8)	12 (2.7)	18 (3.3)
Korea, Rep. of		2 (1.3)	3 (1.3)	27 (3.4)	45 (3.8)	13 (2.8)	10 (2.3)
Netherlands	r	0 (0.0)	0 (0.0)	0 (0.0)	98 (1.0)	0 (0.0)	1 (0.9)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore	r	1 (0.6)	11 (2.9)	20 (3.8)	48 (4.9)	9 (2.3)	13 (3.3)
States							
Connecticut	s	5 (4.3)	2 (0.2)	31 (6.5)	31 (7.5)	1 (1.3)	29 (7.4)
Idaho	s	2 (1.4)	0 (0.0)	34 (7.7)	33 (8.0)	3 (2.9)	27 (6.9)
Illinois	r	11 (3.4)	0 (0.3)	43 (7.5)	25 (6.1)	0 (0.0)	20 (4.7)
Indiana	r	4 (2.4)	1 (1.1)	41 (8.1)	31 (5.9)	6 (3.3)	17 (5.3)
Maryland	s	6 (3.1)	1 (1.1)	39 (6.5)	37 (5.7)	1 (1.2)	16 (5.0)
Massachusetts	r	6 (3.1)	3 (2.2)	39 (7.3)	21 (4.6)	5 (2.4)	25 (5.5)
Michigan	r	15 (5.0)	0 (0.2)	28 (6.3)	33 (5.5)	9 (3.9)	14 (5.3)
Missouri	r	6 (3.4)	2 (0.1)	23 (5.3)	24 (6.4)	12 (4.8)	32 (6.5)
North Carolina		0 (0.3)	0 (0.0)	43 (5.1)	38 (5.0)	1 (0.9)	17 (4.9)
Oregon	r	10 (3.9)	7 (3.5)	27 (6.3)	40 (6.2)	4 (2.8)	12 (3.6)
Pennsylvania	r	2 (1.6)	0 (0.0)	48 (6.6)	18 (4.3)	6 (1.1)	26 (5.6)
South Carolina	r	0 (0.0)	0 (0.0)	40 (6.3)	44 (6.9)	2 (0.8)	14 (3.5)
Texas	r	5 (5.0)	1 (1.2)	40 (6.1)	34 (5.8)	0 (0.2)	20 (5.1)
Districts and Consortia							
Academy School Dist. #20, CO		0 (0.0)	0 (0.0)	60 (0.4)	24 (0.5)	2 (0.4)	14 (0.2)
Chicago Public Schools, IL	r	13 (7.0)	1 (1.5)	37 (11.7)	23 (6.2)	0 (0.0)	26 (9.7)
Delaware Science Coalition, DE		x x	x x	x x	x x	x x	x x
First in the World Consort., IL		2 (0.2)	0 (0.0)	63 (6.2)	20 (7.4)	8 (1.9)	7 (0.7)
Fremont/Lincoln/WestSide PS, NE	s	0 (0.0)	12 (1.9)	4 (3.9)	30 (5.7)	15 (2.1)	39 (7.8)
Guilford County, NC		0 (0.0)	0 (0.0)	42 (5.7)	40 (6.0)	6 (0.9)	12 (4.2)
Jersey City Public Schools, NJ	r	0 (0.0)	0 (0.0)	42 (5.2)	36 (5.0)	0 (0.0)	21 (2.1)
Miami-Dade County PS, FL	s	11 (5.7)	12 (7.4)	30 (5.7)	39 (5.6)	1 (0.2)	6 (2.1)
Michigan Invitational Group, MI	r	11 (5.8)	2 (1.5)	25 (3.7)	45 (6.3)	1 (0.1)	15 (2.4)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		0 (0.0)	0 (0.0)	48 (5.6)	41 (5.7)	11 (0.4)	0 (0.0)
Project SMART Consortium, OH	r	3 (0.1)	5 (0.4)	34 (3.7)	32 (4.7)	4 (1.0)	22 (3.3)
Rochester City Sch. Dist., NY	r	0 (0.0)	0 (0.0)	24 (4.1)	48 (4.7)	0 (0.0)	28 (6.1)
SW Math/Sci. Collaborative, PA	r	1 (0.5)	0 (0.0)	43 (5.8)	28 (6.5)	0 (0.0)	29 (4.9)
International Avg. (All Countries)		8 (0.3)	5 (0.3)	19 (0.6)	35 (0.7)	9 (0.4)	24 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for chemistry are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.23.

[1] For each topic in Exhibit 5.23, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R2.12 When Environmental and Resource Issues Topics Are Taught*

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year[1]			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	21 (2.8)	8 (2.1)	15 (2.3)	34 (3.3)	3 (0.7)	19 (2.5)
Belgium (Flemish)	r	4 (1.9)	6 (3.3)	6 (2.0)	64 (4.9)	3 (1.5)	17 (3.6)
Canada	s	9 (2.1)	10 (2.0)	19 (3.6)	51 (4.5)	3 (1.2)	8 (1.7)
Chinese Taipei	r	16 (3.8)	5 (2.2)	4 (1.8)	22 (3.4)	3 (1.5)	51 (4.4)
Czech Republic		10 (4.3)	9 (3.0)	9 (2.7)	64 (5.4)	0 (0.0)	9 (2.7)
England	s	15 (4.1)	8 (2.9)	5 (2.0)	43 (5.5)	1 (0.8)	27 (4.9)
Hong Kong, SAR	r	4 (1.9)	10 (3.1)	4 (2.0)	29 (5.0)	6 (2.4)	46 (5.3)
Italy		17 (3.2)	13 (2.7)	17 (3.0)	29 (3.8)	3 (1.4)	20 (2.8)
Japan		1 (0.0)	1 (0.0)	1 (0.0)	6 (2.0)	0 (0.0)	92 (2.5)
Korea, Rep. of		13 (2.7)	7 (2.2)	4 (1.7)	31 (3.7)	3 (1.4)	42 (4.5)
Netherlands		1 (0.5)	2 (1.1)	5 (1.9)	92 (2.5)	0 (0.0)	1 (1.0)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore	r	13 (2.6)	12 (3.1)	10 (2.9)	41 (4.5)	12 (2.9)	13 (3.4)
States							
Connecticut	s	40 (7.6)	12 (5.3)	4 (2.1)	27 (6.4)	0 (0.0)	17 (6.2)
Idaho	s	12 (4.4)	5 (2.7)	5 (1.9)	36 (5.2)	0 (0.0)	43 (7.7)
Illinois	r	21 (5.9)	4 (1.8)	31 (7.4)	24 (6.3)	4 (2.5)	16 (4.1)
Indiana	s	25 (4.8)	6 (2.7)	18 (6.3)	31 (5.6)	3 (2.7)	17 (5.1)
Maryland	s	32 (6.4)	15 (5.1)	13 (4.1)	20 (5.5)	4 (3.0)	16 (5.0)
Massachusetts	r	39 (7.3)	13 (4.3)	6 (2.9)	29 (6.4)	3 (2.0)	10 (3.4)
Michigan	r	25 (5.7)	7 (2.9)	22 (6.4)	29 (6.0)	6 (3.8)	11 (4.3)
Missouri	r	27 (6.8)	10 (2.5)	14 (4.9)	39 (5.7)	0 (0.4)	10 (3.5)
North Carolina	r	19 (5.6)	5 (2.0)	19 (5.9)	31 (5.9)	3 (1.9)	23 (5.6)
Oregon	r	27 (7.0)	9 (5.2)	20 (5.7)	25 (5.4)	2 (1.5)	17 (5.5)
Pennsylvania	r	21 (5.9)	2 (1.7)	14 (3.1)	34 (7.8)	1 (0.5)	28 (6.5)
South Carolina	r	11 (3.7)	12 (4.2)	13 (4.4)	53 (7.1)	4 (2.3)	6 (2.3)
Texas	r	16 (5.5)	7 (2.9)	18 (4.9)	45 (7.8)	2 (1.8)	13 (3.3)
Districts and Consortia							
Academy School Dist. #20, CO	s	56 (0.6)	0 (0.0)	16 (0.3)	28 (0.6)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	r	23 (10.0)	6 (4.6)	4 (3.5)	24 (10.3)	0 (0.0)	43 (13.0)
Delaware Science Coalition, DE	s	11 (5.0)	0 (0.0)	14 (4.9)	33 (5.6)	11 (4.6)	31 (4.9)
First in the World Consort., IL		44 (6.2)	13 (6.5)	7 (1.0)	36 (8.0)	0 (0.0)	0 (0.0)
Fremont/Lincoln/WestSide PS, NE	s	15 (4.9)	11 (6.8)	17 (11.2)	32 (6.5)	0 (0.1)	25 (6.5)
Guilford County, NC	r	7 (4.0)	10 (2.2)	31 (5.9)	28 (5.6)	0 (0.0)	24 (3.8)
Jersey City Public Schools, NJ	r	11 (5.7)	10 (4.3)	9 (0.9)	67 (5.6)	0 (0.0)	2 (0.2)
Miami-Dade County PS, FL	s	18 (4.9)	6 (3.5)	11 (3.9)	46 (8.6)	1 (0.7)	18 (6.5)
Michigan Invitational Group, MI	s	34 (3.5)	18 (3.7)	13 (7.7)	15 (6.5)	0 (0.0)	20 (4.0)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		2 (0.6)	36 (2.0)	0 (0.0)	40 (5.0)	21 (4.8)	0 (0.0)
Project SMART Consortium, OH	r	26 (4.4)	9 (0.8)	11 (3.0)	45 (4.6)	1 (1.1)	8 (1.7)
Rochester City Sch. Dist., NY	s	13 (3.6)	7 (4.5)	0 (0.0)	14 (3.6)	0 (0.0)	67 (6.4)
SW Math/Sci. Collaborative, PA	r	32 (8.2)	4 (2.4)	11 (5.4)	34 (8.1)	3 (2.5)	15 (7.1)
International Avg. (All Countries)		9 (0.4)	7 (0.4)	13 (0.5)	43 (0.7)	3 (0.2)	26 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for environmental and resource issues are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.24.

[1] For each topic in Exhibit 5.24, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R2.13 When Scientific Inquiry and the Nature of Science Topics Are Taught*

8th Grade Science

		Percentage of Students					
		Taught Topics Before This Year Only		Taught Topics During This Year[1]			Not Yet Taught 50% or More of Topics
		More Than 80% of Topics	More Than 50% Up to and Including 80% of Topics	More Than 50% of Topics Each Taught More Than 5 Periods	More Than 50% of Topics Each Taught at Least 1-5 Periods	50% or Less of Topics Taught	
Countries							
United States	r	2 (0.8)	1 (0.4)	49 (4.0)	43 (4.1)	2 (1.3)	2 (1.1)
Belgium (Flemish)	r	3 (2.6)	2 (1.1)	30 (4.4)	37 (4.7)	2 (1.3)	26 (4.8)
Canada	r	2 (0.9)	0 (0.3)	47 (3.1)	47 (3.0)	2 (0.9)	1 (0.7)
Chinese Taipei		31 (4.1)	6 (2.3)	10 (2.5)	26 (3.8)	4 (1.7)	23 (3.9)
Czech Republic	r	2 (1.7)	3 (0.8)	11 (3.7)	52 (5.6)	9 (3.2)	22 (4.4)
England	s	2 (1.1)	3 (2.0)	46 (5.1)	46 (5.0)	1 (0.5)	2 (1.1)
Hong Kong, SAR		18 (3.5)	10 (2.6)	12 (3.1)	27 (3.9)	9 (2.7)	24 (3.8)
Italy		25 (3.4)	14 (2.5)	11 (2.8)	32 (3.6)	14 (3.0)	5 (1.8)
Japan		11 (2.5)	8 (2.5)	28 (3.9)	44 (4.2)	5 (1.7)	5 (1.8)
Korea, Rep. of		8 (1.9)	4 (1.7)	14 (2.9)	59 (4.0)	6 (2.0)	9 (2.3)
Netherlands		3 (2.8)	0 (0.0)	1 (0.7)	96 (3.0)	1 (0.7)	0 (0.0)
Russian Federation		– –	– –	– –	– –	– –	– –
Singapore		13 (3.2)	8 (2.5)	18 (3.5)	46 (4.5)	9 (2.5)	6 (2.4)
States							
Connecticut	s	6 (3.8)	1 (0.1)	64 (6.7)	28 (7.1)	1 (0.9)	0 (0.0)
Idaho	s	7 (2.8)	0 (0.1)	35 (8.7)	56 (8.3)	0 (0.0)	1 (0.6)
Illinois		1 (1.4)	0 (0.0)	57 (5.0)	35 (5.5)	4 (2.8)	3 (2.1)
Indiana	r	5 (2.9)	1 (0.1)	44 (7.6)	49 (8.2)	1 (0.6)	0 (0.0)
Maryland	r	1 (0.7)	0 (0.0)	74 (5.3)	24 (5.1)	0 (0.0)	1 (0.8)
Massachusetts	r	0 (0.0)	1 (0.9)	66 (6.6)	33 (6.6)	0 (0.0)	0 (0.2)
Michigan	r	1 (1.0)	1 (0.6)	67 (6.3)	31 (6.0)	0 (0.0)	0 (0.5)
Missouri	r	4 (2.4)	0 (0.0)	48 (5.0)	41 (5.5)	4 (2.3)	3 (2.7)
North Carolina		2 (1.2)	1 (1.1)	49 (4.5)	35 (6.1)	7 (3.6)	6 (3.1)
Oregon		0 (0.0)	0 (0.0)	59 (8.1)	39 (7.6)	0 (0.0)	2 (1.4)
Pennsylvania	r	3 (2.7)	0 (0.2)	53 (7.5)	35 (5.6)	8 (2.1)	1 (0.6)
South Carolina		2 (0.1)	0 (0.0)	61 (5.9)	35 (6.0)	0 (0.0)	2 (1.4)
Texas	r	8 (5.3)	0 (0.0)	59 (6.3)	33 (6.4)	0 (0.0)	0 (0.2)
Districts and Consortia							
Academy School Dist. #20, CO		0 (0.0)	0 (0.0)	74 (0.4)	26 (0.4)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	r	0 (0.0)	0 (0.0)	62 (13.3)	33 (11.7)	0 (0.0)	6 (0.8)
Delaware Science Coalition, DE	s	4 (0.7)	3 (2.4)	59 (6.3)	34 (6.4)	0 (0.0)	0 (0.0)
First in the World Consort., IL		4 (1.6)	0 (0.0)	84 (2.5)	12 (3.1)	0 (0.0)	1 (0.8)
Fremont/Lincoln/WestSide PS, NE	r	0 (0.0)	0 (0.0)	50 (7.5)	50 (7.5)	0 (0.0)	0 (0.0)
Guilford County, NC	r	3 (2.1)	2 (0.8)	58 (3.4)	36 (3.8)	1 (1.2)	0 (0.0)
Jersey City Public Schools, NJ	r	0 (0.0)	0 (0.0)	61 (5.2)	39 (5.2)	0 (0.0)	0 (0.0)
Miami-Dade County PS, FL	s	5 (3.5)	0 (0.4)	65 (7.1)	30 (6.0)	0 (0.0)	0 (0.0)
Michigan Invitational Group, MI	r	8 (2.9)	0 (0.0)	61 (6.8)	29 (5.8)	2 (0.1)	0 (0.0)
Montgomery County, MD		x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		0 (0.0)	0 (0.0)	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	r	2 (0.1)	0 (0.0)	44 (3.4)	52 (3.4)	2 (0.6)	0 (0.0)
Rochester City Sch. Dist., NY	r	0 (0.0)	0 (0.0)	51 (4.9)	49 (4.9)	0 (0.0)	0 (0.0)
SW Math/Sci. Collaborative, PA		1 (1.2)	0 (0.3)	43 (6.4)	49 (7.5)	6 (5.1)	0 (0.0)
International Avg. (All Countries)		9 (0.4)	4 (0.3)	22 (0.6)	44 (0.8)	6 (0.4)	15 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Categories of topic coverage for scientific inquiry and the nature of science are based on combined responses to questions about the individual science subtopics in the content area described in Exhibit 5.25.

[1] For each topic in Exhibit 5.25, teachers were asked if the topic was taught before this year, taught 1-5 periods this year, taught more than 5 periods this year, or not yet taught. Topics taught during this year are included in this category regardless if taught before this year.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

REFERENCE 3

Teachers and Instruction

Exhibit R3.1 Teachers' Confidence in Their Preparation to Teach Science Topics

	Percentage of Students Whose Teachers Report Feeling Very Well Prepared to Teach Topic¹					
	Earth science – earth's features and physical processes	Earth science – the solar system and the universe	Biology – structure and function of human systems	Biology – diversity, structure, and processes of plant and animal life	Chemistry – classification and structure of matter	Chemistry – chemical reactivity and transformation
Countries						
United States	r 61 (3.0)	r 56 (3.4)	r 65 (2.5)	r 62 (3.0)	r 58 (3.4)	r 42 (4.1)
Belgium (Flemish)	r 64 (4.5)	r 30 (4.9)	r 79 (2.9)	65 (3.9)	s 58 (5.7)	s 37 (5.9)
Canada	r 41 (3.4)	r 30 (3.6)	r 59 (3.4)	r 60 (3.0)	s 48 (3.7)	s 36 (3.9)
Chinese Taipei	17 (3.9)	16 (3.6)	10 (3.6)	12 (4.0)	64 (4.3)	66 (4.4)
Czech Republic	70 (3.4)	68 (3.6)	77 (3.1)	74 (3.8)	69 (3.7)	68 (3.5)
England	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	8 (2.7)	9 (2.6)	44 (4.2)	38 (4.5)	35 (4.8)	36 (4.1)
Italy	29 (3.6)	33 (3.8)	67 (3.6)	63 (3.7)	49 (3.6)	36 (4.0)
Japan	12 (2.8)	11 (2.8)	19 (3.5)	16 (3.1)	25 (3.5)	31 (3.6)
Korea, Rep. of	26 (3.7)	22 (3.3)	42 (3.6)	34 (3.7)	40 (4.0)	45 (3.6)
Netherlands	r 54 (4.1)	r 43 (4.5)	r 59 (3.8)	r 56 (3.9)	r 41 (4.2)	r 35 (3.9)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	13 (3.3)	11 (3.2)	56 (4.6)	52 (4.6)	63 (3.5)	57 (4.1)
States						
Connecticut	s 70 (7.1)	s 48 (9.7)	s 64 (7.5)	s 55 (7.4)	s 75 (6.1)	s 55 (9.1)
Idaho	r 51 (5.8)	r 49 (8.0)	r 59 (7.4)	r 57 (7.3)	r 51 (4.1)	r 35 (6.7)
Illinois	53 (6.2)	44 (6.9)	73 (5.9)	71 (6.1)	58 (5.4)	51 (5.3)
Indiana	61 (6.3)	61 (8.9)	73 (6.1)	65 (7.4)	70 (6.9)	54 (7.6)
Maryland	r 61 (5.7)	r 55 (5.8)	r 67 (5.1)	r 67 (5.5)	r 67 (5.8)	r 48 (5.9)
Massachusetts	64 (6.4)	54 (5.9)	68 (6.4)	65 (6.5)	69 (5.8)	47 (6.6)
Michigan	r 58 (7.3)	r 45 (6.8)	r 72 (6.7)	r 68 (6.1)	r 63 (6.8)	r 44 (8.8)
Missouri	71 (5.8)	64 (6.9)	76 (4.8)	66 (6.3)	50 (5.5)	27 (5.6)
North Carolina	60 (5.0)	47 (5.5)	r 55 (6.2)	51 (5.6)	55 (5.9)	43 (5.6)
Oregon	83 (4.6)	70 (5.2)	66 (7.1)	71 (7.0)	52 (6.3)	38 (7.2)
Pennsylvania	54 (5.3)	49 (5.3)	52 (8.8)	52 (5.0)	52 (6.2)	38 (6.6)
South Carolina	72 (6.3)	76 (5.5)	65 (6.0)	61 (6.9)	49 (6.6)	31 (6.4)
Texas	r 85 (4.8)	r 72 (5.2)	r 70 (6.6)	r 64 (6.6)	r 48 (7.0)	r 35 (6.7)
Districts and Consortia						
Academy School Dist. #20, CO	56 (0.5)	66 (0.5)	80 (0.3)	80 (0.3)	68 (0.4)	60 (0.4)
Chicago Public Schools, IL	50 (8.8)	50 (12.8)	60 (9.8)	r 58 (9.8)	49 (9.4)	41 (9.3)
Delaware Science Coalition, DE	r 63 (5.0)	r 60 (4.9)	r 53 (4.6)	r 47 (6.8)	r 57 (5.7)	r 33 (7.1)
First in the World Consort., IL	45 (7.5)	27 (5.1)	94 (4.3)	85 (7.2)	81 (3.3)	62 (8.0)
Fremont/Lincoln/WestSide PS, NE	50(10.3)	63 (8.3)	77 (3.1)	83 (4.0)	55 (3.6)	47 (4.6)
Guilford County, NC	61 (7.2)	41 (5.2)	50 (5.3)	55 (5.8)	61 (5.7)	47 (7.1)
Jersey City Public Schools, NJ	r 58 (2.9)	r 49 (3.0)	r 61 (3.1)	r 64 (2.9)	r 43 (2.8)	r 17 (3.4)
Miami-Dade County PS, FL	s 54(10.3)	s 46 (8.9)	s 68 (8.8)	s 57 (8.3)	s 62 (7.4)	s 50 (8.5)
Michigan Invitational Group, MI	77 (5.1)	61 (6.2)	57 (7.7)	62 (7.0)	65 (2.9)	58 (3.6)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	41 (2.5)	24 (3.0)	67 (3.9)	65 (2.8)	82 (1.7)	48 (4.8)
Project SMART Consortium, OH	79 (3.7)	64 (4.5)	60 (4.1)	60 (2.7)	73 (4.5)	52 (4.7)
Rochester City Sch. Dist., NY	r 25 (7.5)	r 23 (5.7)	85 (4.4)	78 (4.8)	59 (5.7)	26 (5.7)
SW Math/Sci. Collaborative, PA	73 (6.6)	61 (8.9)	51 (6.7)	56 (6.0)	63 (8.3)	46 (7.4)
International Avg. (All Countries)	36 (0.6)	32 (0.6)	60 (0.6)	55 (0.6)	51 (0.7)	46 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

[1] Does not include students whose teachers report that they do not teach the topic.

[2] Percentage of students averaged across topics.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.1 (Continued) Teachers' Confidence in Their Preparation to Teach Science Topics

8th Grade Science

	Percentage of Students Whose Teachers Report Feeling Very Well Prepared to Teach Topic¹				
	Physics – types of energy, sources of energy, conversion between energy types	Physics – light	Environmental and resources issues	Scientific methods and inquiry skills	Average²
Countries					
United States	r 55 (4.2)	r 40 (3.6)	r 56 (3.8)	86 (2.2)	58 (1.5)
Belgium (Flemish)	r 33 (4.1)	r 63 (5.6)	28 (2.6)	30 (3.2)	47 (2.1)
Canada	r 48 (3.8)	s 34 (3.4)	r 45 (3.7)	58 (3.0)	44 (1.7)
Chinese Taipei	70 (3.8)	58 (4.1)	20 (3.6)	21 (3.6)	42 (2.6)
Czech Republic	64 (3.2)	r 60 (3.7)	66 (2.8)	12 (2.0)	64 (2.0)
England	– –	– –	– –	– –	– –
Hong Kong, SAR	47 (4.7)	33 (4.5)	30 (4.1)	36 (4.3)	34 (2.4)
Italy	40 (3.5)	31 (3.5)	48 (4.3)	32 (3.8)	42 (2.1)
Japan	17 (2.9)	11 (3.0)	17 (3.4)	11 (3.0)	17 (1.7)
Korea, Rep. of	35 (3.6)	17 (3.1)	22 (3.3)	21 (3.0)	31 (1.9)
Netherlands	r 54 (3.0)	r 57 (3.5)	49 (3.6)	41 (4.5)	50 (1.7)
Russian Federation	– –	– –	– –	– –	– –
Singapore	58 (4.0)	57 (3.9)	30 (4.0)	35 (4.5)	46 (2.4)
States					
Connecticut	s 63 (7.6)	s 50 (7.0)	s 60 (8.2)	89 (4.0)	64 (3.6)
Idaho	r 60 (7.3)	r 41 (8.7)	r 44 (5.5)	66 (4.6)	53 (3.8)
Illinois	46 (7.0)	39 (7.3)	58 (6.5)	84 (2.6)	58 (2.6)
Indiana	58 (8.0)	52 (7.8)	50 (6.5)	90 (3.3)	65 (3.0)
Maryland	r 53 (5.2)	r 51 (5.9)	r 60 (7.1)	87 (3.4)	62 (3.4)
Massachusetts	55 (6.8)	43 (5.8)	60 (4.7)	91 (2.5)	61 (2.1)
Michigan	62 (6.1)	50 (5.5)	47 (6.3)	74 (5.7)	58 (3.0)
Missouri	41 (5.9)	33 (6.1)	60 (7.3)	81 (5.6)	57 (2.6)
North Carolina	47 (7.9)	38 (6.0)	67 (6.5)	76 (5.6)	53 (4.0)
Oregon	51 (6.5)	35 (6.5)	65 (7.0)	85 (4.5)	62 (3.3)
Pennsylvania	37 (5.2)	32 (5.2)	53 (5.8)	79 (6.8)	52 (3.4)
South Carolina	36 (6.6)	36 (7.2)	61 (6.0)	86 (4.9)	57 (3.3)
Texas	r 47 (7.8)	r 24 (4.8)	r 60 (5.5)	88 (4.8)	60 (3.5)
Districts and Consortia					
Academy School Dist. #20, CO	82 (0.4)	37 (0.4)	63 (0.5)	75 (0.3)	69 (0.1)
Chicago Public Schools, IL	48 (12.8)	26 (8.0)	33 (10.8)	74 (11.6)	49 (6.3)
Delaware Science Coalition, DE	r 28 (5.2)	r 26 (5.1)	r 50 (8.6)	69 (5.5)	49 (2.9)
First in the World Consort., IL	58 (8.8)	50 (6.7)	72 (5.7)	83 (7.5)	69 (3.7)
Fremont/Lincoln/WestSide PS, NE	51 (6.4)	40 (9.3)	41 (6.3)	88 (2.6)	59 (2.5)
Guilford County, NC	51 (5.8)	31 (4.4)	67 (4.9)	75 (5.1)	54 (3.3)
Jersey City Public Schools, NJ	r 39 (2.8)	r 32 (2.9)	r 51 (2.6)	68 (2.5)	46 (2.6)
Miami-Dade County PS, FL	s 63 (8.4)	s 52 (7.8)	s 69 (8.7)	82 (5.8)	60 (4.4)
Michigan Invitational Group, MI	58 (4.1)	31 (3.9)	47 (6.5)	83 (4.8)	62 (3.4)
Montgomery County, MD	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	93 (1.6)	63 (4.2)	46 (3.7)	98 (0.3)	64 (1.6)
Project SMART Consortium, OH	72 (3.7)	60 (5.7)	50 (5.6)	84 (4.2)	67 (2.1)
Rochester City Sch. Dist., NY	62 (4.9)	32 (6.1)	56 (5.9)	78 (3.9)	57 (4.1)
SW Math/Sci. Collaborative, PA	54 (7.5)	25 (7.2)	52 (5.9)	84 (5.6)	56 (3.4)
International Avg. (All Countries)	50 (0.6)	45 (0.6)	39 (0.6)	34 (0.6)	46 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

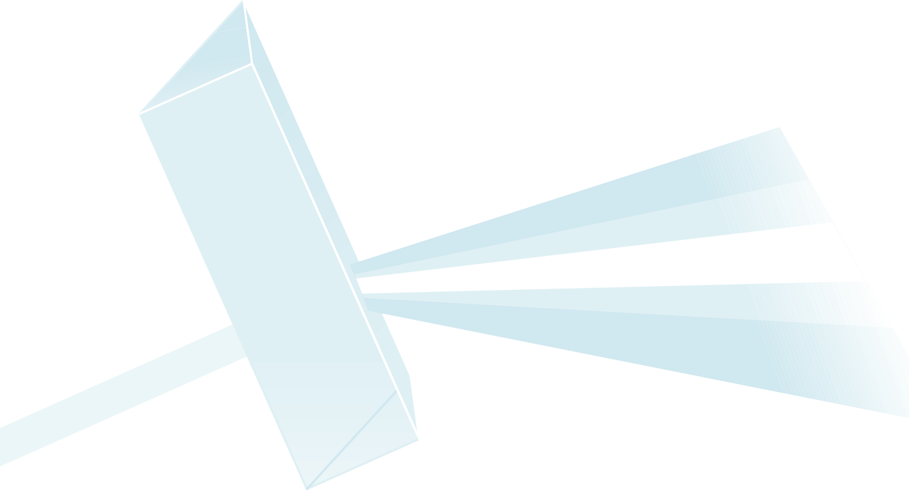


Exhibit R3.2 Shortages of Teachers Qualified to Teach the Sciences Affecting Capacity to Provide Instruction*

8th Grade Science

Percentage of Students Whose Schools Report That Shortages Affect Instructional Capacity Some or A Lot

Participants with General/ Integrated Science		
Countries		
United States	r	16 (2.5)
Canada		19 (2.1)
Chinese Taipei [a]		21 (3.4)
England	r	5 (2.1)
Hong Kong, SAR		13 (2.7)
Italy		26 (3.6)
Japan		17 (3.3)
Korea, Rep. of		32 (3.9)
Singapore		17 (3.2)
States		
Connecticut	s	10 (5.0)
Idaho	r	4 (2.3)
Illinois		9 (3.8)
Indiana		10 (6.7)
Maryland	r	23 (5.8)
Massachusetts	s	5 (4.1)
Michigan		10 (4.6)
Missouri		15 (5.8)
North Carolina	r	24 (6.8)
Oregon		8 (4.2)
Pennsylvania		5 (2.9)
South Carolina		22 (6.7)
Texas	r	27 (9.3)
Districts and Consortia		
Academy School Dist. #20, CO		0 (0.0)
Chicago Public Schools, IL	s	26 (10.2)
Delaware Science Coalition, DE	r	20 (2.3)
First in the World Consort., IL	r	0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r	0 (0.0)
Guilford County, NC	r	32 (1.0)
Jersey City Public Schools, NJ		29 (1.8)
Miami-Dade County PS, FL		x x
Michigan Invitational Group, MI		40 (1.6)
Montgomery County, MD	s	19 (10.8)
Naperville Sch. Dist. #203, IL		0 (0.0)
Project SMART Consortium, OH		19 (0.8)
Rochester City Sch. Dist., NY	r	19 (1.3)
SW Math/Sci. Collaborative, PA		4 (3.1)
International Avg. (All General Science Countries)		35 (0.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries with Separate Science Subjects								
		Earth Science		Biology		Physics		Chemistry
Belgium (Flemish)		4 (1.5)		7 (3.3)		4 (1.6)		– –
Czech Republic		12 (3.8)		9 (3.1)		9 (2.7)		6 (2.6)
Netherlands	r	5 (1.6)	r	12 (5.8)	r	24 (6.5)	r	22 (6.6)
Russian Federation		42 (3.5)		40 (3.6)		39 (3.7)		40 (4.0)
International Avg. (All Separate Science Countries)		25 (0.9)		26 (0.9)		28 (0.9)		27 (1.0)

Background data provided by schools.

* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

[a] Chinese Taipei: Data pertain to teachers of grade 8 physics/chemistry course.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

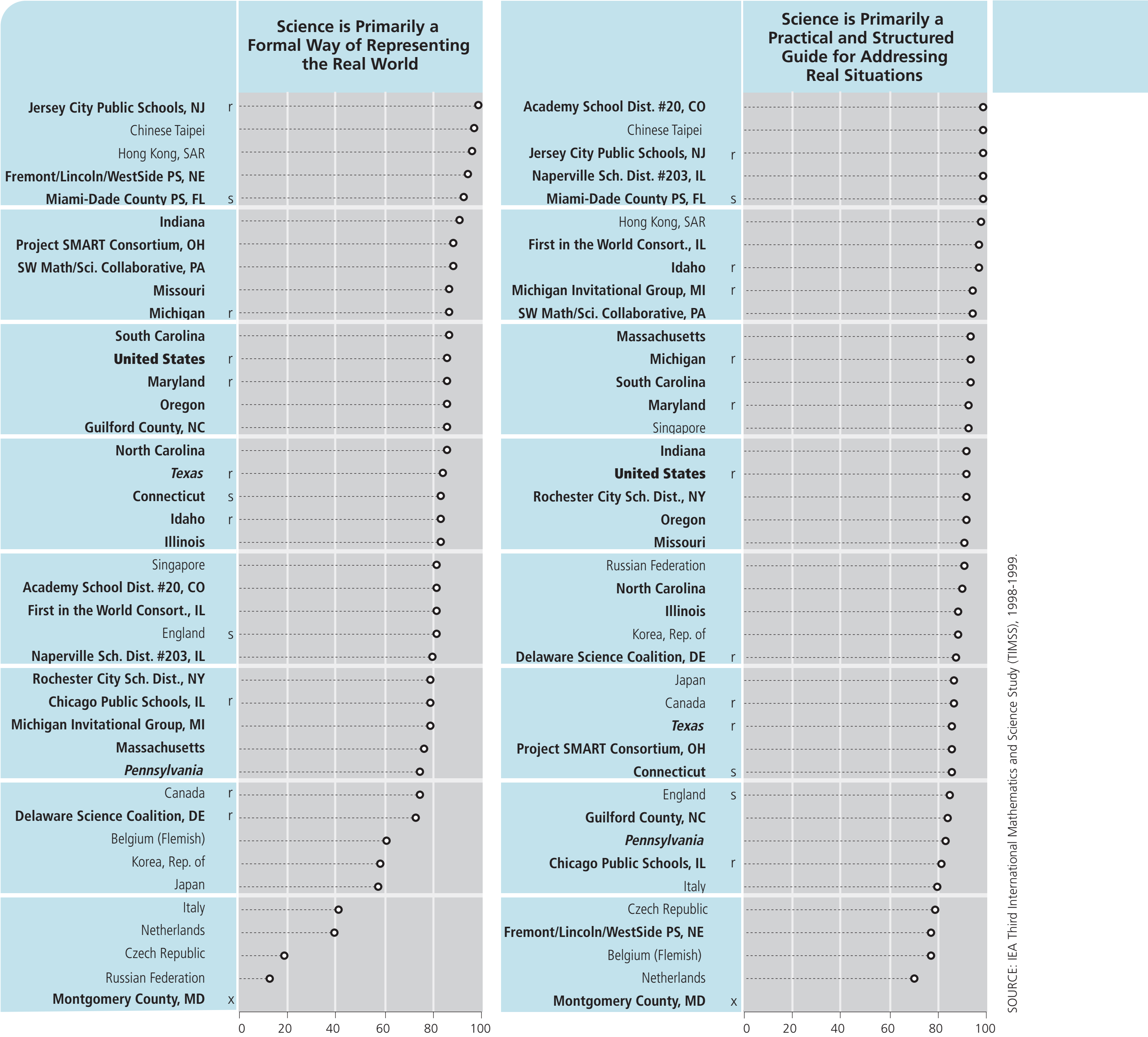
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An “r” indicates school response data available for 70-84% of students. An “s” indicates school response data available for 50-60% of students. An “x” indicates school response data available for <50% of students.

Exhibit R3.3 Percentage of Students Whose Science Teachers Agree or Strongly Agree with Statements About the Nature of Science and Science Teaching

8th Grade Science



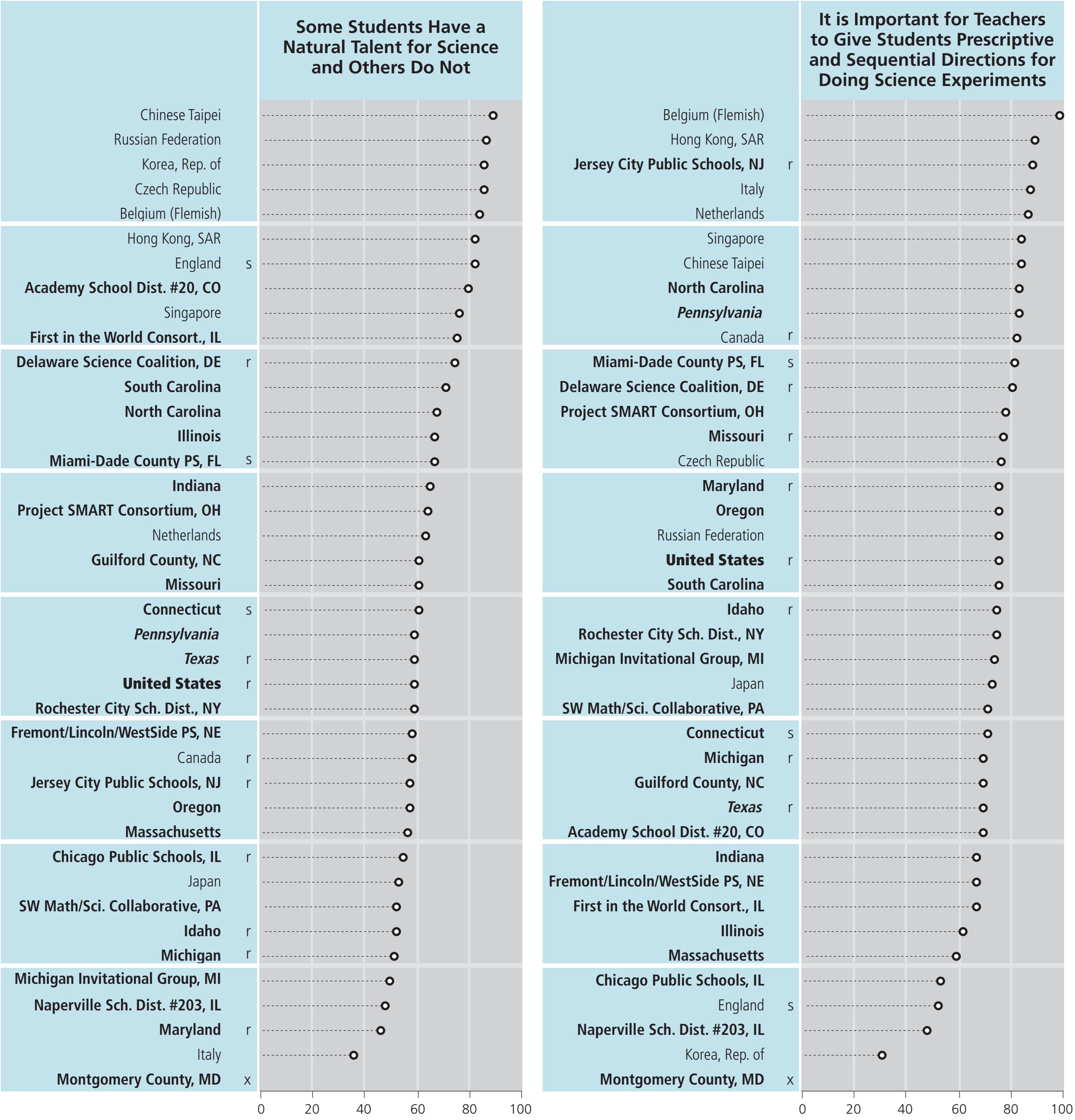
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

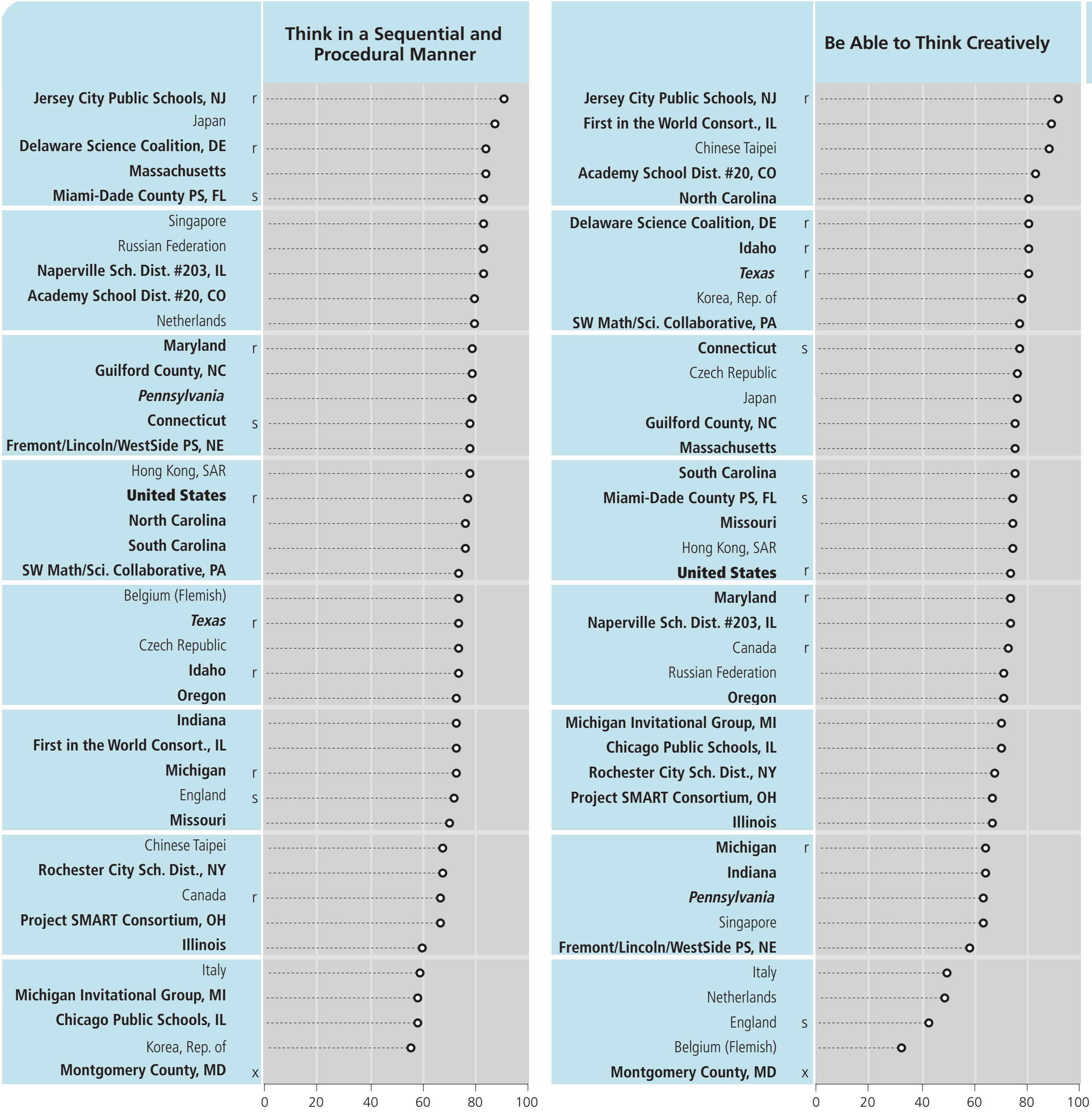
Exhibit R3.3 (Continued) Percentage of Students Whose Science Teachers Agree or Strongly Agree with Statements About the Nature of Science and Science Teaching



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit R3.4 Percentage of Students Whose Science Teachers Think Particular Abilities Are Very Important for Students' Success in Science in School

8th Grade Science



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

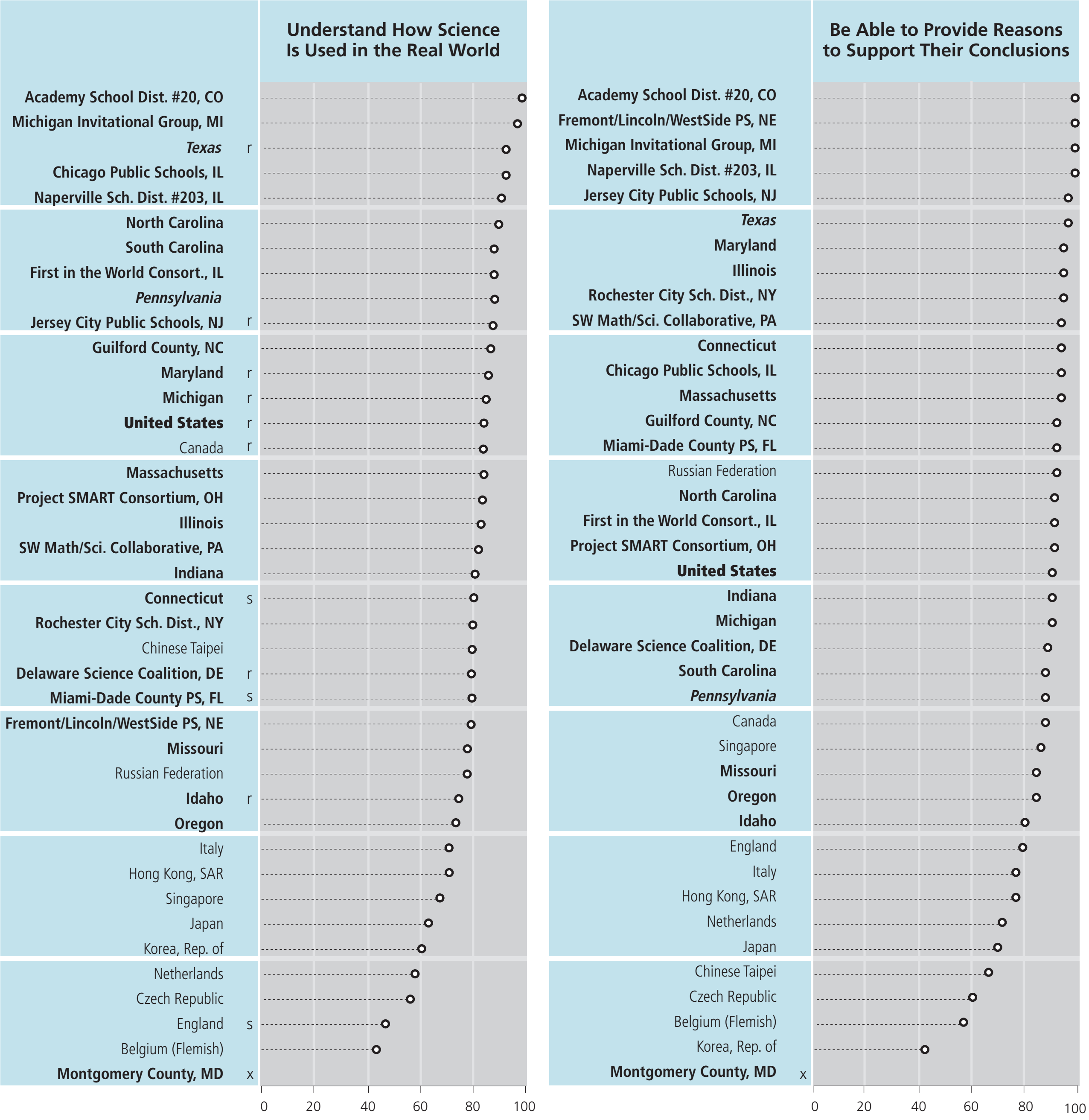
Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.4
(Continued)

Percentage of Students Whose Science Teachers Think Particular Abilities Are Very Important for Students' Success in Science in School



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit R3.5 How Teachers Spend Their Formally Scheduled School Time

8th Grade Science

	Percentage of Formally Scheduled School Time Averaged Across Students				
	Teaching Science, Mathematics, and Other Subjects	Teaching Science[1]	Curriculum Planning[2]	Administrative Duties	Other Activities[3]
Countries					
United States	r 74 (1.0)	r 62 (1.7)	r 13 (0.7)	r 2 (0.3)	r 12 (0.9)
Belgium (Flemish)	86 (1.1)	64 (2.2)	3 (0.4)	1 (0.3)	10 (0.7)
Canada	79 (1.0)	41 (1.6)	8 (0.5)	1 (0.3)	12 (0.7)
Chinese Taipei	59 (2.3)	58 (2.4)	10 (1.0)	5 (1.0)	26 (1.7)
Czech Republic	68 (1.6)	41 (1.2)	13 (1.1)	3 (0.3)	16 (0.6)
England	s 89 (1.0)	s 84 (1.1)	s 1 (0.4)	s 3 (0.6)	s 8 (0.8)
Hong Kong, SAR	x x	x x	x x	x x	x x
Italy	87 (1.1)	31 (0.7)	7 (0.8)	0 (0.1)	6 (0.6)
Japan	65 (1.9)	58 (2.0)	9 (1.0)	4 (0.4)	22 (1.3)
Korea, Rep. of	48 (1.3)	47 (1.3)	15 (0.6)	13 (0.6)	24 (1.0)
Netherlands [4]	r 87 (0.7)	r 75 (2.1)	– –	– –	r 13 (0.7)
Russian Federation [5]	– –	– –	– –	– –	– –
Singapore	75 (0.9)	65 (1.2)	– –	3 (0.4)	22 (0.8)
States					
Connecticut	s 68 (2.5)	s 61 (3.0)	s 15 (2.4)	s 3 (0.9)	s 14 (1.7)
Idaho	r 77 (1.9)	s 67 (2.8)	r 15 (1.6)	r 2 (0.9)	r 8 (1.3)
Illinois	72 (2.0)	57 (2.1)	13 (1.2)	2 (1.3)	13 (1.8)
Indiana	r 71 (3.0)	r 59 (4.4)	r 15 (1.2)	r 1 (0.4)	r 13 (3.2)
Maryland	r 70 (2.0)	s 66 (2.2)	r 19 (1.3)	r 2 (0.5)	r 9 (1.2)
Massachusetts	73 (1.3)	r 66 (2.0)	15 (1.5)	2 (0.5)	10 (1.1)
Michigan	r 73 (2.5)	r 54 (2.4)	r 16 (2.1)	r 2 (0.7)	r 9 (1.4)
Missouri	74 (2.2)	r 65 (2.5)	13 (1.6)	1 (0.5)	12 (1.4)
North Carolina	63 (2.4)	r 50 (3.2)	20 (1.6)	2 (0.6)	15 (1.9)
Oregon	78 (1.9)	r 63 (2.6)	13 (1.3)	1 (0.4)	8 (1.1)
Pennsylvania	73 (1.8)	r 63 (5.2)	8 (0.9)	2 (0.5)	17 (1.7)
South Carolina	64 (2.3)	r 55 (3.0)	20 (1.6)	1 (0.3)	15 (1.7)
Texas	r 70 (2.5)	r 63 (3.1)	r 15 (1.7)	r 2 (0.6)	r 14 (1.8)
Districts and Consortia					
Academy School Dist. #20, CO	64 (0.1)	r 51 (0.1)	25 (0.1)	0 (0.0)	11 (0.1)
Chicago Public Schools, IL	79 (2.6)	r 52 (5.3)	r 9 (1.6)	2 (0.8)	11 (2.4)
Delaware Science Coalition, DE	r 71 (1.9)	s 55 (1.9)	r 17 (1.2)	r 0 (0.3)	r 12 (1.8)
First in the World Consort., IL	73 (0.9)	r 65 (2.5)	18 (1.0)	0 (0.2)	10 (0.9)
Fremont/Lincoln/WestSide PS, NE	70 (1.0)	67 (1.0)	22 (1.9)	r 0 (0.0)	8 (2.0)
Guilford County, NC	55 (1.9)	47 (1.9)	25 (1.6)	r 5 (1.1)	15 (1.4)
Jersey City Public Schools, NJ	r 77 (1.0)	s 66 (2.2)	r 15 (0.8)	s 1 (0.0)	r 7 (0.4)
Miami-Dade County PS, FL	s 72 (5.7)	s 59 (5.6)	s 11 (2.1)	s 2 (1.2)	s 15 (3.5)
Michigan Invitational Group, MI	78 (0.8)	62 (0.9)	10 (0.5)	0 (0.2)	12 (0.9)
Montgomery County, MD	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	61 (0.8)	52 (0.9)	20 (0.8)	2 (0.2)	17 (0.4)
Project SMART Consortium, OH	71 (1.3)	r 68 (1.3)	17 (0.6)	1 (0.1)	11 (1.3)
Rochester City Sch. Dist., NY	r 66 (1.0)	r 59 (2.5)	r 20 (0.9)	r 5 (0.6)	r 10 (1.1)
SW Math/Sci. Collaborative, PA	72 (2.3)	64 (2.8)	9 (1.1)	2 (0.4)	17 (2.0)
International Avg. (All Countries)	71 (0.2)	58 (0.3)	10 (0.1)	4 (0.1)	17 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

[1] Reflects total hours reported teaching general/integrated science, physical science, earth science, life science, biology, chemistry, and physics.

[2] Includes individual curriculum planning and cooperative curriculum planning.

[3] Includes student supervision (other than teaching), student counseling/appraisal, other non-student contact time, and other activities.

[4] Netherlands: Data in other activities category reflects the total reported for curriculum planning, administrative duties, and other activities.

[5] Russian Federation: Formally scheduled school time is for instruction only; teachers are not formally scheduled for other activities.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

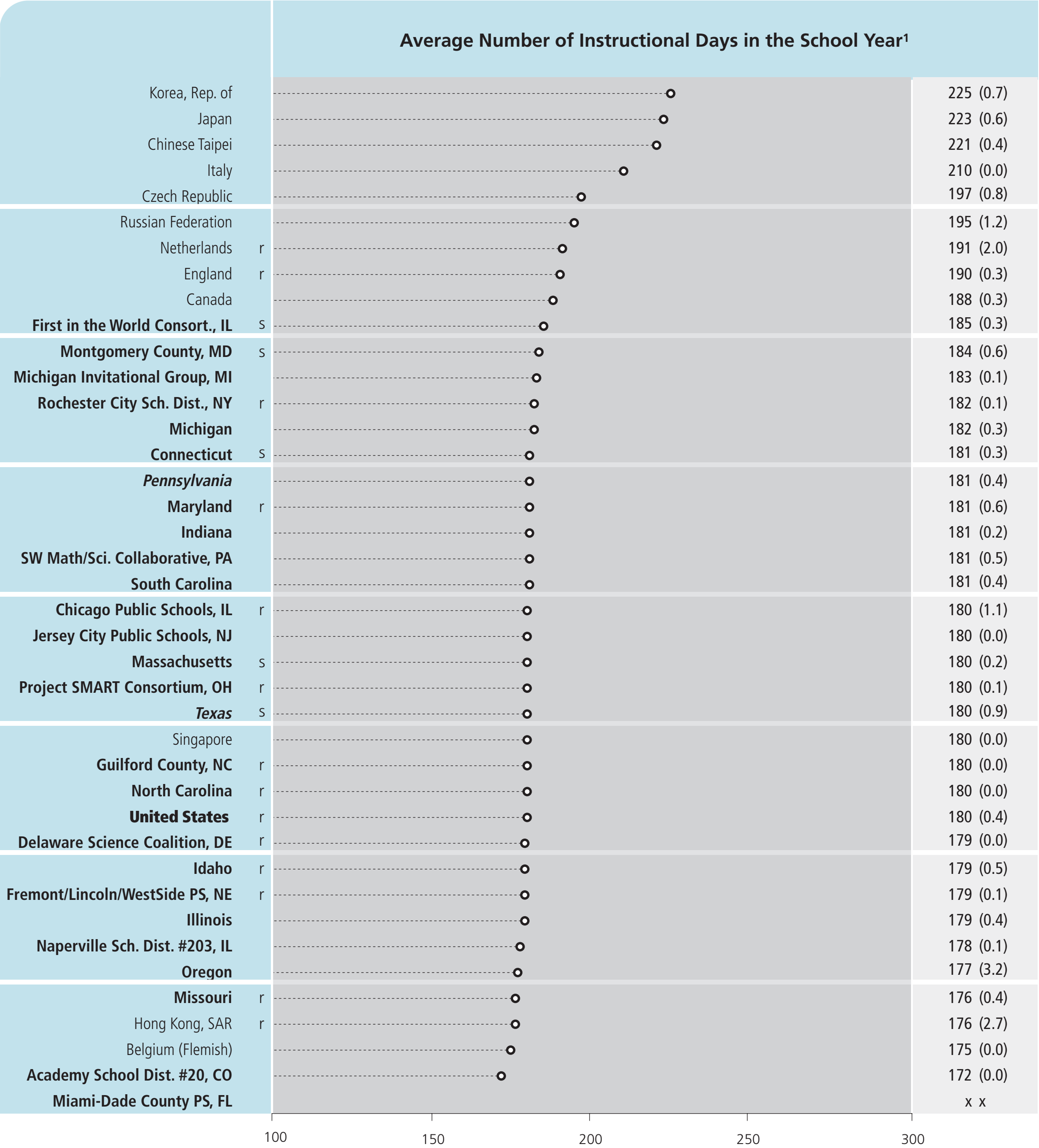
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.6 Average Number of Instructional Days in the School Year

8th Grade Science



Average Number of Instructional Days in the School Year[1]

Korea, Rep. of		225 (0.7)
Japan		223 (0.6)
Chinese Taipei		221 (0.4)
Italy		210 (0.0)
Czech Republic		197 (0.8)
Russian Federation		195 (1.2)
Netherlands	r	191 (2.0)
England	r	190 (0.3)
Canada		188 (0.3)
First in the World Consort., IL	s	185 (0.3)
Montgomery County, MD	s	184 (0.6)
Michigan Invitational Group, MI		183 (0.1)
Rochester City Sch. Dist., NY	r	182 (0.1)
Michigan		182 (0.3)
Connecticut	s	181 (0.3)
Pennsylvania		181 (0.4)
Maryland	r	181 (0.6)
Indiana		181 (0.2)
SW Math/Sci. Collaborative, PA		181 (0.5)
South Carolina		181 (0.4)
Chicago Public Schools, IL	r	180 (1.1)
Jersey City Public Schools, NJ		180 (0.0)
Massachusetts	s	180 (0.2)
Project SMART Consortium, OH	r	180 (0.1)
Texas	s	180 (0.9)
Singapore		180 (0.0)
Guilford County, NC	r	180 (0.0)
North Carolina	r	180 (0.0)
United States	r	180 (0.4)
Delaware Science Coalition, DE	r	179 (0.0)
Idaho	r	179 (0.5)
Fremont/Lincoln/WestSide PS, NE	r	179 (0.1)
Illinois		179 (0.4)
Naperville Sch. Dist. #203, IL		178 (0.1)
Oregon		177 (3.2)
Missouri	r	176 (0.4)
Hong Kong, SAR	r	176 (2.7)
Belgium (Flemish)		175 (0.0)
Academy School Dist. #20, CO		172 (0.0)
Miami-Dade County PS, FL		x x

International Avg. (All Countries)	193 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

[1] Days reported averaged across students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit R3.7 Asking Students to Do Problem-Solving Activities During Science Lessons

8th Grade Science

	Percentage of Students Whose Teachers Report Most or Every Lesson				
	Explain Reasoning Behind an Idea	Represent and Analyze Relationships Using Tables, Charts, or Graphs	Work on Problems for Which There Is No Immediately Obvious Method of Solution	Write Explanations About What Was Observed and Why it Happened	Put Events or Objects in Order and Give a Reason for the Organization
Countries					
United States	r 80 (3.2)	r 40 (3.1)	r 18 (2.3)	r 59 (3.3)	r 40 (3.3)
Belgium (Flemish)	53 (3.4)	37 (2.6)	r 6 (1.5)	12 (2.0)	9 (1.7)
Canada	r 85 (2.5)	r 35 (3.3)	r 17 (3.1)	r 78 (2.4)	r 36 (3.7)
Chinese Taipei	42 (3.6)	35 (3.7)	14 (2.9)	57 (4.4)	34 (3.7)
Czech Republic	89 (2.0)	17 (1.9)	10 (1.9)	32 (2.9)	32 (2.8)
England	s 64 (4.8)	s 24 (3.7)	s 3 (1.2)	s 67 (4.6)	s 21 (3.7)
Hong Kong, SAR	50 (4.6)	22 (4.0)	10 (2.6)	34 (4.2)	23 (3.5)
Italy	88 (2.4)	44 (3.6)	25 (3.4)	46 (4.1)	43 (4.1)
Japan	69 (4.1)	60 (4.0)	32 (4.0)	57 (4.0)	48 (4.2)
Korea, Rep. of	58 (4.0)	47 (4.0)	16 (2.9)	50 (3.6)	17 (3.0)
Netherlands	57 (3.7)	15 (2.5)	18 (2.8)	34 (4.7)	20 (2.5)
Russian Federation	55 (2.2)	35 (1.8)	10 (1.6)	36 (1.9)	71 (2.2)
Singapore	63 (4.3)	13 (2.8)	8 (1.9)	44 (4.7)	30 (4.1)
States					
Connecticut	s 82 (5.0)	s 41 (8.8)	s 24 (6.4)	s 69 (6.6)	s 34 (7.3)
Idaho	r 73 (5.0)	r 36 (6.0)	r 12 (4.8)	r 47 (7.3)	r 25 (5.6)
Illinois	76 (4.6)	37 (6.7)	21 (6.0)	51 (6.8)	31 (6.8)
Indiana	86 (3.3)	30 (5.6)	36 (6.0)	69 (6.7)	37 (7.7)
Maryland	r 85 (3.9)	s 60 (5.5)	s 29 (5.3)	s 79 (5.3)	s 40 (5.5)
Massachusetts	84 (4.2)	49 (6.3)	24 (4.7)	r 68 (4.9)	r 36 (5.3)
Michigan	r 81 (5.4)	r 46 (6.5)	r 18 (4.8)	r 63 (6.2)	r 36 (6.1)
Missouri	r 81 (4.7)	r 43 (5.8)	r 24 (5.6)	r 54 (6.5)	r 39 (4.8)
North Carolina	81 (5.9)	38 (7.0)	24 (5.2)	64 (4.9)	45 (4.7)
Oregon	76 (6.1)	45 (6.5)	21 (6.0)	56 (6.6)	35 (5.3)
Pennsylvania	77 (6.4)	38 (8.5)	9 (2.5)	51 (8.5)	33 (8.1)
South Carolina	81 (5.6)	65 (4.3)	21 (4.5)	51 (6.6)	36 (5.6)
Texas	r 81 (4.8)	r 64 (5.3)	r 27 (6.7)	r 69 (5.3)	r 59 (6.9)
Districts and Consortia					
Academy School Dist. #20, CO	92 (0.1)	56 (0.4)	26 (0.3)	92 (0.1)	36 (0.3)
Chicago Public Schools, IL	r 81 (8.5)	r 30 (10.7)	r 6 (3.6)	r 62 (10.5)	r 35 (11.7)
Delaware Science Coalition, DE	r 86 (6.1)	r 24 (3.4)	r 18 (5.2)	r 49 (8.5)	r 33 (6.8)
First in the World Consort., IL	82 (2.5)	33 (3.3)	36 (6.3)	69 (3.8)	35 (6.0)
Fremont/Lincoln/WestSide PS, NE	71 (7.6)	56 (3.7)	15 (6.9)	62 (7.0)	19 (8.5)
Guilford County, NC	91 (2.6)	62 (4.3)	47 (5.9)	61 (5.2)	35 (5.0)
Jersey City Public Schools, NJ	r 79 (2.0)	r 57 (4.3)	r 24 (6.7)	r 71 (6.3)	r 40 (4.9)
Miami-Dade County PS, FL	s 82 (8.5)	s 40 (9.2)	s 13 (4.6)	s 79 (5.9)	s 48 (8.4)
Michigan Invitational Group, MI	67 (1.9)	33 (4.5)	7 (0.7)	55 (6.1)	29 (5.5)
Montgomery County, MD	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	79 (1.0)	29 (1.9)	98 (0.6)	44 (4.2)
Project SMART Consortium, OH	r 70 (3.5)	r 46 (4.0)	r 18 (3.5)	r 50 (3.1)	r 28 (4.2)
Rochester City Sch. Dist., NY	r 94 (3.7)	r 26 (5.5)	r 10 (3.7)	r 69 (4.8)	r 16 (3.8)
SW Math/Sci. Collaborative, PA	85 (5.2)	27 (5.0)	23 (7.3)	48 (8.0)	28 (5.5)
International Avg. (All Countries)	68 (0.6)	35 (0.5)	15 (0.4)	52 (0.6)	42 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.8 Teachers Demonstrating an Experiment in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often

Participants with General/ Integrated Science	
Countries	
United States	71 (1.1)
Canada	77 (1.2)
Chinese Taipei [a]	70 (1.3)
England	91 (0.9)
Hong Kong, SAR	88 (0.9)
Italy	29 (1.6)
Japan	75 (1.5)
Korea, Rep. of	53 (1.7)
Singapore	88 (1.0)
States	
Connecticut	78 (2.6)
Idaho	74 (2.3)
Illinois	73 (2.1)
Indiana	73 (1.9)
Maryland	79 (1.6)
Massachusetts	76 (2.2)
Michigan	75 (2.0)
Missouri	67 (3.0)
North Carolina	73 (2.2)
Oregon	78 (1.8)
Pennsylvania	69 (3.0)
South Carolina	73 (2.6)
Texas	73 (2.3)
Districts and Consortia	
Academy School Dist. #20, CO	84 (1.0)
Chicago Public Schools, IL	60 (3.8)
Delaware Science Coalition, DE	71 (2.6)
First in the World Consort., IL	87 (1.5)
Fremont/Lincoln/WestSide PS, NE	76 (1.9)
Guilford County, NC	75 (2.1)
Jersey City Public Schools, NJ	71 (1.7)
Miami-Dade County PS, FL	75 (3.2)
Michigan Invitational Group, MI	74 (1.5)
Montgomery County, MD	76 (2.1)
Naperville Sch. Dist. #203, IL	81 (1.0)
Project SMART Consortium, OH	75 (1.5)
Rochester City Sch. Dist., NY	s 83 (2.5)
SW Math/Sci. Collaborative, PA	69 (3.2)
International Avg. (All General Science Countries)	71 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries with Separate Science Subjects	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	13 (1.0)	71 (1.5)	81 (2.3)	– –
Czech Republic	6 (0.8)	24 (1.8)	53 (2.3)	76 (1.9)
Netherlands [b]	7 (0.9)	32 (2.8)	56 (2.7)	– –
Russian Federation	17 (1.1)	37 (1.7)	69 (1.7)	75 (1.6)
International Avg. (All Separate Science Countries)	19 (0.3)	42 (0.4)	61 (0.5)	68 (0.5)

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit R3.9 Students Doing an Experiment or Practical Investigation in Science Classes*

8th Grade Science

Percentage of Students Reporting Almost Always or Pretty Often

Participants with General/ Integrated Science		
Countries		
United States		65 (1.5)
Canada		69 (1.4)
Chinese Taipei [a]		57 (1.6)
England		89 (1.1)
Hong Kong, SAR		77 (1.2)
Italy		18 (1.1)
Japan		79 (1.7)
Korea, Rep. of		46 (1.5)
Singapore		65 (1.4)
States		
Connecticut		75 (2.9)
Idaho		60 (3.1)
Illinois		64 (2.9)
Indiana		66 (2.5)
Maryland		77 (1.8)
Massachusetts		70 (2.8)
Michigan		72 (2.3)
Missouri		60 (2.7)
North Carolina		64 (2.7)
Oregon		73 (2.4)
Pennsylvania		61 (3.1)
South Carolina		63 (3.1)
Texas		62 (2.5)
Districts and Consortia		
Academy School Dist. #20, CO		87 (0.9)
Chicago Public Schools, IL		44 (4.5)
Delaware Science Coalition, DE		65 (2.5)
First in the World Consort., IL		86 (2.6)
Fremont/Lincoln/WestSide PS, NE		78 (2.0)
Guilford County, NC		65 (2.4)
Jersey City Public Schools, NJ		55 (1.9)
Miami-Dade County PS, FL		66 (3.3)
Michigan Invitational Group, MI		73 (1.0)
Montgomery County, MD		75 (2.5)
Naperville Sch. Dist. #203, IL		89 (1.1)
Project SMART Consortium, OH		68 (1.5)
Rochester City Sch. Dist., NY	s	77 (2.7)
SW Math/Sci. Collaborative, PA		58 (3.8)
International Avg. (All General Science Countries)		57 (0.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Countries with Separate Science Subjects	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	8 (0.7)	36 (1.6)	61 (3.1)	– –
Czech Republic	5 (0.5)	25 (2.0)	31 (2.2)	39 (2.4)
Netherlands [b]	5 (0.8)	20 (2.2)	41 (2.9)	– –
Russian Federation	13 (0.9)	20 (1.0)	41 (1.6)	41 (1.8)
International Avg. (All Separate Science Countries)	15 (0.3)	27 (0.4)	39 (0.5)	39 (0.5)

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit R3.10 Students Using Things from Everyday Life in Solving Science Problems*

Percentage of Students Reporting Almost Always or Pretty Often

Participants with General/ Integrated Science	
Countries	
United States	50 (1.0)
Canada	51 (0.9)
Chinese Taipei [a]	66 (1.2)
England	51 (1.2)
Hong Kong, SAR	63 (1.0)
Italy	31 (1.1)
Japan	21 (1.1)
Korea, Rep. of	39 (1.1)
Singapore	64 (1.2)
States	
Connecticut	51 (1.9)
Idaho	49 (1.7)
Illinois	50 (1.8)
Indiana	47 (1.9)
Maryland	52 (1.3)
Massachusetts	48 (1.5)
Michigan	49 (1.8)
Missouri	49 (2.0)
North Carolina	56 (1.6)
Oregon	48 (1.8)
Pennsylvania	44 (1.9)
South Carolina	51 (1.9)
Texas	47 (1.7)
Districts and Consortia	
Academy School Dist. #20, CO	50 (1.4)
Chicago Public Schools, IL	51 (2.6)
Delaware Science Coalition, DE	49 (2.1)
First in the World Consort., IL	49 (2.0)
Fremont/Lincoln/WestSide PS, NE	53 (2.1)
Guilford County, NC	52 (1.4)
Jersey City Public Schools, NJ	59 (2.0)
Miami-Dade County PS, FL	64 (2.0)
Michigan Invitational Group, MI	48 (1.8)
Montgomery County, MD	48 (1.8)
Naperville Sch. Dist. #203, IL	60 (1.4)
Project SMART Consortium, OH	50 (1.7)
Rochester City Sch. Dist., NY	s 65 (2.7)
SW Math/Sci. Collaborative, PA	45 (2.2)
International Avg. (All General Science Countries)	49 (0.2)

	Countries with Separate Science Subjects			
	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	29 (0.9)	35 (1.1)	40 (1.8)	– –
Czech Republic	31 (1.4)	37 (1.5)	39 (1.7)	31 (1.4)
Netherlands [b]	33 (1.7)	42 (2.0)	31 (1.6)	– –
Russian Federation	39 (1.7)	43 (1.3)	41 (1.1)	37 (1.4)
International Avg. (All Science Separate Countries)	34 (0.4)	41 (0.4)	42 (0.4)	38 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

Exhibit R3.11 Amount of Science Homework

8th Grade Science

		Percentage of Students Taught by Teachers						
		Assigning Homework Three Times a Week or More Often		**Assigning Homework Once or Twice a Week**		**Assigning Homework Less Than Once a Week**		**Never Assigning Homework**
		30 Minutes or Less	More Than 30 Minutes	30 Minutes or Less	More Than 30 Minutes	30 Minutes or Less	More Than 30 Minutes	
Countries								
United States	r	35 (3.8)	8 (1.4)	32 (3.5)	11 (2.0)	10 (2.1)	2 (0.7)	3 (1.6)
Belgium (Flemish)		0 (0.0)	0 (0.0)	7 (2.0)	1 (0.6)	68 (3.5)	10 (2.1)	14 (2.4)
Canada		19 (2.7)	6 (2.1)	50 (3.5)	8 (1.8)	14 (2.6)	3 (1.4)	0 (0.3)
Chinese Taipei		8 (2.4)	7 (2.2)	42 (4.3)	19 (3.2)	20 (3.3)	4 (1.6)	0 (0.0)
Czech Republic		0 (0.2)	0 (0.0)	20 (2.4)	0 (0.3)	74 (2.5)	1 (0.5)	5 (0.9)
England		3 (1.7)	0 (0.0)	51 (4.3)	37 (4.1)	7 (2.1)	1 (0.8)	0 (0.0)
Hong Kong, SAR	r	1 (0.8)	1 (0.0)	53 (4.3)	13 (2.8)	19 (3.6)	13 (2.9)	1 (0.0)
Italy		3 (1.4)	8 (2.3)	28 (3.0)	50 (3.4)	8 (1.8)	3 (1.3)	0 (0.4)
Japan	s	2 (1.1)	1 (1.0)	10 (2.6)	3 (1.3)	43 (4.2)	23 (3.6)	20 (3.4)
Korea, Rep. of		9 (2.5)	1 (1.0)	27 (3.6)	6 (2.0)	37 (3.8)	16 (2.7)	3 (0.8)
Netherlands		6 (1.8)	2 (1.1)	72 (3.2)	4 (1.1)	15 (3.4)	1 (0.4)	1 (0.7)
Russian Federation		12 (1.4)	6 (0.9)	53 (2.5)	26 (2.4)	3 (0.8)	0 (0.2)	0 (0.2)
Singapore		9 (2.6)	5 (1.4)	44 (4.0)	30 (4.1)	11 (2.4)	2 (1.1)	1 (0.6)
States								
Connecticut		66 (6.8)	13 (4.6)	16 (4.8)	2 (0.3)	1 (0.8)	1 (0.1)	0 (0.0)
Idaho		22 (5.6)	1 (0.7)	29 (5.3)	9 (2.5)	32 (7.3)	1 (0.1)	6 (3.7)
Illinois		38 (6.8)	8 (3.2)	33 (7.4)	7 (2.4)	14 (4.4)	1 (0.6)	0 (0.0)
Indiana		39 (8.2)	3 (1.7)	35 (7.3)	7 (2.5)	13 (5.1)	2 (1.9)	1 (1.2)
Maryland		47 (6.0)	5 (0.9)	35 (4.9)	6 (2.3)	6 (2.0)	0 (0.0)	1 (0.9)
Massachusetts		59 (5.7)	18 (3.9)	20 (5.1)	3 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
Michigan		32 (6.0)	4 (1.8)	41 (5.5)	10 (3.0)	9 (3.6)	3 (2.6)	1 (0.9)
Missouri		27 (5.5)	3 (2.3)	39 (6.9)	10 (3.2)	16 (3.7)	3 (1.7)	1 (1.3)
North Carolina		44 (6.6)	4 (2.0)	33 (5.2)	3 (2.1)	14 (3.2)	3 (2.2)	0 (0.0)
Oregon		11 (3.9)	1 (0.0)	47 (7.1)	18 (5.5)	15 (5.1)	6 (2.9)	3 (2.9)
Pennsylvania		39 (5.6)	6 (3.7)	32 (4.6)	11 (3.7)	10 (3.4)	1 (0.7)	0 (0.3)
South Carolina		36 (7.7)	4 (2.5)	44 (6.8)	2 (1.0)	8 (2.6)	3 (1.6)	3 (1.8)
Texas		10 (2.9)	3 (2.3)	41 (6.7)	14 (4.1)	23 (6.7)	5 (2.5)	4 (1.4)
Districts and Consortia								
Academy School Dist. #20, CO		16 (0.2)	24 (0.3)	33 (0.4)	26 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL		45 (13.0)	19 (9.2)	17 (7.3)	19 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)
Delaware Science Coalition, DE		43 (6.7)	0 (0.0)	41 (6.1)	4 (3.6)	11 (5.2)	0 (0.0)	0 (0.0)
First in the World Consort., IL		67 (7.3)	4 (3.5)	17 (5.7)	0 (0.0)	10 (1.6)	1 (0.1)	0 (0.0)
Fremont/Lincoln/WestSide PS, NE		18 (3.3)	3 (3.0)	29 (8.2)	4 (3.7)	39 (4.6)	0 (0.0)	7 (7.0)
Guilford County, NC		27 (5.2)	0 (0.0)	54 (5.1)	5 (1.8)	13 (3.7)	0 (0.0)	0 (0.0)
Jersey City Public Schools, NJ		43 (4.6)	15 (3.2)	34 (4.6)	4 (0.5)	3 (0.3)	0 (0.0)	0 (0.0)
Miami-Dade County PS, FL		40 (10.5)	15 (5.2)	27 (9.0)	12 (4.7)	4 (3.7)	1 (0.1)	0 (0.0)
Michigan Invitational Group, MI		39 (6.2)	6 (1.1)	33 (6.9)	22 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)
Montgomery County, MD		x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		79 (2.9)	17 (2.8)	4 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH		31 (4.0)	1 (0.9)	34 (3.2)	21 (3.3)	13 (2.9)	0 (0.0)	0 (0.0)
Rochester City Sch. Dist., NY		16 (4.3)	18 (3.4)	24 (5.3)	25 (5.0)	17 (5.5)	0 (0.0)	0 (0.0)
SW Math/Sci. Collaborative, PA		30 (7.2)	4 (2.3)	43 (6.2)	5 (3.0)	14 (5.1)	3 (1.2)	2 (1.3)
International Avg. (All Countries)		15 (0.4)	5 (0.3)	37 (0.6)	15 (0.4)	20 (0.4)	5 (0.3)	3 (0.2)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.12 Assigning Science Homework Based on Projects and Investigations*

		Sometimes or Always		Never or Rarely	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement
Countries					
United States	r	58 (3.4)	521 (6.6)	42 (3.4)	519 (5.3)
Belgium (Flemish)	r	11 (2.5)	534 (10.5)	89 (2.5)	537 (4.4)
Canada	r	56 (3.4)	532 (3.5)	44 (3.4)	538 (4.6)
Chinese Taipei		6 (2.1)	566 (14.4)	94 (2.1)	569 (4.5)
Czech Republic		12 (1.8)	550 (10.0)	88 (1.8)	540 (4.1)
England	s	24 (4.2)	563 (14.3)	76 (4.2)	542 (6.0)
Hong Kong, SAR		10 (2.6)	551 (8.1)	90 (2.6)	527 (4.2)
Italy		44 (4.1)	493 (5.4)	56 (4.1)	493 (5.3)
Japan	r	4 (1.9)	558 (9.0)	96 (1.9)	550 (2.2)
Korea, Rep. of		35 (4.0)	552 (3.7)	65 (4.0)	547 (3.4)
Netherlands		27 (2.9)	549 (7.2)	73 (2.9)	544 (8.9)
Russian Federation		29 (2.0)	538 (12.8)	71 (2.0)	526 (5.3)
Singapore		38 (4.3)	575 (11.0)	62 (4.3)	563 (10.0)
States					
Connecticut	s	63 (6.0)	531 (14.2)	37 (6.0)	540 (10.6)
Idaho	s	51 (4.9)	531 (7.0)	49 (4.9)	523 (9.8)
Illinois		45 (7.9)	522 (9.3)	55 (7.9)	530 (7.2)
Indiana	r	69 (5.9)	537 (8.2)	31 (5.9)	537 (10.8)
Maryland	s	61 (5.9)	505 (9.4)	39 (5.9)	503 (12.3)
Massachusetts	r	55 (5.3)	521 (9.8)	45 (5.3)	554 (8.8)
Michigan	r	53 (6.5)	564 (7.1)	47 (6.5)	544 (10.7)
Missouri	r	54 (4.5)	523 (12.1)	46 (4.5)	528 (5.4)
North Carolina		60 (3.7)	509 (10.2)	40 (3.7)	502 (7.9)
Oregon		68 (6.0)	544 (6.8)	32 (6.0)	532 (10.8)
Pennsylvania		52 (6.6)	532 (9.1)	48 (6.6)	526 (6.5)
South Carolina		59 (6.3)	516 (8.7)	41 (6.3)	510 (9.7)
Texas	s	62 (7.6)	535 (10.1)	38 (7.6)	478 (16.8)
Districts and Consortia					
Academy School Dist. #20, CO		69 (0.6)	561 (2.6)	31 (0.6)	555 (3.5)
Chicago Public Schools, IL	r	50 (10.7)	451 (19.4)	50 (10.7)	456 (12.2)
Delaware Science Coalition, DE	s	37 (5.6)	499 (17.4)	63 (5.6)	501 (13.1)
First in the World Consort., IL		78 (3.4)	559 (6.4)	22 (3.4)	581 (9.2)
Fremont/Lincoln/WestSide PS, NE	r	63 (7.1)	508 (12.7)	37 (7.1)	520 (8.0)
Guilford County, NC		68 (5.1)	548 (9.0)	32 (5.1)	503 (17.9)
Jersey City Public Schools, NJ	r	81 (1.9)	451 (10.1)	19 (1.9)	439 (7.7)
Miami-Dade County PS, FL	s	81 (5.9)	421 (11.5)	19 (5.9)	472 (13.7)
Michigan Invitational Group, MI		48 (3.1)	561 (6.7)	52 (3.1)	568 (9.7)
Montgomery County, MD		x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		92 (0.8)	582 (4.6)	8 (0.8)	610 (13.0)
Project SMART Consortium, OH	r	44 (4.0)	526 (12.0)	56 (4.0)	546 (11.5)
Rochester City Sch. Dist., NY	r	18 (4.7)	463 (11.5)	82 (4.7)	447 (10.4)
SW Math/Sci. Collaborative, PA		61 (8.0)	542 (8.5)	39 (8.0)	548 (12.9)
International Avg. (All Countries)		34 (0.6)	491 (1.4)	66 (0.6)	485 (1.0)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by teachers.

* Based on average response to questions about assigning homework based on small investigation(s) or gathering data, working individually on long term projects or experiments, and working as a small group on long term projects or experiments.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

Exhibit R3.13 Frequency of Having a Quiz or Test in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often

Participants with General/Integrated Science

Countries	
United States	77 (1.2)
Canada	62 (1.8)
Chinese Taipei [a]	74 (1.3)
England	63 (1.7)
Hong Kong, SAR	36 (1.8)
Italy	35 (1.4)
Japan	29 (1.8)
Korea, Rep. of	27 (1.7)
Singapore	64 (1.3)
States	
Connecticut	78 (1.8)
Idaho	79 (2.2)
Illinois	76 (2.7)
Indiana	74 (2.3)
Maryland	70 (2.0)
Massachusetts	80 (1.5)
Michigan	73 (3.0)
Missouri	79 (1.4)
North Carolina	85 (1.9)
Oregon	70 (2.3)
Pennsylvania	75 (2.3)
South Carolina	85 (1.6)
Texas	77 (1.9)
Districts and Consortia	
Academy School Dist. #20, CO	73 (1.2)
Chicago Public Schools, IL	78 (3.7)
Delaware Science Coalition, DE	73 (2.8)
First in the World Consort., IL	76 (2.1)
Fremont/Lincoln/WestSide PS, NE	69 (3.0)
Guilford County, NC	82 (2.4)
Jersey City Public Schools, NJ	75 (2.0)
Miami-Dade County PS, FL	76 (2.1)
Michigan Invitational Group, MI	77 (1.7)
Montgomery County, MD	58 (3.1)
Naperville Sch. Dist. #203, IL	85 (0.6)
Project SMART Consortium, OH	77 (1.6)
Rochester City Sch. Dist., NY	s 81 (1.7)
SW Math/Sci. Collaborative, PA	74 (1.4)
International Avg. (All General Science Countries)	58 (0.3)

Countries with Separate Science Subjects

	Earth Science	Biology	Physics	Chemistry
Belgium (Flemish)	45 (1.9)	55 (1.5)	58 (2.4)	– –
Czech Republic	37 (2.2)	40 (2.1)	38 (1.7)	45 (2.2)
Netherlands [b]	49 (2.7)	56 (3.1)	51 (2.7)	– –
Russian Federation	65 (1.2)	66 (1.5)	75 (1.1)	77 (1.2)
International Avg. (All Separate Science Countries)	46 (0.5)	49 (0.5)	51 (0.4)	52 (0.5)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by students.

* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

[a] Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.

[b] Netherlands: Data for physics/chemistry teachers are reported in the physics panel.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates data are not available.

An "s" indicates a 50-69% student response rate.

REFERENCE 4

School Contexts for Learning and Instruction

Exhibit R4.1

Shortages or Inadequacies in General Facilities and Materials That Affect Schools' Capacity to Provide Science Instruction Some or A Lot

8th Grade Science

	Percentage of Students Affected by Shortage or Inadequacy				
	Instuctional Materials	Budget for Supplies	School Buildings/ Grounds	Heating/Cooling and Lighting	Instructional Space
Countries					
United States	r 22 (2.9)	r 27 (4.1)	r 33 (3.4)	r 17 (3.5)	r 33 (3.4)
Belgium (Flemish)	6 (2.2)	5 (2.1)	20 (3.3)	4 (1.8)	20 (4.2)
Canada	45 (2.8)	43 (2.8)	29 (2.8)	11 (1.9)	25 (2.4)
Chinese Taipei	45 (4.4)	45 (4.0)	59 (4.1)	41 (3.9)	51 (4.0)
Czech Republic	22 (5.0)	52 (5.5)	15 (3.3)	5 (1.4)	11 (3.3)
England	r 37 (4.9)	r 31 (4.5)	r 42 (5.3)	r 17 (3.6)	r 38 (5.1)
Hong Kong, SAR	35 (3.9)	21 (3.9)	57 (4.8)	24 (3.4)	57 (4.6)
Italy	28 (3.5)	28 (3.6)	31 (3.7)	15 (2.7)	35 (3.4)
Japan	17 (2.9)	14 (3.0)	29 (3.8)	31 (3.5)	34 (3.5)
Korea, Rep. of	37 (3.9)	29 (4.0)	51 (4.5)	52 (4.2)	55 (4.2)
Netherlands	r 10 (4.0)	r 19 (6.4)	r 45 (7.0)	r 9 (2.8)	r 26 (5.3)
Russian Federation	92 (2.4)	81 (3.1)	73 (3.6)	63 (4.4)	69 (3.2)
Singapore	10 (2.2)	7 (2.0)	23 (2.6)	11 (2.4)	26 (3.3)
States					
Connecticut	s 15 (5.4)	s 18 (7.2)	s 23 (8.0)	s 9 (5.0)	s 28 (8.3)
Idaho	r 15 (6.5)	r 34 (9.4)	r 24 (5.3)	r 23 (4.7)	r 29 (8.1)
Illinois	15 (5.1)	19 (5.0)	16 (5.4)	12 (4.6)	31 (7.2)
Indiana	17 (6.8)	17 (5.2)	20 (6.2)	15 (5.2)	33 (7.8)
Maryland	r 36 (6.8)	r 27 (6.8)	r 29 (6.9)	r 27 (5.9)	r 41 (5.8)
Massachusetts	s 26 (6.6)	s 18 (6.4)	s 38 (6.9)	s 17 (6.0)	s 26 (7.5)
Michigan	14 (4.1)	20 (4.9)	27 (7.5)	10 (4.3)	36 (7.4)
Missouri	23 (7.3)	24 (7.3)	26 (6.2)	18 (5.0)	40 (6.7)
North Carolina	r 35 (7.3)	r 37 (7.6)	r 40 (7.8)	r 23 (7.5)	r 48 (8.3)
Oregon	56 (6.9)	57 (7.3)	42 (6.9)	22 (7.6)	56 (7.5)
Pennsylvania	7 (2.8)	8 (3.5)	24 (8.3)	15 (5.3)	27 (7.7)
South Carolina	14 (6.0)	r 26 (7.1)	39 (8.4)	21 (7.2)	50 (9.3)
Texas	r 10 (5.9)	r 18 (7.0)	r 29 (7.4)	r 16 (7.1)	r 33 (8.6)
Districts and Consortia					
Academy School Dist. #20, CO	0 (0.0)	25 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	s 13 (7.5)	s 27 (12.5)	s 34 (11.5)	s 32 (11.8)	s 29 (12.5)
Delaware Science Coalition, DE	r 31 (2.1)	r 36 (2.1)	r 27 (1.7)	r 26 (1.9)	r 28 (2.3)
First in the World Consort., IL	r 13 (0.4)	r 11 (0.4)	r 19 (0.8)	r 0 (0.0)	r 28 (0.9)
Fremont/Lincoln/WestSide PS, NE	r 33 (1.5)	r 49 (1.6)	r 39 (1.5)	r 49 (1.6)	r 57 (1.7)
Guilford County, NC	s 0 (0.0)	s 0 (0.0)	s 30 (1.0)	r 43 (1.1)	r 36 (1.0)
Jersey City Public Schools, NJ	11 (0.7)	9 (0.7)	43 (1.4)	16 (0.8)	r 65 (1.7)
Miami-Dade County PS, FL	s 17 (9.6)	s 25 (12.0)	s 53 (14.8)	s 3 (2.9)	s 59 (11.5)
Michigan Invitational Group, MI	30 (1.3)	30 (1.3)	38 (1.7)	22 (1.0)	49 (1.6)
Montgomery County, MD	s 18 (10.2)	s 5 (5.4)	s 25 (12.0)	s 23 (9.1)	s 53 (8.9)
Naperville Sch. Dist. #203, IL	24 (1.5)	24 (1.5)	24 (1.5)	0 (0.0)	45 (1.5)
Project SMART Consortium, OH	22 (0.8)	r 24 (1.4)	r 29 (1.4)	22 (0.9)	29 (1.3)
Rochester City Sch. Dist., NY	r 41 (1.5)	r 41 (1.5)	r 0 (0.0)	r 16 (0.5)	r 16 (0.5)
SW Math/Sci. Collaborative, PA	18 (7.4)	13 (5.8)	18 (7.3)	17 (7.1)	23 (7.3)
International Avg. (All Countries)	45 (0.6)	47 (0.6)	50 (0.7)	36 (0.6)	47 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students.

Exhibit R4.2

Shortages or Inadequacies in Equipment and Materials for Science Instruction That Affect Schools' Capacity to Provide Science Instruction Some or A Lot

8th Grade Science

	Percentage of Students Affected by Shortage or Inadequacy					
	Science Laboratory Equipment and Materials	Computers for Science Instruction	Computer Software for Science Instruction	Calculators for Science Instruction	Library Materials Relevant to Science Instruction	Audio-Visual Resources for Science Instruction
Countries						
United States	r 38 (4.2)	r 45 (4.1)	r 47 (4.1)	r 29 (3.8)	r 29 (3.9)	r 30 (4.0)
Belgium (Flemish)	14 (3.5)	29 (4.5)	30 (4.6)	4 (1.4)	9 (2.4)	11 (3.8)
Canada	37 (3.2)	49 (2.8)	54 (2.9)	27 (2.5)	39 (2.9)	33 (3.4)
Chinese Taipei	56 (4.1)	62 (4.1)	68 (4.2)	50 (4.4)	56 (4.5)	58 (4.5)
Czech Republic	27 (5.0)	37 (5.1)	40 (5.2)	8 (3.0)	13 (3.2)	13 (3.3)
England	r 41 (4.7)	r 54 (4.9)	r 53 (5.1)	r 26 (4.1)	r 30 (4.4)	r 26 (4.2)
Hong Kong, SAR	36 (4.5)	65 (4.3)	71 (4.1)	20 (3.6)	32 (4.3)	43 (4.7)
Italy	54 (3.6)	38 (3.8)	51 (4.0)	16 (2.8)	39 (3.9)	41 (3.4)
Japan	42 (4.1)	36 (4.3)	43 (4.4)	9 (2.5)	23 (3.7)	36 (3.8)
Korea, Rep. of	60 (4.1)	65 (4.1)	77 (3.7)	43 (4.2)	62 (4.1)	68 (3.9)
Netherlands	r 24 (5.5)	r 43 (6.7)	r 46 (7.4)	r 4 (1.7)	r 20 (4.7)	r 16 (4.6)
Russian Federation	93 (1.9)	87 (3.0)	85 (3.6)	61 (4.1)	81 (3.2)	84 (4.0)
Singapore	11 (2.8)	32 (3.8)	37 (4.2)	6 (1.8)	14 (2.8)	17 (3.1)
States						
Connecticut	s 28 (8.3)	s 37 (7.2)	s 32 (7.3)	s 11 (5.1)	s 28 (8.7)	s 20 (6.5)
Idaho	r 54 (7.8)	r 59 (8.4)	r 66 (8.3)	r 22 (7.7)	r 29 (7.4)	r 34 (7.7)
Illinois	22 (5.8)	32 (6.1)	35 (6.7)	10 (4.2)	18 (5.5)	18 (5.6)
Indiana	33 (7.2)	38 (8.1)	32 (8.1)	18 (7.4)	29 (7.4)	28 (7.2)
Maryland	r 39 (6.1)	r 55 (7.5)	r 57 (7.3)	r 43 (7.1)	r 34 (7.6)	r 35 (7.0)
Massachusetts	s 24 (6.6)	s 49 (8.5)	s 49 (7.0)	s 23 (8.2)	s 24 (7.6)	s 19 (6.7)
Michigan	34 (5.7)	48 (6.2)	51 (7.1)	16 (5.6)	19 (5.6)	24 (6.8)
Missouri	45 (6.9)	56 (7.1)	57 (7.4)	44 (7.4)	30 (7.3)	33 (7.4)
North Carolina	r 56 (7.4)	r 59 (7.6)	r 70 (6.3)	r 47 (8.0)	r 51 (7.7)	r 53 (8.2)
Oregon	52 (6.5)	60 (6.4)	65 (6.9)	40 (8.1)	35 (7.9)	29 (7.0)
Pennsylvania	36 (6.7)	39 (6.8)	39 (6.9)	27 (7.9)	26 (7.1)	29 (7.5)
South Carolina	41 (7.5)	49 (9.6)	r 53 (8.8)	40 (7.7)	47 (8.6)	r 35 (8.5)
Texas	r 33 (7.7)	r 51 (8.5)	r 50 (9.4)	r 30 (7.6)	r 19 (7.3)	r 22 (8.3)
Districts and Consortia						
Academy School Dist. #20, CO	0 (0.0)	0 (0.0)	17 (0.4)	17 (0.4)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	s 54 (14.2)	s 48 (12.7)	s 68 (11.8)	s 37 (13.9)	s 44 (14.5)	s 45 (13.9)
Delaware Science Coalition, DE	r 50 (2.0)	r 63 (1.9)	r 64 (2.1)	r 35 (1.8)	r 39 (2.1)	r 41 (2.1)
First in the World Consort., IL	r 0 (0.0)	r 8 (1.1)	r 8 (1.1)	s 9 (1.2)	r 8 (1.1)	r 0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r 43 (1.6)	r 35 (1.5)	r 49 (1.6)	r 49 (1.6)	r 22 (1.4)	r 35 (1.5)
Guilford County, NC	r 35 (1.0)	r 47 (1.2)	r 47 (1.2)	r 22 (0.8)	r 20 (0.7)	r 20 (0.7)
Jersey City Public Schools, NJ	42 (1.6)	51 (1.4)	47 (1.5)	24 (1.9)	36 (1.2)	30 (1.2)
Miami-Dade County PS, FL	s 37 (13.8)	s 24 (12.9)	x x	x x	x x	x x
Michigan Invitational Group, MI	35 (1.6)	22 (1.3)	26 (1.3)	28 (1.4)	21 (1.4)	24 (1.3)
Montgomery County, MD	s 30 (14.3)	s 23 (13.1)	s 13 (9.3)	s 23 (13.1)	s 0 (0.0)	s 0 (0.0)
Naperville Sch. Dist. #203, IL	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	38 (1.4)	54 (1.4)	49 (1.4)	20 (1.1)	23 (1.2)	28 (1.2)
Rochester City Sch. Dist., NY	r 35 (1.4)	r 60 (1.6)	r 60 (1.6)	r 35 (1.4)	r 35 (1.4)	r 35 (1.4)
SW Math/Sci. Collaborative, PA	17 (7.0)	36 (6.9)	34 (8.5)	21 (6.7)	14 (4.8)	16 (4.5)
International Avg. (All Countries)	58 (0.6)	59 (0.7)	60 (0.7)	35 (0.6)	50 (0.6)	53 (0.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit R4.3 Availability of Computers for Instructional Purposes

8th Grade Science

		Percentage of Students by Number of Students per Computer[1]				Percentage of Students in Schools Without Any Computers
		Fewer than 15 Students per Computer	15-30 Students per Computer	31-50 Students per Computer	More than 50 Students per Computer	
Countries						
United States	s	97 (1.8)	3 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
Belgium (Flemish)	r	83 (3.0)	9 (2.2)	1 (0.8)	4 (1.7)	4 (1.6)
Canada		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chinese Taipei		90 (2.5)	9 (2.6)	1 (0.8)	0 (0.0)	0 (0.0)
Czech Republic		89 (3.0)	2 (1.4)	5 (2.4)	0 (0.0)	3 (1.2)
England	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Hong Kong, SAR	r	86 (3.3)	3 (1.5)	4 (1.8)	3 (1.3)	5 (2.2)
Italy		64 (3.4)	19 (2.9)	7 (2.2)	3 (1.3)	6 (1.6)
Japan		92 (2.7)	5 (1.8)	0 (0.0)	0 (0.0)	3 (1.9)
Korea, Rep. of		75 (3.6)	14 (3.2)	6 (1.8)	5 (1.8)	1 (0.0)
Netherlands	s	99 (1.0)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)
Russian Federation		37 (4.9)	6 (2.0)	1 (0.0)	3 (1.5)	53 (4.8)
Singapore		98 (1.3)	2 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)
States						
Connecticut		x x	x x	x x	x x	x x
Idaho	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Illinois	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Indiana		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Maryland	s	97 (3.2)	3 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)
Massachusetts	s	94 (3.9)	6 (3.9)	0 (0.0)	0 (0.0)	0 (0.0)
Michigan	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Missouri	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
North Carolina	r	97 (2.6)	3 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)
Oregon	r	98 (2.0)	0 (0.0)	0 (0.0)	2 (2.0)	0 (0.0)
Pennsylvania	r	91 (5.6)	2 (0.3)	0 (0.3)	0 (0.0)	6 (5.2)
South Carolina	r	97 (2.6)	3 (2.6)	0 (0.0)	0 (0.0)	0 (0.0)
Texas	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Districts and Consortia						
Academy School Dist. #20, CO	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL		x x	x x	x x	x x	x x
Delaware Science Coalition, DE	s	97 (0.2)	3 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)
First in the World Consort., IL	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Fremont/Lincoln/WestSide PS, NE	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Guilford County, NC	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Jersey City Public Schools, NJ	r	90 (0.3)	10 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)
Miami-Dade County PS, FL		x x	x x	x x	x x	x x
Michigan Invitational Group, MI	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Montgomery County, MD		x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Rochester City Sch. Dist., NY	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
SW Math/Sci. Collaborative, PA	r	99 (1.5)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)
International Avg. (All Countries)		60 (0.4)	6 (0.3)	3 (0.2)	6 (0.3)	25 (0.4)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

[1] Based on ratio of grade 8 enrollment to total computers for instructional use by grade 8 teachers and students.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.

Exhibit R4.4 Schools' Access to the Internet

		Percentage of Students by Level of Access			
		Access to World Wide Web (with or without e-mail)	Access to E-mail Only	No Internet Access but Planning to Get Internet Access by 2001	No Access and No Immediate Plans to Obtain Access
Countries					
United States	r	91 (3.1)	0 (0.0)	9 (2.8)	0 (0.0)
Belgium (Flemish)		73 (4.0)	1 (0.7)	24 (3.9)	2 (1.2)
Canada		96 (1.2)	1 (0.5)	3 (1.0)	0 (0.3)
Chinese Taipei		89 (2.8)	5 (1.9)	6 (2.0)	0 (0.0)
Czech Republic		34 (5.1)	2 (1.7)	45 (5.4)	19 (3.8)
England	r	86 (3.4)	1 (0.1)	13 (3.3)	0 (0.0)
Hong Kong, SAR	r	85 (3.7)	0 (0.0)	15 (3.7)	0 (0.0)
Italy		41 (4.2)	4 (1.6)	54 (4.2)	2 (1.2)
Japan		29 (3.9)	2 (1.1)	29 (4.0)	41 (4.2)
Korea, Rep. of		48 (4.4)	0 (0.0)	46 (4.3)	6 (1.9)
Netherlands	r	81 (7.1)	3 (1.9)	15 (7.0)	1 (0.7)
Russian Federation		5 (1.4)	0 (0.0)	16 (2.8)	79 (2.4)
Singapore		89 (3.0)	1 (0.9)	10 (2.8)	0 (0.0)
States					
Connecticut	s	99 (1.5)	0 (0.0)	1 (0.2)	0 (0.0)
Idaho	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Illinois		92 (2.6)	0 (0.0)	8 (2.6)	0 (0.0)
Indiana		86 (6.6)	0 (0.0)	8 (3.0)	6 (0.3)
Maryland	r	95 (3.5)	0 (0.0)	5 (3.5)	0 (0.0)
Massachusetts	s	90 (5.7)	0 (0.0)	10 (5.7)	0 (0.0)
Michigan		91 (3.1)	0 (0.0)	9 (3.1)	0 (0.0)
Missouri		87 (5.6)	0 (0.0)	11 (5.1)	2 (2.2)
North Carolina	r	95 (3.5)	2 (0.2)	3 (2.6)	0 (0.0)
Oregon		91 (4.7)	0 (0.0)	9 (4.7)	0 (0.0)
Pennsylvania	r	83 (3.5)	0 (0.0)	15 (3.2)	1 (1.3)
South Carolina	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Texas	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Districts and Consortia					
Academy School Dist. #20, CO		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chicago Public Schools, IL	r	44 (13.8)	0 (0.0)	56 (13.8)	0 (0.0)
Delaware Science Coalition, DE	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
First in the World Consort., IL	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Fremont/Lincoln/WestSide PS, NE	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Guilford County, NC	r	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Jersey City Public Schools, NJ	r	90 (1.1)	10 (1.1)	0 (0.0)	0 (0.0)
Miami-Dade County PS, FL		x x	x x	x x	x x
Michigan Invitational Group, MI		94 (1.3)	0 (0.0)	6 (1.3)	0 (0.0)
Montgomery County, MD	s	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Naperville Sch. Dist. #203, IL		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Project SMART Consortium, OH		91 (0.3)	0 (0.0)	9 (0.3)	0 (0.0)
Rochester City Sch. Dist., NY	s	69 (1.6)	0 (0.0)	31 (1.6)	0 (0.0)
SW Math/Sci. Collaborative, PA	r	95 (3.5)	0 (0.0)	5 (3.5)	0 (0.0)
International Avg. (All Countries)		41 (0.5)	1 (0.2)	29 (0.6)	29 (0.5)

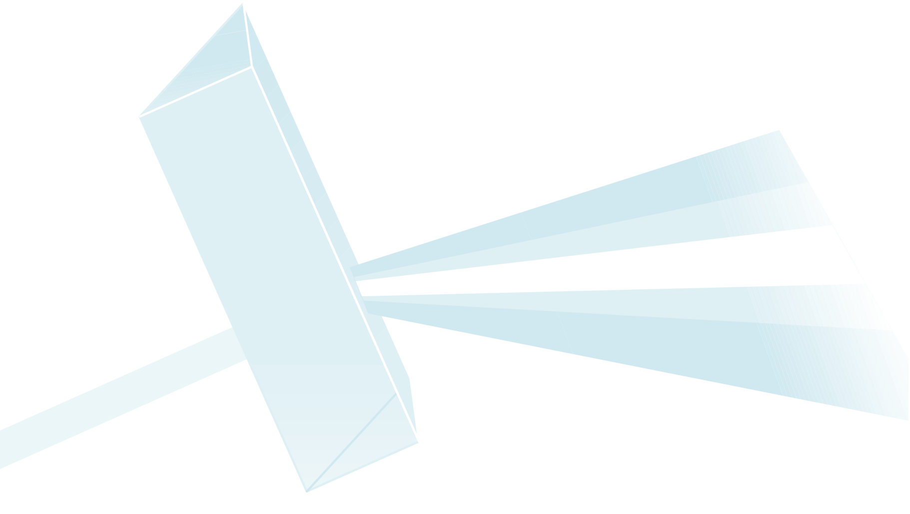
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Background data provided by schools.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students. An "x" indicates school response data available for <50% of students.



APPENDIX A

Overview of TIMSS Benchmarking Procedures: Science Achievement

A

History

TIMSS 1999 represents the continuation of a long series of studies conducted by the International Association for the Evaluation of Educational Achievement (IEA). Since its inception in 1959, the IEA has conducted more than 15 studies of cross-national achievement in the curricular areas of mathematics, science, language, civics, and reading. The Third International Mathematics and Science Study (TIMSS), conducted in 1994-1995, was the largest and most complex IEA study, and included both mathematics and science at third and fourth grades, seventh and eighth grades, and the final year of secondary school. In 1999, TIMSS again assessed eighth-grade students in both mathematics and science to measure trends in student achievement since 1995. TIMSS 1999 was also known as TIMSS-Repeat, or TIMSS-R.[1]

To provide U.S. states and school districts with an opportunity to benchmark the performance of their students against that of students in the high-performing TIMSS countries, the International Study Center at Boston College, with the support of the National Center for Education Statistics and the National Science Foundation, established the TIMSS 1999 Benchmarking Study. Through this project, the TIMSS mathematics and science achievement tests and questionnaires were administered to representative samples of students in participating states and school districts in the spring of 1999, at the same time the tests and questionnaires were administered in the TIMSS countries. Participation in TIMSS Benchmarking was intended to help states and districts understand their comparative educational standing, assess the rigor and effectiveness of their own mathematics and science programs in an international context, and improve the teaching and learning of mathematics and science.

Participants in TIMSS Benchmarking

Thirteen states availed of the opportunity to participate in the Benchmarking Study. Eight public school districts and six consortia also participated, for a total of fourteen districts and consortia. They are listed in Exhibit 1 of the Introduction, together with the 38 countries that took part in TIMSS 1999.

---

[1] The TIMSS 1999 results for mathematics and science, respectively, are reported in Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., and Smith, T.A. (2000), *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College, and in Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Gregory, K.D., Smith, T.A., Chrostowski, S.J., Garden, R.A., and O'Connor, K.M. (2000), *TIMSS 1999 International Science Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA: Boston College

Developing the TIMSS 1999 Science Test

The TIMSS curriculum framework underlying the science tests was developed for TIMSS in 1995 by groups of science educators with input from the TIMSS National Research Coordinators (NRCS). As shown in Exhibit A.1, the science curriculum framework contains three dimensions or aspects. The *content* aspect represents the subject matter content of school science. The *performance expectations* aspect describes, in a non-hierarchical way, the many kinds of performances or behaviors that might be expected of students in school science. The *perspectives* aspect focuses on the development of students' attitudes, interest, and motivation in science. Because the frameworks were developed to include content, performance expectations, and perspectives for the entire span of curricula from the beginning of schooling through the completion of secondary school, some aspects may not be reflected in the eighth-grade TIMSS assessment.[2] Working within the framework, science test specifications for TIMSS in 1995 were developed that included items representing a wide range of science topics and eliciting a range of skills from the students. The 1995 tests were developed through an international consensus involving input from experts in science and measurement specialists, ensuring they reflected current thinking and priorities in the sciences.

About one-third of the items in the 1995 assessment were kept secure to measure trends over time; the remaining items were released for public use. An essential part of the development of the 1999 assessment, therefore, was to replace the released items with items of similar content, format, and difficulty. With the assistance of the Science and Mathematics Item Replacement Committee, a group of internationally prominent mathematics and science educators nominated by participating countries to advise on subject-matter issues in the assessment, over 300 mathematics and science items were developed as potential replacements. After an extensive process of review and field testing, 98 items were selected for use as replacements in the 1999 science assessment.

Exhibit A.2 presents the six content areas included in the 1999 science test and the numbers of items and score points in each area. Distributions are also included for the five performance categories derived from the performance expectations aspect of the curriculum framework. About one-fourth of the items were in the free-response format, requiring students to generate and write their own answers. Designed to take about one-third of students' test time, some free-response questions asked for short answers while others required extended responses with students

---

[2] The complete TIMSS curriculum frameworks can be found in Robitaille, D.F., et al. (1993), *TIMSS Monograph No.1: Curriculum Frameworks for Mathematics and Science*, Vancouver, BC: Pacific Educational Press.

showing their work or providing explanations for their answers. The remaining questions used a multiple-choice format. In scoring the tests, correct answers to most questions were worth one point. Consistent with the approach of allotting students longer response time for the constructed-response questions than for multiple-choice questions, however, responses to some of these questions (particularly those requiring extended responses) were evaluated for partial credit, with a fully correct answer being awarded two points (see later section on scoring). The total number of score points available for analysis thus somewhat exceeds the number of items.

Every effort was made to help ensure that the tests represented the curricula of the participating countries and that the items exhibited no bias towards or against particular countries. The final forms of the tests were endorsed by the NRCs of the participating countries.[3]

---

[3] For a full discussion of the TIMSS 1999 test development effort, please see Garden, R.A. and Smith, T.A. (2000), "TIMSS Test Development" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

Exhibit A.1 The Three Aspects and Major Categories of the Science Frameworks

8th Grade Science

Content	Performance Expectations	Perspectives
Earth Sciences	Understanding	Attitudes
Life Sciences	Theorizing, Analyzing, and Solving Problems	Careers
Physical Sciences	Using Tools, Routine Procedures and Science Processes	Participation
Science, Technology, and Mathematics	Investigating the Natural World	Increasing Interest
Environmental Issues	Communicating	Safety
Nature of Science		Habits of Mind
Science and Other Disciplines		

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.2

Distribution of Science Items by Content Reporting Category and Performance Category

8th Grade Science

Content Category	Percentage of Items	Total Number of Items	Number of Multiple-Choice Items	Number of Free-Response Items[1]	Number of Score Points[2]
Earth Science	15	22	17	5	23
Life Science	27	40	28	12	42
Physics	27	39	28	11	39
Chemistry	14	20	15	5	22
Environmental and Resource Issues	9	13	7	6	14
Scientific Inquiry and the Nature of Science	8	12	9	3	13
Total	100	146	104	42	153

Performance Category	Percentage of Items	Total Number of Items	Number of Multiple-Choice Items	Number of Free-Response Items[1]	Number of Score Points[2]
Understanding Simple Information	39	57	56	1	57
Understanding Complex Information	31	45	30	15	47
Theorizing, Analyzing and Solving Problems	19	28	5	23	32
Using Tools, Routine Procedures and Science Processes	7	10	9	1	10
Investigating the Natural World	4	6	4	2	7
Total	100	146	104	42	153

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

[1] Free response items include both short-answer and extended-response types.

[2] In scoring the tests, correct answers to most items were worth one point. However, responses to some free-response items were evaluated for partial credit with a fully correct answer awarded up to two points. Thus, the number of score points exceeds the number of items in the test.

TIMSS Test Design

Not all of the students in the TIMSS assessment responded to all of the science items. To ensure broad subject-matter coverage without overburdening individual students, TIMSS used a rotated design that included both the mathematics and science items. Thus, the same students participated in both the mathematics and science testing. As in 1995, the 1999 assessment consisted of eight booklets, each requiring 90 minutes of response time. Each participating student was assigned one booklet only. In accordance with the design, the mathematics and science items were assembled into 26 clusters (labeled A through Z). The secure trend items were in clusters A through H, and items replacing the released 1995 items in clusters I through Z. Eight of the clusters were designed to take 12 minutes to complete; 10 of the clusters, 22 minutes; and 8 clusters, 10 minutes. In all, the design provided 396 testing minutes, 198 for mathematics and 198 for science. Cluster A was a core cluster assigned to all booklets. The remaining clusters were assigned to the booklets in accordance with the rotated design so that representative samples of students responded to each cluster.[4]

Background Questionnaires

TIMSS in 1999 administered a broad array of questionnaires to collect data on the educational context for student achievement and to measure trends since 1995. *National Research Coordinators*, with the assistance of their curriculum experts, provided detailed information on the organization, emphases, and content coverage of the mathematics and science curriculum. The *students* who were tested answered questions pertaining to their attitudes towards mathematics and science, their academic self-concept, classroom activities, home background, and out-of-school activities. The mathematics and science *teachers* of sampled students responded to questions about teaching emphasis on the topics in the curriculum frameworks, instructional practices, professional training and education, and their views on mathematics and science. The heads of *schools* responded to questions about school staffing and resources, mathematics and science course offerings, and teacher support.

---

[4] The 1999 TIMSS test design is identical to the design for 1995, which is fully documented in Adams, R. and Gonzalez, E. (1996), "TIMSS Test Design" in M.O. Martin and D.L. Kelly (eds.), *Third International Mathematics and Science Study Technical Report, Volume I*, Chestnut Hill, MA: Boston College.

Translation and Verification

The TIMSS instruments were prepared in English and translated into 33 languages, with 10 of the 38 countries collecting data in two languages. In addition, it sometimes was necessary to modify the international versions for cultural reasons, even in the nine countries that tested in English. This process represented an enormous effort for the national centers, with many checks along the way. The translation effort included (1) developing explicit guidelines for translation and cultural adaptation; (2) translation of the instruments by the national centers in accordance with the guidelines, using two or more independent translations; (3) consultation with subject-matter experts on cultural adaptations to ensure that the meaning and difficulty of items did not change; (4) verification of translation quality by professional translators from an independent translation company; (5) corrections by the national centers in accordance with the suggestions made; (6) verification by the International Study Center that corrections were made; and (7) a series of statistical checks after the testing to detect items that did not perform comparably across countries.[5]

Population Definition and Sampling

TIMSS in 1995 had as its target population students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing, which were seventh- and eighth-grade students in most countries. TIMSS in 1999 used the same definition to identify the target grades, but assessed students in the upper of the two grades only, which was the eighth grade in most countries, including the United States.[6] The eighth grade was the target population for all of the Benchmarking participants.

The selection of valid and efficient samples was essential to the success of TIMSS and of the Benchmarking Study. For TIMSS internationally, NRCs, including Westat, the sampling and data collection coordinator for TIMSS in the United States, received training in how to select the school and student samples and in the use of the sampling software, and worked in close consultation with Statistics Canada, the TIMSS sampling consultants, on all phases of sampling. As well as conducting the sampling and data collection for the U.S. national TIMSS sample, Westat was also responsible for sampling and data collection in each of the Benchmarking states, districts, and consortia.

---

[5] More details about the translation verification procedures can be found in O'Connor, K., and Malak, B. (2000), "Translation and Cultural Adaptation of the TIMSS Instruments" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

[6] The sample design for TIMSS is described in detail in Foy, P., and Joncas, M. (2000), "TIMSS Sample Design" in M.O. Martin, K.D. Gregory, and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College. Sampling for the Benchmarking project is described in Fowler, J., Rizzo, L., and Rust, K. (2001), "TIMSS Benchmarking Sampling Design and Implementation" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

To document the quality of the school and student samples in each of the TIMSS countries, staff from Statistics Canada and the International Study Center worked with the TIMSS sampling referee (Keith Rust, Westat) to review sampling plans, sampling frames, and sampling implementation. Particular attention was paid to coverage of the target population and to participation by the sampled schools and students. The data from the few countries that did not fully meet all of the sampling guidelines are annotated in the TIMSS international reports, and are also annotated in this report. The TIMSS samples for the Benchmarking participants were also carefully reviewed in light of the TIMSS sampling guidelines, and the results annotated where appropriate. Since Westat was the sampling contractor for the Benchmarking project, the role of sampling referee for the Benchmarking review was filled by Pierre Foy, of Statistics Canada.

Although all countries and Benchmarking participants were expected to draw samples representative of the entire internationally desired population (all students in the upper of the two adjacent grades with the greatest proportion of 13-year-olds), the few countries where this was not possible were permitted to define a national desired population that excluded part of the internationally desired population. Exhibit A.3 shows any differences in coverage between the international and national desired populations. Almost all TIMSS countries achieved 100 percent coverage (36 out of 38), with Lithuania and Latvia the exceptions. Consequently, the results for Lithuania are annotated, and because coverage fell below 65 percent for Latvia, the Latvian results are labeled “Latvia (LSS),” for Latvian-Speaking Schools. Additionally, because of scheduling difficulties, Lithuania was unable to test its eighth-grade students in May 1999 as planned. Instead, the students were tested in September 1999, when they had moved into the ninth grade. The results for Lithuania are annotated to reflect this as well. Exhibit A.3 also shows that the sampling plans for the Benchmarking participants all incorporated 100 percent coverage of the desired population. Four of the 13 states (Idaho, Indiana, Michigan, and Pennsylvania) as well as the Southwest Pennsylvania Math and Science Collaborative included private schools as well as public schools.

In operationalizing their desired eighth-grade population, countries and Benchmarking participants could define a population to be sampled that excluded a small percentage (less than 10 percent) of certain kinds of schools or students that would be very difficult or resource-intensive to test (e.g., schools for students with special needs or schools that were very small or located in extremely rural areas). Exhibit A.3 also shows that the degree of such exclusions was small. Among countries, only Israel reached the 10 percent limit, and among Benchmarking participants, only Guilford County and Montgomery County did so. All three are annotated as such in the achievement chapters of this report.

Within countries, TIMSS used a two-stage sample design, in which the first stage involved selecting about 150 public and private schools in each country. Within each school, countries were to use random procedures to select one mathematics class at the eighth grade. All of the students in that class were to participate in the TIMSS testing. This approach was designed to yield a representative sample of about 3,750 students per country. Typically, between 450 and 3,750 students responded to each achievement item in each country, depending on the booklets in which the items appeared.

States participating in the Benchmarking study were required to sample at least 50 schools and approximately 2,000 eighth-grade students. School districts and consortia were required to sample at least 25 schools and at least 1,000 students. Where there were fewer than 25 schools in a district or consortium, all schools were to be included, and the within-school sample increased to yield the total of 1,000 students.

Exhibits A.4 and A.5 present achieved sample sizes for schools and students, respectively, for the TIMSS countries and for the Benchmarking participants. Where a district or consortium was part of a state that also participated, the state sample was augmented by the district or consortium sample, properly weighted in accordance with its size. Schools in a state that were sampled as part of the U.S. national TIMSS sample were also used to augment the state sample. For example, the Illinois sample consists of 90 schools, 41 from the state Benchmarking sample (including five schools from the national TIMSS sample), 27 from the Chicago Public Schools, 17 from the First in the World Consortium, and five from the Naperville School District.

Exhibit A.6 shows the participation rates for schools, students, and overall, both with and without the use of replacement schools, for TIMSS countries and Benchmarking participants. All of the countries met the guideline for sampling participation – 85 percent of both the schools and students, or a combined rate (the product of school and student participation) of 75 percent – although Belgium (Flemish), England, Hong Kong, and the Netherlands did so only after including replacement schools, and are annotated accordingly in the achievement chapters.

With the exception of Pennsylvania and Texas, all the Benchmarking participants met the sampling guidelines, although Indiana did so only after including replacement schools. Indiana is annotated to reflect this in the achievement chapters, and Pennsylvania and Texas are italicized in all exhibits in this report.

Exhibit A.3 Coverage of TIMSS 1999 Target Population – Countries

8th Grade Science

	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
United States	100%		0%	4%	4%
Australia	100%		1%	1%	2%
Belgium (Flemish)	100%		1%	0%	1%
Bulgaria	100%		5%	0%	5%
Canada	100%		4%	2%	6%
Chile	100%		3%	0%	3%
Chinese Taipei	100%		1%	1%	2%
Cyprus	100%		0%	1%	1%
Czech Republic	100%		5%	0%	5%
England	100%		2%	3%	5%
Finland	100%		3%	0%	4%
Hong Kong, SAR	100%		1%	0%	1%
Hungary	100%		4%	0%	4%
Indonesia	100%		0%	0%	0%
Iran, Islamic Rep. of	100%		4%	0%	4%
Israel	100%		8%	8%	16%
Italy	100%		4%	2%	7%
Japan	100%		1%	0%	1%
Jordan	100%		2%	1%	3%
Korea, Rep. of	100%		2%	2%	4%
Latvia (LSS)	61%	Latvian-speaking students only	4%	0%	4%
Lithuania	87%	Lithuanian-speaking students only	5%	0%	5%
Macedonia, Rep. of	100%		1%	0%	1%
Malaysia	100%		5%	0%	5%
Moldova	100%		2%	0%	2%
Morocco	100%		1%	0%	1%
Netherlands	100%		1%	0%	1%
New Zealand	100%		2%	1%	2%
Philippines	100%		3%	0%	3%
Romania	100%		4%	0%	4%
Russian Federation	100%		1%	1%	2%
Singapore	100%		0%	0%	0%
Slovak Republic	100%		7%	0%	7%
Slovenia	100%		3%	0%	3%
South Africa	100%		2%	0%	2%
Thailand	100%		3%	0%	3%
Tunisia	100%		0%	0%	0%
Turkey	100%		2%	0%	2%

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.3
(Continued)

Coverage of TIMSS 1999 Target Population – States and Districts/Consortia

8th Grade Science

	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
States					
Connecticut	100%		0%	5%	5%
Idaho	100%	Included private schools	0%	2%	2%
Illinois	100%		0%	4%	4%
Indiana	100%	Included private schools	0%	6%	6%
Maryland	100%		0%	6%	6%
Massachusetts	100%		0%	5%	5%
Michigan	100%	Included private schools	0%	2%	2%
Missouri	100%		0%	4%	4%
North Carolina	100%		0%	4%	4%
Oregon	100%		0%	5%	5%
Pennsylvania	100%	Included private schools	0%	6%	6%
South Carolina	100%		0%	2%	2%
Texas	100%		0%	4%	4%
Districts and Consortia					
Academy School Dist. #20, CO	100%		NA	2%	2%
Chicago Public Schools, IL	100%		NA	4%	4%
Delaware Science Coalition, DE	100%		NA	5%	5%
First in the World Consort., IL	100%		NA	2%	2%
Fremont/Lincoln/WestSide PS, NE	100%		NA	2%	2%
Guilford County, NC	100%		NA	10%	10%
Jersey City Public Schools, NJ	100%		NA	6%	6%
Miami-Dade County PS, FL	100%		NA	7%	7%
Michigan Invitational Group, MI	100%		NA	2%	2%
Montgomery County, MD	100%		NA	17%	17%
Naperville Sch. Dist. #203, IL	100%		NA	7%	7%
Project SMART Consortium, OH	100%		NA	2%	2%
Rochester City Sch. Dist., NY	100%		NA	1%	1%
SW Math/Sci. Collaborative, PA	100%	Included private schools	NA	4%	4%

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.4

School Sample Sizes – Countries

8th Grade Science

	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample That Participated	Number of Replacement Schools That Participated	Total Number of Schools That Participated
United States	250	246	202	19	221
Australia	184	182	152	18	170
Belgium (Flemish)	150	150	106	29	135
Bulgaria	172	169	163	0	163
Canada	410	398	376	9	385
Chile	186	185	181	4	185
Chinese Taipei	150	150	150	0	150
Cyprus	61	61	61	0	61
Czech Republic	150	142	136	6	142
England	150	150	76	52	128
Finland	160	160	155	4	159
Hong Kong, SAR	180	180	135	2	137
Hungary	150	150	147	0	147
Indonesia	150	150	132	18	150
Iran, Islamic Rep. of	170	170	164	6	170
Israel	150	139	137	2	139
Italy	180	180	170	10	180
Japan	150	150	140	0	140
Jordan	150	147	146	1	147
Korea, Rep. of	150	150	150	0	150
Latvia (LSS)	150	148	143	2	145
Lithuania	150	150	150	0	150
Macedonia, Rep. of	150	150	149	0	149
Malaysia	150	150	148	2	150
Moldova	150	150	145	5	150
Morocco	174	174	172	1	173
Netherlands	150	148	86	40	126
New Zealand	156	156	145	7	152
Philippines	150	150	148	2	150
Romania	150	150	147	0	147
Russian Federation	190	190	186	3	189
Singapore	145	145	145	0	145
Slovak Republic	150	150	143	2	145
Slovenia	150	150	147	2	149
South Africa	225	219	183	11	194
Thailand	150	150	143	7	150
Tunisia	150	149	126	23	149
Turkey	204	204	202	2	204

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample That Participated	Number of Replacement Schools That Participated	Total Number of Schools That Participated
States					
Connecticut	54	54	52	0	52
Idaho	54	54	47	0	47
Illinois	90	90	85	0	85
Indiana	61	61	39	13	52
Maryland	79	77	73	0	73
Massachusetts	59	58	57	0	57
Michigan	66	62	55	2	57
Missouri	57	55	43	8	51
North Carolina	71	68	67	0	67
Oregon	51	51	45	0	45
Pennsylvania	116	113	80	0	80
South Carolina	53	53	49	0	49
Texas	71	70	51	1	52
Districts and Consortia					
Academy School Dist. #20, CO	4	4	4	0	4
Chicago Public Schools, IL	27	27	26	0	26
Delaware Science Coalition, DE	25	25	25	0	25
First in the World Consort., IL	17	17	15	0	15
Fremont/Lincoln/WestSide PS, NE	12	12	12	0	12
Guilford County, NC	17	17	17	0	17
Jersey City Public Schools, NJ	25	25	24	0	24
Miami-Dade County PS, FL	25	25	25	0	25
Michigan Invitational Group, MI	21	21	21	0	21
Montgomery County, MD	25	25	25	0	25
Naperville Sch. Dist. #203, IL	5	5	5	0	5
Project SMART Consortium, OH	24	24	24	0	24
Rochester City Sch. Dist., NY	7	7	7	0	7
SW Math/Sci. Collaborative, PA	50	49	39	0	39

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.5 Student Sample Sizes – Countries

8th Grade Science

	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
United States	94%	9981	115	142	9724	652	9072
Australia	90%	4600	96	53	4451	419	4032
Belgium (Flemish)	97%	5387	12	0	5375	116	5259
Bulgaria	96%	3461	63	0	3398	126	3272
Canada	96%	9490	84	245	9161	391	8770
Chile	96%	6283	119	18	6146	239	5907
Chinese Taipei	99%	5889	30	42	5817	45	5772
Cyprus	97%	3296	38	32	3226	110	3116
Czech Republic	96%	3640	24	0	3616	163	3453
England	90%	3400	27	115	3258	298	2960
Finland	96%	3060	17	13	3030	110	2920
Hong Kong, SAR	98%	5310	18	1	5291	112	5179
Hungary	95%	3350	0	0	3350	167	3183
Indonesia	97%	6162	106	1	6055	207	5848
Iran, Islamic Rep. of	98%	5497	104	0	5393	92	5301
Israel	94%	4670	29	187	4454	259	4195
Italy	97%	3531	23	86	3422	94	3328
Japan	95%	4996	15	12	4969	224	4745
Jordan	99%	5300	130	42	5128	76	5052
Korea, Rep. of	100%	6285	29	128	6128	14	6114
Latvia (LSS)	93%	3128	16	4	3108	235	2873
Lithuania	89%	2668	0	0	2668	307	2361
Macedonia, Rep. of	98%	4096	0	0	4096	73	4023
Malaysia	99%	5713	98	0	5615	38	5577
Moldova	98%	3824	23	0	3801	90	3711
Morocco	92%	5841	42	0	5799	397	5402
Netherlands	95%	3099	12	0	3087	125	2962
New Zealand	94%	3966	96	22	3848	235	3613
Philippines	92%	7591	461	0	7130	529	6601
Romania	98%	3514	36	0	3478	53	3425
Russian Federation	97%	4557	48	34	4475	143	4332
Singapore	98%	5100	37	0	5063	97	4966
Slovak Republic	98%	3695	149	0	3546	49	3497
Slovenia	95%	3287	0	4	3283	174	3109
South Africa	93%	9071	256	0	8815	669	8146
Thailand	99%	5831	59	0	5772	40	5732
Tunisia	98%	5189	45	0	5144	93	5051
Turkey	99%	7972	49	0	7923	82	7841

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.5
(Continued)

Student Sample Sizes – States and Districts/Consortia

	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
States							
Connecticut	94%	2190	6	43	2141	124	2023
Idaho	95%	1968	17	27	1924	94	1847
Illinois	96%	5144	30	136	4978	227	4781
Indiana	95%	2175	9	27	2139	102	2046
Maryland	94%	3877	21	339	3517	221	3317
Massachusetts	95%	2538	18	54	2466	131	2353
Michigan	96%	2811	7	44	2760	143	2623
Missouri	94%	2147	27	40	2080	128	1979
North Carolina	94%	3502	34	191	3277	214	3097
Oregon	93%	2044	24	29	1991	126	1889
Pennsylvania	95%	3463	18	60	3385	167	3236
South Carolina	94%	2177	18	36	2123	130	2011
Texas	93%	2189	18	44	2127	149	1996
Districts and Consortia							
Academy School Dist. #20, CO	94%	1329	0	15	1314	81	1233
Chicago Public Schools, IL	94%	1227	13	21	1193	74	1132
Delaware Science Coalition, DE	92%	1389	16	18	1355	103	1268
First in the World Consort., IL	96%	782	1	2	779	30	750
Fremont/Lincoln/WestSide PS, NE	95%	1178	20	25	1133	60	1093
Guilford County, NC	92%	1215	17	121	1077	76	1018
Jersey City Public Schools, NJ	94%	1116	5	47	1064	65	1004
Miami-Dade County PS, FL	91%	1356	23	10	1323	117	1229
Michigan Invitational Group, MI	91%	994	0	11	983	80	903
Montgomery County, MD	94%	1481	13	254	1214	72	1155
Naperville Sch. Dist. #203, IL	96%	1343	9	84	1250	47	1212
Project SMART Consortium, OH	94%	1188	11	18	1159	74	1096
Rochester City Sch. Dist., NY	84%	1165	8	9	1148	190	966
SW Math/Sci. Collaborative, PA	95%	1638	14	21	1603	79	1538

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.6 Overall Participation Rates – Countries

8th Grade Science

	School Participation		Student Participation	Overall Participation	
	Before Replacement	After Replacement		Before Replacement	After Replacement
United States	83%	90%	94%	78%	85%
Australia	83%	93%	90%	75%	84%
Belgium (Flemish)	72%	89%	97%	70%	87%
Bulgaria	97%	97%	96%	93%	93%
Canada	92%	95%	96%	88%	92%
Chile	98%	100%	96%	94%	96%
Chinese Taipei	100%	100%	99%	99%	99%
Cyprus	100%	100%	97%	97%	97%
Czech Republic	94%	100%	96%	90%	96%
England	49%	85%	90%	45%	77%
Finland	97%	100%	96%	93%	96%
Hong Kong, SAR	75%	76%	98%	74%	75%
Hungary	98%	98%	95%	93%	93%
Indonesia	84%	100%	97%	81%	97%
Iran, Islamic Rep. of	96%	100%	98%	95%	98%
Israel	98%	100%	94%	93%	94%
Italy	94%	100%	97%	91%	97%
Japan	93%	93%	95%	89%	89%
Jordan	99%	100%	99%	98%	99%
Korea, Rep. of	100%	100%	100%	100%	100%
Latvia (LSS)	96%	98%	93%	89%	91%
Lithuania	100%	100%	89%	89%	89%
Macedonia, Rep. of	99%	99%	98%	98%	98%
Malaysia	99%	100%	99%	98%	99%
Moldova	96%	100%	98%	94%	98%
Morocco	99%	99%	92%	91%	92%
Netherlands	62%	85%	95%	59%	81%
New Zealand	93%	97%	94%	87%	91%
Philippines	98%	100%	92%	91%	92%
Romania	98%	98%	98%	97%	97%
Russian Federation	98%	100%	97%	95%	97%
Singapore	100%	100%	98%	98%	98%
Slovak Republic	95%	96%	98%	93%	94%
Slovenia	98%	99%	95%	93%	94%
South Africa	85%	91%	93%	79%	84%
Thailand	93%	100%	99%	93%	99%
Tunisia	84%	100%	98%	82%	98%
Turkey	99%	100%	99%	98%	99%

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.6
(Continued)

Overall Participation Rates – States and Districts/Consortia

8th Grade Science

	School Participation		Student Participation	Overall Participation	
	Before Replacement	After Replacement		Before Replacement	After Replacement
States					
Connecticut	96%	96%	94%	90%	90%
Idaho	88%	88%	95%	83%	83%
Illinois	95%	95%	96%	91%	91%
Indiana	61%	83%	95%	58%	79%
Maryland	94%	94%	94%	88%	88%
Massachusetts	98%	98%	95%	93%	93%
Michigan	89%	92%	96%	85%	88%
Missouri	79%	94%	94%	75%	88%
North Carolina	98%	98%	94%	92%	92%
Oregon	89%	89%	93%	83%	83%
Pennsylvania	66%	66%	95%	63%	63%
South Carolina	92%	92%	94%	86%	86%
Texas	73%	74%	93%	67%	69%
Districts and Consortia					
Academy School Dist. #20, CO	100%	100%	94%	94%	94%
Chicago Public Schools, IL	95%	95%	94%	90%	90%
Delaware Science Coalition, DE	100%	100%	92%	92%	92%
First in the World Consort., IL	93%	93%	96%	90%	90%
Fremont/Lincoln/WestSide PS, NE	100%	100%	95%	95%	95%
Guilford County, NC	100%	100%	92%	92%	92%
Jersey City Public Schools, NJ	97%	97%	94%	91%	91%
Miami-Dade County PS, FL	100%	100%	91%	91%	91%
Michigan Invitational Group, MI	100%	100%	91%	91%	91%
Montgomery County, MD	100%	100%	94%	94%	94%
Naperville Sch. Dist. #203, IL	100%	100%	96%	96%	96%
Project SMART Consortium, OH	100%	100%	94%	94%	94%
Rochester City Sch. Dist., NY	100%	100%	84%	84%	84%
SW Math/Sci. Collaborative, PA	78%	78%	95%	75%	75%

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Data Collection

Each participating country was responsible for carrying out all aspects of the data collection, using standardized procedures developed for the study. Training manuals were created for school coordinators and test administrators that explained procedures for receipt and distribution of materials as well as for the activities related to the testing sessions. These manuals covered procedures for test security, standardized scripts to regulate directions and timing, rules for answering students' questions, and steps to ensure that identification on the test booklets and questionnaires corresponded to the information on the forms used to track students. As the data collection contractor for the U.S. national TIMSS, Westat was fully acquainted with the TIMSS procedures, and applied them in each of the Benchmarking jurisdictions in the same way as in the national data collection.

Each country was responsible for conducting quality control procedures and describing this effort in the NRC's report documenting procedures used in the study. In addition, the International Study Center considered it essential to monitor compliance with standardized procedures through an international program of quality control site visits. NRCs were asked to nominate one or more persons unconnected with their national center, such as retired school teachers, to serve as quality control monitors for their countries. The International Study Center developed manuals for the monitors and briefed them in two-day training sessions about TIMSS, the responsibilities of the national centers in conducting the study, and their own roles and responsibilities. In all, 71 international quality control monitors participated in this training.

The international quality control monitors interviewed the NRCs about data collection plans and procedures. They also visited a sample of 15 schools where they observed testing sessions and interviewed school coordinators.[7] Quality control monitors interviewed school coordinators in all 38 countries, and observed a total of 550 testing sessions. The results of the interviews conducted by the international quality control monitors indicated that, in general, NRCs had prepared well for data collection and, despite the heavy demands of the schedule and shortages of resources, were able to conduct the data collection efficiently and professionally. Similarly, the TIMSS tests appeared to have been administered in compliance with international procedures, including the activities before the testing session, those during testing, and the school-level activities related to receiving, distributing, and returning material from the national centers.

---

[7] Steps taken to ensure high-quality data collection in TIMSS internationally are described in detail in O'Connor, K., and Stemler, S. (2000), "Quality Control in the TIMSS Data Collection" in M.O. Martin, K.D. Gregory and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

As a parallel quality control effort for the Benchmarking project, the International Study Center recruited and trained a team of 18 quality control observers, and sent them to observe the data collection activities of the Westat test administrators in a sample of about 10 percent of the schools in the study (98 schools in all).[8] In line with the experience internationally, the observers reported that the data collection was conducted successfully according to the prescribed procedures, and that no serious problems were encountered.

Scoring the Free-Response Items

Because about one-third of the written test time was devoted to free-response items, TIMSS needed to develop procedures for reliably evaluating student responses within and across countries. Scoring used two-digit codes with rubrics specific to each item. The first digit designates the correctness level of the response. The second digit, combined with the first, represents a diagnostic code identifying specific types of approaches, strategies, or common errors and misconceptions. Although not used in this report, analyses of responses based on the second digit should provide insight into ways to help students better understand science concepts and problem-solving approaches.

To ensure reliable scoring procedures based on the TIMSS rubrics, the International Study Center prepared detailed guides containing the rubrics and explanations of how to implement them, together with example student responses for the various rubric categories. These guides, along with training packets containing extensive examples of student responses for practice in applying the rubrics, were used as a basis for intensive training in scoring the free-response items. The training sessions were designed to help representatives of national centers who would then be responsible for training personnel in their countries to apply the two-digit codes reliably. In the United States, the scoring was conducted by National Computer Systems (NCS) under contract to Westat. To ensure that student responses from the Benchmarking participants were scored in the same way as those from the U.S. national sample, NCS had both sets of data scored at the same time and by the same scoring staff.

To gather and document empirical information about the within-country agreement among scorers, TIMSS arranged to have systematic subsamples of at least 100 students' responses to each item coded independently by two readers. Exhibit A.7 shows the average and range of the within-country percent of exact agreement between scorers on the

---

[8] Quality control measures for the Benchmarking project are described in O'Connor, K. and Stemler, S. (2001), "Quality Control in the TIMSS Benchmarking Data Collection" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

free-response items in the science test for 37 of the 38 countries. A high percentage of exact agreement was observed, with an overall average of 95 percent across the 37 countries. The TIMSS data from the reliability studies indicate that scoring procedures were robust for the science items, especially for the correctness score used for the analyses in this report. In the United States, the average percent exact agreement was 94 percent for the correctness score and 89 percent for the diagnostic score. Since the Benchmarking data were combined with the U.S. national TIMSS sample for scoring purposes, this high level of scoring reliability applies to the Benchmarking data also.

Exhibit A.7 TIMSS 1999 Within-Country Free-Response Scoring Reliability Data for Science Items

	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Min	Max		Min	Max
United States	94	74	100	89	64	100
Australia	95	83	100	87	71	99
Belgium (Flemish)	96	86	100	96	86	100
Bulgaria	95	60	100	87	46	100
Canada	89	70	100	77	51	99
Chile	96	78	100	91	71	100
Chinese Taipei	98	91	100	96	80	100
Cyprus	–	–	–	–	–	–
Czech Republic	87	57	100	75	43	100
England	97	88	100	90	74	100
Finland	97	87	100	92	81	100
Hong Kong, SAR	86	44	100	75	44	99
Hungary	97	88	100	93	77	100
Indonesia	87	57	99	74	33	95
Iran, Islamic Rep.	90	66	100	80	43	98
Israel	96	88	100	89	75	98
Italy	95	81	100	90	78	99
Japan	93	80	100	84	59	100
Jordan	98	94	100	93	83	100
Korea, Rep. of	91	73	100	84	61	100
Latvia (LSS)	96	77	100	92	60	100
Lithuania	94	56	100	90	56	100
Macedonia, Rep. of	99	94	100	97	94	100
Malaysia	99	98	100	98	94	100
Moldova	95	87	100	91	78	99
Morocco	88	51	99	74	50	94
Netherlands	91	70	100	83	68	100
New Zealand	95	85	100	88	68	99
Philippines	91	75	100	80	51	100
Romania	99	93	100	96	93	100
Russian Federation	98	93	100	95	88	100
Singapore	96	89	100	92	81	99
Slovak Republic	99	85	100	98	85	100
Slovenia	97	84	100	89	78	100
South Africa	97	80	100	91	80	98
Thailand	100	99	100	100	99	100
Tunisia	98	85	100	98	77	100
Turkey	100	98	100	99	97	100
International Avg.	95	79	100	89	71	99

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

A dash (–) indicates data are not available.

Test Reliability

Exhibit A.8 displays the science test reliability coefficient for each country and Benchmarking participant. This coefficient is the median KR-20 reliability across the eight test booklets. Among countries, median reliabilities ranged from 0.62 in Morocco to 0.86 in Singapore. The international median, 0.80, is the median of the reliability coefficients for all countries. Reliability coefficients among Benchmarking participants were generally close to the international median, ranging from 0.82 to 0.86 across states, and from 0.77 to 0.85 across districts and consortia.

Exhibit A.8 Cronbach's Alpha Reliability Coefficient – TIMSS 1999 Science Test

8th Grade Science

Countries	Reliability Coefficient[1]
United States	0.85
Australia	0.84
Belgium (Flemish)	0.75
Bulgaria	0.82
Canada	0.78
Chile	0.77
Chinese Taipei	0.83
Cyprus	0.76
Czech Republic	0.79
England	0.84
Finland	0.76
Hong Kong, SAR	0.76
Hungary	0.83
Indonesia	0.75
Iran, Islamic Rep.	0.77
Israel	0.84
Italy	0.81
Japan	0.79
Jordan	0.82
Korea, Rep. of	0.81
Latvia (LSS)	0.78
Lithuania	0.81
Macedonia, Rep. of	0.81
Malaysia	0.77
Moldova	0.81
Morocco	0.62
Netherlands	0.80
New Zealand	0.84
Philippines	0.76
Romania	0.82
Russian Federation	0.84
Singapore	0.86
Slovak Republic	0.80
Slovenia	0.80
South Africa	0.77
Thailand	0.75
Tunisia	0.65
Turkey	0.74
International Median	0.80

States	Reliability Coefficient[1]
Connecticut	0.83
Idaho	0.83
Illinois	0.83
Indiana	0.82
Maryland	0.83
Massachusetts	0.83
Michigan	0.84
Missouri	0.83
North Carolina	0.83
Oregon	0.82
Pennsylvania	0.82
South Carolina	0.85
Texas	0.86
Districts and Consortia	
Academy School Dist. #20, CO	0.81
Chicago Public Schools, IL	0.78
Delaware Science Coalition, DE	0.82
First in the World Consort., IL	0.81
Fremont/Lincoln/WestSide PS, NE	0.85
Guilford County, NC	0.85
Jersey City Public Schools, NJ	0.82
Miami-Dade County PS, FL	0.82
Michigan Invitational Group, MI	0.83
Montgomery County, MD	0.83
Naperville Sch. Dist. #203, IL	0.77
Project SMART Consortium, OH	0.83
Rochester City Sch. Dist., NY	0.80
SW Math/Sci. Collaborative, PA	0.82

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

---

[1] For each country and jurisdiction, the reliability coefficient is the median KR-20 reliability across the eight test booklets.

Data Processing

To ensure the availability of comparable, high-quality data for analysis, TIMSS took rigorous quality control steps to create the international database.[9] TIMSS prepared manuals and software for countries to use in entering their data, so that the information would be in a standardized international format before being forwarded to the IEA Data Processing Center in Hamburg for creation of the international database. Upon arrival at the Data Processing Center, the data underwent an exhaustive cleaning process. This involved several iterative steps and procedures designed to identify, document, and correct deviations from the international instruments, file structures, and coding schemes. The process also emphasized consistency of information within national data sets and appropriate linking among the many student, teacher, and school data files. In the United States, the creation of the data files for both the Benchmarking participants and the U.S. national TIMSS effort was the responsibility of Westat, working closely with NCS. After the data files were checked carefully by Westat, they were sent to the IEA Data Processing Center, where they underwent further validity checks before being forwarded to the International Study Center.

IRT Scaling and Data Analysis

The general approach to reporting the TIMSS achievement data was based primarily on item response theory (IRT) scaling methods.[10] The science results were summarized using a family of 2-parameter and 3-parameter IRT models for dichotomously-scored items (right or wrong), and generalized partial credit models for items with 0, 1, or 2 available score points. The IRT scaling method produces a score by averaging the responses of each student to the items that he or she took in a way that takes into account the difficulty and discriminating power of each item. The methodology used in TIMSS includes refinements that enable reliable scores to be produced even though individual students responded to relatively small subsets of the total science item pool. Achievement scales were produced for each of the six science content areas (earth science, life science, physics, chemistry, environmental and resource issues, and scientific inquiry and the nature of science), as well as for science overall.

The IRT methodology was preferred for developing comparable estimates of performance for all students, since students answered different test items depending upon which of the eight test booklets they received. The IRT analysis provides a common scale on which performance can be compared across countries. In addition to providing a basis for estimating

---

[9] These steps are detailed in Hastedt, D., and Gonzalez, E. (2000), "Data Management and Database Construction" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

[10] For a detailed description of the TIMSS scaling, see Yamamoto, K., and Kulick, E. (2000), "Scaling Methods and Procedures for the TIMSS Mathematics and Science Scales" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

mean achievement, scale scores permit estimates of how students within countries vary and provide information on percentiles of performance. To provide a reliable measure of student achievement in both 1999 and 1995, the overall science scale was calibrated using students from the countries that participated in both years. When all countries participating in 1995 at the eighth grade are treated equally, the TIMSS scale average over those countries is 500 and the standard deviation is 100. Since the countries varied in size, each country was weighted to contribute equally to the mean and standard deviation of the scale. The average and standard deviation of the scale scores are arbitrary and do not affect scale interpretation. When the metric of the scale had been established, students from the countries that tested in 1999 but not 1995 were assigned scores on the basis of the new scale. IRT scales were also created for each of the six science content areas for the 1999 data. Students from the Benchmarking samples were assigned scores on the overall science scale as well as in each of the six science content areas using the same item parameters and estimation procedures as for TIMSS internationally.

To allow more accurate estimation of summary statistics for student subpopulations, the TIMSS scaling made use of plausible-value technology, whereby five separate estimates of each student's score were generated on each scale, based on the student's responses to the items in the student's booklet and the student's background characteristics. The five score estimates are known as "plausible values," and the variability between them encapsulates the uncertainty inherent in the score estimation process.

Estimating Sampling Error

Because the statistics presented in this report are estimates of performance based on samples of students, rather than the values that could be calculated if every student in every country or Benchmarking jurisdiction had answered every question, it is important to have measures of the degree of uncertainty of the estimates. The jackknife procedure was used to estimate the standard error associated with each statistic presented in this report.[11] The jackknife standard errors also include an error component due to variation between the five plausible values generated for each student. The use of confidence intervals, based on the standard errors, provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. An estimated sample statistic plus or minus two standard errors represents a 95 percent confidence interval for the corresponding population result.

---

[11] Procedures for computing jackknifed standard errors are presented in Gonzalez, E. and Foy, P. (2000), "Estimation of Sampling Variance" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

Making Multiple Comparisons

This report makes extensive use of statistical hypothesis-testing to provide a basis for evaluating the significance of differences in percentages and in average achievement scores. Each separate test follows the usual convention of holding to 0.05 the probability that reported differences could be due to sampling variability alone. However, in exhibits where statistical significance tests are reported, the results of many tests are reported simultaneously, usually at least one for each country and Benchmarking participant in the exhibit. The significance tests in these exhibits are based on a Bonferroni procedure for multiple comparisons that hold to 0.05 the probability of erroneously declaring a statistic (mean or percentage) for one entity to be different from that for another entity. In the multiple comparison charts (Exhibit 1.2 and those in Appendix B), the Bonferroni procedure adjusts for the number of entities in the chart, minus one. In exhibits where a country or Benchmarking participant statistic is compared to the international average, the adjustment is for the number of entities.[12]

Setting International Benchmarks of Student Achievement

International benchmarks of student achievement were computed at each grade level for both mathematics and science. The benchmarks are points in the weighted international distribution of achievement scores that separate the 10 percent of students located on top of the distribution, the top 25 percent of students, the top 50 percent, and the bottom 25 percent. The percentage of students in each country and Benchmarking jurisdiction meeting or exceeding the international benchmarks is reported. The benchmarks correspond to the 90th, 75th, 50th, and 25th percentiles of the international distribution of achievement. When computing these percentiles, each country contributed as many students to the distribution as there were students in the target population in the country. That is, each country's contribution to setting the international benchmarks was proportional to the estimated population enrolled at the eighth grade.

In order to interpret the TIMSS scale scores and analyze achievement at the international benchmarks, TIMSS conducted a scale anchoring analysis to describe achievement of students at those four points on the scale. Scale anchoring is a way of describing students' performance at different points on a scale in terms of what they know and can do. It involves a

---

[12] The application of the Bonferroni procedures is described in Gonzalez, E., and Gregory, K. (2000), "Reporting Student Achievement in Mathematics and Science" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College.

statistical component, in which items that discriminate between successive points on the scale are identified, and a judgmental component in which subject-matter experts examine the items and generalize to students' knowledge and understandings.[13]

Science Curriculum Questionnaire

In an effort to collect information about the content of the intended curriculum in science, TIMSS asked National Research Coordinators and Coordinators from the Benchmarking jurisdictions to complete a questionnaire about the structure, organization, and content coverage of their curricula. Coordinators reviewed 42 science topics and reported the percentage of their eighth-grade students for which each topic was intended in their curriculum. Although most topic descriptions were used without modification, there were occasions when Coordinators found it necessary to expand on or qualify the topic description to describe their situation accurately. The country-specific adaptations to the science curriculum questionnaire are presented in Exhibit A.9. No adaptations to the list of topics were necessary for the U.S. national version. Among Benchmarking participants, seven of the states and none of the districts or consortia made adaptations, and these are shown in Exhibit A.10.

---

[13] The scale anchoring procedure is described fully in Gregory, K., and Mullis, I. (2000), "Describing International Benchmarks of Student Achievement" in M.O. Martin, K.D. Gregory, K.M. O'Connor, and S.E. Stemler (eds.), *TIMSS 1999 Benchmarking Technical Report*, Chestnut Hill, MA: Boston College. An application of the procedure to the 1995 TIMSS data may be found in Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

Exhibit A.9 Country-Specific Variations in Science Topics in the Curriculum Questionnaire

8th Grade Science

	Topic	Response	Comments
Australia	Earth Science: Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	All or almost all of the students (at least 90%)	In some states, physical cycles, plate tectonics, & fossils not included in curriculum through grade 8.
	Biology: Interactions of living things (biomes and ecosystems, interdependence)	All or almost all of the students (at least 90%)	For one state, biomes not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Taught at a rudimentary level.
	Chemistry: Acids, bases, and salts	All or almost all of the students (at least 90%)	Taught at a rudimentary level.
	Physics: Wave phenomena, sound, and vibration	All or almost all of the students (at least 90%)	Taught at a basic level.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Acceleration not included in curriculum through grade 8.
Belgium	Biology: Reproduction, genetics, evolution, and speciation	All or almost all of the students (at least 90%)	Genetics, evolution, and speciation not included in curriculum through grade 8.
	Chemistry Topics	Not included in curriculum through grade 8	Chemistry is not yet taught as a formal course at grade 8, except in Steiner schools.
	Physics: Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)	All or almost all of the students (at least 90%)	Physics taught as a separate subject in only one education network.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Work not included in curriculum through grade 8.
	Physics: Light (reflection, refraction, light and color)	All or almost all of the students (at least 90%)	Physics taught as a separate subject in only one education network.
Chile	Earth Science: Earth's physical features (layers, landforms, bodies of water, rocks, soil)	All or almost all of the students (at least 90%)	Rocks & soil not included in curriculum through grade 8.
	Earth Science: Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	All or almost all of the students (at least 90%)	Plate tectonics & fossils not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	All or almost all of the students (at least 90%)	Genetics, evolution, and speciation not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Atoms, ions, and crystals not included in curriculum through grade 8.
	Chemistry: Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	All or almost all of the students (at least 90%)	Oxidation not included in curriculum through grade 8.
Chinese Taipei	Biology: Human nutrition, health, and disease	Not included in curriculum through grade 8	Human nutrition, health, and disease not part of science curriculum, but some of it is covered in health education class.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	Not included in curriculum through grade 8	Chemical, kinetic, electric and light energy not covered in detail until grade 9. The properties of electric and light energy are covered but not in detail.
	Physics: Gas laws (relationship between temperature / pressure / volume)	All or almost all of the students (at least 90%)	Temperature not included in curriculum through grade 8.
	Physics: Electricity and magnetism (circuits, conductivity, magnets)	All or almost all of the students (at least 90%)	Magnets not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	All or almost all of the students (at least 90%)	Formulating hypotheses, drawing conclusions, and generalizing not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error, accuracy, scales)	All or almost all of the students (at least 90%)	Reliability not included in curriculum through grade 8.
Cyprus	Earth Science: Earth's physical features (layers, landforms, bodies of water, rocks, soil)	All or almost all of the students (at least 90%)	Landforms, rocks, & soil not included in curriculum through grade 8.
	Earth Science: Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	All or almost all of the students (at least 90%)	Plate tectonics & fossils not included in curriculum through grade 8.
	Biology: Biology of plant and animal life (diversity, structure, life processes, life cycles)	All or almost all of the students (at least 90%)	Diversity not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	All or almost all of the students (at least 90%)	Genetics, evolution, and speciation not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Crystals not included in curriculum through grade 8.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Work and efficiency not included in curriculum through grade 8.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Country-Specific Variations in Science Topics in the Curriculum Questionnaire

	Topic	Response	Comments
Iran	Chemistry: Energy and chemical change (exothermic and endothermic reactions, reaction rates)	All or almost all of the students (at least 90%)	Topic is briefly covered in or by the end of grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	Not included in curriculum through grade 8.	Types of forces and balanced/unbalanced forces briefly covered by the end of grade 8.
Israel	Biology: Human bodily processes (metabolism, respiration, digestion)	All or almost all of the students (at least 90%)	Metabolism & digestion not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	Not included in curriculum through grade 8	Reproduction included in curriculum through grade 8.
Japan	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior and acceleration not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error, accuracy, scales)	Not included in curriculum through grade 8.	Replication and scales included in curriculum through grade 8.
Korea	Biology: Biology of plant and animal life (diversity, structure, life processes, life cycles)	All or almost all of the students (at least 90%)	Diversity and life processes are not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Ions and crystals not included in curriculum through grade 8.
	Chemistry: Acids, bases, and salts	All or almost all of the students (at least 90%)	Salts not included in curriculum through grade 8.
	Physics: Subatomic Particles (protons, electrons, neutrons)	Not included in curriculum through grade 8.	Electrons included in curriculum through grade 8.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Work and efficiency not included in curriculum through grade 8.
	Physics: Light (reflection, refraction, light and color)	All or almost all of the students (at least 90%)	Light and color not included in curriculum through grade 8.
	Physics: Electricity and magnetism (circuits, conductivity, magnets)	All or almost all of the students (at least 90%)	Conductivity not included in curriculum through grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior and acceleration not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	Not included in curriculum through grade 8.	Making observations included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error, accuracy, scales)	Not included in curriculum through grade 8.	Scales included in curriculum through grade 8.
New Zealand	Biology: Interactions of living things (biomes and ecosystems, interdependence)	All or almost all of the students (at least 90%)	Biomes not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	About half of the students	Evolution and speciation not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	About half of the students	Ions not included in curriculum through grade 8.
	Chemistry: Formation of solutions (solvents, solutes, soluble/insoluble substances)	All or almost all of the students (at least 90%)	Experiments with the phenomena only.
	Chemistry: Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	All or almost all of the students (at least 90%)	Definition of chemical change not included in curriculum through grade 8.
	Chemistry: Energy and chemical change (exothermic and endothermic reactions, reaction rates)	About half of the students	Exothermic and endothermic reactions not included in curriculum through grade 8.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Kinetic energy not included in curriculum through grade 8 (Level 6).
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior is not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error, accuracy, scales)	About half of the students	Experimental error not included in curriculum through grade 8.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Country-Specific Variations in Science Topics in the Curriculum Questionnaire

8th Grade Science

	Topic	Response	Comments
Russian Federation	Biology: Interactions of living things (biomes and ecosystems, interdependence)	Not included in curriculum through grade 8	Topic is briefly covered at the end of grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	Not included in curriculum through grade 8	Reproduction included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Crystals not included in curriculum through grade 8.
	Chemistry: Formation of solutions (solvents, solutes, soluble/insoluble substances)	All or almost all of the students (at least 90%)	Solvents and solutes not included in curriculum through grade 8.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Light energy not included in curriculum through grade 8.
	Physics: Heat and temperature	All or almost all of the students (at least 90%)	Temperature not included in curriculum through grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Acceleration not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Gathering, organizing, and representing data (units, tables, charts, graphs)	All or almost all of the students (at least 90%)	Charts and graphs not included in curriculum through grade 8.
Tunisia	Biology: Human bodily processes (metabolism, respiration, digestion)	All or almost all of the students (at least 90%)	Metabolism not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	All or almost all of the students (at least 90%)	Evolution and speciation not included in curriculum through grade 8.
	Environmental & Resource Issues: Pollution (acid rain, global warming, ozone layer, water pollution)	All or almost all of the students (at least 90%)	Acid rain, global warming, & ozone layer not included in curriculum through grade 8.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit A.10 State-Specific Variations in Science Topics in the Curriculum Questionnaire

8th Grade Science

	Topic	Response	Comments
Connecticut	Biology: Human bodily processes (metabolism, respiration, digestion)	All or almost all of the students (at least 90%)	Speciation not included in curriculum through grade 8.
	Chemistry: Structure of matter (atoms, ions, molecules, crystals)	All or almost all of the students (at least 90%)	Crystals not included in curriculum through grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior not included in curriculum through grade 8.
	Physics: Buoyancy	All or almost all of the students (at least 90%)	Only density included in curriculum through grade 8.
Maryland	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Balanced/unbalanced forces and fluid behavior not included in curriculum through grade 8.
Massachusetts	Chemistry: Acids, bases, and salts	All or almost all of the students (at least 90%)	Salts not included in curriculum through grade 8.
	Chemistry: Energy and chemical change (exothermic and endothermic reactions, reaction rates)	All or almost all of the students (at least 90%)	Reaction rates not included in curriculum through grade 8.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Efficiency not included in curriculum through grade 8.
	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error, accuracy, scales)	All or almost all of the students (at least 90%)	Reliability and accuracy not included in curriculum through grade 8.
Michigan	Earth Science: Earth atmosphere (layers, composition, temperature, pressure)	All or almost all of the students (at least 90%)	Layers not included in curriculum through grade 8.
	Earth Science: Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	All or almost all of the students (at least 90%)	Plate tectonics not included in curriculum through grade 8.
	Biology: Reproduction, genetics, evolution, and speciation	All or almost all of the students (at least 90%)	Evolution and speciation not included in curriculum through grade 8.
	Chemistry: Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	All or almost all of the students (at least 90%)	Taught at a basic level.
	Physics: Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	All or almost all of the students (at least 90%)	Work and efficiency not included in curriculum through grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior not included in curriculum through grade 8.
Oregon	Earth Science: Earth's physical features (layers, landforms, bodies of water, rocks, soil)	All or almost all of the students (at least 90%)	Landforms not included in curriculum through grade 8.
	Earth Science: Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils).	All or almost all of the students (at least 90%)	Fossils not included in curriculum through grade 8.
	Earth Science: Earth in the solar system and the universe (interactions between Earth, sun, and moon; relationship to planets and stars)	All or almost all of the students (at least 90%)	Relationship to planets not included in curriculum through grade 8.
	Biology: Biology of plant and animal life (diversity, structure, life processes, life cycles)	All or almost all of the students (at least 90%)	Diversity not included in curriculum through grade 8.
	Environmental & Resource Issues: Food supply and reproduction, population, and environmental effects of natural and man-made events	All or almost all of the students (at least 90%)	Food supply not included in curriculum through grade 8.
South Carolina	Biology: Reproduction, genetics, evolution, and speciation	About half of the students	Evolution addressed in detail in High School.
	Chemistry: Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	About half of the students	Oxidation and combustion addressed in detail in High School.
	Chemistry: Energy and chemical change (exothermic and endothermic reactions, reaction rates)	About half of the students	Reaction rates not included in curriculum through grade 8.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior not included in curriculum through grade 8.
Texas	Biology: Biology of plant and animal life (diversity, structure, life processes, life cycles)	All or almost all of the students (at least 90%)	Life processes not covered in detail.
	Biology: Photosynthesis	All or almost all of the students (at least 90%)	Taught at a basic level.
	Chemistry: Formation of solutions (solvents, solutes, soluble/insoluble substances)	All or almost all of the students (at least 90%)	Taught at a basic level.
	Physics: Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	All or almost all of the students (at least 90%)	Fluid behavior not included in curriculum through grade 8.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

APPENDIX B

Multiple Comparisons of Average Achievement in Science Content Areas

Exhibit B.1 Multiple Comparisons of Average Achievement in Earth Science

8th Grade Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Hungary	**Naperville Sch. Dist. #203, IL**	**Michigan Invitational Group, MI**	Slovenia	**First in the World Consort., IL**	Chinese Taipei	Slovak Republic	**Academy School Dist. #20, CO**	Netherlands	Japan	Belgium (Flemish)	Czech Republic	Korea, Rep. of	**Project SMART Consortium, OH**	Russian Federation	**SW Math/Sci. Collaborative, PA**	**Oregon**	**Michigan**	England	Singapore	Finland	Bulgaria	**Guilford County, NC**	Australia	Canada	**Montgomery County, MD**	**Massachusetts**	**Indiana**	***Pennsylvania***	**South Carolina**	**Idaho**	**Missouri**
Hungary		●	●	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	●		●	●	●	●	●	●	●	●	▲	●	▲	●	▲	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲
Slovenia	▼	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲
First in the World Consort., IL	▼	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	●	▲	▲	▲
Chinese Taipei	▼	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	●	▲	▲	▲
Slovak Republic	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Academy School Dist. #20, CO	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Netherlands	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Japan	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Czech Republic	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Korea, Rep. of	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Project SMART Consortium, OH	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Russian Federation	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SW Math/Sci. Collaborative, PA	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Singapore	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Finland	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Bulgaria	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Guilford County, NC	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Australia	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Canada	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Massachusetts	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Indiana	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Pennsylvania	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
South Carolina	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Idaho	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Missouri	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Connecticut	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
Illinois	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	▼	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	▼	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	▼	●	●	●	●	●	●	●
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	▼	●	●	●	●
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

Multiple Comparisons of Average Achievement in Earth Science

	Connecticut	Hong Kong, SAR	**Illinois**	New Zealand	**United States**	***Texas***	Italy	**North Carolina**	**Delaware Science Coalition, DE**	**Fremont/Lincoln/WestSide PS, NE**	Latvia (LSS)	**Maryland**	Malaysia	Lithuania	Romania	Israel	Thailand	Moldova	Macedonia, Rep. of	**Rochester City Sch. Dist., NY**	Cyprus	Iran, Islamic Rep.	**Chicago Public Schools, IL**	**Jersey City Public Schools, NJ**	Jordan	**Miami-Dade County PS, FL**	Tunisia	Chile	Turkey	Indonesia	Philippines	Morocco	South Africa
Hungary	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovak Republic	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	●	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Belgium (Flemish)	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Korea, Rep. of	▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Project SMART Consortium, OH	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Russian Federation	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
SW Math/Sci. Collaborative, PA	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Oregon	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	●	▲	●	●	▲	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Finland	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Bulgaria	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Guilford County, NC	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Montgomery County, MD	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Massachusetts	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Indiana	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Pennsylvania	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
South Carolina	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Idaho	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Missouri	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Connecticut		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong, SAR	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Illinois	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Texas	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Italy	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
North Carolina	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Delaware Science Coalition, DE	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Fremont/Lincoln/WestSide PS, NE	●	●	●	●	●	●	●	●	●		●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Maryland	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Malaysia	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Lithuania	▼	▼	▼	▼	▼	●	▼	●	●	▼	●	●	●		●	●	●	●	●	●	●	●	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Romania	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Israel	▼	▼	▼	▼	▼	●	▼	▼	●	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Thailand	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	▲	▲	▲
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	▲	▲	▲
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	▲	▲	▲
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		▲	▲	▲
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	▲
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	

▲ Average achievement significantly higher than comparison participant

● No statistically significant difference from comparison participant

▼ Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.2 Multiple Comparisons of Average Achievement in Life Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Naperville Sch. Dist. #203, IL	**First in the World Consort., IL**	**Academy School Dist. #20, CO**	**Michigan Invitational Group, MI**	Chinese Taipei	**SW Math/Sci. Collaborative, PA**	Czech Republic	**Michigan**	Singapore	**Oregon**	**Project SMART Consortium, OH**	**Indiana**	Netherlands	Slovak Republic	Hungary	Belgium (Flemish)	Japan	**Connecticut**	England	**Guilford County, NC**	**Massachusetts**	**Idaho**	Australia	**Montgomery County, MD**	***Pennsylvania***	Korea, Rep. of	**Missouri**	**Illinois**	**Fremont/Lincoln/WestSide PS, NE**	Canada	Slovenia	Finland
Naperville Sch. Dist. #203, IL		●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	●		●	●	●	●	▲	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	▲	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	▼	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲
SW Math/Sci. Collaborative, PA	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Czech Republic	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲
Michigan	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Singapore	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Project SMART Consortium, OH	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Indiana	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Netherlands	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hungary	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Japan	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connecticut	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Guilford County, NC	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Massachusetts	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Idaho	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Australia	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Pennsylvania	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Korea, Rep. of	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Missouri	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Illinois	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Canada	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Slovenia	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Finland	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
United States	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
South Carolina	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Russian Federation	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bulgaria	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	●	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	●	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	●	●	●	●	●	▼	▼	●	▼	●	●	●	●	●	●
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	▼	▼	●	▼	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	▼	●	●
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

United States	**South Carolina**	Russian Federation	Hong Kong, SAR	Bulgaria	***Texas***	**North Carolina**	**Maryland**	Latvia (LSS)	Thailand	**Delaware Science Coalition, DE**	New Zealand	Lithuania	Italy	Malaysia	Moldova	**Rochester City Sch. Dist., NY**	Romania	**Chicago Public Schools, IL**	Cyprus	Macedonia, Rep. of	Israel	**Jersey City Public Schools, NJ**	Jordan	Indonesia	**Miami-Dade County PS, FL**	Turkey	Tunisia	Iran, Islamic Rep.	Chile	Philippines	Morocco	South Africa	
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Naperville Sch. Dist. #203, IL**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**First in the World Consort., IL**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Academy School Dist. #20, CO**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan Invitational Group, MI**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Chinese Taipei
●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**SW Math/Sci. Collaborative, PA**
▲	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Czech Republic
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan**
●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Singapore
●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Oregon**
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Project SMART Consortium, OH**
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Indiana**
●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Netherlands
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovak Republic
●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hungary
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Belgium (Flemish)
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Japan
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Connecticut**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	England
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Guilford County, NC**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Massachusetts**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Idaho**
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Australia
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Montgomery County, MD**
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Pennsylvania***
●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Korea, Rep. of
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Missouri**
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Illinois**
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Fremont/Lincoln/WestSide PS, NE**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Canada
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovenia
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Finland
	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**United States**
●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**South Carolina**
●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Russian Federation
●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hong Kong, SAR
●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Bulgaria
●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Texas***
●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**North Carolina**
●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Maryland**
●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Latvia (LSS)
●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Thailand
●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Delaware Science Coalition, DE**
●	●	●	●	●	●	●	●	●	●	●		●	●	●	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New Zealand
▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Lithuania
▼	▼	▼	▼	●	●	▼	●	▼	●	●	●	●		●	●	●	●	●	▲	●	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	Italy
▼	▼	▼	▼	▼	●	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	Malaysia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	Moldova
▼	▼	▼	▼	▼	●	▼	●	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	**Rochester City Sch. Dist., NY**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	Romania
▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	**Chicago Public Schools, IL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	Cyprus
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	Macedonia, Rep. of
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	Israel
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	**Jersey City Public Schools, NJ**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●		●	●	●	●	●	●	▲	▲	▲	Jordan
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●	●		●	●	●	●	▲	▲	▲	▲	Indonesia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	**Miami-Dade County PS, FL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	●		●	●	●	▲	▲	▲	Turkey
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	●	●		●	●	▲	▲	▲	Tunisia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	●	●	●		●	▲	▲	▲	Iran, Islamic Rep.
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●		▲	▲	▲	Chile
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	▲	Philippines
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	Morocco
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		South Africa

▲	Average achievement significantly higher than comparison participant
●	No statistically significant difference from comparison participant
▼	Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.3 Multiple Comparisons of Average Achievement in Physics

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Singapore	**Naperville Sch. Dist. #203, IL**	Chinese Taipei	Japan	Korea, Rep. of	Hungary	**First in the World Consort., IL**	Netherlands	**Michigan Invitational Group, MI**	**Academy School Dist. #20, CO**	Australia	Belgium (Flemish)	Russian Federation	England	Czech Republic	Slovenia	**Michigan**	Hong Kong, SAR	Canada	Finland	Slovak Republic	**Project SMART Consortium, OH**	**SW Math/Sci. Collaborative, PA**	**Montgomery County, MD**	**Oregon**	**Guilford County, NC**	Lithuania	**Massachusetts**	**Indiana**	**Connecticut**	**Idaho**	**Missouri**
Singapore		●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	●	●		●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▼	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Korea, Rep. of	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hungary	▼	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	●	▲	▲
Netherlands	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	●	▲
Michigan Invitational Group, MI	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Academy School Dist. #20, CO	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Australia	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	●	▲
Russian Federation	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Czech Republic	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovenia	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Canada	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Finland	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Project SMART Consortium, OH	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
SW Math/Sci. Collaborative, PA	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Oregon	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Guilford County, NC	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Massachusetts	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Indiana	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Connecticut	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Idaho	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Missouri	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Illinois	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bulgaria	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pennsylvania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
South Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

Exhibit B.3
(Continued)

Multiple Comparisons of Average Achievement in Physics

Illinois	Bulgaria	***Pennsylvania***	New Zealand	**United States**	Latvia (LSS)	Malaysia	***Texas***	**Fremont/Lincoln/WestSide PS, NE**	**South Carolina**	**Maryland**	**North Carolina**	**Delaware Science Coalition, DE**	Israel	Italy	Thailand	Romania	Macedonia, Rep. of	Cyprus	Jordan	Moldova	**Chicago Public Schools, IL**	Indonesia	**Rochester City Sch. Dist., NY**	**Jersey City Public Schools, NJ**	Iran, Islamic Rep.	Turkey	**Miami-Dade County PS, FL**	Chile	Tunisia	Philippines	Morocco	South Africa	
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Singapore
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Naperville Sch. Dist. #203, IL**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Chinese Taipei
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Japan
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Korea, Rep. of
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hungary
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**First in the World Consort., IL**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Netherlands
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan Invitational Group, MI**
●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Academy School Dist. #20, CO**
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Australia
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Belgium (Flemish)
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Russian Federation
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	England
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Czech Republic
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovenia
●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan**
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hong Kong, SAR
●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Canada
●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Finland
●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovak Republic
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Project SMART Consortium, OH**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**SW Math/Sci. Collaborative, PA**
●	●	●	●	●	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Montgomery County, MD**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Oregon**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Guilford County, NC**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Lithuania
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Massachusetts**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Indiana**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Connecticut**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Idaho**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Missouri**
	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Illinois**
●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Bulgaria
●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Pennsylvania***
●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New Zealand
●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**United States**
●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Latvia (LSS)
●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Malaysia
●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Texas***
●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Fremont/Lincoln/WestSide PS, NE**
●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**South Carolina**
●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Maryland**
●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**North Carolina**
●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	**Delaware Science Coalition, DE**
●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Israel
▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	Italy
▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	Thailand
▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	Romania
▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	Macedonia, Rep. of
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	Cyprus
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	Jordan
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	Moldova
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	**Chicago Public Schools, IL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	Indonesia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	**Rochester City Sch. Dist., NY**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	**Jersey City Public Schools, NJ**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	Iran, Islamic Rep.
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	●	●	●	●	●	●		●	●	●	▲	▲	▲	Turkey
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	▲	▲	▲	**Miami-Dade County PS, FL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	▲	▲	▲	Chile
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●		▲	▲	▲	Tunisia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	▲	Philippines
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		▲	Morocco
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		South Africa

▲	Average achievement significantly higher than comparison participant
●	No statistically significant difference from comparison participant
▼	Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.4 Multiple Comparisons of Average Achievement in Chemistry

8th Grade Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Chinese Taipei	**Naperville Sch. Dist. #203, IL**	**Michigan Invitational Group, MI**	**Academy School Dist. #20, CO**	**First in the World Consort., IL**	Hungary	Singapore	**SW Math/Sci. Collaborative, PA**	**Michigan**	Finland	**Project SMART Consortium, OH**	Japan	Bulgaria	**Oregon**	Slovak Republic	**Indiana**	England	Korea, Rep. of	Russian Federation	**Massachusetts**	**Connecticut**	Canada	Australia	**Montgomery County, MD**	**Guilford County, NC**	**Idaho**	***Pennsylvania***	Hong Kong, SAR	Netherlands	**Missouri**	**Fremont/Lincoln/WestSide PS, NE**	Czech Republic
Chinese Taipei		●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	●	●	●		●	●	●	●	●	●	●	▲	●	●	▲	●	▲	▲	●	●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●	●	▲	▲	●	●	●	▲	▲	▲	▲	▲
Hungary	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	●	▲	▲	●	●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲
Singapore	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
SW Math/Sci. Collaborative, PA	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Finland	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲
Project SMART Consortium, OH	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Japan	▼	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bulgaria	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Indiana	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Korea, Rep. of	▼	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Russian Federation	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Massachusetts	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Connecticut	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Canada	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Australia	▼	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Guilford County, NC	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Idaho	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Pennsylvania	▼	▼	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Netherlands	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Missouri	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Czech Republic	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Slovenia	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Illinois	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●
South Carolina	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	▼	●	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	▼	▼	●	●	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

	Slovenia	**Illinois**	**United States**	Belgium (Flemish)	New Zealand	**South Carolina**	**North Carolina**	**Maryland**	***Texas***	**Delaware Science Coalition, DE**	Italy	Latvia (LSS)	Iran, Islamic Rep.	Lithuania	Malaysia	Jordan	Romania	Macedonia, Rep. of	Israel	Cyprus	**Rochester City Sch. Dist., NY**	Moldova	**Chicago Public Schools, IL**	Tunisia	Thailand	Turkey	**Miami-Dade County PS, FL**	Chile	**Jersey City Public Schools, NJ**	Indonesia	Philippines	Morocco	South Africa
Chinese Taipei	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hungary	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
SW Math/Sci. Collaborative, PA	●	●	●	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan	●	●	▲	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Finland	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Project SMART Consortium, OH	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▲	●	▲	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Bulgaria	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Oregon	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovak Republic	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Indiana	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Korea, Rep. of	●	●	●	●	▲	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Russian Federation	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Massachusetts	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Connecticut	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Montgomery County, MD	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Guilford County, NC	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Idaho	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Pennsylvania	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong, SAR	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Missouri	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Fremont/Lincoln/WestSide PS, NE	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Illinois	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Belgium (Flemish)	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
South Carolina	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
North Carolina	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Maryland	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Texas	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Delaware Science Coalition, DE	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Italy	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	●	●	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Iran, Islamic Rep.	▼	●	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Lithuania	▼	●	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Malaysia	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Jordan	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Romania	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Macedonia, Rep. of	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Israel	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	●	▲	▲	▲
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	●	●	▲	▲	▲
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲	▲
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	▲	▲	▲
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	▲	▲	▲
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	▲	▲	▲
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	▲	▲
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		▲	▲	▲
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼		●	▲
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

▲	Average achievement significantly higher than comparison participant
●	No statistically significant difference from comparison participant
▼	Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.5 Multiple Comparisons of Average Achievement in Environmental and Resource Issues

8th Grade Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Singapore	Chinese Taipei	**Naperville Sch. Dist. #203, IL**	**Michigan Invitational Group, MI**	**First in the World Consort., IL**	**Academy School Dist. #20, CO**	**Guilford County, NC**	Australia	**Michigan**	**SW Math/Sci. Collaborative, PA**	**Indiana**	Netherlands	**Project SMART Consortium, OH**	Korea, Rep. of	**Idaho**	***Pennsylvania***	**Massachusetts**	Canada	**Oregon**	Slovenia	Hong Kong, SAR	England	**Montgomery County, MD**	Czech Republic	**Connecticut**	**Missouri**	Finland	Belgium (Flemish)	**Illinois**	Slovak Republic	**United States**	**Fremont/Lincoln/WestSide PS, NE**
Singapore		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Naperville Sch. Dist. #203, IL	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	●	●	●	●		●	●	●	●	●	●	●	●	▲	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	▼	▼	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲
Guilford County, NC	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Australia	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SW Math/Sci. Collaborative, PA	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Indiana	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Netherlands	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Project SMART Consortium, OH	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Korea, Rep. of	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Idaho	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pennsylvania	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Massachusetts	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Canada	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oregon	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Slovenia	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Czech Republic	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Connecticut	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Missouri	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Finland	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Belgium (Flemish)	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Illinois	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Slovak Republic	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
United States	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Thailand	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Japan	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
South Carolina	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Carolina	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Maryland	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Malaysia	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hungary	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Russian Federation	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	●	●	▼	●	●	●	▼	●	▼	●	●	●	●	●	●	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	●	●	▼	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	▼	▼	▼	●	●	●	●	●	▼	●	●	●	●
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	▼	●	▼	●	●
Bulgaria	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	▼	●	▼	●	●
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

Thailand	Japan	**South Carolina**	**North Carolina**	**Maryland**	New Zealand	Malaysia	***Texas***	Hungary	Russian Federation	**Delaware Science Coalition, DE**	Latvia (LSS)	Italy	Indonesia	Bulgaria	Jordan	Cyprus	Romania	Iran, Islamic Rep.	Tunisia	Turkey	Lithuania	Israel	**Jersey City Public Schools, NJ**	Chile	Moldova	**Chicago Public Schools, IL**	**Rochester City Sch. Dist., NY**	Macedonia, Rep. of	**Miami-Dade County PS, FL**	Morocco	Philippines	South Africa	
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Singapore
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Chinese Taipei
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Naperville Sch. Dist. #203, IL**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan Invitational Group, MI**
▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**First in the World Consort., IL**
▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Academy School Dist. #20, CO**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Guilford County, NC**
▲	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Australia
●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Michigan**
●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**SW Math/Sci. Collaborative, PA**
●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Indiana**
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Netherlands
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Project SMART Consortium, OH**
●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Korea, Rep. of
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Idaho**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Pennsylvania***
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Massachusetts**
●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Canada
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Oregon**
●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovenia
●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hong Kong, SAR
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	England
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Montgomery County, MD**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Czech Republic
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Connecticut**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Missouri**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Finland
●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Belgium (Flemish)
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Illinois**
●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Slovak Republic
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**United States**
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Fremont/Lincoln/WestSide PS, NE**
	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Thailand
●		●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Japan
●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**South Carolina**
●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**North Carolina**
●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Maryland**
●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New Zealand
●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Malaysia
●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	***Texas***
●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Hungary
●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Russian Federation
●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	**Delaware Science Coalition, DE**
●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Latvia (LSS)
●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Italy
●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Indonesia
▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	Bulgaria
▼	▼	●	●	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	Jordan
▼	▼	●	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	Cyprus
▼	▼	●	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	Romania
▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	Iran, Islamic Rep.
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	Tunisia
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	●	▲	▲	▲	Turkey
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	Lithuania
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	▲	●	▲	▲	▲	Israel
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	**Jersey City Public Schools, NJ**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	Chile
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	Moldova
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	▲	▲	▲	**Chicago Public Schools, IL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	▲	▲	▲	**Rochester City Sch. Dist., NY**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	▲	▲	▲	Macedonia, Rep. of
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	▲	**Miami-Dade County PS, FL**
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	▲	Morocco
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		▲	Philippines
▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		South Africa

▲	Average achievement significantly higher than comparison participant
●	No statistically significant difference from comparison participant
▼	Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.6 Multiple Comparisons of Average Achievement in Scientific Inquiry and the Nature of Science

8th Grade Science

Instructions: Read across the row for a participant to compare performance with the participants listed along the top of the chart. The symbols indicate whether the average achievement of the participant in the row is significantly lower than that of the comparison participant, significantly higher than that of the comparison participant, or if there is no statistically significant difference between the average achievement of the two participants.

	Naperville Sch. Dist. #203, IL	**First in the World Consort., IL**	Singapore	Korea, Rep. of	**Michigan Invitational Group, MI**	Japan	**Massachusetts**	**Montgomery County, MD**	**SW Math/Sci. Collaborative, PA**	**Academy School Dist. #20, CO**	Chinese Taipei	**Michigan**	England	Australia	Netherlands	**Connecticut**	**Guilford County, NC**	Canada	**Illinois**	***Pennsylvania***	Hong Kong, SAR	Finland	**Indiana**	**Project SMART Consortium, OH**	Belgium (Flemish)	Hungary	**Oregon**	**Maryland**	**United States**	Czech Republic	New Zealand	**South Carolina**
Naperville Sch. Dist. #203, IL		●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	●		●	●	●	▲	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▼	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	●	▲
Korea, Rep. of	▼	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan Invitational Group, MI	▼	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	●
Japan	▼	▼	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	●	●
Massachusetts	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Montgomery County, MD	▼	▼	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SW Math/Sci. Collaborative, PA	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Academy School Dist. #20, CO	▼	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Chinese Taipei	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Michigan	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
England	▼	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Australia	▼	▼	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Netherlands	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connecticut	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Guilford County, NC	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Canada	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Illinois	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
Pennsylvania	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Finland	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Indiana	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
Project SMART Consortium, OH	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Belgium (Flemish)	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Hungary	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
Oregon	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Maryland	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
United States	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Czech Republic	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
New Zealand	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
South Carolina	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
North Carolina	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Missouri	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●
Texas	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Idaho	▼	▼	▼	●	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovenia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●	▼	●	●	●	●	●	●	●	●	●	●	●
Fremont/Lincoln/WestSide PS, NE	▼	▼	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●
Delaware Science Coalition, DE	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●
Jersey City Public Schools, NJ	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	●	●	●	●	●	●	●	●	●	●
Chicago Public Schools, IL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	▼	●	●	●
Russian Federation	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Italy	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Malaysia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Lithuania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Bulgaria	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

Exhibit B.6 (Continued)

Multiple Comparisons of Average Achievement in Scientific Inquiry and the Nature of Science

	North Carolina	**Missouri**	***Texas***	**Idaho**	Slovenia	**Fremont/Lincoln/WestSide PS, NE**	Slovak Republic	**Delaware Science Coalition, DE**	Latvia (LSS)	**Jersey City Public Schools, NJ**	**Chicago Public Schools, IL**	Russian Federation	Italy	Malaysia	Lithuania	Bulgaria	**Rochester City Sch. Dist., NY**	Israel	Moldova	Cyprus	Macedonia, Rep. of	**Miami-Dade County PS, FL**	Thailand	Romania	Tunisia	Iran, Islamic Rep.	Indonesia	Turkey	Chile	Jordan	Philippines	Morocco	South Africa
Naperville Sch. Dist. #203, IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
First in the World Consort., IL	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Korea, Rep. of	▲	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan Invitational Group, MI	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Massachusetts	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Montgomery County, MD	▲	▲	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
SW Math/Sci. Collaborative, PA	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Academy School Dist. #20, CO	▲	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chinese Taipei	▲	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Michigan	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Connecticut	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Guilford County, NC	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Illinois	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Pennsylvania	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong, SAR	●	▲	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Finland	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Indiana	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Project SMART Consortium, OH	●	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Belgium (Flemish)	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hungary	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Oregon	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Maryland	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	●	●	●	●	●	●	●	●	▲	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
South Carolina	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
North Carolina		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Missouri	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Texas	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Idaho	●	●	●		●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Fremont/Lincoln/WestSide PS, NE	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovak Republic	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Delaware Science Coalition, DE	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Jersey City Public Schools, NJ	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Chicago Public Schools, IL	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Russian Federation	▼	▼	●	●	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Italy	▼	▼	●	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Malaysia	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●		●	●	●	●	●	▲	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Lithuania	▼	▼	●	●	▼	●	▼	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Bulgaria	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Rochester City Sch. Dist., NY	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲
Israel	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲
Moldova	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	●	▲	●	▲	▲	▲	▲	▲
Macedonia, Rep. of	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲
Miami-Dade County PS, FL	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	▲	▲	▲
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	▼	▼	●	●	●	●	●	●	●	●		●	●	●	●	●	▲	●	▲	▲	▲
Romania	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	▲	▲	▲
Tunisia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●		●	●	●	●	●	▲	▲	▲
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●		●	●	●	●	▲	▲	▲
Indonesia	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	●	●	●	●	●	●		●	●	●	▲	▲	▲
Turkey	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	▼	●	●	●	●	●	●	●	●		●	●	▲	▲	▲
Chile	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●		●	▲	▲	▲
Jordan	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●		▲	▲	▲
Philippines	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●	▲
Morocco	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		▲
South Africa	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

- ▲ Average achievement significantly higher than comparison participant
- ● No statistically significant difference from comparison participant
- ▼ Average achievement significantly lower than comparison participant

Significance tests adjusted for multiple comparisons

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

APPENDIX

C

Percentiles and Standard Deviations of Science Achievement

Exhibit C.1 Percentiles of Achievement in Science – Countries

8th Grade Science

	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
United States	349 (5.5)	450 (5.4)	520 (5.3)	583 (4.6)	667 (3.4)
Australia	391 (5.9)	485 (7.8)	544 (4.4)	601 (5.6)	675 (3.8)
Belgium (Flemish)	415 (10.9)	490 (4.5)	539 (3.4)	583 (3.3)	642 (6.2)
Bulgaria	356 (9.9)	459 (5.4)	521 (4.5)	581 (7.4)	663 (9.8)
Canada	403 (4.9)	482 (3.2)	534 (2.5)	586 (2.5)	657 (3.6)
Chile	272 (5.8)	363 (3.6)	423 (3.3)	480 (6.1)	561 (7.8)
Chinese Taipei	414 (7.0)	514 (4.2)	574 (5.6)	630 (4.2)	704 (4.8)
Cyprus	315 (4.4)	407 (3.4)	464 (2.7)	518 (2.8)	593 (5.4)
Czech Republic	410 (6.8)	485 (5.4)	539 (4.5)	593 (7.2)	672 (4.0)
England	388 (4.5)	479 (6.8)	540 (6.2)	598 (5.8)	686 (8.4)
Finland	407 (8.3)	485 (3.7)	536 (3.8)	587 (2.6)	662 (8.6)
Hong Kong, SAR	410 (9.3)	488 (5.0)	533 (4.1)	576 (4.6)	637 (4.5)
Hungary	411 (10.1)	499 (4.7)	556 (3.5)	609 (4.1)	686 (4.1)
Indonesia	291 (11.6)	383 (4.4)	439 (4.5)	492 (4.0)	568 (6.7)
Iran, Islamic Rep.	307 (8.6)	392 (4.3)	449 (3.9)	505 (6.2)	584 (4.9)
Israel	282 (9.6)	400 (7.6)	476 (4.5)	543 (3.7)	627 (4.6)
Italy	344 (5.6)	436 (4.8)	496 (5.1)	554 (4.4)	631 (4.3)
Japan	421 (5.2)	501 (1.8)	553 (2.3)	602 (3.2)	667 (3.8)
Jordan	276 (10.6)	380 (3.5)	454 (3.9)	524 (4.8)	611 (4.6)
Korea, Rep. of	406 (4.1)	493 (2.8)	550 (3.6)	607 (3.9)	684 (4.7)
Latvia (LSS)	371 (12.6)	452 (4.5)	504 (4.2)	555 (5.6)	627 (7.7)
Lithuania	352 (9.6)	434 (5.9)	490 (4.2)	543 (3.5)	622 (6.5)
Macedonia, Rep. of	289 (8.2)	394 (8.0)	464 (3.8)	527 (5.3)	607 (5.8)
Malaysia	356 (7.7)	440 (4.7)	493 (4.5)	547 (4.3)	626 (4.8)
Moldova	299 (7.1)	396 (4.2)	462 (4.0)	525 (4.8)	611 (3.2)
Morocco	147 (8.5)	256 (5.6)	326 (5.8)	395 (3.7)	483 (5.1)
Netherlands	411 (14.5)	500 (9.0)	551 (5.7)	595 (5.3)	662 (9.9)
New Zealand	348 (11.2)	451 (5.7)	515 (6.7)	574 (4.4)	652 (9.3)
Philippines	144 (9.2)	261 (7.2)	347 (8.1)	431 (10.3)	539 (7.7)
Romania	306 (8.3)	409 (9.1)	476 (7.4)	539 (8.2)	624 (5.2)
Russian Federation	374 (5.9)	468 (8.0)	529 (5.6)	591 (7.5)	683 (11.8)
Singapore	395 (15.2)	507 (9.8)	574 (8.9)	635 (8.0)	718 (9.3)
Slovak Republic	406 (4.6)	485 (4.5)	537 (3.0)	586 (5.5)	659 (8.8)
Slovenia	392 (5.9)	477 (3.3)	534 (4.4)	590 (2.6)	670 (6.1)
South Africa	53 (4.4)	149 (5.1)	223 (6.2)	316 (12.9)	504 (12.1)
Thailand	362 (4.7)	435 (2.9)	483 (4.8)	532 (6.3)	602 (6.6)
Tunisia	318 (5.3)	385 (4.5)	431 (3.1)	474 (3.2)	538 (6.3)
Turkey	302 (8.1)	380 (5.6)	434 (5.0)	487 (4.4)	562 (4.6)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

( ) Standard errors appear in parentheses.

Exhibit C.1
(Continued)

Percentiles of Achievement in Science – States and Districts/Consortia

8th Grade Science

	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
States					
Connecticut	373 (16.9)	471 (16.1)	533 (10.8)	592 (7.4)	670 (16.3)
Idaho	376 (13.1)	475 (10.0)	533 (7.8)	585 (5.7)	655 (5.0)
Illinois	367 (10.5)	461 (7.5)	524 (7.0)	583 (8.6)	661 (10.6)
Indiana	384 (8.4)	479 (9.0)	539 (6.9)	594 (5.3)	669 (8.1)
Maryland	345 (11.5)	442 (11.4)	510 (8.7)	573 (7.8)	654 (10.3)
Massachusetts	385 (9.5)	476 (7.9)	535 (7.6)	593 (8.7)	674 (15.1)
Michigan	375 (25.7)	489 (11.0)	551 (7.5)	608 (8.6)	687 (7.3)
Missouri	367 (14.4)	466 (9.9)	527 (6.7)	585 (7.4)	659 (9.0)
North Carolina	355 (6.8)	448 (9.8)	512 (6.8)	571 (7.9)	647 (6.7)
Oregon	373 (13.2)	481 (11.6)	543 (3.7)	598 (5.8)	674 (3.9)
Pennsylvania	376 (12.3)	476 (9.1)	532 (8.0)	587 (5.9)	668 (7.3)
South Carolina	349 (8.0)	447 (5.7)	515 (8.1)	579 (5.8)	658 (8.0)
Texas	326 (14.6)	441 (15.5)	518 (13.4)	583 (8.0)	663 (7.8)
Districts and Consortia					
Academy School Dist. #20, CO	428 (9.2)	511 (4.8)	562 (2.5)	611 (3.8)	676 (5.3)
Chicago Public Schools, IL	301 (17.5)	390 (10.0)	451 (8.7)	511 (12.2)	594 (13.2)
Delaware Science Coalition, DE	344 (11.3)	437 (6.7)	503 (9.4)	568 (12.5)	647 (13.6)
First in the World Consort., IL	439 (11.9)	514 (4.6)	565 (6.2)	620 (8.8)	686 (7.4)
Fremont/Lincoln/WestSide PS, NE	346 (8.4)	457 (9.1)	518 (9.3)	573 (5.6)	648 (7.1)
Guilford County, NC	374 (11.3)	470 (9.2)	539 (7.5)	601 (8.1)	677 (4.9)
Jersey City Public Schools, NJ	280 (14.1)	377 (8.5)	441 (8.1)	503 (11.1)	594 (16.6)
Miami-Dade County PS, FL	245 (22.8)	358 (9.6)	430 (6.7)	498 (12.5)	600 (15.3)
Michigan Invitational Group, MI	420 (11.1)	513 (8.0)	566 (6.5)	617 (11.3)	693 (8.2)
Montgomery County, MD	375 (11.5)	473 (5.7)	536 (5.1)	594 (4.2)	674 (5.2)
Naperville Sch. Dist. #203, IL	457 (8.3)	537 (4.6)	585 (3.9)	633 (5.4)	707 (6.8)
Project SMART Consortium, OH	392 (10.5)	483 (9.8)	543 (10.5)	599 (9.7)	674 (8.4)
Rochester City Sch. Dist., NY	310 (11.6)	392 (5.7)	450 (7.4)	510 (10.5)	597 (14.5)
SW Math/Sci. Collaborative, PA	400 (19.2)	488 (10.6)	546 (6.6)	601 (8.1)	679 (18.3)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit C.2 Standard Deviations of Achievement in Science – Countries

	Overall		Girls		Boys	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
United States	515 (4.6)	97 (2.0)	505 (4.6)	92 (2.0)	524 (5.5)	102 (2.6)
Australia	540 (4.4)	87 (2.1)	532 (5.1)	82 (2.6)	549 (6.0)	92 (2.7)
Belgium (Flemish)	535 (3.1)	69 (2.9)	526 (4.6)	67 (3.1)	544 (7.2)	71 (4.7)
Bulgaria	518 (5.4)	93 (3.3)	511 (5.8)	89 (3.6)	525 (6.5)	97 (3.6)
Canada	533 (2.1)	78 (1.5)	526 (3.2)	76 (2.2)	540 (2.4)	79 (1.6)
Chile	420 (3.7)	88 (2.8)	409 (4.3)	84 (3.0)	432 (5.1)	90 (2.9)
Chinese Taipei	569 (4.4)	89 (2.2)	561 (3.9)	83 (2.2)	578 (5.7)	94 (2.7)
Cyprus	460 (2.4)	84 (1.5)	455 (3.1)	78 (2.2)	465 (3.0)	89 (2.5)
Czech Republic	539 (4.2)	80 (2.0)	523 (4.8)	77 (2.5)	557 (4.9)	80 (2.7)
England	538 (4.8)	91 (3.0)	522 (6.2)	87 (4.0)	554 (5.3)	91 (3.4)
Finland	535 (3.5)	78 (2.4)	530 (4.0)	73 (2.4)	540 (4.5)	83 (3.6)
Hong Kong, SAR	530 (3.7)	70 (3.2)	522 (4.4)	64 (3.5)	537 (5.1)	74 (4.3)
Hungary	552 (3.7)	84 (2.4)	540 (4.0)	80 (2.2)	565 (4.5)	86 (3.8)
Indonesia	435 (4.5)	84 (3.3)	427 (6.5)	84 (3.6)	444 (4.8)	84 (3.0)
Iran, Islamic Rep.	448 (3.8)	84 (2.6)	430 (5.7)	81 (2.9)	461 (4.4)	84 (2.6)
Israel	468 (4.9)	105 (3.4)	461 (6.0)	99 (3.2)	476 (5.5)	110 (3.7)
Italy	493 (3.9)	87 (2.0)	484 (4.1)	84 (2.5)	503 (5.6)	90 (2.4)
Japan	550 (2.2)	76 (1.8)	543 (2.8)	72 (2.1)	556 (3.6)	79 (2.3)
Jordan	450 (3.8)	103 (2.9)	460 (5.0)	96 (2.6)	442 (5.9)	107 (3.8)
Korea, Rep. of	549 (2.6)	85 (1.6)	538 (4.0)	84 (2.1)	559 (3.2)	85 (1.4)
Latvia (LSS)	503 (4.8)	78 (2.2)	495 (5.6)	75 (2.1)	510 (4.8)	81 (3.0)
Lithuania	488 (4.1)	83 (2.9)	478 (4.4)	79 (3.7)	499 (5.0)	86 (3.0)
Macedonia, Rep. of	458 (5.2)	97 (2.8)	458 (6.0)	95 (3.2)	458 (5.4)	99 (3.2)
Malaysia	492 (4.4)	82 (2.6)	488 (5.5)	81 (2.8)	498 (5.8)	83 (3.2)
Moldova	459 (4.0)	95 (2.1)	454 (4.4)	93 (2.2)	465 (5.4)	97 (3.5)
Morocco	323 (4.3)	102 (1.9)	312 (5.9)	102 (2.7)	330 (5.9)	102 (2.4)
Netherlands	545 (6.9)	77 (4.1)	536 (7.1)	74 (3.3)	554 (7.3)	78 (5.4)
New Zealand	510 (4.9)	93 (3.1)	506 (5.4)	90 (3.2)	513 (7.0)	96 (3.7)
Philippines	345 (7.5)	121 (3.3)	351 (8.2)	118 (3.5)	339 (8.9)	123 (4.3)
Romania	472 (5.8)	97 (2.7)	468 (6.4)	97 (3.0)	475 (6.5)	98 (3.3)
Russian Federation	529 (6.4)	93 (2.7)	519 (7.1)	91 (3.4)	540 (6.2)	95 (2.7)
Singapore	568 (8.0)	97 (3.9)	557 (7.9)	93 (4.3)	578 (9.7)	100 (4.4)
Slovak Republic	535 (3.3)	78 (2.0)	525 (3.4)	74 (2.5)	546 (4.5)	80 (2.2)
Slovenia	533 (3.2)	84 (2.0)	527 (3.7)	80 (1.4)	540 (3.7)	88 (3.7)
South Africa	243 (7.8)	132 (5.5)	234 (9.2)	133 (6.1)	253 (7.7)	131 (6.0)
Thailand	482 (4.0)	73 (2.4)	481 (4.6)	72 (2.5)	484 (4.4)	75 (2.9)
Tunisia	430 (3.4)	67 (1.3)	417 (3.3)	65 (1.5)	442 (4.3)	67 (1.9)
Turkey	433 (4.3)	80 (2.5)	431 (4.8)	76 (2.8)	434 (4.3)	82 (2.7)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

( ) Standard errors appear in parentheses.

Exhibit C.2 (Continued) Standard Deviations of Achievement in Science – States and Districts/Consortia

	Overall		Girls		Boys	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
States						
Connecticut	529 (10.6)	91 (4.6)	518 (10.2)	88 (4.3)	542 (11.7)	93 (5.6)
Idaho	526 (6.6)	85 (3.2)	515 (6.4)	80 (3.3)	537 (7.6)	88 (4.2)
Illinois	521 (6.7)	89 (3.0)	508 (7.6)	87 (3.2)	533 (6.8)	90 (4.0)
Indiana	534 (6.9)	86 (2.9)	523 (7.0)	82 (3.2)	545 (7.3)	89 (3.2)
Maryland	506 (7.7)	95 (3.4)	498 (7.7)	91 (3.3)	516 (8.3)	99 (4.4)
Massachusetts	533 (7.5)	89 (4.1)	527 (7.6)	85 (4.9)	540 (8.1)	92 (4.3)
Michigan	544 (8.6)	94 (4.8)	533 (8.9)	90 (5.0)	556 (9.0)	96 (5.5)
Missouri	523 (6.5)	89 (3.5)	512 (7.1)	86 (3.7)	534 (7.2)	92 (4.1)
North Carolina	508 (4.8)	90 (1.8)	498 (2.8)	87 (4.8)	520 (7.1)	92 (3.0)
Oregon	536 (6.3)	91 (4.4)	524 (7.0)	87 (5.3)	549 (7.6)	94 (4.5)
Pennsylvania	529 (6.7)	87 (3.3)	519 (7.1)	82 (4.6)	540 (7.1)	91 (2.9)
South Carolina	511 (6.2)	95 (3.6)	506 (7.5)	88 (3.9)	517 (6.8)	101 (5.1)
Texas	509 (16.5)	104 (11.1)	499 (9.6)	98 (8.1)	519 (23.8)	109 (15.3)
Districts and Consortia						
Academy School Dist. #20, CO	559 (2.1)	77 (2.2)	554 (3.6)	72 (2.9)	563 (3.4)	81 (3.6)
Chicago Public Schools, IL	449 (9.7)	90 (3.9)	442 (10.2)	90 (4.9)	458 (10.4)	89 (3.9)
Delaware Science Coalition, DE	500 (9.2)	94 (3.6)	491 (9.3)	90 (3.8)	511 (10.5)	96 (5.2)
First in the World Consort., IL	565 (9.0)	78 (3.8)	553 (9.2)	70 (3.3)	578 (9.3)	82 (5.4)
Fremont/Lincoln/WestSide PS, NE	511 (6.6)	91 (3.9)	503 (7.2)	86 (5.7)	519 (8.2)	94 (4.5)
Guilford County, NC	534 (10.0)	93 (3.0)	522 (9.9)	88 (3.8)	547 (11.3)	96 (3.9)
Jersey City Public Schools, NJ	440 (9.9)	96 (5.3)	432 (10.8)	94 (6.4)	448 (10.7)	98 (5.1)
Miami-Dade County PS, FL	426 (10.7)	106 (5.3)	416 (9.1)	100 (6.2)	435 (12.8)	112 (5.6)
Michigan Invitational Group, MI	563 (6.9)	82 (3.6)	555 (8.1)	78 (4.4)	572 (7.3)	85 (4.6)
Montgomery County, MD	531 (4.2)	92 (3.6)	523 (5.7)	91 (6.1)	540 (5.5)	93 (2.9)
Naperville Sch. Dist. #203, IL	584 (5.0)	76 (3.9)	576 (6.3)	74 (4.7)	592 (4.9)	78 (4.1)
Project SMART Consortium, OH	539 (8.4)	86 (3.4)	536 (8.9)	80 (4.0)	543 (9.4)	91 (4.3)
Rochester City Sch. Dist., NY	452 (9.1)	89 (5.3)	443 (9.4)	85 (6.0)	461 (11.2)	93 (5.7)
SW Math/Sci. Collaborative, PA	543 (7.6)	85 (4.8)	529 (7.7)	82 (5.1)	558 (7.9)	87 (4.9)

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

APPENDIX

Descriptions of Science Items at Each Benchmark

D

Lower Quarter Benchmark Items

Earth Science

B01	Interprets a diagram of the Earth's layers and identifies the center as the hottest.
F05	Recognizes that there is less oxygen at high altitudes.
H03	Recognizes that the moon is visible because of reflected sunlight.

Life Science

B04	Recognizes that exercise causes an increase in breathing and pulse rates.
C08	Recognizes the function of nerves in transmitting visual messages to the brain.
D06	Recognizes the flower as the part of the plant from which seeds develop.
E08	Recognizes that a human inherits traits from both parents.
F03	Recognizes that sensory messages are interpreted in the brain.
G09	Recognizes that traits are transferred to offspring through the sperm and egg.
H02	Recognizes that vitamins are needed by the human body for normal functioning.
X02A	Demonstrates understanding of ecosystems by describing one role of trees in a rainforest.

Physics

A10	Recognizes the necessity of reflected light for visibility of an object.
B06	Recognizes that white surfaces reflect more light than colored surfaces.
G07	Identifies the diagram depicting the correct arrangement of batteries in a flashlight.
J04	Recognizes the relationship between surface area and evaporation rate.
K19	Identifies the ray diagram that shows the path of light reflected from a vertical mirror.

Lower Quarter Benchmark Items continued

Chemistry

A09	Applies knowledge of the need of oxygen for burning to a practical situation to identify that fanning a fire provides more oxygen.
C10	From its physical description, identifies a heterogeneous powder as a mixture (requires knowledge of scientific terminology).

Median Benchmark Items

Earth Science

E09	Locates point when the temperature becomes colder from data presented in a time and temperature table.
I16	Given a diagram of the Earth's water cycle, recognizes the Sun as the source of energy for the water cycle.
J01	Recognizes that plates that make up Earth's surface have been moving for millions of years.
J09	Extracts information from a table of planetary conditions to describe a condition hostile to human life.
O14	Demonstrates knowledge of relative distance to explain why Jupiter, although bigger than Earth's moon, appears smaller when viewed from Earth.

Life Science

A07	From a list of organs, identifies the heart as the organ not situated in the abdomen.
D05	Recognizes that nerves carry sensory messages to the brain (requires knowledge of scientific terms).
F01	Recognizes that feeding milk to its young is a defining characteristic of mammals.
G08	Recognizes oxygen transport as the main function of red blood cells.
H01	Distinguishes between bodily functions that are carried out by the blood and those that are not.
L02	Recognizes that seedlings growing in a forest have large leaves to gather light for photosynthesis.
L05	Recognizes that wolves place their scent on trees to mark their territory.
R03D	Applies knowledge of ecosystems to state one unwanted outcome of introducing a new species into a lake. (Partial credit)
X02B	Demonstrates understanding of ecosystems by describing one role of the Sun in a rainforest.

Median Benchmark Items continued

Physics

A08	Recognizes that a compressed spring has more stored energy than an uncompressed one.
C09	Identifies the apparent position of reflected image in a mirror on a diagram representing three dimensions.
C12	Recognizes examples of fossil fuels.
D02	Applies knowledge of magnetic properties to interpret diagram and identify substance based on its attraction to a magnet.
D04	Recognizes that a given sequence of energy changes applies to gasoline burning to power a car.
F02	Recognizes that a person feels cooler when wearing light-colored clothing because it reflects more radiation.
I14	Applies knowledge that sound requires a medium to travel through by contrasting a situation on the Earth to a situation on the Moon.
J08	From a list of radiation types, identifies ultraviolet as the form of solar energy that causes damage to the skin.
L01	Identifies the diagram that shows the forces acting on a wheel that will result in rotation.
M15	Applies knowledge of circular motion to identify the diagram that shows that an object will move in a straight line when released from a circular path.
N01	Applies concept of electrical circuits and knowledge of conductors to identify diagrams that show a complete circuit.
N09	Applies knowledge of levers to identify the diagram that shows the best way to balance two buckets of unequal weight.

Chemistry

F06	Recognizes that painting iron prevents exposure to oxygen and moisture.
M13	Given three diagrams depicting candles burning in open and closed jars, explains that the candles in the closed jars will be extinguished due to a lack of air. (Partial credit)

Environmental and Resource Issues

A11	Recognizes that overgrazing leads to soil erosion.
F04	Recognizes that soil erosion is more likely in barren sloping areas.
P05D	Provides one reason for why famine occurs. (Partial credit)
W01A	Describes a positive effect on farming of the presence of a dam upriver from the farm.

Scientific Inquiry and the Nature of Science

O13	Extrapolates from data presented in a linear distance versus time graph.

Upper Quarter Benchmark Items

Earth Science

A12	Applies knowledge of the effect of topography on river flow to identify the change in river shape and speed as it flows from a mountain to a plain.
G11	Recognizes a definition of sedimentary rock.
K15	Recognizes that fossil fuels were formed from the remains of living things.
Q11	Recognizes the definition of an Earth year (time it takes the Earth to revolve once around the Sun).
Q16	Applies knowledge of the relative distances of the Sun and Moon from Earth to explain why light from the Moon reaches Earth in less time.
Z02	Demonstrates some knowledge of Earth's water cycle by drawing a diagram showing how water from the sea can fall as rain on land (includes three of four required steps: evaporation, condensation, transportation, precipitation). (Partial credit)

Life Science

E10	Determines characteristic used to sort animals into two groups as presented in a 3 x 2 table.
I12	Applies knowledge of the processes of photosynthesis and respiration to identify gases used up and given off by plants and animals in a forest ecosystem pictured in a diagram.
J02	Recognizes that an external skeleton is a feature shared by all insects.
K12	Applies knowledge of sexual reproduction process to draw a conclusion about how to control insect populations.
L08	Applies knowledge of energy flow to complete a food web diagram.
N03	Recognizes that bacteria are involved in converting milk to yogurt.
N05	Demonstrates knowledge that plants need minerals, which can be obtained from bone meal used as fertilizer.
O16	Describes the processes that take place in the human body to prevent it from overheating during exercise.
O17	Demonstrates knowledge of contagious diseases by explaining why some people catch colds and others do not.

Life Science continued

Q17	Recognizes light absorption as the main function of chlorophyll.
Y01	Provides a partial explanation of why the heart beats faster during exercise that includes physiological needs (eg., oxygen, carbon dioxide removal) or the role of the circulatory system (increased blood flow). (Partial credit)

Physics

B02	Applies knowledge of energy conversion in a practical context to identify that an engine converts much of the chemical energy derived from burning gasoline to heat.
E11	Applies scientific principle of the effect of distance on shadow size and interprets diagram to solve a quantitative problem involving the change in shadow size when the distance of the light source is increased.
I13	Completes a brief table showing the relation between voltage and current.
I15	Based on a diagram demonstrating an investigation of thermal conductivity, identifes that metal conducts heat faster than glass, wood, or plastic.
M14	Given a three-dimensional diagram depicting an object placed at an angle to a mirror plane, draws the apparent position the reflected image.
P01	Determines the speed of a car from data presented in a linear distance vs. time graph.
Q13	Recognizes that the height of an alcohol column in a thermometer rises with increasing temperature because the alcohol expands more than the glass when heated.

Chemistry

G10	Applies knowledge of the structure of matter to recognize that nothing remains of an object if all of its atoms are removed.
H06	Recognizes that burning wood releases energy.
J03	Identifies that sugars are compounds composed of molecules that are made up of atoms.
K14	Recognizes that both burning coal and exploding fireworks release energy.

Upper Quarter Benchmark Items continued

Chemistry continued

M13	Given three diagrams depicting candles burning in open and closed jars, applies knowledge of burning to explain that the candle flame in the closed jar with the least amount of oxygen available will go out first.
N07	From a list of chemical and physical changes, identifies rusting as a chemical reaction.
Z01D	Describes one consequence of applying a shorter galvanization process to produce steel beams. (Partial credit)

Environmental and Resource Issues

C11	Recognizes the relationship between global warming and the increase in carbon dioxide levels in the atmosphere.
G12	From a list of renewable and non-renewable energy sources, identifies coal as a non-renewable energy source.
L07	Recognizes that insecticides become less effective over time because certain insects pass their resistance to the insecticide to their offspring.
O10	States one reason why a hole in Earth’s ozone layer may be harmful to people.
W02D	States two reasons why some people do not have enough drinking water, even though the surface of Earth has more water than land.

Scientific Inquiry and the Nature of Science

I11	Given a report of an experiment, distinguishes an observation from a prediction, conclusion, theory or hypothesis.
I20	Interprets data presented in a non-linear distance vs. time graph.
K13	Identifies the diagram depicting an appropriate control for a given experimental setup (effect of soil conditions on plant growth).
M12	Applies knowledge of experimental controls and interprets diagrams to identify variables to be controlled and varied in a described experiment (effect of height of ramp on speed of cart).
N04	Identifies an appropriate conclusion from observations of evaporating liquids.

Top 10% Benchmark Items

Earth Science

B05	Applies knowledge of patterns of prevailing winds and precipitation around a mountain to identify a dry region on a diagram of elevation and temperature.
C07	Applies knowledge of the effect of weathering over time to interpret diagram and draw conclusion about the relative age of two mountain systems based on shape.
D03	Interprets a contour map and identifies direction of river flow from higher to lower elevation.
E12	From a list of rock types, identifies limestone as the type involved in the formation of underground caves.
H04	Applies knowledge of soil composition and interprets diagram to identify the soil layer containing the most organic material.
Z02	Demonstrates understanding of Earth's water cycle by drawing a diagram showing how water from the sea can fall as rain on land (includes all of four required steps: evaporation, condensation, transportation, precipitation).

Life Science

I19	Recognizes the hierarchy of organization in living organisms (cell, tissue, organ, organism).
K18	Demonstrates knowledge of structure/function by describing one advantage of having two ears.
L03	Applies knowledge of the structure/function of animal characteristics to identify features belonging to animals that are preyed on by other animals.
M11	Demonstrates knowledge of the properties of lenses by explaining how eye glasses and contact lenses help some people see more clearly.
N06	Recognizes the definition of a tissue (group of cells with similar structure and function).
N08	Recognizes that the ability to regulate body temperature explains why mammals are found in very cold regions of the world but lizards are not.

Top 10% Benchmark Items continued

Life Science continued

P03	Applies knowledge of tree growth to explain why a nail placed in the trunk of a tree remained at the same level from the ground despite the increased height of the tree.
P04	Recognizes that the rate of metabolism decreases during hibernation.
P06	Names a digestive substance found in the stomach and describes its function.
R03D	Applies knowledge of ecosystems to state two unwanted outcomes of introducing a new species into a lake.

Physics

D01	Identifies the ray diagram depicting light passing through a magnifying glass.
J05	Applies knowledge of gravitational force by recognizing that gravity acts on a rocket at rest, while ascending, and when returning to Earth.
L04	Given data on fuel consumption and work accomplished, determines and explains which of two machines is more efficient.
N10	Applies knowledge of light reflection to explain why a white reflector shines more light toward a wall than a black reflector.
Q12	Demonstrates an understanding that the surface of a liquid remains horizontal by drawing the level of the liquid on a frame-of-reference diagram depicting a tilted U-shaped container.
Y02	Applies knowledge of phase change and the boiling point of water to explain that the temperature of water does not exceed its boiling point despite the addition of heat.
Z03	Applies knowledge of gas pressure and thermal expansion to a practical situation to explain the effect of heat on the volume of a balloon.

Chemistry

I10	From a list of gases, identifies oxygen as the gas that causes rust formation.
K17	Recognizes that a compound results from a reaction between chlorine gas and sodium metal.
M10	Distinguishes between mixtures and a pure substance (sugar).

Chemistry continued

O15	Recognizes that an ion is formed when a neutral atom gains an electron.
Q14	Recognizes that when sugar is dissolved in water, the sugar molecules continue to exist, but in solution.
Q15	Recognizes a phase change as not involving a chemical change.
Z01A	Applies knowledge of rusting in a practical context to explain why steel beams must be galvanized.

Environmental and Resource Issues

P05D	Provides two reasons for why famine occurs.
R06	Recognizes that rising ocean levels could result from global warming.

Scientific Inquiry and the Nature of Science

P07	Recognizes that repeated scientific measurements enable scientists to estimate experimental error.

Items Above the Top 10% Benchmark

Earth Science

J06	Recognizes that the tilt of the Earth’s axis is an important factor in explaining why the seasons occur.
O12	Identifies the order of abundance in the Earth’s atmosphere of nitrogen, oxygen, and carbon dioxide.
R04	Demonstrates knowledge of how atmospheric conditions vary at different altitudes in a practical context.

Life Science

I17	Froma list of animals, identifies fish as having been on Earth for the longest period of time.
J07	Recognizes that the best reason for including protein in a healthy diet is that it is the main source of raw materials for cell growth and repair.
N02	Applies understanding of the interrelationships of organisms in a food web to explain what will most likely happen to a robin population when the corn crop fails.
Y01	Provides an explanation of why the heart beats faster during exercise that includes physiological needs (eg., oxygen, carbon dioxide removal) and the role of the circulatory system (increased blood flow).

Physics

B03	Uses mass and volume data presented in a table to determine which of four objects has the greatest density.
E07	Recognizes that the nucleus of most atoms is composed of protons and neutrons.
H05	Recognizes that energy stored in food comes from the sun.
K10	Demonstrates knowledge of polarity of magnets by labeling poles on a diagram of a magnet cut into three pieces.
P02	Demonstrates knowledge of light properties by providing an explanation for the same amount of light from a given source reaching surfaces at different distances.

Physics continued

Q18	Applies the principle of conservation of mass during phase change to explain why the mass of water remains unchanged after it is frozen.
R02	Applies knowledge of the relationship between absorption and reflection of light and the appearance of color to identify why a red object appears black in green light.
X01	Applies knowledge of energy conversion to a practical situation to explain why the electrical energy used by a lamp is more than the amount of light energy produced.

Chemistry

L06	Applies knowledge of the process of filtration and the difference between solutions and mixtures to identify a separable mixture.
O11	Identifies a chemical change from examples of physical and chemical changes.
R05	Applies knowledge of the need for oxygen or air for burning to a practial situation to explain why increased surface area increases the rate of combustion.
Z01D	Describes two consequences of applying a shorter galvanization process to produce steel beams.

Environmental and Resource Issues

I18	States that sulfur dioxide produced by burning coal combines with water vapor in the atmosphere to form acid rain.
K16	Recognizes that gases from burning fossil fuels are a principal cause of acid rain.
W01B	Describes a negative effect on farming of the presence of a dam upriver from the farm.

Scientific Inquiry and the Nature of Science

K11	Identifies the diagram that shows the most appropriate thermometer scale for accurately measuring a given range of temperatures.
R01	Demonstrates knowledge of experimentation by recognizing a tentative statement that is based on observations as a hypothesis.

Items Above the Top 10% Benchmark continued

Scientific Inquiry and the Nature of Science continued

W03	Given a table of results from an investigatigation of how the length of a spring changes as different masses are hung from it, describes the relationship between mass and length.
X03	Describes a complete procedure for investigating how long it takes the heart rate to return to normal after exercising.
X03	Describes a partial procedure for investigating how long it takes the heart rate to return to normal after excercising. (Partial credit)
Y03	From a description of an experiment investigating the effect of dissolved salt on the freezing point of water, states the problem under investigation or a conclusion based on prior knowledge.

APPENDIX

Acknowledgments

TIMSS 1999 and the TIMSS Benchmarking Study were collaborative efforts among hundreds of individuals around the world. Staff from the national research centers in each participating country and from each Benchmarking jurisdiction, the International Association for the Evaluation for Educational Achievement (IEA), the International Study Center (ISC) at Boston College, advisors, and funding agencies worked closely to develop and implement the projects. They would not have been possible without the tireless efforts of all involved. Below, the individuals and organizations are acknowledged for their contributions. Given that implementing the studies has spanned approximately four years and involved so many people and organizations, this list may not pay heed to all who contributed throughout the life of the project. Any omission is inadvertent. TIMSS 1999 and the Benchmarking Study also acknowledge the students, teachers, and school principals who contributed their time and effort to the study. This report would not be possible without them.

Funding Agencies

Funding for the international coordination of TIMSS 1999 was provided by the National Center for Education Statistics (NCES) in the U.S. Department of Education, the U.S. National Science Foundation (NSF), the World Bank, and participating countries. Each participating country was responsible for funding local project costs and implementing TIMSS 1999 in accordance with the international procedures. Funding for the overall design, administration, data management, and quality assurance activities of TIMSS Benchmarking was provided by NCES, NSF, and the Office of Educational Research and Improvement (OERI) in the U.S. Department of Education. Valena Plisko, Eugene Owen, and Patrick Gonzales of NCES; Janice Earle, Larry Suter, and Elizabeth VanderPutten of NSF; Carol Sue Fromboluti and Jill Edwards Staton of OERI, and Maggie McNeely formerly of OERI each played a crucial role in making TIMSS 1999 and the Benchmarking Study possible and for ensuring the quality of the studies. Each Benchmarking participant contracted directly with Boston College to fund data-collection activities in its own jurisdiction.

Management and Operations

TIMSS 1999 was conducted under the auspices of the IEA. TIMSS 1999 was co-directed by Michael O. Martin and Ina V.S. Mullis, and managed centrally by the staff of the International Study Center in the Lynch School of Education at Boston College. Although the study was directed by the International Study Center and its staff members implemented various parts of TIMSS 1999, important activities also were carried out in centers around the world. In the IEA Secretariat in Amsterdam, Hans Wagemaker, Executive Director, was responsible for overseeing fundraising and country participation. The IEA Secretariat also coordinated translation verification and recruiting of international quality control monitors. The data were processed centrally by the IEA Data Processing Center in Hamburg. Statistics Canada in Ottawa was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. Educational Testing Service (ETS) in Princeton, New Jersey, conducted the scaling of the achievement data.

For the Benchmarking Study, Westat in Rockville, Maryland, was responsible for sampling, data collection activities, and preliminary data processing. National Computer Systems (NCS) in Iowa City, Iowa, conducted the scoring for Benchmarking jurisdictions along with the national scoring effort. All data were processed in accordance with international standards at the IEA Data Processing Center. Scaling of the achievement data was conducted by Educational Testing Service.

IEA Secretariat

Hans Wagemaker, Executive Director

Barbara Malak, Manager Membership Relations

Leendert Dijkhuizen, Fiscal Officer

International Study Center at Boston College Responsible for TIMSS and PIRLS

Michael O. Martin, Co-Director

Ina V.S. Mullis, Co-Director

Eugenio J. González, Director of Operations and Data Analysis

Kathleen M. O'Connor, TIMSS Benchmarking Coordinator

Kelvin D. Gregory, TIMSS Study Coordinator

Teresa A. Smith, TIMSS Science Coordinator

Robert Garden, TIMSS Mathematics Coordinator

Dana L. Kelly, PIRLS Study Coordinator

Steven Chrostowski, Research Associate

Ce Shen, Research Associate (former)

Julie Miles, Research Associate

Steven Stemler, Research Associate

Ann Kennedy, Research Associate

Maria José Ramirez, Research Assistant

Joseph Galia, Statistician/Programmer

Lana Seliger, Statistician/Programmer (former)

Andrea Pastelis, Database Manager

Kieran Brosnan, Technology Support Specialist

Christine Conley, Publications Design Manager

José Nieto, Publications Manager

Tom Hoffmann, Internet Communications Manager

Mario Pita, Data Graphics Specialist

Betty Hugh, Data Graphics Specialist

Christina Lopez, Data Graphics Specialist (former)

Isaac Li, Data Graphics Assistant

Kathleen Packard, Manager, Finance

Susan Comeau, Manager, Office Administration

Ann Tan, Manager, Conference Administration

Monica Guidi, Administrative Coordinator

Laura Misas, Administrative Coordinator

Rita Holmes, Administrative Coordinator

Statistics Canada

Pierre Foy, Senior Methodologist

Marc Joncas, Senior Methodologist

Andrea Farkas, Junior Methodologist

Salina Park, Cooperative Exchange Student

IEA Data Processing Center

Dirk Hastedt, Senior Researcher

Heiko Sibberns, Senior Researcher

Knut Schwippert, Senior Researcher

Caroline Dupeyrat, Researcher

Oliver Neuschmidt, Researcher

Stephan Petzchen, Research Assistant

Anneke Niemeyer, Research Assistant

Juliane Pickel, Research Assistant

Educational Testing Service

Kentaro Yamamoto, Principal Research Scientist

Ed Kulick, Manager, Research Data Analysis

Westat

Nancy Caldwell, Vice President and Associate Director, Survey Operations Group

Keith Rust, Vice President and Associate Director, Statistical Group

Stephen Roey, Senior Systems Analyst

Project Management Team

Michael Martin, International Study Center

Ina Mullis, International Study Center

Eugenio González, International Study Center

Hans Wagemaker, IEA Secretariat

Dirk Hastedt, IEA Data Processing Center

Pierre Foy, Statistics Canada

Kentaro Yamamoto, Educational Testing Service

Eugene Johnson, American Institutes for Research

Sampling Referees

Pierre Foy, Statistics Canada – TIMSS 1999 Benchmarking

Keith Rust, Westat – TIMSS 1999 International

Benchmarking Participants

Individuals from each Benchmarking jurisdiction were instrumental in conducting the TIMSS Benchmarking Study in their state, district, or consortium. They were responsible for obtaining funding for the project; obtaining cooperation of sampled schools, classes, and students; responding to curriculum questionnaires; reviewing data; contributing to the development of the Benchmarking reports; and coordinating activities with the International Study Center. Jurisdictions would like to acknowledge the following people for their extensive contributions.

States

Connecticut

Patricia Brandt
Connecticut Department of Education
165 Capital Avenue
Hartford CT 06145-2219

Abigail L. Hughes
Connecticut Department of Education
165 Capital Avenue
Hartford CT 06145-2219

Douglas Rindone
Connecticut Department of Education
165 Capital Avenue
Hartford CT 06145-2219

Theodore S. Sergi
Connecticut Department of Education
165 Capital Avenue
Hartford CT 06145-2219

Idaho

Tom Farley
Idaho Department of Education
P.O. Box 83720
Boise ID 83720-0027

Susan Harrington
Idaho Department of Education
P.O. Box 83720
Boise ID 83720-0027

Sally Tiel
Idaho Department of Education
P.O. Box 83720
Boise ID 83720-0027

Illinois

Mervin Brennan
Illinois State Board of Education
100 North First Street
Springfield IL 62777

Carmen Chapman
Illinois State Board of Education
100 North First Street
Springfield IL 62777

Megan Forness
Illinois State Board of Education
Assessment E216
100 North First Street
Springfield IL 62777

Andy Metcalf
Illinois State Board of Education
100 North First Street
Springfield IL 62777

Pam Stanko
Illinois State Board of Education
100 North First Street
Springfield IL 62777

Indiana

Larry Grau
Office of the Governor
State House
200 West Washington Street, Room 206
Indianapolis IN 46204-2797

Dwayne James
Indiana Department of Education
Room 229, State House
Indianapolis IN 46204

Stan Jones
Commissioner for Higher Education
101 West Ohio Street - Suite 550
Indianapolis IN 46204

Cheryl Orr
Indiana's Education Roundtable
101 West Ohio Street - Suite 550
Indianapolis IN 46204

Suellen Reed
Superintendent of Public Instruction
Room 229, State House
Indianapolis IN 46204-2797

Cynthia Roach
Indiana Department of Education
Division of Assessment
Room 229, State House
Indianapolis IN 46204-2797

Maryland

Diane Householder
Maryland State Department of Education
200 West Baltimore Street
Baltimore MD 21201-2595

Mark Moody
Maryland State Department of Education
200 West Baltimore Street
Baltimore MD 21201-2595

Kathy Rosenberg
Maryland State Department of Education
200 West Baltimore Street
Baltimore MD 21201-2595

Massachusetts

Jeffrey Nellhaus
Massachusetts Department of Education
350 Main Street
Malden MA 02148-5023

Sheldon Rothman
Massachusetts Department of Education
350 Main Street
Malden MA 02148-5023

Kit Viator
Massachusetts Department of Education
350 Main Street
Malden MA 02148-5023

Lori Wright
Massachusetts Department of Education
350 Main Street
Malden MA 02148-5023

Michigan

Charles Allan
Michigan Department of Education
Curriculum Development Program
P.O. Box 30008
Lansing MI 48909

Missouri

James Friedebach
Missouri Department of Education
205 Jefferson
P.O. Box 480
Jefferson City MO 65102-0480

North Carolina

Louis Fabrizio
North Carolina Department
of Public Instruction
301 North Wilmington Street
Raleigh NC 27601-2825

Tammy Howard
North Carolina Department
of Public Instruction
301 North Wilmington Street
Raleigh NC 27601-2825

Oregon

Joanne Flint
Oregon Department of Education
255 Capital Street NE
Salem OR 97310-0203

Wayne Neuberger
Oregon Department of Education
255 Capital Street NE
Salem OR 97310-0203

Pennsylvania

R. Jay Gift
Pennsylvania Department of Education
333 Market Street, 8th Floor
Harrisburg PA 17126-0333

Frank Marburger
Pennsylvania Department of Education
333 Market Street, 8th Floor
Harrisburg PA 17126-0333

Lee Plempel
Pennsylvania Department of Education
333 Market Street, 8th Floor
Harrisburg PA 17126-0333

Charlie Wayne
Pennsylvania Department of Education
333 Market Street, 8th Floor
Harrisburg PA 17126-0333

South Carolina

Karen Horne
South Carolina Department of Education
1429 Senate Street
Columbia SC 29201

Susan Agruso
South Carolina Department of Education
1429 Senate Street
Columbia SC 29201

Lane Peeler
South Carolina Department of Education
611-B Rutledge Building
1429 Senate Street
Columbia SC 29201

Paul Sandifer
South Carolina Department of Education
607 Rutledge Building
1429 Senate Street
Columbia SC 29201

Teri Siskind
South Carolina Department of Education
607 Rutledge Building
1429 Senate Street
Columbia SC 29201

Texas

Chris Castillo Comer
Texas Education Agency
1701 North Congress Avenue
Austin TX 78701

Ed Miller
Texas Education Agency
1701 North Congress Avenue
Austin TX 78701-1494

Phyllis Stolp
Texas Education Agency
1700 North Congress Avenue
Austin TX 78701

Districts and Consortia

Academy School District #20

Wendy Crist
Academy School District #20
7610 North Union Boulevard
Colorado Springs CO 80920

Alisabeth Hohn
Academy School District #20
7610 North Union Boulevard
Colorado Springs CO 80920

Chicago Public Schools

Gery Chico
Chicago Public Schools
125 South Clark Street
Chicago IL 60603

Richard Daley
City Hall
121 North LaSalle Street
Chicago IL 60603

Joseph Hahn
Chicago Public Schools
125 South Clark Street 11th Floor
Chicago IL 60603

Phil Hansen
Chicago Public Schools
125 South Clark Street
Chicago IL 60603

Paul Vallas
Chicago Public Schools
125 South Clark Street
Chicago IL 60603

Melanie Wojtulewicz
Chicago Public Schools
1326 West 14th Place
Room 315A
Chicago IL 60608

Delaware Science Coalition

Gail Ames
Delaware Science Coalition
2916 Duncan Road
Wilmington DE 19808

John Collette
Delaware Science Coalition
309 Brockton Road
Wilmington DE 19803

Julie Cwikla Banks
University of Delaware
305 M Willard Hall
Newark DE 19716

Valerie Maxwell
Appoquinimink School District
118 South Sixth Street
Odessa DE 19730

First in the World Consortium

Elaine Aumiller
North Central Regional
Education Lab (NCREL)
1120 East Diehl Road, Suite 200
Naperville IL 60563

Blase Masini
North Central Regional
Education Lab (NCREL)
1120 East Diehl Road, Suite 200
Naperville IL 60563

Paul Kimmelman
1306 Hidden Lake Drive
Buffalo Grove IL 60089

David Kroeze
First in the World Consortium
Northbrook School District #27
1250 Sanders Road
Northbrook IL 60062

Fremont/Lincoln/Westside Public Schools

James Findley
Westside Public Schools
909 South 76th Street
Omaha NE 68114-4599

Marilyn Moore
Lincoln Public Schools
Box 82889
Lincoln NE 68501-2889

Stephen Sexton
Fremont Public Schools
957 North Pierce Street
Fremont NE 68025

Terry Snyder
Fremont Public Schools
957 North Pierce Street
Fremont NE 68025

Guilford County Schools

Lynne Johnson
Guilford County Schools
120 Franklin Boulevard
Greensboro NC 27401

Diane Spencer
Guilford County Schools
120 Franklin Boulevard
Greensboro NC 27401

Sadie Bryant Woods
Guilford County Schools
134 Franklin Boulevard
Greensboro NC 27401

Jersey City Public Schools

Richard DiPatri
Jersey City Public Schools
State District Superintendent
346 Claremont Avenue
Jersey City NJ 07305

Adele Macula
Jersey City Board of Education
346 Claremont Avenue
Jersey City NJ 07305

Aldo Sanchez-Abreu
Jersey City Board of Education
346 Claremont Avenue
Jersey City NJ 07305

Patsy Wang-Iverson
Mid-Atlantic Eisenhower Consortium
Research for Better Schools
444 North Third Street
Philadelphia PA 19123

Miami-Dade County Public Schools

Joseph Burke
Miami-Dade County Public Schools
1500 Biscayne Boulevard
Room 327T
Miami FL 33132

Gisela Feild
Miami-Dade County Public Schools
1500 Biscayne Boulevard
Suite 225
Miami FL 33132

Joseph Mathos
Miami-Dade County Public Schools
1450 Northeast 2nd Avenue #931
Miami FL 33132

Vilma Rubiera
Miami-Dade County Public Schools
1500 Biscayne Boulevard
Suite 225
Miami FL 33132

Alex Shneyderman
Miami-Dade County Public Schools
1500 Biscayne Boulevard
Suite 225
Miami FL 33132

Constance Thornton
Miami-Dade County Public Schools
1500 Biscayne Boulevard
Suite 327
Miami FL 33132

Michigan Invitational Group

Robert Dunn
Michigan Invitational Group
Michigan Department of Education
658 Grat Strasse
Manchester MI 48158

Montgomery County Public Schools

Marlaine Hartzman
Montgomery County Public Schools
850 Hungerford Drive, Room 11
Rockville MD 20850

John Larson
Montgomery County Public Schools
850 Hungerford Drive, Room 11
Rockville MD 20850

Naperville Community School District 203

Russ Bryan
Naperville Community School District 203
203 West Hillside Road
Naperville IL 60540

Lenore Johnson
Naperville Community School District 203
203 West Hillside Road
Naperville IL 60540

Jack Hinterlong
Naperville Community School District 203
203 Hillside Road
Naperville IL 60540

Donald E. Weber, Ed.D
Naperville Community School District 203
203 West Hillside Road
Naperville IL 60540

Jodi Wirt
Naperville Community School District 203
203 Hillside Road
Naperville IL 60540

Project SMART Consortium

Dennis Kowalski
Strongville City School
13200 Pearl Road
Stongsville OH 44136

Terry Krivak
c/o Ohio Aerospace Institute
22800 Cedar Point Road
Cleveland OH 44142

Anne Mikesell
Ohio Department of Education
25 South Front Street, 5th Floor
Columbus OH 43215

Linda Williams
Mentor Exempted Village
6451 Center Street
Mentor OH 44060

Paul R. Williams
Project SMART Consortium
Beachwood City School District
24601 Fairmount Boulevard
Beachwood OH 44122

Rochester City School District

Ann Pinnella Brown
Rochester City School District
131 West Broad Street
Rochester NY 14614

Cecilia Golden
Rochester City School District
131 West Broad Street
Rochester NY 14614

Corinthia Sims
Rochester City School District
131 West Broad Street
Rochester NY 14614

Southwest Pennsylvania Math and Science Collaborative

Nancy Bunt
2650 Regional Enterprise Tower
425 Sixth Avenue
Pittsburgh PA 15219

Marcia Seeley
2650 Regional Enterprise Tower
425 Sixth Avenue
Pittsburgh PA 15219

Lou Tamler
2650 Regional Enterprise Tower
425 Sixth Avenue
Pittsburgh PA 15219

Cynthia A. Tananis
University of Pittsburgh
5P26 WWPH School of Education
Pittsburgh PA 15260

National Research Coordinators

The TIMSS 1999 National Research Coordinators and their staff had the enormous task of implementing the TIMSS 1999 design. This required obtaining funding for the project; participating in the development of the instruments and procedures; conducting field tests; participating in and conducting training sessions; translating the instruments and procedural manuals into the local language; selecting the sample of schools and students; working with the schools to arrange for the testing; arranging for data collection, coding, and data entry; preparing the data files for submission to the IEA Data Processing Center; contributing to the development of the international reports; and preparing national reports. The way in which the national centers operated and the resources that were available varied considerably across the TIMSS 1999 countries. In some countries, the tasks were conducted centrally, while in others, various components were subcontracted to other organizations. In some countries, resources were more than adequate, while in some cases, the national centers were operating with limited resources. Of course, across the life of the project, some NRCs have changed. This list attempts to include all past NRCs who served for a significant period of time as well as all the present NRCs. All of the TIMSS 1999 National Research Coordinators and their staff members are to be commended for their professionalism and their dedication in conducting all aspects of TIMSS.

Australia

Susan Zammit
Australian Council for Educational
Research (ACER)
19 Prospect Hill Road
Private Bag 55
Camberwell, Victoria 3124

Belgium (Flemish)

Jan Van Damme
Afd. Didactiek
Vesaliusstraat 2
B-3000 Leuven

Christiane Brusselmans-Dehairs
Jean-Pierre Verhaeghe
Vakgroep Onderwijskunde Universiteit Gent
Henri Dunantlaan 2
B-9000 Gent

Ann Van Den Broeck
Dekenstraat 2
Afd. Didactiek
B-3000 Leuven

Bulgaria

Kiril Bankov
Faculty of Mathematics and Informatics
University of Sofia
1164 Sophia

Canada

Alan Taylor
Applied Research and Evaluation Services
(ARES)
University of British Columbia
6058 Pearl Avenue,
Burnaby, BC V5H 3P9

Richard Jones
Education Quality & Accountability
Office(EQAO)
2 Carlton Street, Suite 1200
Toronto, ON M5B2M9

Jean-Louis Lebel
Direction de la sanction des etudes
1035 rue De La Chevrotiere
26 etage
Quebec GIR 5A5

Michael Marshall
University of British Columbia
Faculty of Education, Room 6
2125 Main Mall
Vancouver, BC V6T1Z4

Chile

Maria Inès Alvarez
Unidad de Curriculum y Evaluación
Ministerio de Educación
Alameda 1146
Sector B, Piso 8

Chinese Taipei

Jau-D Chen
Dean of General Affairs
National Taiwan Normal University
162, East Hoping Road Section 1
Taipei, Taiwan 117

Cyprus

Constantinos Papanastasiou
Dept. of Education
University of Cyprus
P.O. Box 20537
Nicosia CY-1678

Czech Republic

Jana Paleckova
Institute for Information of Education (UIV)
Senovazne nam.26
111 21 Praha 1

England

Graham Ruddock
National Foundation for Educational
Research (NFER)
The Mere, Upton Park
Slough, Berkshire SL1 2DQ

Finland

Pekka Kupari
University of Jyvaskyla
Institute for the Educational Research
P.O. Box 35
SF – 40351 Jyvaskyla

Hong Kong, SAR

Frederick Leung
The University of Hong Kong – Dept. of
Curriculum
Faculty of Education, Room 219
Pokfulam Road
Hong Kong, SAR

Hungary

Péter Vari
National Institute of Public Education
Centre for Evaluation Studies
Dorottya u.8, Pf 701/420
1051 Budapest

Indonesia

Jahja Umar
Examiniation Development Center
Jalan Gunung Sahari Raya – 4
Jakarta Pusat
Jakarta

Iran, Islamic Republic

Ali Reza Kiamanesh
Ministry of Education
196, Institute for Education Research
Keshavaraz Boulevard
Tehran, 14166

Israel

Ruth Zuzovsky
Tel Aviv University
School of Education
Center for Science and Technology Education
Ramat Aviv 69978

Italy

Anna Maria Caputo
Ministerio della Pubblica Istruzione
Centro Europeo Dell 'Educazione (CEDE)
5- Villa Falconieri
Frascati (Roma) 00044

Japan

Yuji Saruta
Hanako Senuma
National Institute for Educational Research (NIER)
6-5-22 Shimomeguro
Meguro-ku, Tokyo 153-8681

Jordan

Tayseer Al-Nhar
National Center for Human Resources Development
P.O. Box 560
Amman, Jordan 11941

Korea, Republic of

Sungsook Kim
Chung Park
Korea Institute of Curriculum & Evaluation(KICE)
25-1 Samchung-dong
GhongRo-Gu, Seoul 110-230

Latvia

Andrejs Geske
University of Latvia
IEA National Research Center
Jurmalas Gatve 74/76, Room 204A
Riga LV-1083

Lithuania

Algirdas Zabulionis
National Examinations Center
Ministry of Education and Science
M. Katkaus 44
Vilnius LT2051

Macedonia, Republic of

Anica Aleksova
Ministry of Education and Science
Bureau for Development of Education
Ruder Boskovic St. bb.
1 000 Skopje

Malaysia

Azmi Zakaria
Ministry of Education
Level 2,3 &5 Block J South
Pusat Bandar Damansara, Kuala Lumpur 50604

Moldova, Republic of

Ilie Nasu
Ministry of Education and Science
University "A. Russo"
Str. Puschin 38
Balti 3100

Lidia Costiuc
1 Piata Mazzi Adunazi Nationale
Chisinau

Morocco

Mohamed Fatihi
Direction de l'Evaluation du Systeme Educatif
Innovations Pedagogiques
32 Boulevard Ibn Toumert
Place Bob Rouah, Rabat

Netherlands

Klaas Bos
University of Twente
Centre for Applied Research in Education(OCTO)
P.O. Box 217
7500 AE Enschede

New Zealand

Megan Chamberlain
Ministry of Education
CER Unit-Research Division
45-47 Pipitea Street
Thorndon, Wellington

Philippines

Ester Ogena
DOST-Science Education Institute
3F PTRI Blg
Bicutan, Taguig
Metro Manila 1604

Vivien Talisayon
Institute Of Science & Mathematics Education Development
University of the Philippines UPISMED
Diliman, Quezon City

Romania

Gabriela Noveanu
Institute for Educational Sciences
Evaluation and Forecasting Division
Str. Stirbei Voda 37
Bucharest Ro-70732

Russian Federation

Galina Kovalyova
Center for Evaluating the Quality of Education
Institute of General Secondary Education
ul. Pogodinskaya 8
Moscow 119905

Singapore

Cheow Cher Wong
Research and Evaluation Branch
Ministry of Education
1 North Buona Vista Dr /MOE Building
Singapore, Singapore 138675

Slovak Republic

Olga Zelmanova
Maria Berova
SPU-National Institute for Education
Pluhova 8, P. O. Box 26
Brastislava 830 00

Slovenia

Barbara Japelj
Educational Research Institute Ljubljana
Gerbiceva 62
Ljubljana 1000

South Africa

Sarah Howie
Human Sciences Research Council
134 Pretorius Street
Private Bag X41
Pretoria 0001

Thailand

Precharn Dechsri
Institute For the Promotion of Teaching Science & Technology (IPST)
924 Sukhumvit Rd. Ekamai
Bangkok 10100

Tunisia

Ktari Mohsen
Ministere de l'Education
Boulevard Bab-Bnet
Tunis

Turkey

Yurdanur Atlioglu
Educational Research and Development Directorate
Gazi Mustafa Kemal Bulvani
No 109/5-6-7
Maltepe, Ankara 06570

United States

Patrick Gonzales
National Center for Education Statistics
United States Dept. of Education
1990 K Street, NW Room 9071
Washington, DC 20006

TIMSS 1999 Advisory Committees

The International Study Center at Boston College was supported in its work by advisory committees. The Subject Matter Item Replacement Committee was instrumental in developing the TIMSS 1999 tests, and the Questionnaire Item Review Committee revised the TIMSS questionnaires. The Scale Anchoring Panel developed the descriptions of the international benchmarks in mathematics and science.

Subject Matter Item Replacement Committee

Mathematics

Antoine Bodin, France
Anna-Maria Caputo, Italy
Nobert Delagrange, Belgium (Flemish)
Jan de Lange, Netherlands
Hee-Chan Lew, Republic of Korea
Mary Lindquist, United States
David Robitaille, Canada

Science

Hans Ernst Fischer, Germany
Galina Kovalyova, Russian Federation
Svein Lie, Norway
Masao Miyake, Japan
Graham Orpwood, Canada
Jana Strakova, Czech Republic
Carolyn Swain, England

Special Consultants

Chancey Jones, Mathematics
Christine O'Sullivan, Science

Questionnaire Item Review Committee

Im Hyung, Republic of Korea
Barbara Japelj, Slovenia
Trevor Williams, United States
Graham Ruddock, England
Klaas Bos, Netherlands

Scale Anchoring Committees

Mathematics

Anica Aleksova, Republic of Macedonia
Lillie Albert, United States
Kiril Bankov, Bulgaria
Jau-D Chen, Chinese Taipei
John Dossey, United States
Barbara Japelj, Slovenia
Mary Lindquist, United States
David Robitaille, Canada
Graham Ruddock, United Kingdom
Hanako Senuma, Japan
Pauline Vos, The Netherlands

Science

Audrey Champagne, United States
Galina Kovalyova, Russian Federation
Jan Lokan, Australia
Jana Paleckova, Czech Republic
Senta Raizen, United States
Vivien Talisayon, Philippines
Hong Kim Tan, Singapore

Typography
This book was set in ITC New Baskerville, designed by George W. Jones, and Frutiger, designed by Adrian Frutiger for Linotype-Hell, released by Adobe.

Book Design and Illustrations
José R. Nieto

Layout and Production
Mario Pita
Betty Hugh
Christina López

Production Assistants
Nathan Pyritz
Susan Messner

Cover Design
Christine Conley