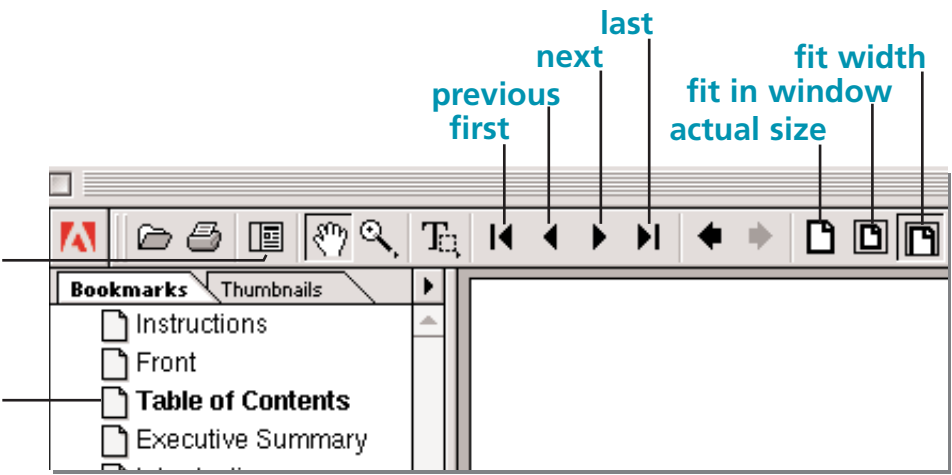


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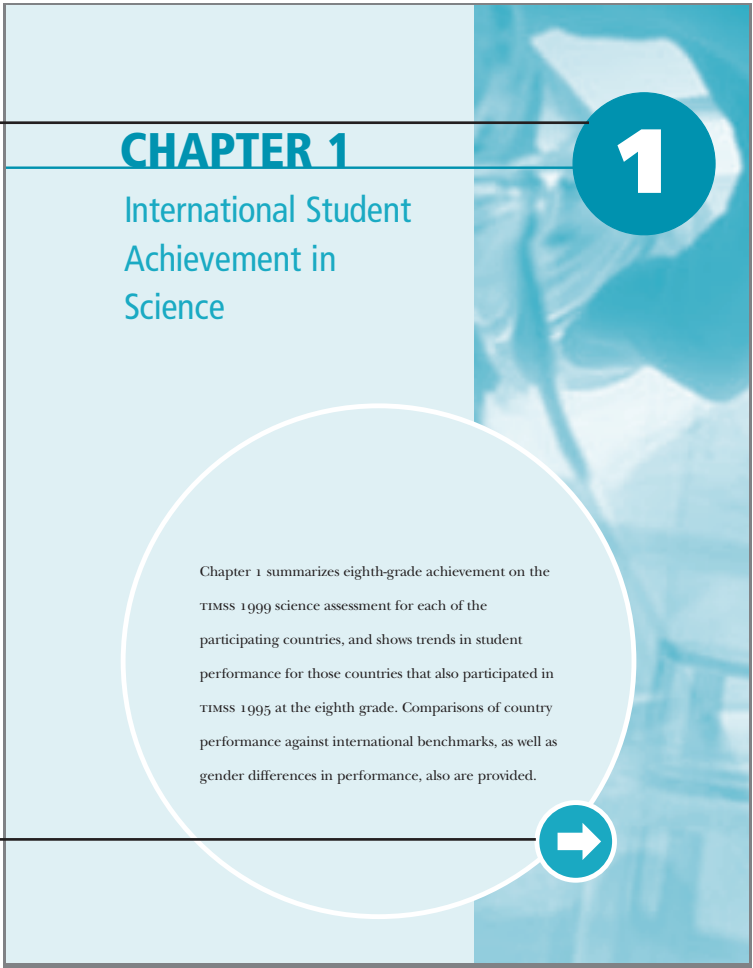
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What Activities Do Students Do in Their Science Lessons?

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

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Exhibit 1.6 Percentages of Students Reaching TIMSS 1999 International Benchmarks of Science Achievement

	Percentages of Students Reaching International Benchmarks			
	Top 10%	Upper Quarter	Median	Lower Quarter
Singapore	32 (3.3)	56 (3.5)	80 (2.6)	94 (1.4)
Chinese Taipei	31 (1.9)	58 (2.0)	83 (1.3)	95 (0.7)
Hungary	22 (1.4)	49 (1.7)	79 (1.4)	95 (0.8)
Korea, Rep. of	22 (1.1)	46 (1.2)	77 (1.0)	94 (0.5)
Japan	19 (1.1)	48 (1.4)	80 (1.0)	96 (0.5)
Australia	19 (1.6)	43 (2.3)	74 (2.0)	93 (0.9)
England *	19 (1.9)	42 (2.3)	72 (2.0)	92 (1.0)
Czech Republic	17 (1.7)	41 (2.2)	74 (1.8)	95 (0.8)
Russian Federation	17 (2.4)	38 (2.8)	68 (2.5)	90 (1.0)
Netherlands *	16 (2.3)	46 (3.8)	79 (3.5)	95 (1.6)
Slovenia	16 (1.1)	39 (1.7)	71 (1.5)	93 (0.7)
United States	15 (1.2)	34 (1.9)	62 (2.0)	85 (1.3)
Finland	14 (1.4)	39 (1.9)	74 (1.5)	95 (0.7)
Slovak Republic	14 (1.4)	39 (2.0)	74 (1.7)	94 (0.7)
Canada	14 (0.9)	38 (1.3)	73 (1.2)	94 (0.6)
Bulgaria	14 (2.1)	34 (2.5)	65 (2.2)	88 (1.5)
New Zealand	12 (1.4)	32 (2.1)	61 (2.2)	86 (1.6)
Belgium (Flemish) *	11 (1.4)	39 (1.6)	76 (1.7)	96 (1.3)
Hong Kong, SAR *	10 (1.1)	35 (2.1)	75 (2.1)	95 (1.0)
Latvia (SS) *	7 (1.3)	24 (2.5)	59 (2.0)	88 (1.4)
Italy	7 (0.9)	23 (1.7)	54 (2.0)	83 (1.2)
Israel †	7 (0.6)	20 (1.2)	45 (1.9)	72 (2.0)
Malaysia	6 (0.9)	21 (1.9)	53 (2.2)	85 (1.5)
Lithuania	6 (0.9)	20 (1.9)	51 (2.1)	83 (1.8)
Romania	6 (0.8)	19 (1.9)	45 (2.5)	75 (2.1)
Macedonia, Rep. of	4 (0.5)	15 (1.6)	40 (1.9)	70 (2.2)
Moldova	4 (0.5)	15 (1.2)	39 (1.8)	70 (1.6)
Jordan	4 (0.5)	15 (1.0)	38 (1.5)	66 (1.6)
Thailand	3 (0.7)	15 (2.0)	47 (2.5)	84 (1.3)
Cyprus	2 (0.5)	12 (0.8)	39 (1.6)	74 (1.4)
Iran, Islamic Rep.	2 (0.3)	9 (1.0)	32 (1.7)	68 (1.7)
Indonesia	1 (0.3)	6 (0.9)	27 (1.6)	64 (2.4)
Turkey	1 (0.2)	6 (0.8)	25 (1.8)	62 (2.4)
Chile	1 (0.4)	5 (1.0)	22 (1.6)	56 (2.7)
Philippines	1 (0.3)	3 (0.7)	13 (1.7)	31 (2.6)
Tunisia	0 (0.1)	3 (0.4)	19 (1.5)	62 (2.0)
South Africa	0 (0.2)	2 (0.6)	6 (1.4)	13 (2.0)
Morocco	0 (0.0)	1 (0.2)	5 (0.5)	20 (1.1)

Percentage of students at or above Top 10% Benchmark

Percentage of students at or above Upper Quarter Benchmark

Percentage of students at or above Median Benchmark

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, The International Mathematics and Science Study (TIMSS), 1999.

* Met guideline for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).

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

1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Reason coverage falls below 65%: Latvia is excluded (LS for Latvian-Speaking Schools only).

2 National Desired Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

International Student Achievement in Science

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begin book



TIMSS 1999

International Science Report

Findings from IEA's Repeat of the Third International Mathematics
and Science Study at the Eighth Grade



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Boston College
Lynch School of Education



The International Association
for the Evaluation of
Educational Achievement



December 2000

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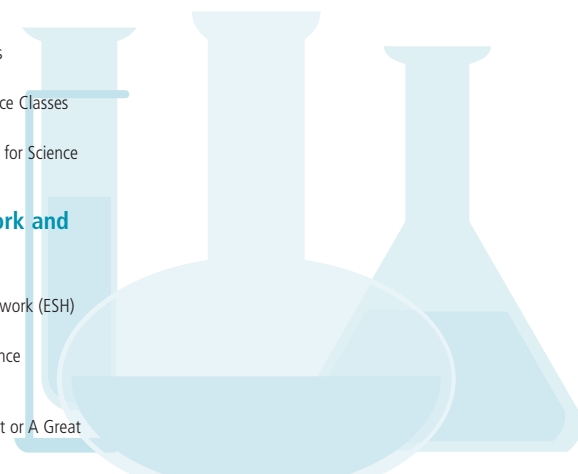
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Science Report





Executive Summary

In 1999, the Third International Mathematics and Science Study (TIMSS) was replicated at the eighth grade. Involving 41 countries and testing at five grade levels, TIMSS was originally conducted in 1995 to provide a base from which policy makers, curriculum specialists, and researchers could better understand the performance of their educational systems. Conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), TIMSS was the first step in a long-term strategy, with further assessments in mathematics and science planned for 1999, 2003, and beyond.

TIMSS 1999, also known as TIMSS-Repeat or TIMSS-R, was designed to provide trends in eighth-grade mathematics and science achievement in an international context. Thirty-eight countries participated in TIMSS 1999. Of these, 26 countries also participated in TIMSS 1995 at the eighth grade and have trend data included in this report. Also, 1999 represents four years since the first TIMSS, and the population of students originally assessed as fourth-graders had advanced to the eighth grade. Thus, for 17 of the 26 countries that participated in TIMSS 1995 at the fourth grade, TIMSS 1999 also provides information about whether the relative performance of these students has changed in the intervening years.

Six content areas were covered in the TIMSS 1999 science test: earth science; life science; physics; chemistry; environmental and resource issues; and scientific inquiry and the nature of science. About one-fourth of the questions were in the free-response format, requiring students to generate and write their answers. (See Chapter 2 for example items illustrating the range of science concepts and processes covered in the TIMSS 1999 tests.) The achievement data are accompanied by extensive questionnaire data about the home, classroom, school, and national contexts within which science learning takes place.

Because a valid and efficient sample in each country is crucial to the quality and integrity of the study, TIMSS developed procedures and standards regarding coverage of the target population, participation, and the age and years of schooling of students. For 1999, all countries met the guidelines, and any variations that occurred are annotated. Indeed, TIMSS 1999 was conducted with rigorous attention to attaining high quality in all aspects of the project.

Students' Science Achievement

- ▶ Chinese Taipei and Singapore had the highest average performance, closely followed by Hungary, Japan, and the Republic of Korea. Other countries that performed very well included the Netherlands, Australia, the Czech Republic, and England. Lower-performing countries included the Philippines, Morocco, and South Africa (see Exhibits 1.1 and 1.2).
- ▶ Countries that showed an increase in average science achievement between 1995 and 1999 were Latvia (LSS)¹, Lithuania, Canada and Hungary. Several countries showed a small decrease in average achievement from 1995 to 1999, but only in the case of Bulgaria was it statistically significant.
- ▶ Boys had significantly higher average science achievement than girls in 16 of the 38 countries in 1999. This was attributable mainly to significantly higher performance by boys in physics, earth science, chemistry, and environmental and resource issues. The gender gap in science achievement is especially apparent among high-performing students, with 29 percent of boys on average across countries in the top achievement quarter, compared with 21 percent of girls. The average gender difference showed a decrease from 1995 to 1999, principally due to the gap narrowing in Hong Kong SAR, Slovenia, and Israel.

¹ Because coverage of the target population falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

Students' Home Environment and Attitudes Towards Science

- ▶ Although the level of home educational resources varied considerably across countries, students from homes with a high level of educational resources (more than 100 books; all three study aids: computer, study desk, and dictionary; and at least one parent finished university) had higher science achievement than students from homes with fewer resources, on average internationally.
- ▶ Eighth-grade students internationally had high expectations for further education. On average across countries, more than half the students reported that they expected to finish university. In almost every country there was a positive association between educational expectations and science achievement.
- ▶ Eighth-grade boys generally had a more positive self-concept in science than girls. This difference was most pronounced in countries where the sciences are taught as separate subjects. Although girls in such countries, on average, had a more favorable science self-concept in biology, this was outweighed by a more favorable self-concept for boys in physics, and to a lesser extent in earth science and chemistry.
- ▶ Although student attitudes towards science were generally positive in countries where eighth-grade science is taught as a single subject, they were less positive in separate-science countries. Attitudes were most positive towards biology and earth science, and least positive towards physics and chemistry. Eighth-grade boys generally had more positive attitudes towards science than girls, particularly in physics, chemistry, and earth science. Girls had more favorable attitudes towards biology.

The Science Curriculum

- ▶ In 35 of the 38 countries, specifications for students' curricular goals in science were developed as national curricula. The exceptions were Australia, Canada, and the United States. In 21 countries, science was taught as a single general subject. In the other countries, separate courses were offered in the different science subjects.
- ▶ Testing and assessment were widely used methods to support curriculum implementation. Belgium (Flemish) and Chinese Taipei were the only countries that reported having no public examinations in science to certify students or select them for university or academic tracks. Approximately two-thirds of the countries conduct system-wide assessments at two or three grades, primarily to inform policy makers about achievement of the intended curriculum.
- ▶ On average across countries, instructional time designated in official curricula for science instruction increases from 11 percent at grade 4 to 16 percent at grade 8. This contrasts with a decrease in the proportion of instructional time designated for mathematics in most countries.
- ▶ Knowing basic facts and understanding science concepts received major emphasis in the official eighth-grade curricula of most participating countries, with at least moderate emphasis placed on application of science concepts. Few countries gave major emphasis to using laboratory equipment or performing science experiments.

Instructional Contexts and Practices

- ▶ Internationally, 58 percent of eighth-grade students were taught science by females and 42 percent by males, and similar percentages were found in a number of countries.
- ▶ Teacher's undergraduate and graduate studies provide some indication of their preparation to teach science. In most countries at least 80 percent of eighth-grade students were taught science by teachers with a major in the appropriate science subject.
- ▶ Eighth-grade science teachers reported only a moderate level of confidence in their preparation to teach science. On average, almost 40 percent of students were taught by teachers who reported a low level of confidence in their preparation. Teachers' confidence in their preparation was greatest for biology, and least for earth science, environmental and resource issues, and scientific methods and inquiry skills.
- ▶ The percentage of instructional time at the eighth grade that was devoted to science ranged from 6 to 19 percent in general science countries. For separate-science countries, the average percentage was six or seven percent for each subject, with students generally taking more than one subject. For the most part, the percentages reported by teachers corresponded with the percentages targeted in the intended curriculum.
- ▶ In 1999, teachers in general science countries reported that more than half the students were in science classes that met between about two and three and a half hours per week. In separate-science countries, students mostly were in classes that met for fewer than two hours per week.
- ▶ Videotapes of classes in the United States and Japan in TIMSS 1995 revealed that outside interruptions can affect the flow of the lesson and detract from instructional time. Internationally in 1999, about one-fifth of the students in general science countries reported that their science classes were interrupted pretty often or almost always, and 28 percent reported that their classes were never interrupted. Almost 40 percent of students in separate science classes reported that their classes were never interrupted.

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- ▶ Science teachers reported spending almost one-quarter of their class time, on average, on lecture-style presentations to the class. They reported devoting substantial percentages of their class time to student experiments (15 percent) and teacher-guided student practice (14 percent).
 - ▶ Almost 40 percent of eighth-grade students in general science countries were in classes where teachers and students reported a high degree of emphasis on conducting science experiments. In contrast, emphasis on experiments was reportedly much less in separate science classes, particularly earth science and biology.
 - ▶ Less than 10 percent of eighth-grade students in general science countries, and half this percentage in separate science countries, reported frequent use of computers in science class. The trend data from 1995 to 1999 show a small but significant increase for integrated science and small decreases for each of the separate sciences. Although there was great variation across countries, about a quarter of the students internationally reported Internet access at school. Despite this access, only 12 percent on average used the Internet to obtain information for science projects on even a monthly basis.

School Factors

- ▶ Students in schools that reported being well resourced generally had higher average science achievement than those in schools where across-the-board shortages affected instructional capacity in science some or a lot. According to their principals, nearly half the students were in schools where instruction was negatively affected by shortages or inadequacies in instructional materials, budget for supplies, school buildings, instructional space, audio-visual resources, and library materials relevant to science instruction. More than half the students were in schools where the capacity to provide science instruction was affected by shortages or inadequacies in science laboratory equipment and materials, computers and computer software, library materials, and audio-visual resources.
- ▶ Clearly schools around the world expect help from parents. Internationally, 85 percent of students attended schools expecting parents to ensure that their children complete their homework, 79 percent attended schools expecting parents to volunteer for school projects or field trips, and about half attended schools expecting parents to help raise funds and to serve on committees.
- ▶ Internationally, one-fifth of the students attended schools where principals reported that attendance was not a problem. However, 60 percent were in schools where principals reported moderate attendance problems, and 19 percent were in schools with some serious attendance problems.
- ▶ Generally, the overwhelming majority of eighth-grade students attended schools judged by principals to have few serious problems threatening an orderly or safe school environment.



INTRODUCTION

TIMSS 1999 International Science Report

In 1999, The Third International Mathematics and Science Study (TIMSS) was replicated at the eighth grade. Thirty-eight countries participated in this mathematics and science assessment, known as TIMSS-R or TIMSS 1999. The science results are presented in this report for the 38 countries that participated in TIMSS in 1999. Trend data also are included for 26 countries that participated in TIMSS in 1995.





What Is TIMSS?

Originally conducted in 1994-1995, the Third International Mathematics and Science Study (TIMSS) was the largest and most comprehensive comparative international study of education ever undertaken. Designed to provide a base from which policy makers, curriculum specialists, and researchers could better understand the performance of their educational systems, 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. Information was collected about educational systems, curriculum, teacher and school characteristics, and instructional practices, providing an extremely rich source of valuable insights into science teaching and learning.

TIMSS results, which were first reported in 1996, have stirred debate, spurred reform efforts, and provided important information to academics, researchers, and decision makers around the world.¹ Since that time most of the participating countries have published one or more national reports, analyzing the findings from their own perspective. In addition, at least 12 book-length international reports have been published, along with hundreds of articles and comments in newsletters, newspapers, and magazines.

What Is TIMSS 1999?

TIMSS was the first step in a long-term strategy, with further assessments in mathematics and science planned for 1999, 2003, and beyond. TIMSS 1999, also known as TIMSS-repeat or TIMSS-R, is a replication of TIMSS at the lower-secondary or middle-school level – the eighth grade in most countries. As a follow-up to the earlier study, TIMSS 1999 adds to the richness of the TIMSS data and their potential to have an impact on policy and practice.

Administered during the 1998-99 school year, TIMSS 1999 was designed to provide trends in eighth-grade mathematics and science achievement in an international context. Also, 1999 represents four years since the first TIMSS, and the population of students originally assessed as fourth-graders had advanced to the eighth grade. Thus, TIMSS 1999

¹ Robitaille, D.F., Beaton, A.E., and Plomp, T., eds. (2000), *The Impact of TIMSS on the Teaching and Learning of Mathematics and Science*, Vancouver, BC: Pacific Educational Press.



also provides information about whether the relative performance of these students has changed in the intervening years. As in the original 1995 study, TIMSS 1999 included a full range of context questionnaires and the TIMSS-R Videotape Classroom Study examining mathematics and science instructional practices in seven nations.²

In countries new to the study as well as those that participated in 1995, the data from TIMSS 1999 can help policy makers and practitioners assess their comparative standing and gauge the rigor and effectiveness of their mathematics and science programs. The aim is to improve the teaching and learning of mathematics and science for students everywhere by providing data about what types of curricula, instructional practices, and school environments result in higher student achievement.

Who Conducted TIMSS 1999?

The original TIMSS and TIMSS 1999 were conducted by the International Association for the Evaluation of Educational Achievement (IEA). With a permanent secretariat based in Amsterdam, the Netherlands, the IEA is an independent international cooperative of national research institutions and governmental research agencies. 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.

Four IEA studies in the areas of mathematics and science preceded TIMSS. These were the First International Mathematics Study, 1959-1967; the First International Science Study, 1966-1973; the Second International Mathematics Study, 1976-1987; and the Second International Science Study, 1980-1989. During the same period, the IEA conducted a number of studies that focused on other areas of schooling, including reading literacy, civics, computer applications, and early childhood education.

Funding for TIMSS 1999 was provided by the United States, the World Bank, and the participating countries. Within the United States, funding agencies include the National Center for Education Statistics of the U.S. Department of Education, the National Science Foundation, and the Department of Education's Office of Educational Research and Improvement.

² Sponsored by the United States, the TIMSS-R Videotape Classroom Study builds on the work of the first TIMSS videotape study of mathematics (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). The first data from the Videotape Classroom Study are anticipated in late 2001.

The IEA delegated responsibility for the overall direction and management of the project 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 in Amsterdam, Statistics Canada in Ottawa, the IEA Data Processing Center in Hamburg, and Educational Testing Service in Princeton, New Jersey.

Which Countries Participated?

Exhibit 1 shows the 38 countries that participated in TIMSS 1999. The decision to participate in any IEA study is coordinated through the secretariat in Amsterdam and made solely by each member country according to its own data needs and resources. Exhibit 1 shows that 26 countries also participated in TIMSS 1995.³ For these, trend data are included in this report, while for 12 of the participants data are included only for TIMSS 1999.⁴ Seventeen of the 26 countries that participated in TIMSS 1995 also have data at the fourth grade.⁵ A list of the countries participating in TIMSS 1995 at grades 4 and 8 can be found in Exhibit A.1 in the appendix.



Each participating country designated a national center to conduct the activities of the study and a National Research Coordinator (NRC) to implement it in accordance with international procedures – a considerable responsibility given the complexity of the data collection and the measurement instruments. The quality of the study depends on the work of the NRCs and their colleagues, and all those involved deserve deep appreciation for their continued commitment to the project.⁶

For the sake of comparability across countries and across assessments, all testing was conducted at the end of the school year, except in Lithuania. As noted in the exhibits in this report, Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year. The six countries on a Southern Hemisphere school schedule (Australia, Chile, Malaysia, New Zealand, Singapore, and South Africa) tested in October through December of 1998, which was the end of the school year there. The remaining countries tested at the end of the 1998-1999 school year, most often in May and June of 1999.

³ Hong Kong became a Special Administrative Region of the People's Republic of China in 1999, and is labeled "Hong Kong, SAR" in the exhibits in this report.

⁴ Italy was unable to complete the steps necessary to have its data available for reporting in 1996, but all scoring and database tasks were completed subsequently. Indonesia and the Philippines participated in 1995, but were unable to complete the steps necessary for their 1995 data to be reported comparably to those of other countries.

⁵ Israel and Thailand also participated at the fourth grade in 1995, but did not satisfy guidelines for sampling procedures at the classroom level, and were not included in the comparison for fourth and eighth grade.

⁶ Please see Appendix E for a list of the TIMSS 1999 National Research Coordinators and the TIMSS 1999 advisory committees.

Exhibit 1 Countries Participating in TIMSS 1999

Countries with Data from 1995 and 1999

Australia
Belgium (Flemish)
Bulgaria
Canada
Cyprus
Czech Republic
England
Hong Kong, SAR*
Hungary
Iran, Islamic Republic
Israel
Italy
Japan
Korea, Republic of
Latvia (LSS)
Lithuania
Netherlands
New Zealand
Romania
Russian Federation
Singapore
Slovak Republic
Slovenia
South Africa
Thailand
United States

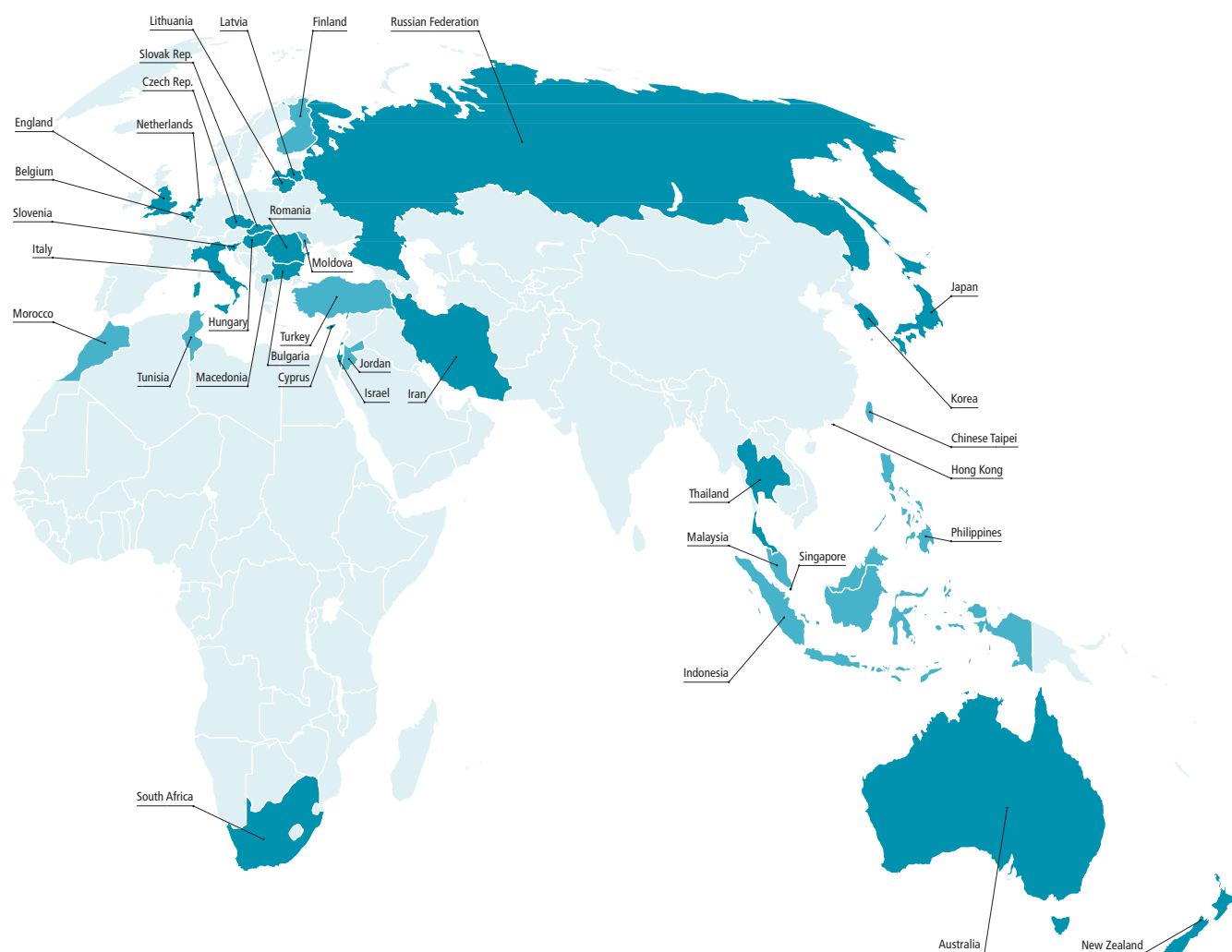
Countries with Data from 1999 Only

Chile
Chinese Taipei
Finland
Indonesia
Jordan
Macedonia, Republic of
Malaysia
Moldova
Morocco
Philippines
Tunisia
Turkey



Countries Participa

* For 1995, Hong Kong. It became a Special Administrative Region of the People's Republic of China in 1999.



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

ting in TIMSS 1999

What Is the Comparability Across the Grades and Ages Tested?

² Exhibit 2 shows information about the grade tested in each country for TIMSS 1999, including each country's name for the grade and the years of formal schooling students in the grade had completed when they were tested. Based on reassessing the same target population as originally defined for TIMSS in 1995, all countries that participated in TIMSS 1999 were to test students in the upper of the two grades with the largest proportion of 13-year-olds. Although in 1995 TIMSS tested students in the two grades with the largest proportion of 13-year-olds, the 1999 replication was carried out at only the upper of the two middle-school grades tested in 1995.

Exhibit 2 reveals that for most but not all countries, the grade tested represented the eighth year of formal schooling. Thus, solely for convenience, the report usually refers to the grade tested as the eighth grade.

It should be noted that students in Finland, in particular, had one year less of formal schooling and were about half a year younger, on average, than were the students tested internationally. Students in Morocco and the Philippines also had only seven years of formal schooling, as did some students in the Russian Federation. Students in the Czech Republic, England, and Moldova, as well as some in Australia and New Zealand, had nine years of formal schooling, yet the average age of the students was at or below the international average. Two countries, Romania and Slovenia, had students somewhat older than the international average, and a third, South Africa, had students about one year older, though these students had eight years of formal schooling. These countries, however, assessed the same grade as in 1995 in order to measure trends.

Having valid and efficient samples in each country is crucial to the quality and integrity of the study. The accuracy of the survey results depends on the quality of the sampling information available, and particularly on the quality of the samples. TIMSS developed procedures and guidelines to ensure that the national samples were of the highest quality possible. Standards were established and well documented for coverage of the target population, participation rates, and the age of students. For the most part, the national samples were drawn in accordance with the TIMSS standards, and achievement results can be compared with confidence. Countries that deviated from the guidelines are specially annotated in the exhibits in this report.⁷

⁷ The TIMSS 1999 sampling requirements and the outcomes of the sampling procedures are described in Appendix A.

Exhibit 2

Information About the Students Tested in TIMSS 1999

	Country's Name for Grade Tested	Years of Formal Schooling ¹	Average Age of Students Tested
Australia	8 or 9	8 or 9	14.3
Belgium (Flemish)	2A & 2P	8	14.1
Bulgaria	8	8	14.8
Canada	8	8	14.0
Chile	8	8	14.4
Chinese Taipei	2nd Grade Junior High School	8	14.2
Cyprus	8	8	13.8
Czech Republic	8	8	14.4
England	Year 9	9	14.2
Finland	7	7	13.8
Hong Kong, SAR	Secondary 2	8	14.2
Hungary	8	8	14.4
Indonesia	2nd Grade Junior Secondary	8	14.6
Iran, Islamic Rep.	8	8	14.6
Israel	8	8	14.1
Italy	3rd Grade Middle School	8	14.0
Japan	2nd Grade Lower Secondary	8	14.4
Jordan	8	8	14.0
Korea, Rep. of	2nd Grade Middle School	8	14.4
Latvia (LSS)	8	8	14.5
Lithuania [†]	9	8.5	15.2
Macedonia, Rep. of	8	8	14.6
Malaysia	Form 2	8	14.4
Moldova	8	9	14.4
Morocco	7	7	14.2
Netherlands	Secondary 2	8	14.2
New Zealand ²	Year 9	8.5 to 9.5	14.0
Philippines	1st Year High School	7	14.1
Romania	8	8	14.8
Russian Federation	8	7 or 8	14.1
Singapore	Secondary 2	8	14.4
Slovak Republic	8	8	14.3
Slovenia	8	8	14.8
South Africa	8	8	15.5
Thailand	Secondary 2	8	14.5
Tunisia	8	8	14.8
Turkey	8	8	14.2
United States	8	8	14.2
International Avg.			14.4

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

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

¹ Years of schooling based on the number of years children in the grade level have been in formal schooling, beginning with primary education (International Standard of Classification of Education Level 1). Does not include pre-primary education.

² The official nomenclature used in New Zealand since 1996 refers to students' years of schooling rather than to a class/grade level. Year 9 students are found in a class level equivalent to grade 8.

What Was the Nature of the Science Test?

Together with the quality of the samples, the quality of the test also receives considerable scrutiny in any comparative study. Developing the 1995 TIMSS tests was a cooperative venture involving all of the NRCS during the entire process. Through a series of efforts, countries submitted items that were reviewed by science subject-matter specialists, and additional items were written to ensure that the desired science topics were covered adequately. Items were pilot tested, the results were reviewed, and new items were written and piloted. As part of the TIMSS dissemination strategy, approximately two-thirds of the 1995 items were released for public use. For TIMSS 1999, these items were replaced with items similar in content, format, and difficulty level.⁸ All of the potential replacement items were reviewed thoroughly by subject-matter experts and field tested. Nearly all the TIMSS 1999 countries participated in field testing the replacement items with nationally representative samples, and all the NRCS had several opportunities to review the items and scoring criteria. The resulting TIMSS 1999 science test contained 146 items representing a range of science topics and skills.

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 are 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).

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 tests.

⁸ The TIMSS 1999 item replacement procedures are described in Appendix A.

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.



The TIMSS 1999 tests were prepared in English and translated into 33 languages. A series of verification checks were conducted to ensure the comparability of the translations.¹⁰

Testing was designed so that no one student took all the items, which would have required more than three hours. Instead, exactly as in 1995, 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.

TIMSS conducted a Test-Curriculum Matching Analysis in which countries examined the TIMSS 1999 test to identify items measuring topics not covered in their curricula. The analysis showed that omitting such items for each country had little effect on the overall pattern of achievement results across all countries.¹¹

¹⁰ See Appendix A for more information about the translation procedures.

¹¹ Results of the Test-Curriculum Matching Analysis are presented in Appendix C.

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 comparing achievement across countries, cultures, and languages. In both the 1995 and 1999 studies, extensive efforts were made to attend to these issues through careful planning and documentation, cooperation among the participating countries, standardized procedures, and rigorous attention to quality control throughout.¹²

Beyond ensuring the integrity of the study procedures and collecting information about system-wide factors that influence students' opportunity to learn,¹³ the results from comparative studies such as TIMSS also need to be considered in light of country-wide demographic and economic factors. Some selected demographic characteristics of the TIMSS 1999 countries are presented in Exhibit 3. Countries range widely in population size, 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 vary 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 4 shows information for selected economic indicators, such as gross national product (GNP) per capita, expenditure on education and research and development as a percentage of GNP, unemployment rate, and amount of development aid. The data reveal that there is great disparity in the economic resources available to countries. Together the indicators in these two exhibits highlight the diversity of the TIMSS 1999 countries, and although the factors they 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.

In some countries science at the eighth grade is taught as a single general or integrated subject, while in other countries it is taught as separate science subjects, namely earth science, biology, physics, and chemistry.

Exhibit 5 shows how science instruction is organized at grade 8 in each of the TIMSS 1999 countries. The majority teach science as a single integrated subject, although in many countries, particularly the European ones, it is common practice to teach science as separate subjects.

¹² 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.

¹³ See Chapter 5 for information about the official science curriculum for each country participating in TIMSS 1999.



Exhibits 3–5 Overleaf

Exhibit 3 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
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
United States	267.6	9159	76	7	99.0	212

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 Ministère du plan et de l'initiation économique: Annuaire de Maroc, 1999.

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

A dash (—) indicates data are not available.

Exhibit 4 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
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
United States	29080	29080	5.4	2.6	5.0	—

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.



Countries Teaching Science as a Single General/Integrated Subject

Australia
Canada
Chile
Cyprus
England
Hong Kong, SAR
Iran, Islamic Republic
Israel
Italy
Japan
Jordan
Korea, Republic of
Malaysia
New Zealand
Philippines
Singapore
South Africa
Thailand
Tunisia
Turkey
United States



Countries Teaching Science as Separate Subjects

Belgium (Flemish)
Bulgaria
Chinese Taipei ¹
Czech Republic
Finland
Hungary
Indonesia ²
Latvia
Lithuania
Macedonia, Republic of
Moldova
Morocco
Netherlands
Romania
Russian Federation
Slovak Republic
Slovenia

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

¹ Chinese Taipei: separate sciences are taught starting in grade 7, with biology in grade 7 and physics/chemistry in grade 8. Teacher background data are reported for the grade 8 physics/chemistry teachers in the physics section of the teacher exhibits. Students were administered the general version of the questionnaire and asked about 'natural science'; student data are presented in the general science section of the student exhibits and pertain to the physics/chemistry course in grade 8.

² Indonesia: students are taught 'IPA science' by separate biology and physics teachers, but students receive a single composite grade. Teacher background data are reported separately for biology and physics teachers. Students were administered the general version of the questionnaire and asked about 'IPA science'; student data are presented in the general science section of the student exhibits and pertain to the composite course in grade 8.

CHAPTER 1

International Student Achievement in Science



1



Chapter 1 summarizes eighth-grade achievement on the TIMSS 1999 science assessment for each of the participating countries, and shows trends in student performance for those countries that also participated in TIMSS 1995 at the eighth grade. Comparisons of country performance against international benchmarks, as well as gender differences in performance, also are provided.

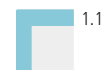




How Do Countries Differ in Science Achievement?

Exhibit 1.1 presents the distribution of student achievement for the 38 countries that participated in TIMSS 1999.¹ Countries are shown in decreasing order of average (mean) scale score, together with an indication of whether the country average is significantly higher or lower than the international average. The international average of 488 was obtained by averaging across the mean scores for each of the 38 participating countries. The results reveal substantial differences in science achievement between the high- and low-performing countries, from an average of 569 for Chinese Taipei to 243 for South Africa. Nineteen countries had average science achievement that was significantly above the international average, including two countries that are participating in TIMSS for the first time – Chinese Taipei and Finland.² Thirteen countries had average achievement below the international average, including nine countries new to TIMSS– Moldova, the Republic of Macedonia, Jordan, Indonesia, Turkey, Tunisia, Chile, the Philippines, and Morocco.

The broad range of achievement both within and across countries is illustrated in Exhibit 1.1 by a graphical representation of the distribution of student performance within each country. Achievement for each country 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 country performed below the 25th percentile for that country, and 75 percent performed above the 25th percentile. The range between the 25th and 75th percentiles represents performance by the middle half of the students. In most countries, the range of performance for the middle group was between 100 and 150 scale-score points. In contrast, 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 include 90 percent of the population, is between 250 and 300 points in most countries. The dark boxes at the midpoints of the distributions show the 95 percent confidence intervals around the average achievement in each country.⁴



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 science test. For more detailed information, see the "IRT Scaling and Data Analysis" section of Appendix A.

² The significance tests in Exhibits 1.1 and 1.2 are based on a Bonferroni procedure for multiple comparisons that holds to 5 percent the probability of erroneously stating the mean of one country to be different from that of another country.

³ Tables of the percentile values and standard deviations for all countries are presented in Appendix D.

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.

As well as showing the wide spread of student achievement within each country, the percentiles also provide a perspective on the size of the differences among countries. Even though performance generally differed very little between one country and the next higher- or lower-performing country, the range in performance across the 38 countries 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.

To aid in interpretation, Exhibit 1.1 also includes the years of formal schooling and average age of the students in each country. Equivalence of chronological age does not necessarily mean that students have received the same number of years of formal schooling or studied the same curriculum. Most notably, students in Finland, Morocco, the Philippines, and parts of the Russian Federation had fewer years of formal schooling than their counterparts in other countries, while those in the Czech Republic, England, Moldova, and parts of Australia and New Zealand had more years of schooling. The average age of students ranged from 13.8 years in Cyprus and Finland to 15.5 years in South Africa.

1.2  Exhibit 1.2 compares overall mean achievement among individual countries. This figure shows whether or not the differences in average achievement between pairs of countries are statistically significant. Selecting a country of interest and reading across the table, a triangle pointing up indicates significantly higher performance than the comparison country 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 countries usually did not significantly differ from each other, although the differences in achievement between the high-performing and low-performing countries were very large. Because of this wide range in performance, the pattern for a number of countries was one of having lower mean achievement than some countries, about the same mean achievement as other countries, and higher mean achievement than a third group of countries.

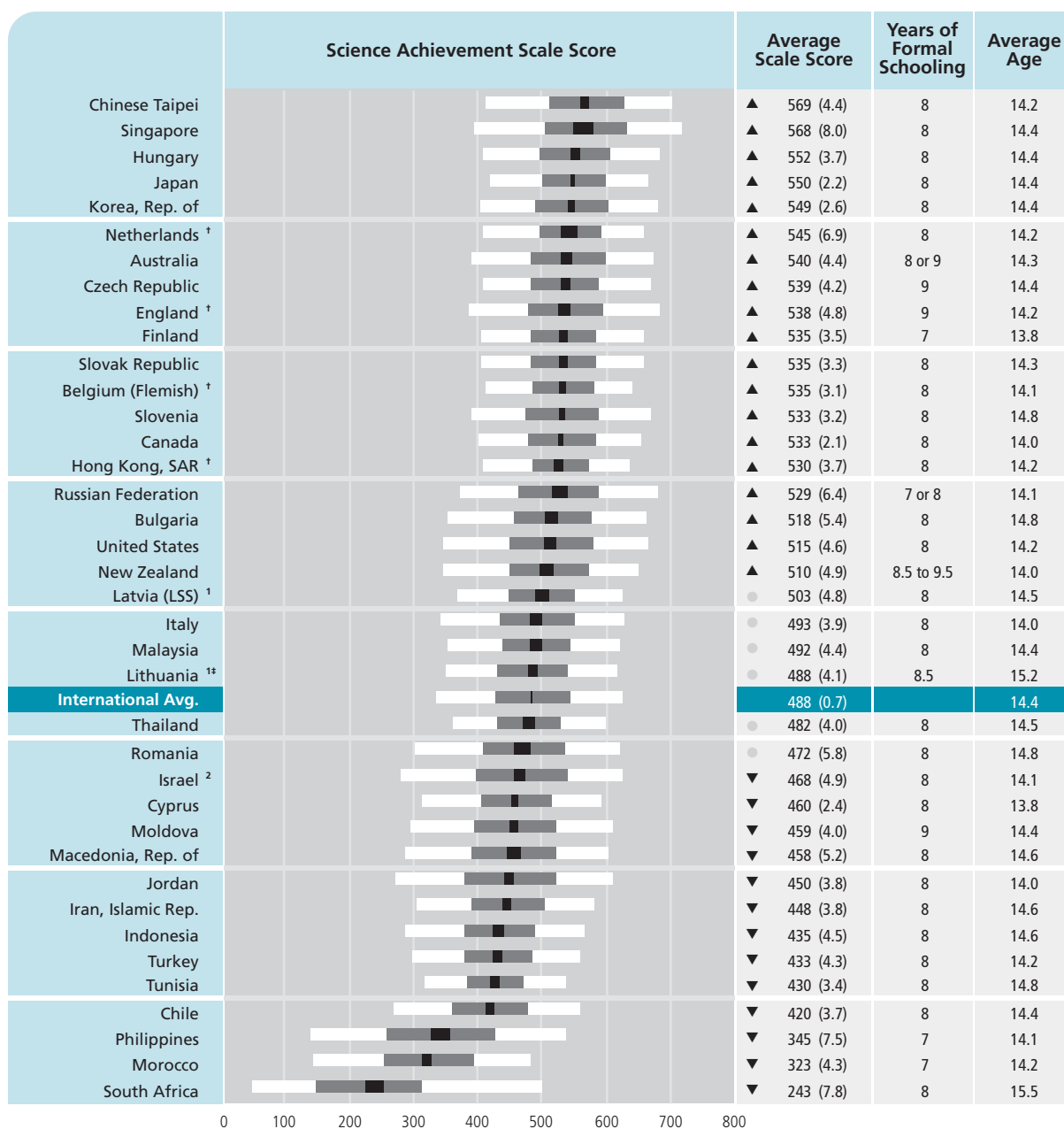


Chinese Taipei and Singapore had the highest average performance, closely followed by Hungary, Japan, and the Republic of Korea. Other countries that performed very well included the Netherlands,⁵ Australia, the Czech Republic, and England. The latter group of countries had similar achievement levels. The difference in performance from one country to the next was often negligible. For example, Finland, the Slovak Republic, Belgium (Flemish), Slovenia, Canada, Hong Kong SAR, the Russian Federation, and Bulgaria outperformed about half of the participating countries. In turn, the United States, while performing less well than Chinese Taipei, Singapore, Hungary, Japan, Korea, the Netherlands, Australia, the Czech Republic, England, Finland, the Slovak Republic, Belgium (Flemish), Slovenia, and Canada, performed at about the same level as Hong Kong, the Russian Federation, Bulgaria, New Zealand, and Latvia (LSS),⁶ and higher than all other countries. In contrast, the Philippines, Morocco, and South Africa performed less well than the other countries, with South Africa having significantly lower achievement than the other two.

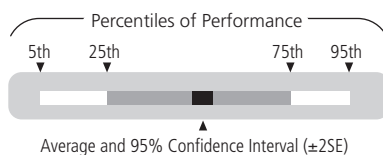
⁵ Average achievement for the Netherlands was lower than that for Chinese Taipei, Singapore, Hungary, Japan, and Korea, but the difference was not statistically significant because the Netherlands had a larger than usual standard error.

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

Exhibit 1.1 Distribution of Science Achievement



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



▲ Country average significantly higher than international average

● No statistically significant difference between country average and international average

▼ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

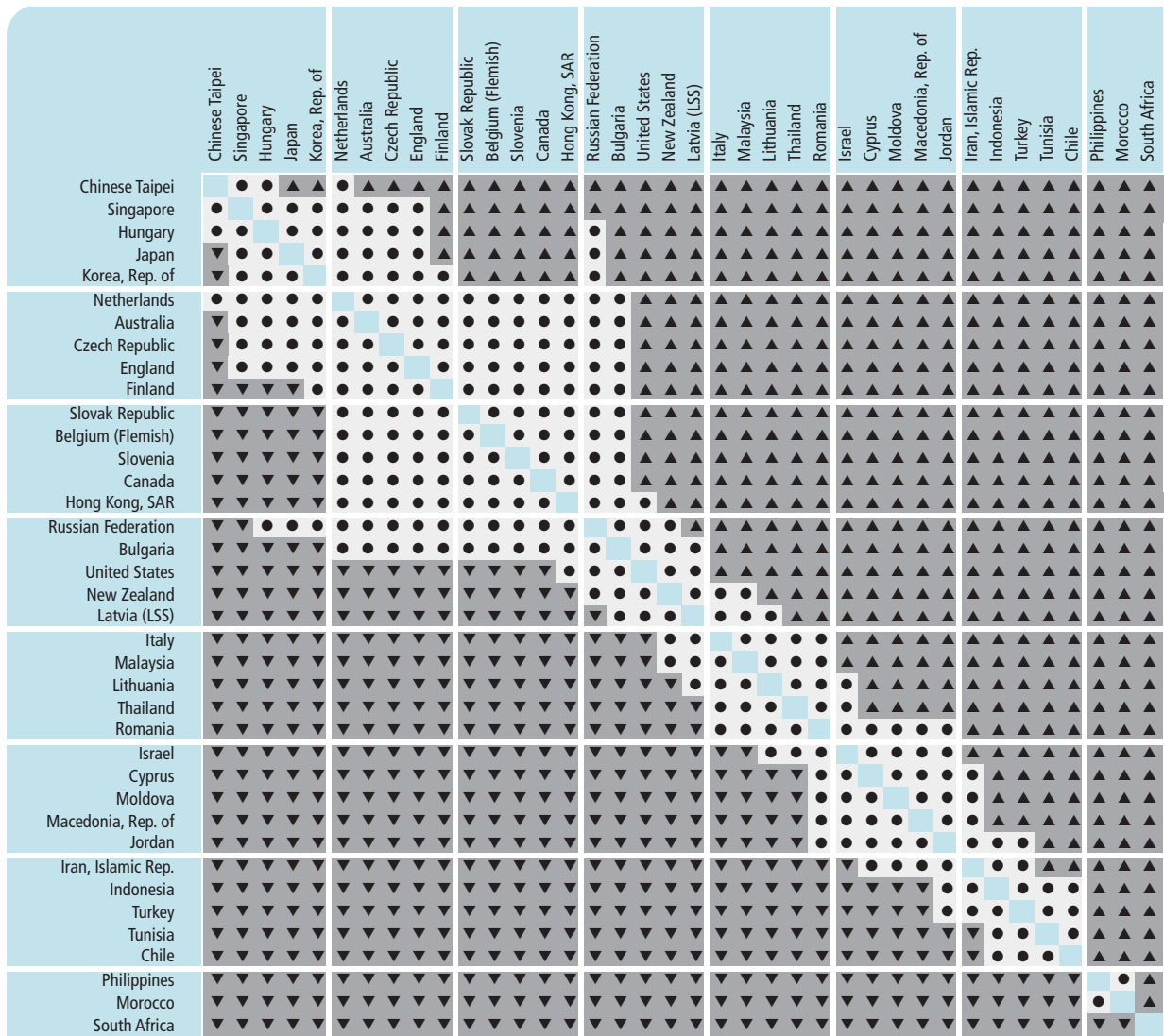
^{*} Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

() 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

TIMSS 1999
8th grade
Science

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



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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

Significance tests adjusted for multiple comparisons

How Has Science Achievement Changed Since 1995?

1.3



Twenty-six countries took part in the TIMSS eighth-grade assessments in both 1995 and 1999. For these countries, Exhibit 1.3 shows the results in 1995 and 1999 and the differences in average achievement between the two years.⁷ Average science achievement across these 26 countries increased from a scale score of 518 in 1995 to 521 in 1999, although the gain was not statistically significant.

In some countries, average science achievement increased considerably between 1995 and 1999. The greatest increase was in Latvia (LSS), with an increase of 27 scale-score points. Lithuania showed a similar increase, although this should be interpreted with caution, since Lithuania conducted the assessment six months later than other participants, when the students were beginning ninth grade rather than finishing eighth grade. Other countries with significant increases in achievement were Canada and Hungary. Hong Kong and Australia also had large increases, although the somewhat larger estimates of measurement error for these countries meant that the differences were not statistically significant.

Several countries showed a small decrease in average achievement from 1995 to 1999, but only in the case of Bulgaria was it statistically significant. Israel, South Africa, and Thailand are shown in a separate panel in Exhibit 1.3 because they used unapproved sampling procedures at the classroom level in 1995. Israel and Thailand showed large decreases since 1995, which could indicate an upward bias in the 1995 results due to their sampling problems in the original TIMSS rather than actual decreases.

1.4



TIMSS in 1995 assessed both fourth- and eighth-grade students. This allowed participants to compare their performance relative to each other at the fourth and eighth grades, and gave a cross-sectional perspective on how relative performance changed between grades.⁸ For example, as shown in Exhibit 1.4, the United States, Australia, and Canada in 1995 performed significantly above the international average at the fourth grade, but just similar to it at the eighth grade. These countries place considerable emphasis on science education in the early grades, so it could be that this apparent relative decline from fourth to eighth grade is partly because other countries begin to emphasize science after the fourth grade. That Singapore, Slovenia, and Hungary, the countries with just average fourth-grade performance but above average eighth-grade performance in 1995, each begin to emphasize science instruction prior to the eighth grade lends support to this interpretation.

⁷ TIMSS used IRT methods to place the eighth-grade results from 1995 and 1999 on the same scale. See Appendix A for more detailed information.

⁸ The science achievement scale for fourth grade is not comparable to that for eighth grade, and so results for fourth grade and eighth grade may be compared only in relative terms, for example with reference to the international average for countries that participated in 1995 at both the fourth and eighth grades.



It has also been argued, at least in the United States, that recent reforms in education had their greatest impact in the earlier grades, and that a second TIMSS assessment could show better results for eighth grade in 1999 than in 1995. Of the three countries with a relative decline from fourth to eighth grade in 1995, only the United States showed the same relative decline from fourth grade in 1995 to eighth grade in 1999. Hopes in that country that the benefits of educational reform would be evident in the 1999 eighth-grade results have not been realized. New Zealand also showed a relative decline at the eighth grade, from about the international average in 1995 to below it in 1999. In Canada and Australia, in contrast, the relative position has improved since 1995, with both countries above the international average at eighth grade in 1999.

Exhibit 1.3 Trends in Science Achievement



Countries with Unapproved Sampling Procedures at the Classroom Level in 1995

Israel	509 (6.3)	484 (5.7)	-25 (8.3)
South Africa	263 (11.1)	243 (7.8)	-20 (13.7)
Thailand	510 (4.7)	482 (4.0)	-28 (6.2)

Difference statistically significant

Difference not statistically significant

Significance tests adjusted for multiple comparisons

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

Exhibit 1.4

Science Achievement for TIMSS 1999 Countries That Participated in 1995 at Both the Fourth and Eighth Grades in Relation to the Average Across These Countries

TIMSS 1999
8th grade
Science

1995

Eighth Grade Difference From Average Across Countries [§]	
Singapore	60 (5.2)
Czech Republic	34 (4.4)
Japan	34 (1.9)
Korea, Rep. of	25 (2.2)
Netherlands	21 (5.8)
Slovenia	20 (2.8)
Hungary	16 (3.1)
England	13 (3.5)
Australia	6 (3.9)
Canada	-7 (2.7)
United States	-8 (5.3)
New Zealand	-10 (4.6)
Hong Kong	-11 (5.5)
Italy	-23 (3.4)
Latvia (LSS)	-44 (3.3)
Iran, Islamic Rep.	-58 (3.5)
Cyprus	-69 (2.2)
Avg. Across Countries [§]	521 (1.0)

Fourth Grade Difference From Average Across Countries [§]	
Korea, Rep. of	62 (2.2)
Japan	39 (1.9)
United States	28 (3.2)
Australia	28 (3.5)
Czech Republic	18 (3.0)
Netherlands	17 (3.1)
England	14 (3.1)
Canada	12 (3.0)
Italy	10 (4.4)
Singapore	10 (4.6)
Slovenia	8 (3.9)
Hong Kong	-6 (3.3)
Hungary	-6 (3.3)
New Zealand	-9 (5.1)
Latvia (LSS)	-27 (4.7)
Cyprus	-64 (3.1)
Iran, Islamic Rep.	-134 (4.4)
Avg. Across Countries [§]	514 (0.9)

1999

Eighth Grade Difference From Average Across Countries [§]	
Singapore	44 (7.6)
Hungary	28 (3.6)
Japan	25 (2.4)
Korea, Rep. of	24 (2.6)
Netherlands	21 (6.5)
Australia	16 (4.3)
Czech Republic	15 (4.1)
England	14 (4.5)
Canada	9 (2.1)
Slovenia	9 (3.3)
Hong Kong, SAR	5 (3.5)
United States	-9 (4.5)
New Zealand	-15 (4.8)
Latvia (LSS)	-21 (4.9)
Italy	-26 (4.5)
Cyprus	-64 (2.3)
Iran, Islamic Rep.	-76 (3.7)
Avg. Across Countries [§]	524 (1.1)

Country average significantly higher than average across countries
Country average not significantly different from average across countries
Country average significantly lower than average across countries
Significance tests adjusted for multiple comparisons

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

[§] Average across the subset of TIMSS 1999 countries that participated and met sampling guidelines in 1995 at both the fourth and eighth grades.

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

How Do Countries Compare with International Benchmarks of Science Achievement?

1.5



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 on the scale 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, and conducted an ambitious scale-anchoring exercise to describe performance at these benchmarks. Exhibit 1.5 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. This point on the scale, which corresponds to a scale score of 616, is the point above which the top 10 percent of the 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.

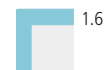
The Upper Quarter Benchmark is the 75th percentile on the science scale. This point, corresponding to a scale score of 558, is the point above which the top 25 percent of students scored. Students scoring at this benchmark typically demonstrated conceptual understanding of some science cycles, systems,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



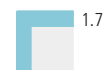
Exhibit 1.6 displays the percentage of students in each participating country that reached each international benchmark, in decreasing order by percentage reaching the Top 10% Benchmark. If student achievement in science were distributed in the same way in every country, then each country would be expected 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), Italy, Israel, Malaysia, and Lithuania came fairly close, no country followed this pattern exactly. Instead, the high-performing countries generally had greater percentages of students reaching each benchmark, and the low-performing countries had lesser percentages. Among the high performers, for example, Singapore and Chinese Taipei had more than one-quarter 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 to 95 percent) reaching the Lower Quarter Benchmark. In contrast, low-performing countries such as 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.



1.6

Although Exhibit 1.6 is organized to draw particular attention to the percentage of high-achieving students in each country, it conveys information about the distribution of middle and low performers also. For example, several countries, including Belgium (Flemish), 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.

Exhibits 1.7 through 1.10 provide more information on the change in student performance from 1995 to 1999 by showing the percentages reaching each international benchmark in each of the years for the 26 countries that participated in both assessments.⁹ Changes from 1995 to 1999 in the percentages of students reaching the Top 10% Benchmark are shown in Exhibit 1.7. Although on average across the 26 countries the percentage of students reaching this benchmark rose from 13 percent in 1995 to 14 percent in 1999, this increase was not statistically significant. Only in Hungary was there a significant increase, from 14 percent in 1995 to 22 percent in 1999. Bulgaria was the only country with a significant decrease, from 24 percent of students reaching the benchmark in 1995 to 14 percent in 1999.



1.7

⁹ For Exhibits 1.7 through 1.10 the benchmarks were those computed from the 1999 data.



1.8



Countries generally had more success increasing the percentage of students reaching the Upper Quarter Benchmark (see Exhibit 1.8). Although on average internationally there was little difference between the percentages reaching this benchmark in 1995 (34 percent) and in 1999 (35 percent), there was a significant increase in Canada, Hungary, Latvia (LSS), and Lithuania, and no country had a significant decrease.

1.9



Exhibit 1.9 shows the change from 1995 to 1999 in the percentage of students reaching the Median Benchmark. Like the two previous benchmarks, the average percentage of students reaching the benchmark increased slightly, in this instance from 65 percent in 1995 to 66 percent in 1999, but the increase was not statistically significant. At this benchmark also, Canada, Latvia (LSS), and Lithuania were the countries with the greatest increases. A somewhat similar situation was obtained for the Lower

1.10



Quarter Benchmark (see Exhibit 1.10), as the international average percentage of students reaching it increased slightly, from 88 percent to 89 percent. Countries with significant increases at this benchmark were Canada, Hong Kong, and Latvia (LSS), and those with significant decreases were the Islamic Republic of Iran, Singapore, and Slovenia.

Taken together, the results from Exhibits 1.7 through 1.10 confirm that the modest increase in average student performance that was evident from Exhibit 1.3 was largely due to improved performance among a few countries. While in Hungary the increase was greatest among the more proficient students – those scoring above the Upper Quarter and Top 10% Benchmarks – in Canada, Latvia (LSS) and Lithuania the increase occurred more generally across the range of student proficiency.



Exhibits 1.5–1.10 Overleaf

• 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

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

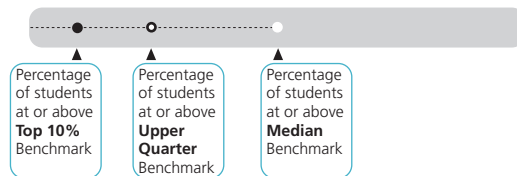
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit 1.6

Percentages of Students Reaching TIMSS 1999 International Benchmarks of Science Achievement

TIMSS 1999
8th grade
Science

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

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).

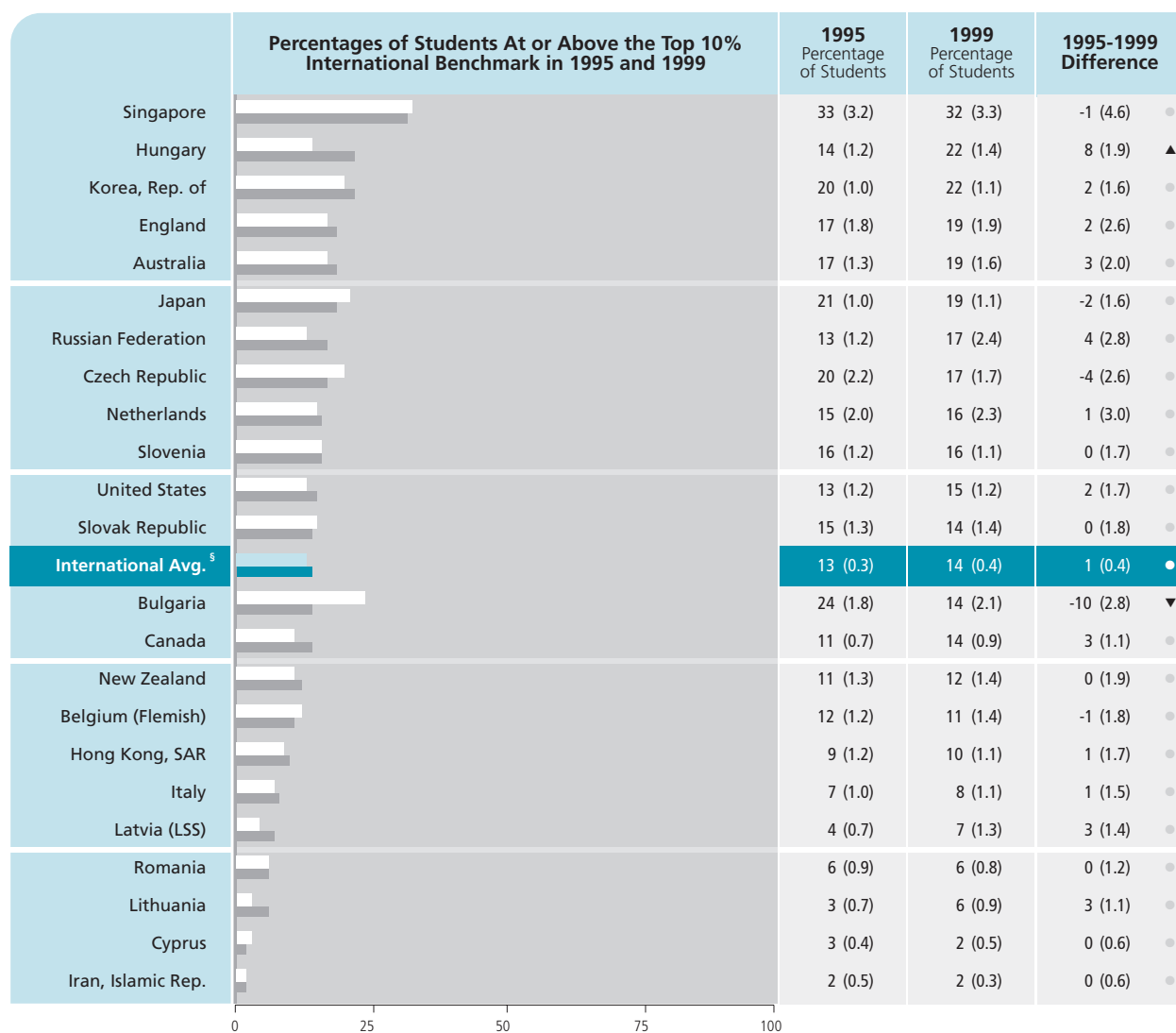
¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

² National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

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

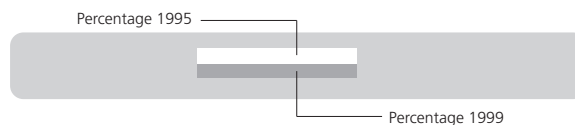
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 1.7 Trends in Percentages of Students Reaching the TIMSS 1999 Top 10% International Benchmark of Science Achievement



Countries with Unapproved Sampling Procedures at the Classroom Level in 1995

Israel	12 (1.8)	8 (0.8)	-4 (2.0)	●
South Africa	1 (0.5)	0 (0.2)	0 (0.6)	●
Thailand	6 (1.3)	3 (0.7)	-2 (1.5)	●



1999 significantly higher than 1995 ▲

No significant difference between 1995 and 1999 ●

1999 significantly lower than 1995 ▼

Significance tests adjusted for multiple comparisons

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

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

Exhibit 1.8

Trends in Percentages of Students Reaching the TIMSS 1999 Upper Quarter International Benchmark of Science Achievement

TIMSS 1999
8th grade
Science

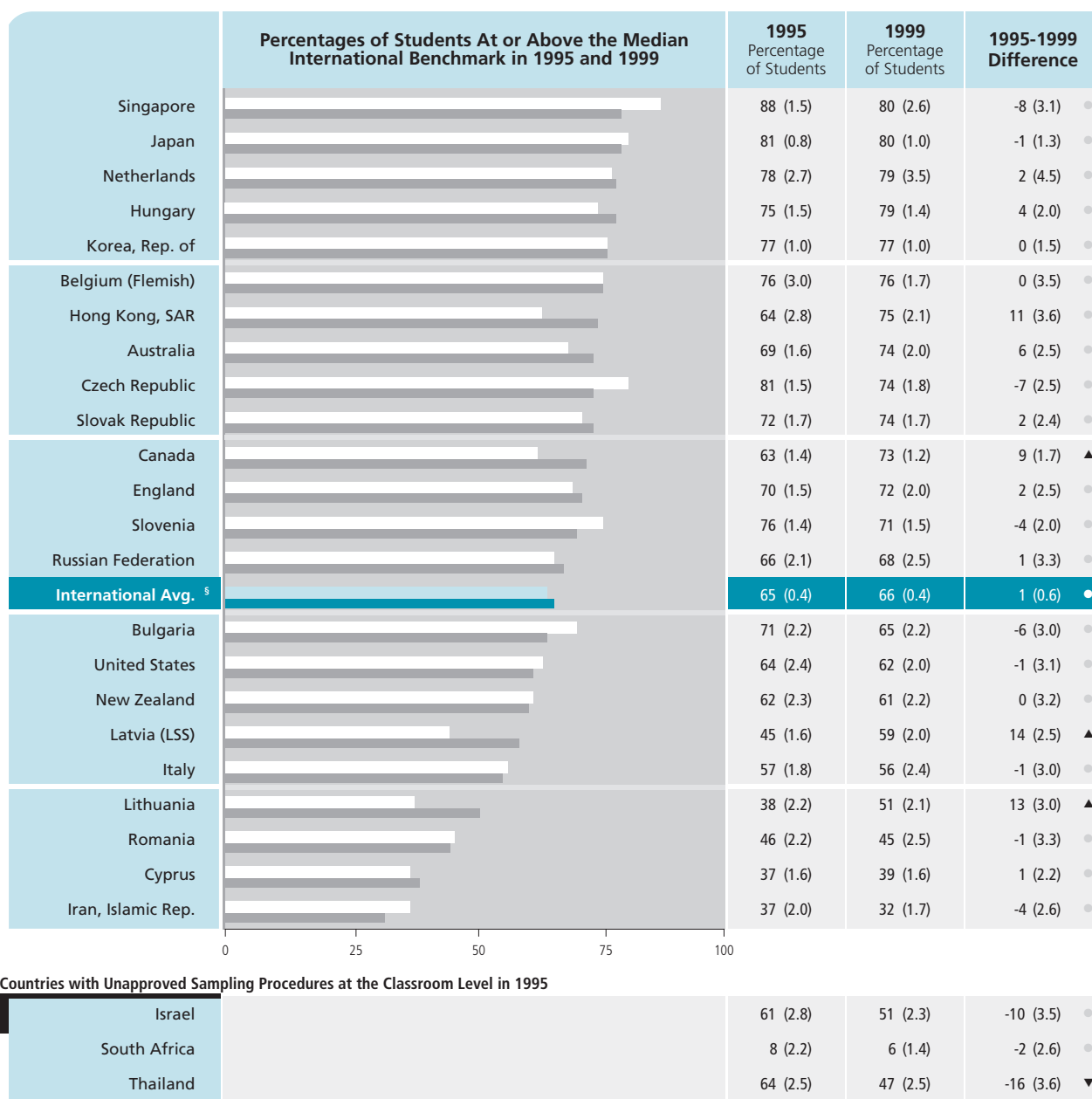
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

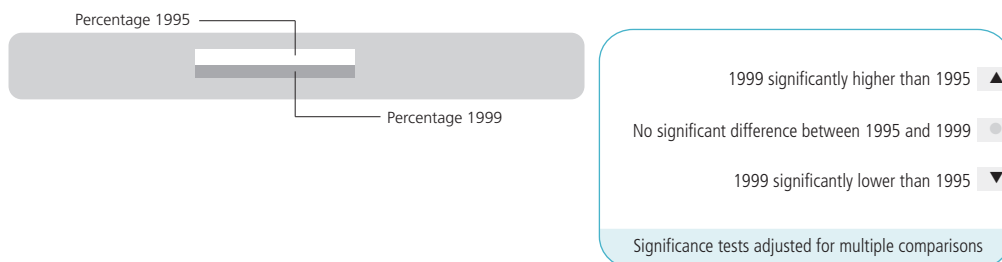
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Exhibit 1.9 Trends in Percentages of Students Reaching the TIMSS 1999 Median International Benchmark of Science Achievement



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



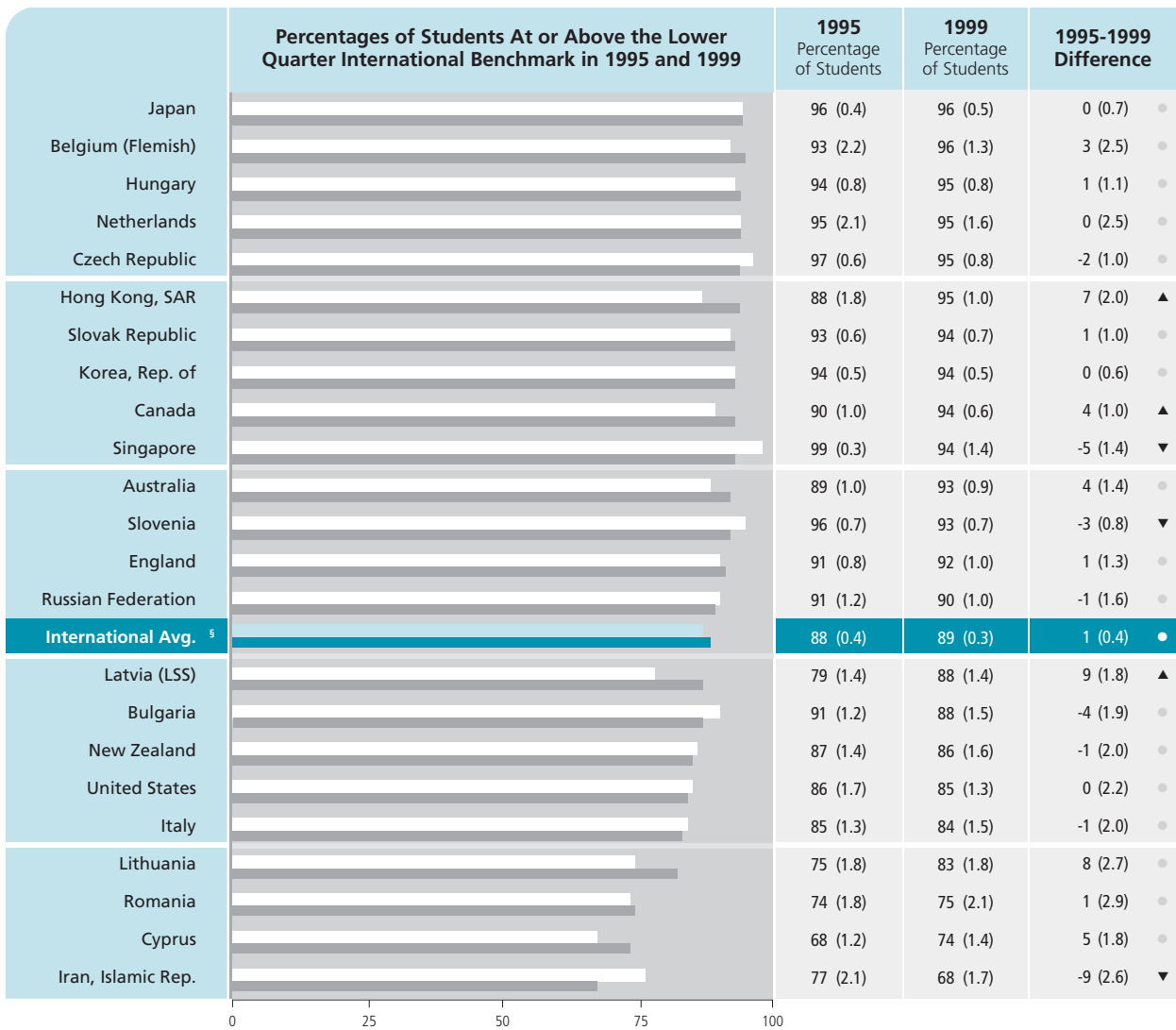
§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

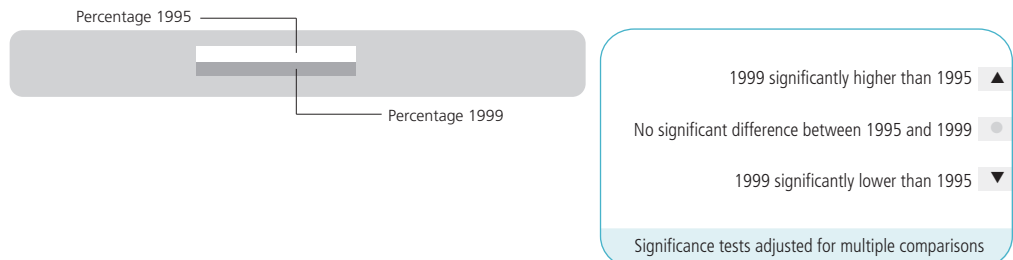
Exhibit 1.10

Trends in Percentages of Students Reaching the TIMSS 1999 Lower Quarter International Benchmark of Science Achievement

TIMSS 1999
8th grade
Science

Countries with Unapproved Sampling Procedures at the Classroom Level in 1995

Israel	86 (1.8)	78 (2.3)	-8 (2.9)	●
South Africa	15 (3.0)	13 (2.0)	-2 (3.6)	●
Thailand	93 (0.9)	84 (1.3)	-9 (1.5)	▼



§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

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

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

What Are the Gender Differences in Science Achievement?

1.11



Exhibits 1.11 through 1.14 show gender differences in eighth-grade science achievement in 1999, and also changes since 1995. Exhibit 1.11 presents average achievement separately for girls and boys for each of the TIMSS 1999 countries, as well as the difference between the means. Countries are shown in increasing order of this gender difference. The gender difference for each country is shown by a bar, indicating the amount of the difference, whether the direction of the difference favored girls or boys, and whether the difference is statistically significant (indicated by a darkened bar). On average across all countries, there was a significant difference of 15 scale-score points favoring boys, although the situation varied considerably from country to country. In many countries the gender difference was negligible. Among those with the smallest difference were Macedonia, Turkey, and Thailand. However, differences large enough to be statistically significant were found in 16 of the 38 countries. The countries with the largest differences were Iran, England, and the Czech Republic, where the mean for boys exceeded the mean for girls by more than 30 scale-score points.

1.12



Exhibit 1.12 provides information on gender differences in science achievement among students with high performance compared to those in the middle of the achievement distribution. For each country, score levels were computed for the highest-scoring 25 percent of students, called the upper quarter level, and for the top-scoring 50 percent of students, called the median level. The percentages of girls and boys in each country 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 each the median level.

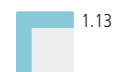
As may be seen from Exhibit 1.12, the gender difference in science at the country level is more apparent among high-performing students, although internationally it was about the same at both the upper quarter and median levels. On average across countries, 29 percent of boys reached the upper quarter 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 1.12 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.

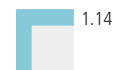
TIMSS in 1995 showed a pervasive difference in science achievement favoring boys, far more evident than in mathematics.¹⁰ These findings were consistent with the results from the second IEA science study conducted in 1983-84, which for 14-year-olds found standard score differences favoring boys in all 23 of the participating countries.¹¹ In the light of this evidence of longstanding gender differences in science achievement, Exhibits 1.13 and 1.14 examine trends in gender differences from 1995 to 1999 for countries that participated in both assessments.

Achievement differences from 1995 to 1999 are presented separately for girls and for boys in Exhibit 1.13. Average science achievement across countries for girls increased significantly, from 506 to 512, over this period. Achievement for boys did not increase significantly, although the 1999 international average of 531 for boys remains well above the average for girls. Countries where science achievement for girls increased significantly from 1995 to 1999 were Latvia (LSS), Hong Kong, Lithuania, and Canada. Achievement for boys increased significantly in Lithuania, Canada, and Cyprus.



1.13

Taking the study of trends in gender differences one step further, Exhibit 1.14 presents the difference in average science achievement between girls and boys in 1995 and in 1999, and shows whether the difference has changed. On average across countries in 1995, achievement for boys significantly exceeded that for girls by 21 scale-score points. In 1999, the difference fell to 18 points, a statistically significant reduction in the gender gap. Average science achievement was greater for boys in 18 countries in 1995, but in just 13 countries in 1999. The countries that contributed to the overall decrease in gender difference were Hong Kong, Slovenia, and Israel, the only countries that had a significant reduction in the gender difference between 1995 and 1999.

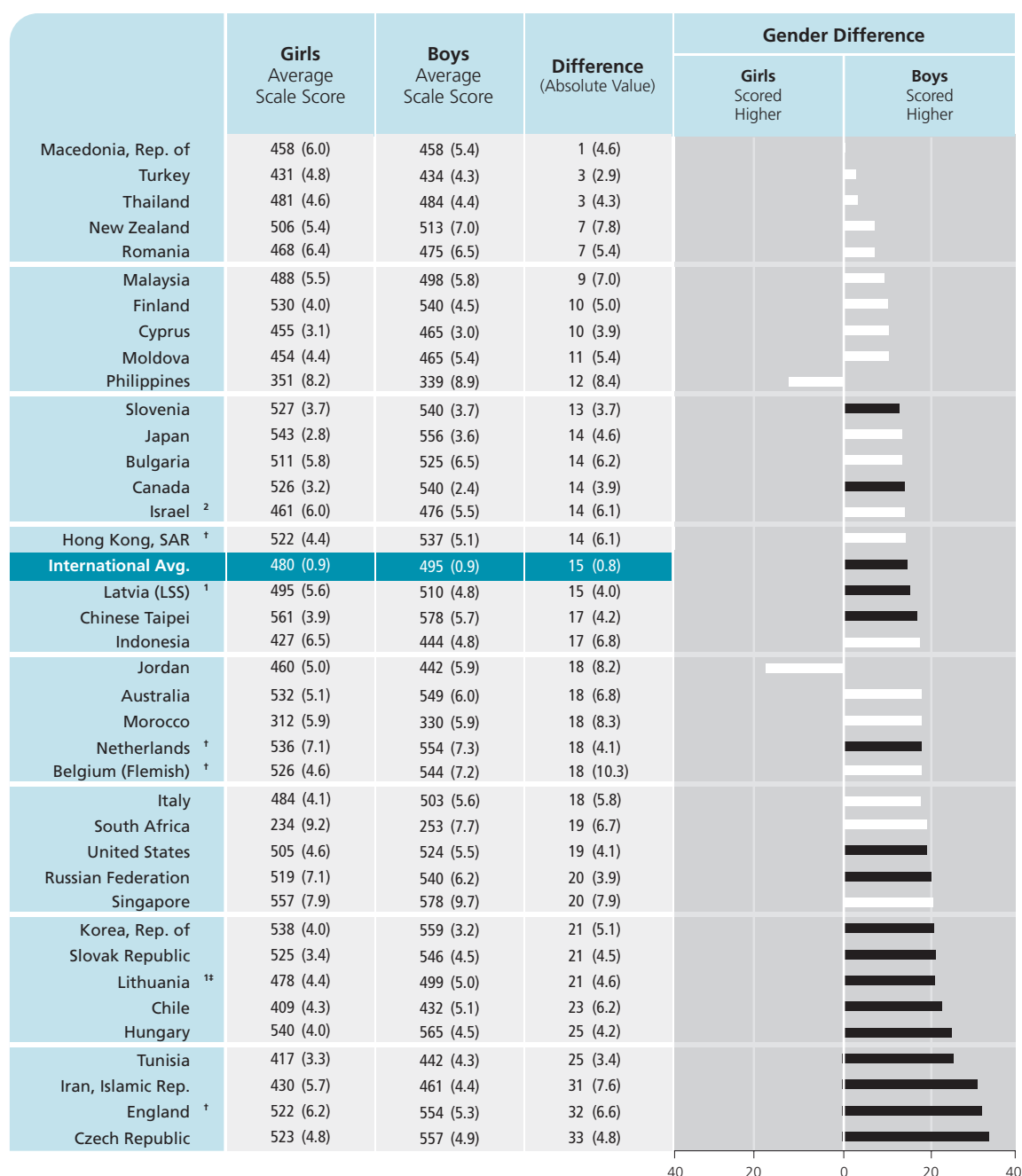


1.14

¹⁰ 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.

¹¹ 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 1.11 Average Science Achievement by Gender



[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

^{†*} 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 1.12

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

TIMSS¹⁹⁹⁹
8th grade
Science

	Upper Quarter			Median	
	Percent of Girls	Percent of Boys		Percent of Girls	Percent of Boys
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 ^{†*}	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)
United States	20 (1.6)	30 (2.0) ▲		46 (2.1)	54 (2.2) ▲
International Avg.	21 (0.3)	29 (0.4) ▲		46 (0.4)	54 (0.4) ▲

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).^{*} 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 1.13 Trends in Average Science Achievement by Gender

Girls				Boys			
	1995 Average Scale Score	1999 Average Scale Score	1995-1999 Difference		1995 Average Scale Score	1999 Average Scale Score	1995-1999 Difference
Latvia (LSS)	464 (3.8)	495 (5.6)	32 (6.5) ▲	Lithuania	477 (4.5)	499 (5.0)	22 (6.6) ▲
Hong Kong, SAR	492 (6.5)	522 (4.4)	30 (7.8) ▲	Latvia (LSS)	490 (4.3)	510 (4.8)	21 (7.0) ●
Lithuania	452 (4.3)	478 (4.4)	26 (6.1) ▲	Canada	521 (3.4)	540 (2.4)	19 (4.1) ▲
Canada	508 (3.2)	526 (3.2)	18 (4.4) ▲	Hungary	549 (3.5)	565 (4.5)	17 (5.6) ●
Hungary	525 (3.7)	540 (4.0)	15 (6.0) ●	Australia	533 (5.5)	549 (6.0)	16 (8.2) ●
Australia	520 (4.4)	532 (5.1)	12 (6.6) ●	Cyprus	451 (2.4)	465 (3.0)	14 (3.9) ▲
New Zealand	497 (5.6)	506 (5.4)	9 (7.9) ●	Hong Kong, SAR	525 (6.3)	537 (5.1)	12 (8.2) ●
Netherlands	528 (5.7)	536 (7.1)	8 (9.0) ●	England	543 (6.0)	554 (5.3)	11 (7.9) ●
Korea, Rep. of	530 (2.5)	538 (4.0)	8 (4.8) ●	Russian Federation	530 (5.1)	540 (6.2)	9 (8.2) ●
International Avg. §	506 (1.1)	512 (1.0)	6 (1.5) ▲	United States	520 (6.1)	524 (5.5)	5 (8.2) ●
Slovak Republic	520 (4.1)	525 (3.4)	5 (5.4) ●	International Avg. §	527 (1.1)	531 (1.1)	3 (1.6) ●
Romania	464 (5.4)	468 (6.4)	4 (8.4) ●	Italy	503 (3.8)	505 (6.4)	2 (7.1) ●
Russian Federation	516 (4.5)	519 (7.1)	4 (8.6) ●	Belgium (Flemish)	542 (9.0)	544 (7.2)	2 (11.7) ●
Belgium (Flemish)	524 (8.7)	526 (4.6)	2 (9.7) ●	Slovak Republic	545 (3.3)	546 (4.5)	1 (5.4) ●
Cyprus	454 (2.9)	455 (3.1)	1 (4.5) ●	Korea, Rep. of	559 (2.8)	559 (3.2)	0 (4.5) ●
Slovenia	526 (3.3)	527 (3.7)	0 (5.1) ●	Netherlands	554 (7.4)	554 (7.3)	0 (10.4) ●
United States	505 (5.4)	505 (4.6)	0 (7.1) ●	Romania	478 (5.6)	475 (6.5)	-3 (8.7) ●
England	522 (4.0)	522 (6.2)	-1 (7.5) ●	Japan	564 (2.2)	556 (3.6)	-7 (4.6) ●
Italy	492 (4.5)	491 (5.1)	-1 (6.9) ●	Singapore	587 (7.0)	578 (9.7)	-9 (12.0) ●
Japan	544 (1.9)	543 (2.8)	-2 (3.5) ●	New Zealand	524 (6.1)	513 (7.0)	-11 (9.4) ●
Czech Republic	538 (5.7)	523 (4.8)	-14 (7.6) ●	Iran, Islamic Rep.	475 (4.6)	461 (4.4)	-14 (6.2) ●
Singapore	574 (6.7)	557 (7.9)	-16 (10.4) ●	Czech Republic	572 (4.8)	557 (4.9)	-15 (6.8) ●
Iran, Islamic Rep.	448 (5.7)	430 (5.7)	-18 (8.2) ●	Slovenia	556 (3.3)	540 (3.7)	-16 (5.0) ▼
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995							
Israel	494 (6.9)	476 (6.6)	-17 (9.2) ●	Israel	532 (6.8)	492 (6.2)	-39 (9.0) ▼
South Africa	243 (9.7)	234 (9.2)	-9 (13.4) ●	South Africa	283 (15.4)	253 (7.7)	-30 (17.3) ●
Thailand	511 (5.4)	481 (4.6)	-30 (7.1) ▼	Thailand	509 (4.9)	484 (4.4)	-25 (6.7) ▼

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations. Trends in gender data for Bulgaria are unavailable.

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

Exhibit 1.14 Trends in Gender Differences in Average Science Achievement

	1995			1999			Change in Gender Difference*
	Girls Average Scale Score	Boys Average Scale Score	Difference (Absolute Value)	Girls Average Scale Score	Boys Average Scale Score	Difference (Absolute Value)	
Australia	520 (4.4)	533 (5.5)	14 (5.8)	532 (5.1)	549 (6.0)	18 (6.8)	↔
Belgium (Flemish)	524 (8.7)	542 (9.0)	18 (12.6)	526 (4.6)	544 (7.2)	18 (10.3)	↔
Canada	508 (3.2)	521 (3.4) ▲	13 (3.8)	526 (3.2)	540 (2.4) ▲	14 (3.9)	↔
Cyprus	454 (2.9)	451 (2.4)	3 (3.4)	455 (3.1)	465 (3.0)	10 (3.9)	↔
Czech Republic	538 (5.7)	572 (4.8) ▲	34 (4.2)	523 (4.8)	557 (4.9) ▲	33 (4.8)	↔
England	522 (4.0)	543 (6.0)	21 (7.8)	522 (6.2)	554 (5.3) ▲	32 (6.6)	↔
Hong Kong, SAR	492 (6.5)	525 (6.3) ▲	33 (6.6)	522 (4.4)	537 (5.1)	14 (6.1)	↘
Hungary	525 (3.7)	549 (3.5) ▲	23 (3.7)	540 (4.0)	565 (4.5) ▲	25 (4.2)	↔
Iran, Islamic Rep.	448 (5.7)	475 (4.6) ▲	27 (7.6)	430 (5.7)	461 (4.4) ▲	31 (7.6)	↔
Italy	492 (4.5)	503 (3.8)	11 (4.4)	491 (5.1)	505 (6.4)	14 (6.2)	↔
Japan	544 (1.9)	564 (2.2) ▲	19 (2.4)	543 (2.8)	556 (3.6)	14 (4.6)	↔
Korea, Rep. of	530 (2.5)	559 (2.8) ▲	29 (4.2)	538 (4.0)	559 (3.2) ▲	21 (5.1)	↔
Latvia (LSS)	464 (3.8)	490 (4.3) ▲	26 (4.4)	495 (5.6)	510 (4.8) ▲	15 (4.0)	↔
Lithuania	452 (4.3)	477 (4.5) ▲	25 (3.5)	478 (4.4)	499 (5.0) ▲	21 (4.6)	↔
Netherlands	528 (5.7)	554 (7.4) ▲	26 (4.4)	536 (7.1)	554 (7.3) ▲	18 (4.1)	↔
New Zealand	497 (5.6)	524 (6.1) ▲	27 (6.6)	506 (5.4)	513 (7.0)	7 (7.8)	↔
Romania	464 (5.4)	478 (5.6) ▲	14 (3.7)	468 (6.4)	475 (6.5)	7 (5.4)	↔
Russian Federation	516 (4.5)	530 (5.1) ▲	15 (3.6)	519 (7.1)	540 (6.2) ▲	20 (3.9)	↔
Singapore	574 (6.7)	587 (7.0)	13 (8.1)	557 (7.9)	578 (9.7)	20 (7.9)	↔
Slovak Republic	520 (4.1)	545 (3.3) ▲	25 (3.3)	525 (3.4)	546 (4.5) ▲	21 (4.5)	↔
Slovenia	526 (3.3)	556 (3.3) ▲	30 (3.7)	527 (3.7)	540 (3.7) ▲	13 (3.7)	↘
United States	505 (5.4)	520 (6.1) ▲	14 (3.0)	505 (4.6)	524 (5.5) ▲	19 (4.1)	↔
International Avg. §	506 (1.0)	527 (1.1) ▲	21 (1.2)	512 (1.1)	531 (1.2) ▲	18 (1.2)	↘
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995							
Israel	494 (6.9)	532 (6.8) ▲	38 (6.3)	476 (6.6)	492 (6.2)	16 (6.3)	↘
South Africa	243 (9.7)	283 (15.4) ▲	40 (13.0)	234 (9.2)	253 (7.7)	19 (6.7)	↔
Thailand	511 (5.4)	509 (4.9)	2 (4.6)	481 (4.6)	484 (4.4)	3 (4.3)	↔

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

Increased

Decreased

No change

* Indicates whether 1999 gender difference is significantly different than 1995 gender difference.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations. Trends in gender data for Bulgaria are unavailable.

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



CHAPTER 2

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 countries 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.





As countries around the world spend their time and energy on improving science education, 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 overall achievement results presented in Chapter 1, this chapter describes eighth-grade science achievement at each of the TIMSS 1999 international benchmarks together with examples of the types of items typically answered correctly by students performing at the benchmark.

Exhibit 1.6, presented previously in Chapter 1, shows the percentages of students in each country reaching each international benchmark – Top 10%, Upper Quarter, Median, and Lower Quarter. The benchmarks delineate performance of the top 10 percent, top quarter, top half, and lower quarter of students in the countries participating in TIMSS 1999 (90th, 75th, 50th, and 25th international percentiles, respectively). The analysis of performance at these benchmarks in science suggests that six primary factors appeared to differentiate performance among 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 used
- 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 answer 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.) 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 that those at the next lower benchmark were unlikely to answer correctly.¹ The sets of items produced by the analysis represented the accomplishments of students reaching each successively higher benchmark, and were used by a panel of subject matter experts from the TIMSS countries to develop the benchmark descriptions.² 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 understanding 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 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 a student 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 when responding to the item.

¹ 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.

² The participants in the scale anchoring process are listed in Appendix E.



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.

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

Finally, it must be emphasized that the descriptions of the international benchmarks are provided as 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 country.

Several example items are included for each benchmark to complement the descriptions by giving a more concrete notion of the abilities students were able to demonstrate. Each example item is accompanied by the percentage of correct responses for each country as well as the international average. In general, the five or six countries scoring highest on the overall test also were among the top performers on the items used to illustrate the benchmarks. Likewise, the five or six countries with the lowest overall achievement also tended to have consistently low percentages of correct responses on the illustrative 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.



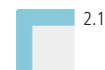
Item Examples and Student Performance

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. For each example item, the percent correct for each of the TIMSS 1999 countries is displayed, as well as the international average. 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.³

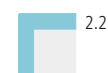
³ Some of the items used to develop the benchmark descriptions are being kept secure to measure achievement trends in future TIMSS assessments and are not available for publication.

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 Upper Quarter, Median, and Lower Quarter benchmarks.

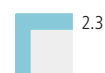


Students performing at the Top 10% Benchmark could communicate scientific information, such as their understanding of plant growth. As illustrated by Example Item 1 in Exhibit 2.2, students could explain why a nail placed in the trunk of a tree remained at the same level from the ground despite the increased height of the tree.

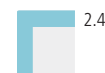


Internationally on average, 41 percent of the eighth-grade students correctly explained that trees grow from the tips of their stems or branches. In top-performing Belgium (Flemish) and Finland, nearly two-thirds of the students gave a correct response.

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 could 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 each machine pumped with the same amount of gasoline. Only in the Netherlands, Korea, Belgium (Flemish), and the Slovak Republic did at least half of the students give a fully correct response.



Students at the Top 10% Benchmark also demonstrated an understanding of gravitational force (Example Item 3 in Exhibit 2.4). On average across countries, 36 percent of students recognized that gravity acts on a rocket while on the launch pad, while ascending under power, and while parachuting back to earth. In only four countries did more than half the students do so (Czech Republic, Finland, Hungary, and Slovak Republic). Nearly one-third of students across countries selected option A, indicating that they have the misconception that gravity acts on the rocket only when it is falling back to earth.





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 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 and the Slovak Republic had the highest performance, with 62 to 64 percent of their students responding correctly. An additional eight countries had about half (50 to 54 percent) of their students responding correctly. Of the top 10 countries on this item, seven were countries where chemistry is taught as a separate subject at grade 8.

2.5



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, two-thirds of the Japanese students did so. Internationally, many students incorrectly identified the thinning ozone layer (option D) as a result of global warming.

2.6



• 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.

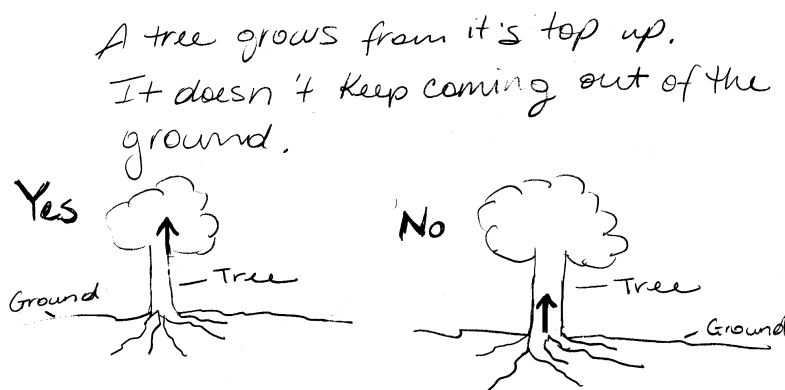
Exhibit 2.2 Top 10% TIMSS International Benchmark – Example Item 1

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

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.



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

	Overall Percent Correct
Belgium (Flemish) [†]	65 (3.5) ▲
Finland	64 (2.6) ▲
Canada	59 (1.9) ▲
Australia	57 (2.6) ▲
Japan	57 (1.9) ▲
Netherlands [†]	56 (3.6) ▲
New Zealand	56 (2.4) ▲
Thailand	55 (2.7) ▲
Slovak Republic	55 (3.0) ▲
England [†]	55 (2.9) ▲
Chinese Taipei	53 (2.0) ▲
Moldova	53 (2.3) ▲
Hungary	50 (2.8) ●
Singapore	49 (2.8) ●
Czech Republic	48 (3.1) ●
Russian Federation	48 (2.7) ●
Cyprus	47 (2.7) ●
Slovenia	45 (2.2) ●
United States	45 (2.2) ●
Turkey	44 (2.4) ●
Italy	43 (2.7) ●
Latvia (LSS) ¹	42 (2.8) ●
International Avg.	41 (0.4)
Hong Kong, SAR [†]	40 (2.1) ●
Israel ²	38 (2.4) ●
Iran, Islamic Rep.	37 (2.0) ●
Lithuania ^{1*}	36 (2.9) ●
Romania	36 (3.0) ●
Malaysia	33 (1.8) ▼
Korea, Rep. of	33 (1.9) ▼
Chile	30 (1.8) ▼
Bulgaria	29 (3.1) ▼
Jordan	24 (1.6) ▼
Indonesia	23 (1.8) ▼
Tunisia	22 (1.9) ▼
Macedonia, Rep. of	21 (2.1) ▼
Philippines	9 (1.4) ▼
South Africa	8 (1.3) ▼
Morocco	2 (0.5) ▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

[†] 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 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*

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.

$$1000 \div 1.25 = 800$$

$$500 \div 0.5 = 1000$$

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.

Netherlands [†]	58 (3.9)	▲
Korea, Rep. of	52 (1.8)	▲
Belgium (Flemish) [†]	51 (3.5)	▲
Slovak Republic	50 (2.9)	▲
Singapore	49 (3.2)	▲
Australia	48 (2.8)	▲
Japan	46 (2.1)	▲
Chinese Taipei	44 (2.1)	▲
Canada	43 (1.9)	▲
New Zealand	42 (2.6)	▲
England [†]	42 (3.0)	▲
Finland	40 (3.0)	●
Lithuania ^{1*}	38 (2.8)	●
Hungary	38 (2.5)	●
Israel ²	35 (2.6)	●
Slovenia	33 (3.0)	●
Russian Federation	33 (2.6)	●
Hong Kong, SAR [†]	32 (2.0)	●
International Avg.	31 (0.4)	
Czech Republic	30 (2.6)	●
United States	30 (1.9)	●
Thailand	28 (2.2)	●
Bulgaria	28 (3.2)	●
Cyprus	27 (2.3)	●
Latvia (LSS) ¹	26 (2.5)	●
Italy	23 (2.3)	●
Romania	22 (2.8)	●
Iran, Islamic Rep.	21 (1.8)	▼
Macedonia, Rep. of	20 (2.5)	▼
Malaysia	20 (1.8)	▼
Indonesia	20 (2.1)	▼
Moldova	19 (2.0)	▼
Jordan	19 (1.9)	▼
Tunisia	19 (1.9)	▼
Turkey	17 (2.3)	▼
Chile	8 (1.3)	▼
Morocco	7 (1.0)	▼
Philippines	4 (0.9)	▼
South Africa	3 (0.7)	▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

[†] 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.

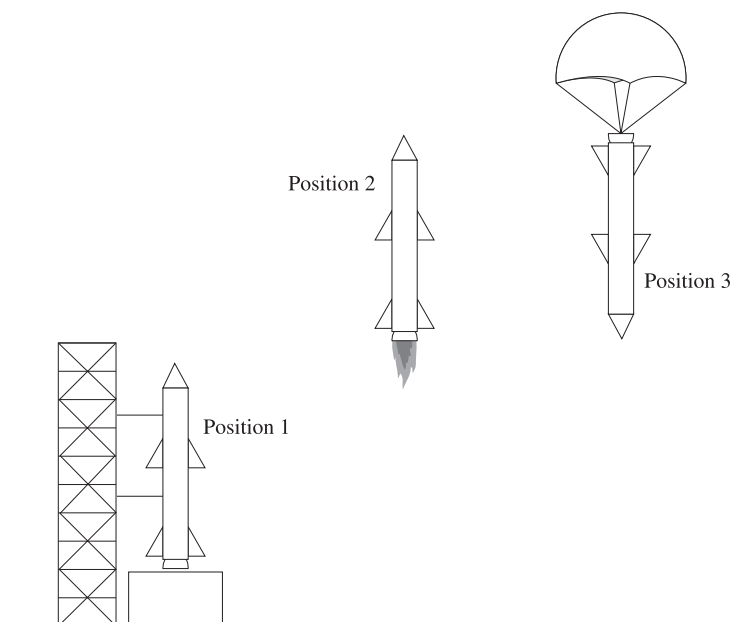
Exhibit 2.4 Top 10% TIMSS International Benchmark – Example Item 3

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

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
Slovak Republic	68 (2.3) ▲
Czech Republic	65 (3.1) ▲
Hungary	65 (2.7) ▲
Finland	53 (3.0) ▲
Singapore	49 (2.8) ▲
Chinese Taipei	48 (2.3) ▲
Lithuania ^{1*}	48 (3.1) ▲
Slovenia	46 (3.0) ▲
United States	46 (2.3) ▲
Russian Federation	46 (3.4) ●
Australia	45 (2.3) ▲
Canada	45 (3.3) ●
England [†]	43 (3.0) ●
Moldova	42 (2.9) ●
Japan	40 (2.0) ●
New Zealand	39 (2.5) ●
Netherlands [†]	39 (5.3) ●
International Avg.	36 (0.4)
Jordan	36 (2.2) ●
Bulgaria	35 (2.5) ●
Thailand	30 (1.9) ●
Iran, Islamic Rep.	30 (2.4) ●
Cyprus	30 (2.6) ●
Romania	29 (2.3) ●
Korea, Rep. of	29 (1.7) ▼
Belgium (Flemish) [†]	29 (2.2) ▼
Philippines	27 (2.0) ▼
Israel ²	26 (2.4) ▼
Italy	25 (2.3) ▼
Hong Kong, SAR [†]	24 (1.6) ▼
Latvia (LSS) ¹	24 (2.2) ▼
Chile	23 (1.6) ▼
Turkey	22 (1.5) ▼
Malaysia	21 (1.9) ▼
Macedonia, Rep. of	19 (2.3) ▼
Tunisia	19 (1.5) ▼
Morocco	17 (2.0) ▼
South Africa	15 (1.4) ▼
Country average significantly higher than international average ▲	
No statistically significant difference between country average and international average ●	
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

[‡] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year. Internationally comparable data are unavailable for Indonesia.

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

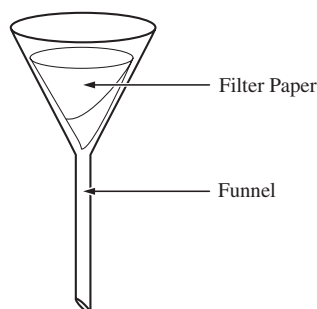
Exhibit 2.5

Top 10% TIMSS International Benchmark – Example Item 4

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

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)	▲
Slovak Republic	62 (2.6)	▲
Lithuania [†]	54 (3.0)	▲
Finland	54 (3.2)	▲
Latvia (LSS) ¹	53 (2.7)	▲
Hungary	52 (2.7)	▲
Korea, Rep. of	51 (1.8)	▲
Russian Federation	50 (2.7)	▲
Canada	50 (1.9)	▲
Singapore	50 (2.6)	▲
Slovenia	48 (2.7)	▲
Netherlands [†]	48 (3.7)	●
Chinese Taipei	46 (2.0)	▲
Romania	42 (3.3)	●
Japan	42 (2.0)	●
Malaysia	42 (2.1)	●
Australia	41 (2.9)	●
New Zealand	39 (2.2)	●
International Avg.	39 (0.4)	
United States	39 (2.1)	●
Cyprus	39 (3.2)	●
Hong Kong, SAR [†]	38 (2.3)	●
Bulgaria	37 (3.9)	●
Moldova	34 (2.5)	●
England [†]	34 (2.6)	●
Tunisia	34 (2.0)	●
Belgium (Flemish) [†]	33 (2.0)	●
Israel ²	32 (1.9)	▼
Italy	30 (2.1)	▼
Thailand	30 (2.1)	▼
Philippines	29 (1.7)	▼
Turkey	28 (1.7)	▼
Macedonia, Rep. of	27 (2.8)	▼
South Africa	27 (1.8)	▼
Jordan	24 (2.2)	▼
Chile	21 (1.6)	▼
Iran, Islamic Rep.	19 (1.7)	▼
Indonesia	15 (1.2)	▼
Morocco	12 (1.3)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] 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 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*

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) ▲	
Lithuania ^{†‡}	57 (3.1) ▲	
Singapore	56 (3.1) ▲	
Australia	52 (3.6) ▲	
Bulgaria	49 (3.5) ▲	
Italy	48 (2.5) ▲	
Korea, Rep. of	47 (2.1) ▲	
Hungary	44 (2.6) ▲	
New Zealand	43 (2.9) ▲	
Cyprus	42 (2.4) ▲	
Slovak Republic	42 (3.0) ●	
Russian Federation	38 (3.2) ●	
South Africa	37 (2.0) ●	
Latvia (LSS) ¹	35 (3.1) ●	
International Avg.	33 (0.4)	
England [†]	33 (2.7) ●	
Belgium (Flemish) [†]	33 (2.7) ●	
Netherlands [†]	33 (3.5) ●	
Czech Republic	32 (3.4) ●	
Canada	31 (2.9) ●	
Finland	31 (2.8) ●	
United States	30 (2.1) ●	
Moldova	29 (2.4) ●	
Slovenia	28 (2.7) ●	
Macedonia, Rep. of	25 (2.3) ▼	
Israel ²	23 (2.3) ▼	
Romania	22 (2.6) ▼	
Morocco	22 (2.1) ▼	
Jordan	20 (1.9) ▼	
Malaysia	18 (1.5) ▼	
Chile	16 (1.7) ▼	
Philippines	16 (1.5) ▼	
Turkey	15 (1.3) ▼	
Thailand	13 (1.5) ▼	
Tunisia	11 (1.3) ▼	
Indonesia	10 (1.3) ▼	
Iran, Islamic Rep.	9 (1.1) ▼	
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

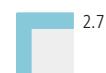
² National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

[‡] 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.

Achievement at the Upper Quarter Benchmark

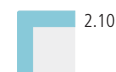
As shown in Exhibit 2.7, students performing at the Upper Quarter Benchmark typically showed a developing understanding of biological systems. Example Item 6 (see Exhibit 2.8) required students to apply knowledge of energy flow to complete a food web diagram. Internationally, 55 percent of students indicated the correct order of energy flow from the providers to the consumers. At least 84 percent of the students in Chinese Taipei, Singapore, Korea, and Malaysia responded correctly to this item.



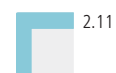
Even though students at the lower benchmarks demonstrated practical knowledge of rusting and burning, only at the Upper Quarter Benchmark did students typically recognize these as chemical reactions. As shown in Example Item 7 in Exhibit 2.9, 55 percent of students internationally recognized that burning releases energy. However, there was a substantial range in performance across countries, from about one-fifth correct in South Africa and Morocco to about four-fifths correct in Chinese Taipei.



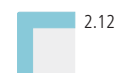
In Example Item 8 (see Exhibit 2.10), students were required to identify rusting as a chemical reaction from a list of chemical and physical changes. On average, slightly less than half of students internationally (49 percent) selected the correct response, compared with 87 percent in top-performing Chinese Taipei. A common misconception demonstrated by students in many countries was that the dissolving of sugar is a chemical reaction (option B).



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. Internationally, slightly less than half of students (48 percent) chose the correct response, while in 10 countries 60 percent or more (up to 76 percent) of students did so. Many students internationally selected option C, which is a true statement related to the effect of insecticides on the environment, but 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. Internationally, less than half the students (48 percent) chose the correct response. In comparison, more than 70 percent of students in five countries did so – England, Singapore, the Netherlands, the United States, and Australia.

• 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

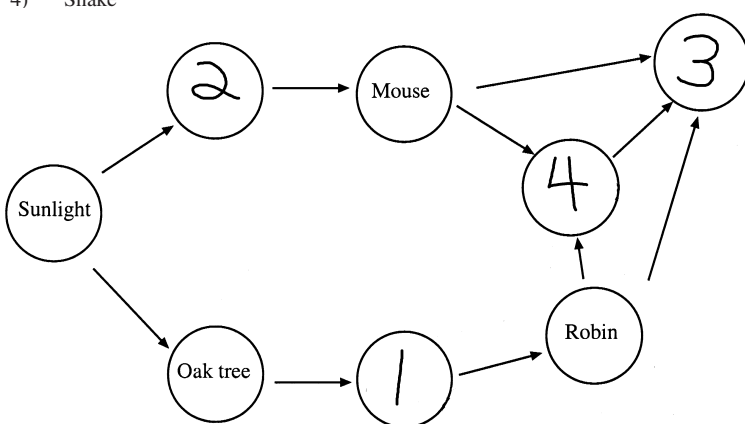
An Item That Students Reaching the Upper Quarter International Benchmark Are Likely to Answer Correctly*

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)	▲
Malaysia	84 (1.8)	▲
England [†]	75 (2.6)	▲
Bulgaria	70 (2.9)	▲
Hungary	70 (2.6)	▲
Japan	68 (2.0)	▲
Russian Federation	67 (3.2)	▲
Indonesia	66 (2.3)	▲
Romania	65 (3.5)	●
Hong Kong, SAR [†]	64 (2.3)	▲
Canada	63 (2.7)	●
Belgium (Flemish) [†]	62 (2.6)	●
Czech Republic	60 (2.9)	●
Australia	60 (2.7)	●
Netherlands [†]	58 (3.1)	●
Thailand	58 (2.5)	●
Finland	57 (2.9)	●
Moldova	56 (2.7)	●
United States	56 (1.7)	●
International Avg.	55 (0.4)	
Slovak Republic	54 (3.5)	●
Jordan	51 (2.2)	●
Latvia (LSS) [†]	50 (2.6)	●
Macedonia, Rep. of	48 (2.7)	●
Slovenia	48 (3.1)	●
Italy	48 (2.3)	●
New Zealand	48 (2.9)	●
Philippines	39 (2.2)	▼
Lithuania ^{†*}	37 (3.1)	▼
Cyprus	37 (2.8)	▼
Turkey	36 (2.3)	▼
Tunisia	36 (2.3)	▼
Israel ²	35 (2.6)	▼
Iran, Islamic Rep.	35 (1.9)	▼
Chile	28 (1.8)	▼
Morocco	16 (2.0)	▼
South Africa	12 (1.6)	▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

[‡] 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 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*

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	
Chinese Taipei	82 (1.0)	▲
Hungary	77 (1.3)	▲
Finland	75 (1.5)	▲
Macedonia, Rep. of	74 (1.5)	▲
Hong Kong, SAR [†]	70 (1.3)	▲
England [†]	68 (1.5)	▲
Singapore	68 (2.1)	▲
Iran, Islamic Rep.	66 (1.3)	▲
Canada	66 (1.2)	▲
Korea, Rep. of	65 (1.0)	▲
Russian Federation	65 (2.6)	▲
Malaysia	65 (1.5)	▲
United States	64 (1.5)	▲
Netherlands [†]	64 (2.9)	●
Bulgaria	63 (2.1)	▲
Belgium (Flemish) [†]	61 (1.6)	▲
Lithuania ^{††}	61 (1.9)	●
Japan	59 (1.2)	●
Israel [‡]	58 (1.9)	●
Australia	58 (1.8)	●
Turkey	58 (1.1)	●
New Zealand	58 (1.6)	●
Slovenia	57 (1.9)	●
International Avg.	55 (0.3)	
Italy	54 (1.7)	●
Cyprus	54 (1.6)	●
Slovak Republic	54 (2.2)	●
Moldova	53 (2.0)	●
Jordan	51 (1.7)	●
Czech Republic	47 (1.9)	▼
Romania	46 (2.0)	▼
Thailand	43 (1.4)	▼
Latvia (LSS) ¹	40 (2.1)	▼
Indonesia	36 (1.3)	▼
Chile	33 (1.4)	▼
Philippines	30 (1.6)	▼
Tunisia	25 (1.0)	▼
South Africa	20 (1.3)	▼
Morocco	17 (1.0)	▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[‡] 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 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*

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)	▲
Singapore	64 (2.8)	▲
Netherlands [†]	64 (2.7)	▲
Russian Federation	60 (2.7)	▲
Korea, Rep. of	59 (1.7)	▲
Iran, Islamic Rep.	58 (2.2)	▲
Malaysia	57 (2.1)	▲
Finland	56 (3.2)	●
Hungary	56 (2.6)	●
Canada	55 (3.2)	●
Bulgaria	54 (3.6)	●
Jordan	54 (2.6)	●
Slovenia	54 (2.8)	●
Australia	53 (2.7)	●
Romania	52 (3.4)	●
United States	52 (1.7)	●
International Avg.	49 (0.4)	
Belgium (Flemish) [†]	49 (3.1)	●
Thailand	49 (2.2)	●
Italy	48 (2.5)	●
Latvia (LSS) ¹	47 (3.1)	●
Czech Republic	47 (3.5)	●
Slovak Republic	47 (3.3)	●
New Zealand	42 (2.6)	●
Macedonia, Rep. of	40 (2.8)	▼
Cyprus	40 (2.3)	▼
Chile	37 (1.9)	▼
Lithuania ^{1*}	37 (3.1)	▼
Indonesia	35 (2.0)	▼
Moldova	34 (2.7)	▼
Turkey	32 (1.8)	▼
Israel ²	31 (2.3)	▼
Philippines	30 (1.9)	▼
Morocco	30 (2.0)	▼
Tunisia	23 (1.8)	▼
South Africa	18 (1.6)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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() 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	
Chinese Taipei	76 (1.7)	▲
Hong Kong, SAR [†]	74 (2.2)	▲
Hungary	70 (2.8)	▲
Singapore	69 (2.2)	▲
Japan	68 (1.7)	▲
Australia	66 (2.5)	▲
United States	62 (1.8)	▲
Netherlands [†]	61 (3.5)	▲
Canada	60 (3.0)	▲
Russian Federation	60 (3.6)	●
Finland	57 (3.0)	●
Slovenia	57 (3.1)	●
Czech Republic	57 (3.3)	●
England [†]	56 (2.6)	●
New Zealand	56 (2.5)	●
Belgium (Flemish) [†]	53 (2.7)	●
Lithuania ^{1‡}	51 (2.9)	●
Israel ²	51 (2.5)	●
Bulgaria	50 (3.3)	●
Italy	50 (2.3)	●
Thailand	49 (2.4)	●
International Avg.	48 (0.4)	
Romania	48 (2.8)	●
Korea, Rep. of	47 (2.0)	●
Slovak Republic	45 (2.9)	●
Turkey	43 (2.2)	●
Moldova	42 (2.8)	●
Iran, Islamic Rep.	38 (2.3)	▼
Chile	38 (1.9)	▼
Latvia (LSS) ¹	38 (2.9)	▼
Macedonia, Rep. of	37 (2.8)	▼
Philippines	33 (1.8)	▼
Jordan	32 (2.1)	▼
Cyprus	31 (2.4)	▼
Indonesia	27 (2.0)	▼
South Africa	25 (1.5)	▼
Malaysia	24 (1.3)	▼
Tunisia	21 (1.6)	▼
Morocco	20 (1.9)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[‡] 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 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*

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	
England [†]	78 (2.6)	▲
Singapore	78 (1.9)	▲
Netherlands [†]	76 (2.8)	▲
United States	76 (1.4)	▲
Australia	70 (2.2)	▲
Israel ²	67 (2.3)	▲
New Zealand	67 (2.6)	▲
Hungary	64 (2.1)	▲
Canada	64 (2.6)	▲
Korea, Rep. of	59 (2.0)	▲
Japan	50 (2.1)	●
Italy	49 (2.9)	●
Jordan	49 (2.2)	●
Belgium (Flemish) [†]	49 (2.0)	●
Hong Kong, SAR [†]	49 (2.1)	●
Czech Republic	49 (3.4)	●
International Avg.	48 (0.4)	
Malaysia	46 (2.3)	●
Bulgaria	45 (3.9)	●
Finland	45 (2.5)	●
Macedonia, Rep. of	44 (2.5)	●
Chinese Taipei	44 (2.0)	●
Indonesia	42 (2.0)	●
Iran, Islamic Rep.	42 (2.4)	●
Turkey	41 (2.0)	▼
Latvia (LSS) ¹	41 (2.7)	●
Slovak Republic	40 (3.3)	●
Lithuania ^{1*}	39 (3.0)	●
Slovenia	39 (2.3)	▼
Morocco	38 (2.2)	▼
Philippines	38 (2.0)	▼
Chile	38 (2.2)	▼
Cyprus	36 (2.6)	▼
Romania	30 (2.5)	▼
South Africa	29 (2.1)	▼
Russian Federation	29 (2.3)	▼
Thailand	28 (2.5)	▼
Tunisia	27 (1.7)	▼
Moldova	19 (1.6)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

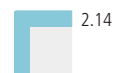
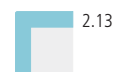
² National Defined Population covers less than 90 percent of National Desired Population (see Exhibit A.8).

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

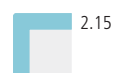
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Achievement at the Median Benchmark

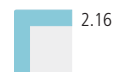
Exhibit 2.13 describes performance at the Median Benchmark. Students at this benchmark could recognize and communicate basic scientific knowledge across a range of topics. Internationally on average, 66 percent of students extracted relevant information from the data table of planetary conditions to 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 to breathe on Proto. 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.



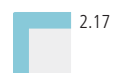
At the Median Benchmark students typically demonstrated some knowledge of the characteristics of animals and plants. In Example 12 (Exhibit 2.15), 70 percent of students on average across countries recognized feeding milk to their young as a characteristic of mammals. In several countries, including Bulgaria, Chinese Taipei, Cyprus, Hong Kong, Iran, Japan, Latvia (LSS), Slovak Republic, and Slovenia, 80 percent or more of students responded correctly.



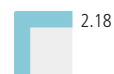
Students at the Median Benchmark typically were familiar with some aspects of force and motion. As shown in Example Item 13 in Exhibit 2.16, students could identify the diagram showing forces that would result in rotation. Performance on this item ranged from 36 percent correct in South Africa to 76 percent correct in Japan, with an international average of 62 percent.



In Example Item 14 (see Exhibit 2.17), students applied knowledge 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. In Hong Kong, the top-performing country on this item, 84 percent of the students responded correctly.



At the Median Benchmark, students were able to apply basic knowledge about 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.





2.19



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, and 92 percent of students in Chinese Taipei, recognized that soil erosion is more likely in barren sloping areas.

• 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*

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	
Slovak Republic	89 (1.4)	▲
Singapore	86 (1.7)	▲
Australia	83 (2.0)	▲
Hungary	83 (1.9)	▲
Canada	82 (2.4)	▲
England [†]	82 (2.4)	▲
Netherlands [†]	81 (2.6)	▲
Latvia (LSS) [†]	80 (2.4)	▲
New Zealand	80 (1.9)	▲
Finland	80 (2.6)	▲
Chinese Taipei	79 (1.5)	▲
Slovenia	78 (2.6)	▲
United States	78 (1.6)	●
Belgium (Flemish) [†]	77 (2.7)	●
Korea, Rep. of	77 (1.5)	●
Czech Republic	75 (3.0)	●
Russian Federation	73 (2.1)	●
Italy	70 (2.4)	●
Hong Kong, SAR [†]	70 (2.2)	●
Japan	69 (1.7)	●
Lithuania ^{1‡}	67 (3.3)	●
Malaysia	67 (2.1)	●
International Avg.	66 (0.4)	
Bulgaria	65 (2.9)	●
Tunisia	64 (2.2)	▼
Thailand	62 (2.6)	▼
Israel ²	62 (2.8)	▼
Jordan	59 (2.4)	▼
Indonesia	59 (2.5)	▼
Macedonia, Rep. of	58 (2.8)	▼
Chile	57 (2.4)	▼
Cyprus	51 (3.0)	▼
Moldova	51 (2.8)	▼
Romania	48 (3.2)	▼
Turkey	47 (2.0)	▼
Iran, Islamic Rep.	45 (2.3)	▼
Philippines	26 (2.3)	▼
Morocco	25 (2.1)	▼
South Africa	21 (2.4)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

[‡] 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 2.15

Exhibit 2.15: Median TIMSS International Benchmark – Example Item 12

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

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
Slovenia	89 (1.0) ▲
Japan	86 (0.8) ▲
Bulgaria	85 (1.6) ▲
Iran, Islamic Rep.	84 (1.1) ▲
Hong Kong, SAR [†]	83 (1.2) ▲
Slovak Republic	81 (1.3) ▲
Chinese Taipei	80 (1.1) ▲
Latvia (LSS) ¹	80 (1.4) ▲
Cyprus	80 (1.1) ▲
Czech Republic	79 (1.9) ▲
Malaysia	78 (1.4) ▲
Hungary	78 (1.5) ▲
Korea, Rep. of	77 (1.1) ▲
Singapore	77 (1.8) ▲
Russian Federation	76 (2.1) ●
Romania	73 (2.1) ●
Thailand	71 (1.4) ●
Finland	71 (1.5) ●
Belgium (Flemish) [†]	70 (1.7) ●
Lithuania ^{1*}	70 (1.8) ●
Macedonia, Rep. of	70 (1.6) ●
International Avg.	70 (0.2)
Italy	70 (1.6) ●
Chile	68 (1.0) ●
Moldova	68 (2.0) ●
Tunisia	67 (1.2) ●
Canada	66 (1.0) ▼
Turkey	65 (1.1) ▼
United States	65 (1.6) ▼
Indonesia	64 (1.5) ▼
Jordan	63 (1.3) ▼
Australia	63 (1.7) ▼
Netherlands [†]	62 (1.8) ▼
Israel ²	60 (1.7) ▼
New Zealand	54 (1.8) ▼
England [†]	52 (2.0) ▼
South Africa	46 (1.5) ▼
Morocco	45 (1.3) ▼
Philippines	30 (1.5) ▼

Country average significantly higher than international average	▲
No statistically significant difference between country average and international average	●
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] 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.

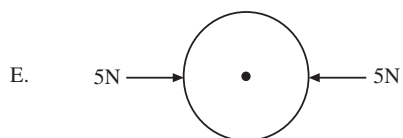
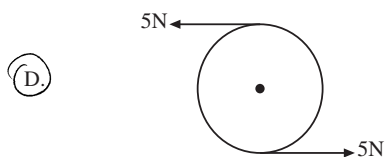
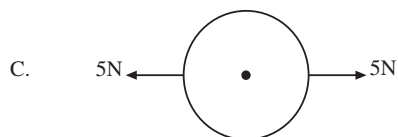
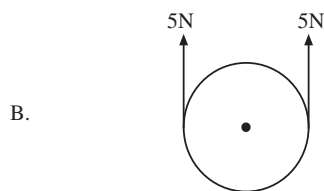
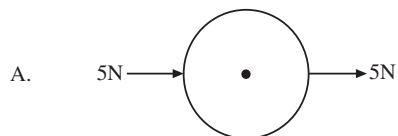
Exhibit 2.16 Median TIMSS International Benchmark – Example Item 13

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

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?



	Overall Percent Correct
Japan	76 (1.6) ▲
Hungary	74 (2.3) ▲
Lithuania ^{†‡}	72 (2.8) ▲
Latvia (LSS) ¹	72 (2.6) ▲
Czech Republic	69 (2.4) ●
Netherlands [†]	69 (3.3) ●
Finland	69 (2.2) ▲
Slovenia	69 (2.4) ●
Russian Federation	68 (2.7) ●
Thailand	67 (1.9) ●
Bulgaria	67 (3.2) ●
Italy	66 (2.7) ●
Canada	66 (2.6) ●
Slovak Republic	66 (2.5) ●
Belgium (Flemish) [†]	64 (2.3) ●
Korea, Rep. of	63 (1.7) ●
Romania	63 (3.2) ●
United States	62 (1.7) ●
Moldova	62 (3.3) ●
International Avg.	62 (0.4)
Hong Kong, SAR [†]	62 (1.9) ●
England [†]	61 (2.6) ●
Chile	60 (2.1) ●
Australia	60 (2.1) ●
Singapore	60 (2.3) ●
Jordan	60 (2.4) ●
New Zealand	59 (2.2) ●
Tunisia	58 (2.0) ●
Malaysia	58 (1.9) ●
Chinese Taipei	58 (2.2) ●
Cyprus	57 (2.7) ●
Turkey	57 (2.1) ●
Israel ²	57 (2.1) ●
Morocco	55 (2.3) ●
Iran, Islamic Rep.	54 (1.9) ▼
Macedonia, Rep. of	54 (2.9) ●
Indonesia	52 (2.5) ▼
Philippines	49 (2.0) ▼
South Africa	36 (1.9) ▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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

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

Exhibit 2.17

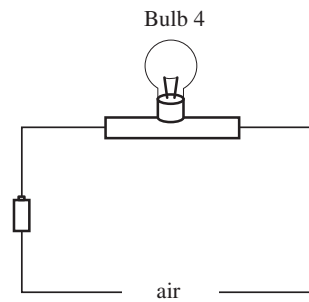
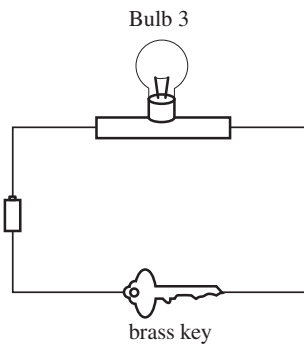
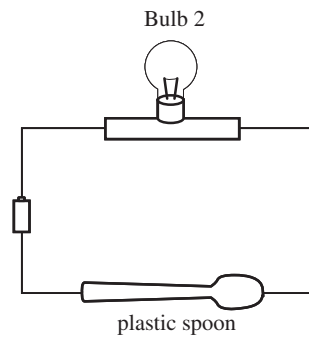
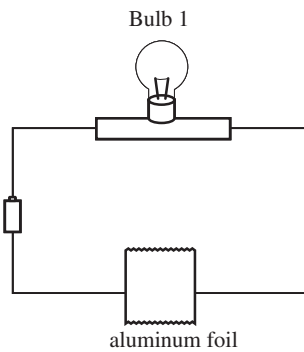
Median TIMSS International Benchmark – Example Item 14

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

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) ▲	
Israel ²	79 (1.9) ▲	
Korea, Rep. of	78 (1.7) ▲	
Netherlands [†]	78 (2.7) ▲	
Hungary	74 (2.3) ▲	
Australia	73 (2.1) ▲	
Malaysia	72 (1.8) ▲	
Czech Republic	72 (2.7) ●	
Slovak Republic	71 (2.5) ●	
Jordan	70 (2.0) ●	
Cyprus	69 (2.3) ●	
Finland	68 (3.0) ●	
Japan	68 (1.9) ●	
Thailand	65 (2.1) ●	
Slovenia	65 (2.7) ●	
England [†]	65 (2.6) ●	
Tunisia	65 (2.2) ●	
United States	64 (1.7) ●	
International Avg.	64 (0.4)	
New Zealand	64 (2.6) ●	
Lithuania ^{†*}	63 (2.6) ●	
Canada	60 (2.2) ●	
Bulgaria	57 (3.1) ●	
Romania	57 (2.7) ●	
Italy	56 (2.3) ▼	
Morocco	56 (2.0) ▼	
Latvia (LSS) ¹	56 (3.5) ●	
Indonesia	52 (2.4) ▼	
Chile	50 (2.1) ▼	
Moldova	48 (2.8) ▼	
Macedonia, Rep. of	48 (2.7) ▼	
Turkey	46 (2.2) ▼	
Iran, Islamic Rep.	43 (1.9) ▼	
Philippines	42 (1.9) ▼	
South Africa	33 (2.0) ▼	

Country average significantly higher than international average	▲
No statistically significant difference between country average and international average	●
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the school year.^() 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*

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) ▲	
Finland	83 (1.3) ▲	
Russian Federation	81 (1.3) ▲	
Hungary	81 (1.3) ▲	
Singapore	81 (1.8) ▲	
Netherlands [†]	80 (2.2) ▲	
Hong Kong, SAR [†]	79 (1.4) ▲	
Jordan	78 (1.2) ▲	
England [†]	76 (1.6) ▲	
Bulgaria	76 (1.7) ▲	
Iran, Islamic Rep.	76 (1.3) ▲	
Lithuania ^{**}	74 (1.6) ▲	
Slovak Republic	73 (1.5) ▲	
Korea, Rep. of	73 (1.1) ▲	
Canada	72 (1.6) ●	
Australia	72 (1.7) ●	
Czech Republic	72 (1.8) ●	
Romania	71 (1.7) ●	
Thailand	70 (1.2) ●	
Slovenia	70 (1.6) ●	
Japan	70 (1.3) ●	
Belgium (Flemish) [†]	70 (1.6) ●	
Latvia (LSS) ¹	69 (1.7) ●	
International Avg.	67 (0.2)	
New Zealand	66 (1.7) ●	
United States	66 (1.4) ●	
Israel ²	66 (1.7) ●	
Malaysia	66 (1.7) ●	
Italy	65 (1.6) ●	
Macedonia, Rep. of	65 (1.8) ●	
Chile	64 (1.1) ●	
Cyprus	62 (1.6) ▼	
Turkey	58 (0.9) ▼	
Philippines	48 (1.6) ▼	
Moldova	47 (1.9) ▼	
Indonesia	47 (1.5) ▼	
Tunisia	44 (1.3) ▼	
South Africa	26 (1.7) ▼	
Morocco	24 (1.1) ▼	
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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

() 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*

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)	▲
Slovak Republic	85 (1.3)	▲
Hong Kong, SAR [†]	85 (1.1)	▲
Netherlands [†]	83 (2.9)	▲
Korea, Rep. of	83 (0.9)	▲
Malaysia	81 (1.1)	▲
Russian Federation	80 (1.3)	▲
Japan	79 (1.0)	▲
England [†]	78 (1.4)	▲
Australia	78 (1.3)	▲
Canada	76 (1.3)	▲
Cyprus	76 (1.3)	▲
Latvia (LSS) ¹	75 (1.7)	▲
Slovenia	75 (1.5)	▲
Tunisia	74 (1.1)	▲
Czech Republic	73 (1.8)	●
Indonesia	73 (1.5)	▲
United States	73 (1.6)	●
New Zealand	71 (1.3)	●
Hungary	70 (1.2)	●
Thailand	69 (1.3)	●
Belgium (Flemish) [†]	68 (1.3)	●
Finland	68 (1.7)	●
International Avg.	68 (0.2)	
Lithuania ^{1*}	66 (1.7)	●
Jordan	65 (1.5)	●
Romania	65 (1.7)	●
Israel ²	63 (1.8)	●
Italy	59 (1.8)	▼
Macedonia, Rep. of	55 (1.7)	▼
Bulgaria	52 (2.0)	▼
Chile	52 (1.3)	▼
Moldova	50 (2.0)	▼
Turkey	49 (1.4)	▼
Iran, Islamic Rep.	44 (1.3)	▼
Morocco	42 (1.0)	▼
Philippines	39 (1.8)	▼
South Africa	26 (1.7)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8 for details).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the school year.

() 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

- 2.20  Exhibit 2.20 describes performance at the Lower Quarter Benchmark. At this level of performance, students typically demonstrated 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. Ninety percent or more of students in 13 countries responded correctly.
- 2.21 

- 2.22  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). However, students did not relate this common knowledge to the function of the circulatory or respiratory system until the higher benchmarks.

- 2.23  At the Lower Quarter Benchmark, students recognized 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, but without the further understanding of light properties shown by students at the higher benchmarks. Internationally, 82 percent of students on average and more than half of students in all countries answered this item correctly.

- 2.24  Students at the Lower Quarter Benchmark also recognized the relationship between larger surface area and increased evaporation rate 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. This item was answered correctly by at least 90 percent of students in nearly half of the countries.

• 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.

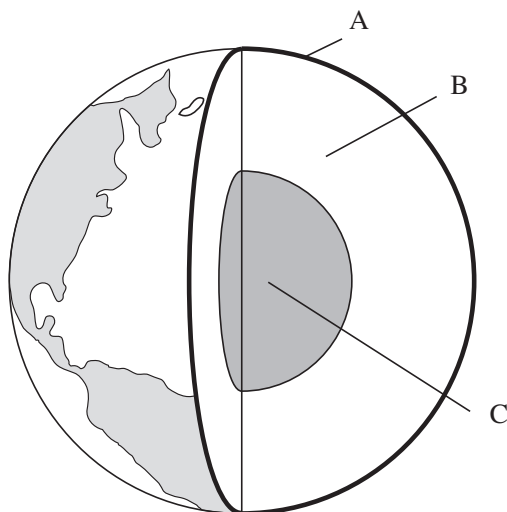
Exhibit 2.21 Lower Quarter TIMSS International Benchmark – Example Item 17

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

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	
Slovenia	96 (0.5)	▲
Slovak Republic	95 (0.6)	▲
Canada	94 (0.5)	▲
Bulgaria	94 (0.8)	▲
Netherlands [†]	93 (2.3)	▲
Finland	93 (0.9)	▲
England [†]	93 (0.9)	▲
United States	92 (0.7)	▲
Hungary	92 (0.9)	▲
Italy	91 (0.9)	▲
Czech Republic	91 (1.3)	▲
Russian Federation	90 (1.1)	▲
Australia	90 (1.0)	▲
New Zealand	89 (0.9)	▲
Japan	89 (0.7)	▲
Belgium (Flemish) [†]	89 (1.6)	▲
Hong Kong, SAR [†]	88 (0.8)	▲
Korea, Rep. of	85 (0.8)	▲
Chinese Taipei	84 (0.8)	●
Singapore	84 (1.2)	●
Lithuania ^{1‡}	83 (1.5)	●
Latvia (LSS) ¹	83 (1.3)	●
International Avg.	82 (0.2)	
Israel ²	80 (1.1)	●
Moldova	79 (1.5)	●
Jordan	79 (1.0)	▼
Malaysia	78 (1.1)	▼
Macedonia, Rep. of	77 (1.4)	▼
Cyprus	77 (1.1)	▼
Turkey	75 (1.1)	▼
Chile	74 (1.1)	▼
Iran, Islamic Rep.	72 (1.2)	▼
Thailand	72 (1.4)	▼
Romania	70 (1.5)	▼
Philippines	67 (1.5)	▼
Tunisia	67 (1.1)	▼
Indonesia	64 (1.1)	▼
South Africa	61 (1.0)	▼
Morocco	54 (1.0)	▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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

() 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*

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)	▲
Hungary	97 (0.5)	▲
Singapore	96 (0.6)	▲
Netherlands [†]	95 (1.2)	▲
Belgium (Flemish) [†]	95 (1.4)	▲
England [†]	95 (1.0)	▲
Slovenia	95 (0.6)	▲
Korea, Rep. of	95 (0.4)	▲
Lithuania ^{††}	95 (0.8)	▲
Canada	94 (0.6)	▲
Chinese Taipei	94 (0.5)	▲
Finland	94 (0.6)	▲
Czech Republic	94 (1.1)	▲
Australia	94 (0.8)	▲
Hong Kong, SAR [†]	93 (0.6)	▲
Tunisia	92 (0.5)	▲
Slovak Republic	92 (1.0)	▲
Bulgaria	92 (1.2)	▲
Latvia (LSS) ¹	92 (0.9)	▲
United States	91 (0.5)	▲
New Zealand	90 (0.8)	▲
Malaysia	89 (0.9)	●
Russian Federation	89 (1.0)	●
Italy	89 (0.9)	●
Cyprus	88 (0.8)	●
International Avg.	87 (0.2)	
Thailand	87 (1.0)	●
Israel ²	86 (1.2)	●
Macedonia, Rep. of	86 (1.2)	●
Moldova	85 (1.2)	●
Romania	84 (1.3)	●
Chile	83 (0.8)	▼
Indonesia	83 (1.1)	▼
Jordan	83 (0.9)	▼
Turkey	79 (1.3)	▼
Iran, Islamic Rep.	79 (1.0)	▼
Philippines	59 (1.8)	▼
Morocco	58 (1.3)	▼
South Africa	36 (1.4)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).^{††} 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 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*

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)	▲
Hungary	94 (0.8)	▲
Slovak Republic	92 (0.8)	▲
Netherlands [†]	92 (1.3)	▲
Singapore	91 (0.9)	▲
Slovenia	91 (0.9)	▲
Czech Republic	90 (1.0)	▲
Russian Federation	90 (1.1)	▲
Australia	89 (0.9)	▲
England [†]	89 (1.1)	▲
Chinese Taipei	89 (0.7)	▲
Lithuania ^{1†}	88 (1.1)	▲
Malaysia	87 (0.8)	▲
Japan	87 (0.9)	▲
Bulgaria	86 (1.0)	▲
Romania	86 (1.3)	●
Latvia (LSS) ¹	86 (1.0)	▲
Hong Kong, SAR [†]	85 (0.8)	▲
Finland	85 (1.1)	●
Israel ²	85 (0.8)	▲
Canada	83 (1.2)	●
United States	83 (0.8)	●
International Avg.	82 (0.2)	
Italy	82 (1.3)	●
New Zealand	81 (1.3)	●
Philippines	80 (1.0)	●
Korea, Rep. of	78 (0.9)	▼
Indonesia	78 (0.9)	▼
Macedonia, Rep. of	77 (1.2)	▼
Cyprus	76 (1.0)	▼
Moldova	75 (1.7)	▼
Turkey	75 (1.1)	▼
Chile	75 (1.0)	▼
Iran, Islamic Rep.	73 (1.1)	▼
Thailand	73 (1.2)	▼
Tunisia	73 (1.1)	▼
Jordan	70 (1.1)	▼
South Africa	69 (0.8)	▼
Morocco	56 (1.2)	▼
Country average significantly higher than international average ▲		
No statistically significant difference between country average and international average ●		
Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] 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 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*

Content Area: Physics

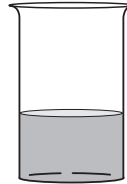
Description: Recognizes the relationship between surface area and evaporation rate.

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.



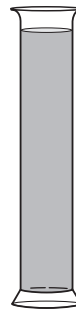
B.



C.



D.



	Overall Percent Correct	
Singapore	98 (0.8)	▲
Hungary	95 (1.1)	▲
Korea, Rep. of	95 (0.8)	▲
Russian Federation	95 (1.4)	▲
Czech Republic	94 (1.6)	▲
Japan	94 (1.2)	▲
Slovak Republic	94 (1.7)	▲
Hong Kong, SAR [†]	93 (1.2)	▲
Moldova	93 (1.5)	▲
Bulgaria	93 (1.4)	▲
Malaysia	93 (1.2)	▲
Chinese Taipei	93 (0.9)	▲
England [†]	92 (1.7)	▲
Canada	91 (1.2)	▲
Australia	90 (1.8)	▲
Latvia (LSS) ¹	90 (1.5)	▲
Lithuania ^{1†}	90 (2.2)	●
Israel ²	89 (1.4)	▲
Netherlands [†]	89 (4.7)	●
Romania	88 (1.8)	●
Cyprus	88 (1.6)	●
New Zealand	88 (1.6)	●
Jordan	87 (1.6)	●
Finland	86 (2.0)	●
Thailand	85 (1.7)	●
International Avg.	84 (0.3)	
Belgium (Flemish) [†]	84 (3.1)	●
United States	84 (1.3)	●
Slovenia	83 (2.0)	●
Macedonia, Rep. of	83 (2.2)	●
Indonesia	75 (1.5)	▼
Tunisia	75 (1.5)	▼
Turkey	74 (1.6)	▼
Chile	72 (1.7)	▼
Italy	70 (2.3)	▼
Iran, Islamic Rep.	69 (1.9)	▼
Philippines	60 (2.2)	▼
South Africa	53 (1.9)	▼
Morocco	45 (2.9)	▼

Country average significantly higher than international average ▲

No statistically significant difference between country average and international average ●

Country 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.

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).[†] 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 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 increase the coverage of chemistry topics in science curricula. In addition, knowledge of systems and cycles in the life and physical sciences was not demonstrated until the upper benchmarks, indicating that more emphasis in these areas may be needed. Basic scientific inquiry skills also were not demonstrated until the upper benchmarks, revealing that science curricula in many countries may not be stressing scientific investigation by grade 8.

In reviewing the item-level results, it also is important to note the variation in performance across the topics covered. For example, on the 20 items presented in this chapter, there was a substantial range in performance for many countries. While some countries consistently ranked high or low in performance, and others had results consistently near the international average, 28 countries performed significantly above the international average on at least one item and significantly below the international average on at least one item (Australia, Belgium (Flemish), Bulgaria, Canada, Cyprus, the Czech Republic, England, Finland, Hong Kong, Indonesia, Iran, Israel, Italy, Jordan, Korea, Latvia (LSS), Lithuania, Macedonia, Malaysia, Moldova, the Netherlands, New Zealand, the Russian Federation, the Slovak Republic, Slovenia, Thailand, Tunisia, and the United States). For example, the Czech Republic had the highest percentage correct on the chemistry item requiring students to identify the heterogeneous mixture that can be separated by filtration (Exhibit 2.5), but performed significantly below the international average on the item requiring knowledge that a burning reaction releases energy (Exhibit 2.9). In some cases, differences of this sort may reflect intended differences in emphasis in national curricula. 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

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. Information on trends also is provided for earth science, life science, physics, and chemistry.





Curriculum data collected as part of TIMSS 1995 and TIMSS 1999 indicate differences among countries in the structure of the science curriculum, especially in the grades at which topics are introduced, the relative emphasis given to topics, the time allocated to science education, and the expectations placed upon the students. The TIMSS curriculum frameworks were constructed to be powerful organizing tools, rich enough to make possible comparative analyses of curriculum and curriculum change in a wide variety of settings and from a variety of curriculum perspectives. The TIMSS 1999 science assessment, based upon the science framework, was designed to allow as fair comparisons as possible among participating countries, and maintained a common structure with TIMSS 1995 enabling the tracking of changes over time.¹

To facilitate comparative analyses of the science data, 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.² 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

¹ Please see the test development section of Appendix A for more information about the test development process. Appendix C provides an analysis of the match between the test and curriculum in the different TIMSS countries and the effect of this match on the TIMSS results.

² In TIMSS 1995, there were five reporting categories. Environmental issues and the nature of science was included as a combined reporting category, reflecting only 14 total items across the two combined content areas. For TIMSS 1999, additional items were developed in each of these two content areas, permitting the reporting of achievement results separately for the environmental and resource issues and the scientific inquiry and the nature of science categories.

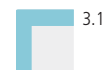
- **Scientific inquiry and the nature of science**

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.

Chapter 3 presents average achievement for the six major content areas covered by the TIMSS 1999 science test. Gender differences in each content area are shown, and trends in achievement between 1995 and 1999 are presented for those countries that participated in both TIMSS assessments.

How Does Achievement Differ Across Science Content Areas?

Exhibit 3.1 presents average achievement in each of the six science content areas. Countries are displayed in decreasing order of achievement for each content area, and symbols indicate whether a country's 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.

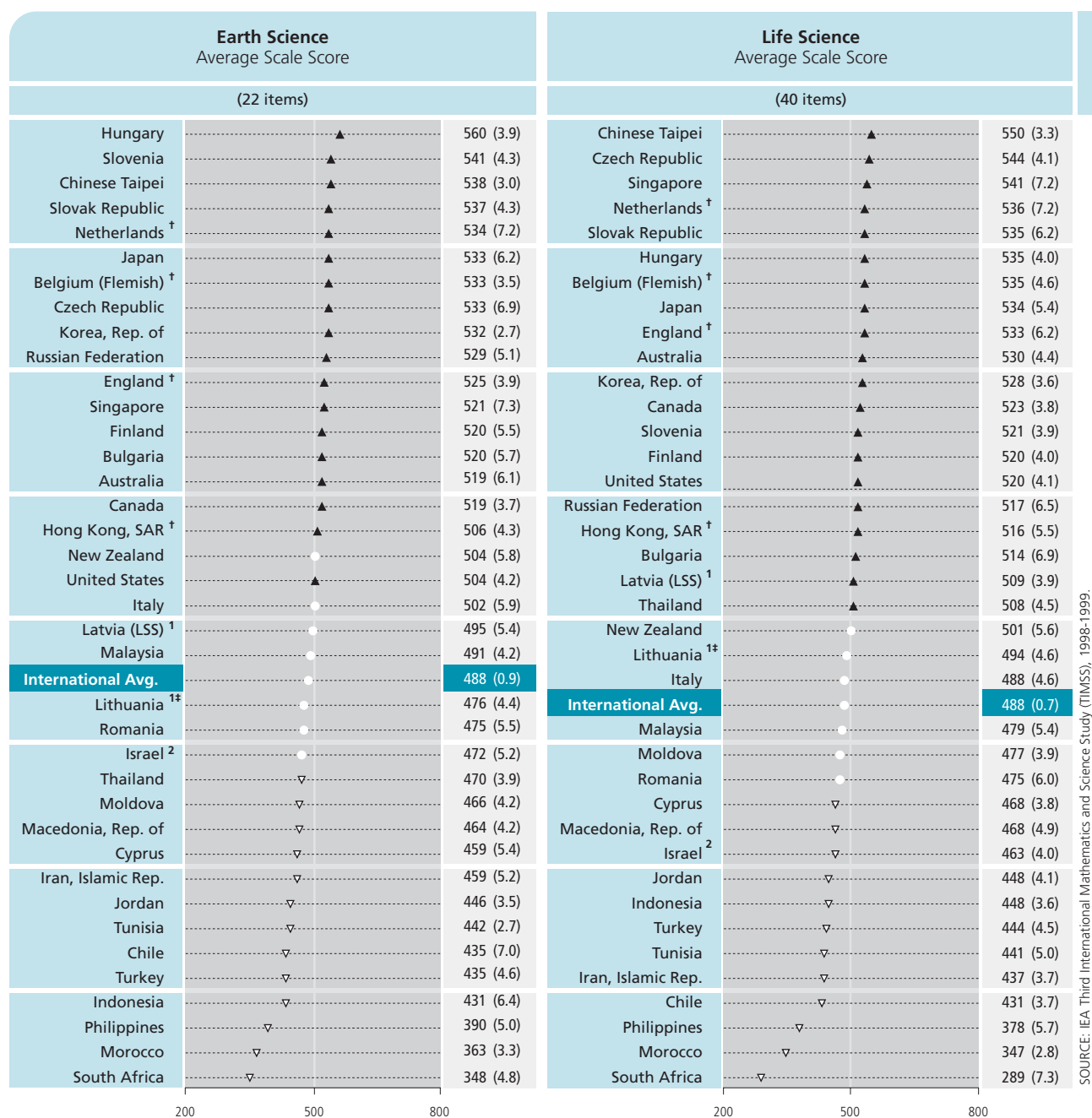


There was a broad range in average achievement within each content area. The largest range was for physics, in which Singapore had an average scale score of 570 and South Africa one of 308, a range of 262 scale-score points. Life science also had a broad range, from 550 for Chinese Taipei to 289 for South Africa. The smallest range was for earth science, in which Hungary had an average scale score of 560 and South Africa one of 348, a range of 212 scale-score points. The range for chemistry was similar, from 563 for Chinese Taipei to 350 for South Africa.

Countries that performed significantly above or below the international average on the science test as a whole also tended to perform above or below the international average on each content area test. Similarly, countries that performed near the international average on the overall science test also tended to perform at about the international average on each content area test, with only one or two exceptions. For example, Latvia (LSS) was significantly above the international average in life science and at the international average for the other content areas. New Zealand performed at about the international average on each content area test, with the exception of scientific inquiry and the nature of science, on which it scored above the international average.

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

Exhibit 3.1 Average Achievement in Science Content Areas



▲ Country average significantly higher than international average

● Country average not significantly different from international average

▽ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

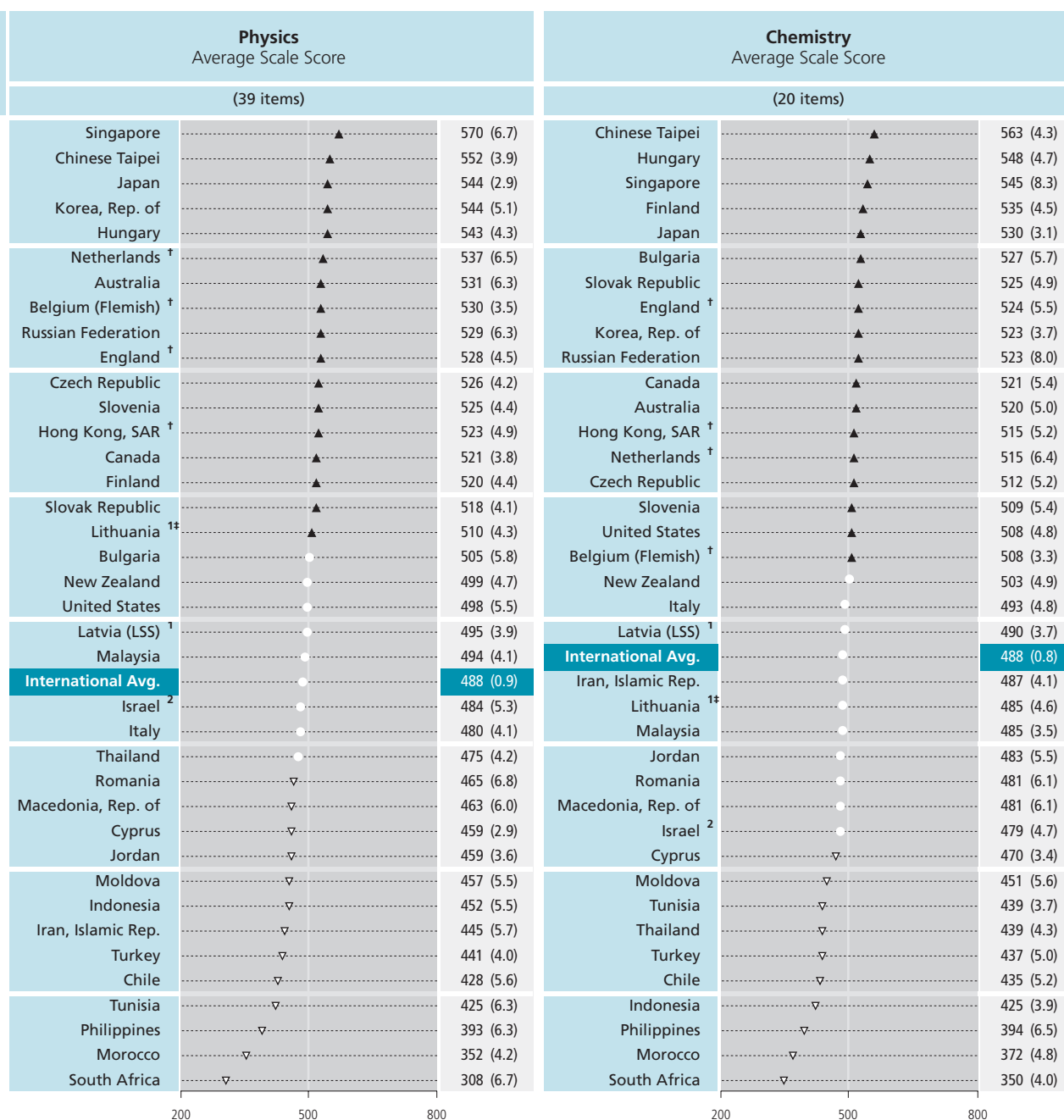
¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). Because coverage falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

² National Defined Population covers less than 90% of National Desired Population (see Exhibit A.5).

[†] 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.

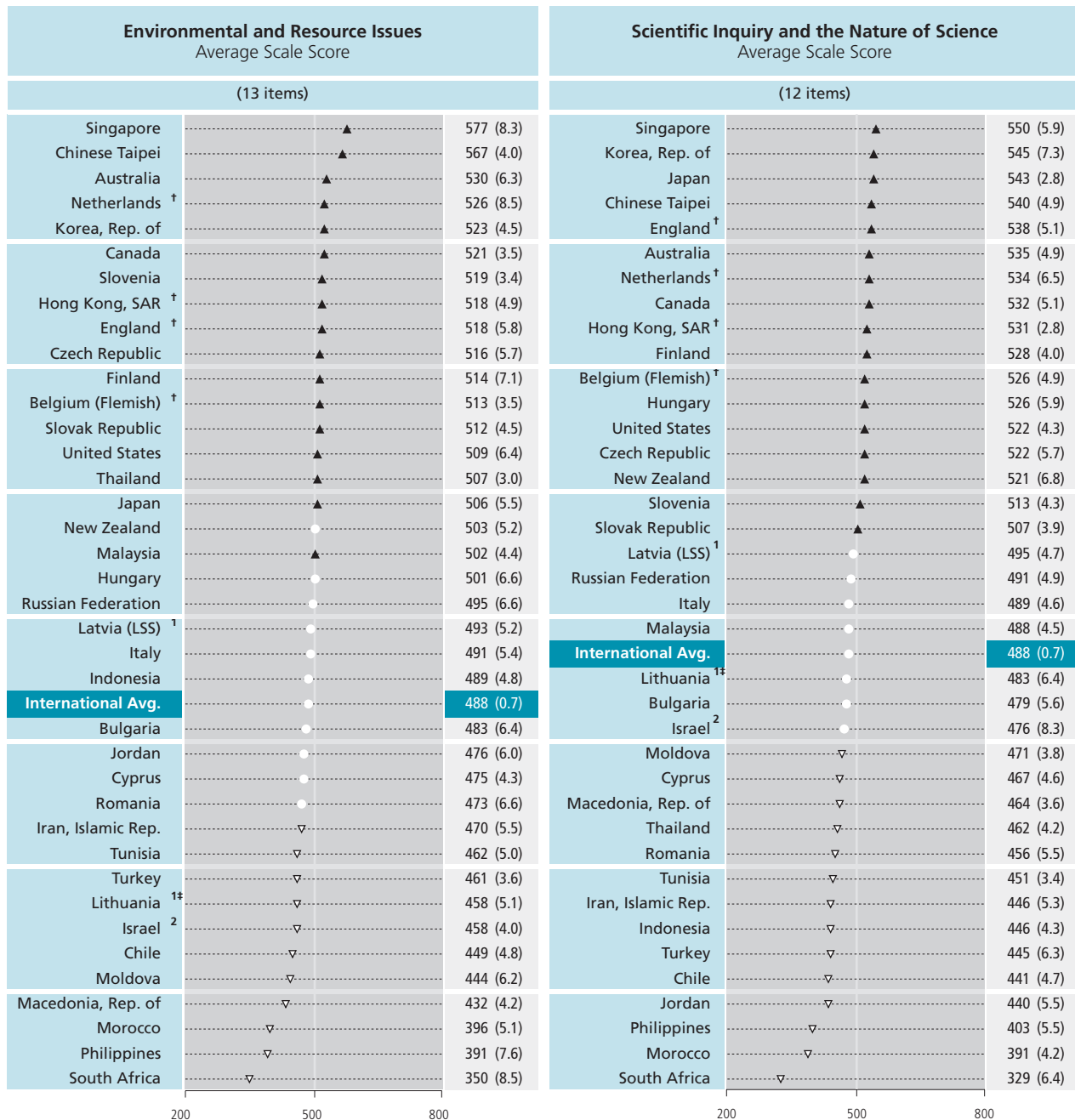
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.



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

Significance tests adjusted for multiple comparisons

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



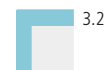
- ▲ Country average significantly higher than international average
- Country average not significantly different from international average
- ▽ Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

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

In Which Content Areas Are Countries Relatively Strong or Weak?

Exhibit 3.2 profiles the relative performance in science content areas within each country, highlighting any variation in performance. For each country, Exhibit 3.2 displays the difference between average performance in each content area and average performance overall. The profiles reveal that many countries performed relatively better or worse in some content areas than in others. For example, students in Bulgaria performed relatively better in chemistry, but less well in environmental and resource issues and in scientific inquiry and the nature of science.



The profiles of relative performance show substantially more variation across the content areas in some countries than in others. For example, in Indonesia, South Africa, and Thailand, there were differences of more than 61 scale-score points (approximately two-thirds of a standard deviation) between the highest and lowest content area averages. In contrast, in countries such as Australia, Cyprus, England, Finland, Hong Kong, Israel, Latvia (LSS), Malaysia, New Zealand, and the Philippines, the difference in average achievement across content areas was 25 scale-score points or less.

Across countries, earth science, life science, and physics were the content areas that least often featured either relatively strong or weak performance. In comparison, relatively stronger or weaker performance in chemistry, environmental and resource issues, and scientific inquiry and the nature of science were observed for a larger number of countries. Of the eight countries in which performance in chemistry was relatively strong, five were countries where the sciences were taught as separate subjects (generally earth science, biology, physics, and chemistry) by the eighth grade. These countries were Bulgaria, Chinese Taipei, Finland, Hungary, and Macedonia. In contrast, student performance was relatively lower in environmental and resource issues among several separate science countries, including Bulgaria, Hungary, Lithuania, Macedonia, and the Russian Federation.

Several high-performing countries had relatively better performance in some content areas than in others. For example, Hungarian students were relatively stronger in earth science and weaker in environmental and resource issues, while students in Chinese Taipei showed the opposite pattern in these subjects. In some countries, the relatively poorer performance in a particular content area may be at least partially accounted for by curricular differences. For example, Chinese Taipei does not teach earth science until ninth grade, while Hungary teaches science as separate subjects (geography, biology, physics, and chemistry) at the

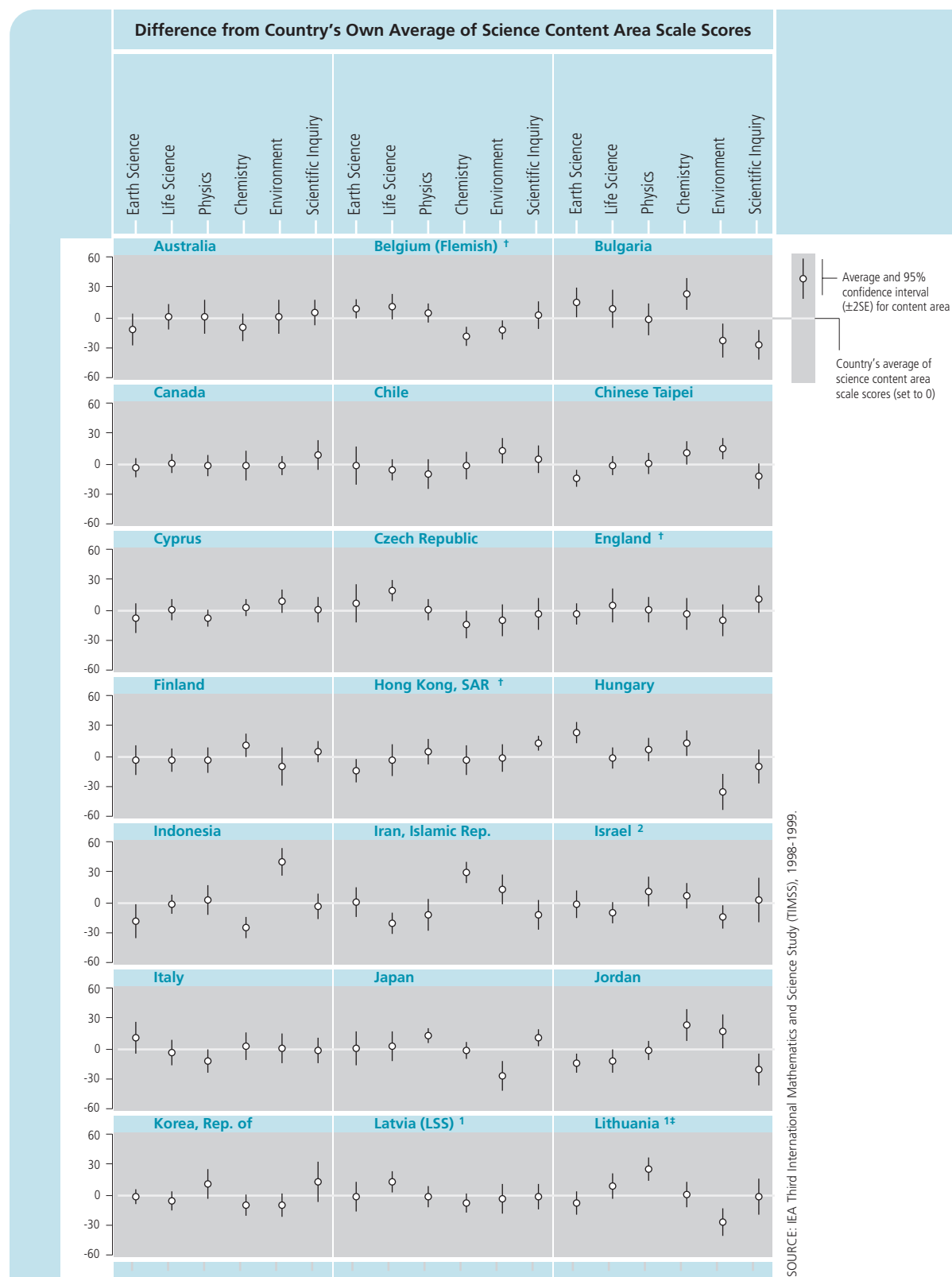


eighth grade (see Exhibit 5.1). Students in Singapore had relatively higher performance in physics and environmental and resource issues, and relatively lower performance in earth science. In contrast, students in Japan had lower performance in environmental and resource issues than in other science content areas.



Exhibit 3.2 Overleaf

Exhibit 3.2 Profiles of Relative Performance in Science Content Areas

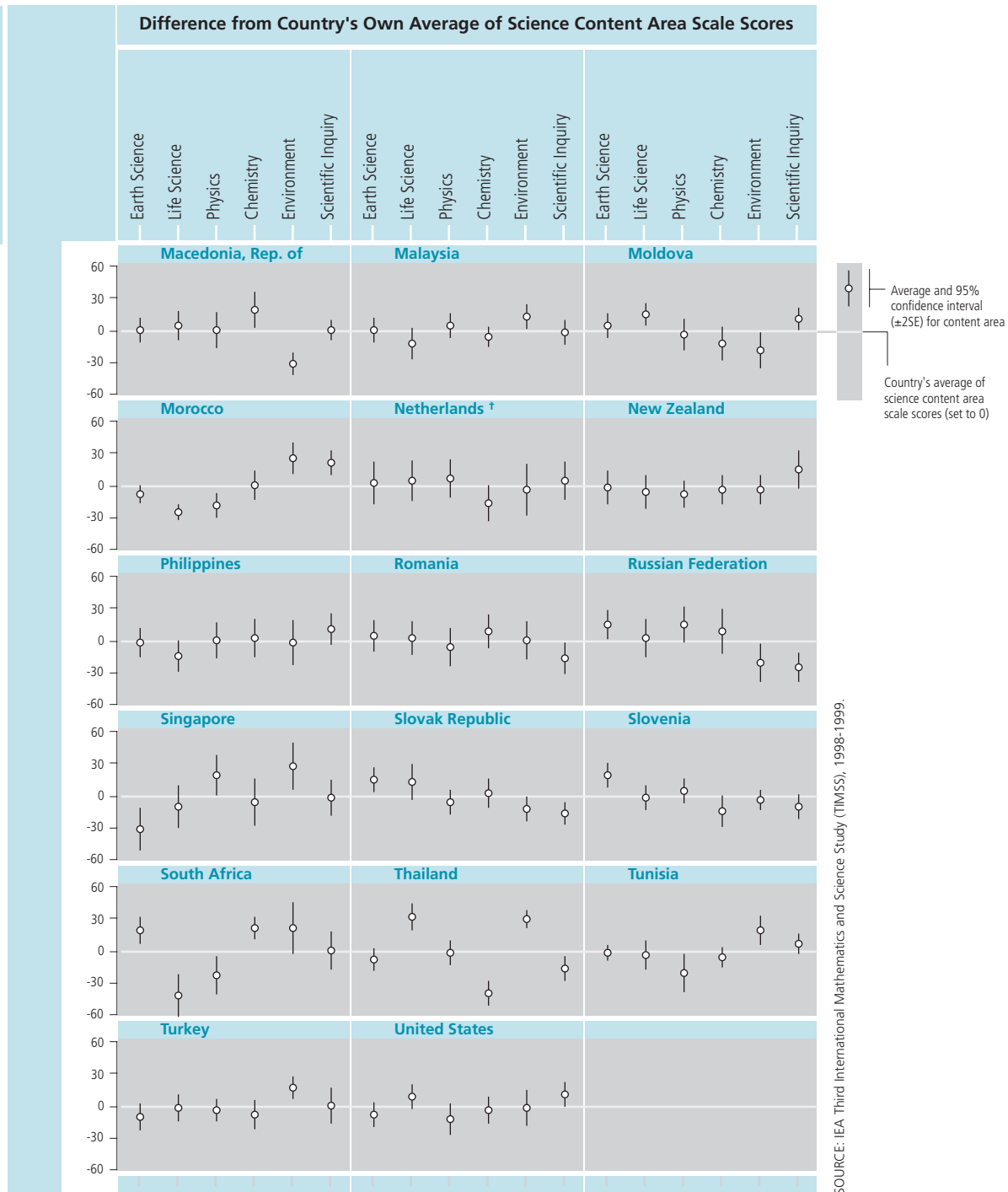


[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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



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

3.3



The average achievement in science content areas by gender is shown in Exhibit 3.3. In two content areas, life science and scientific inquiry and the nature of science, there were no statistically significant gender differences, either across all countries or within each country. However, boys outperformed girls on average internationally in each of the other content areas. The gender difference was greatest in physics, in which boys scored higher than girls by 21 scale-score points on average internationally; in 12 countries boys performed significantly higher than girls. The next largest gender difference was in earth science, in which boys outperformed girls by 17 scale-score points on average internationally; in six countries boys performed significantly higher than girls.

An important stage of item selection for the TIMSS 1995 and TIMSS 1999 tests was the examination of item statistics to detect items that differentiated between groups, including girls and boys, at the country level. Such items were scrutinized and retained when there was no apparent source of gender bias. It is therefore likely that the absence of significant gender differences in the averages for girls and boys in a country is due partly to a balance between items on which one or the other gender tends to perform better. It is also reasonable to assume that where significant differences do occur, they result from gender differences in one or more of those factors in student backgrounds and schooling that have consistently been found to affect achievement in science.

On average across countries, boys had higher achievement than girls in earth science, physics, chemistry, and environmental and resource issues. Although not statistically significant, the average performance for boys in life science exceeded that for girls in 20 of the 38 countries, whereas in scientific inquiry and the nature of science the girls had higher averages than boys in 24 countries. Even though the differences were not statistically significant, it is also interesting to note that in Jordan girls registered a slightly higher average achievement than boys in all content areas.

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),³ while boys were markedly stronger in earth science, physics, and chemistry.

³ Postlethwaite T.N. and Wiley, D.E. (1992), *The IEA Study of Science II: Science Achievement in Twenty-Three Countries*, New York: 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 3.3 Overleaf

Exhibit 3.3 Average Achievement in Science Content Areas by Gender

	Average Scale Scores for Science Content Areas					
	Earth Science		Life Science		Physics	
	Girls	Boys	Girls	Boys	Girls	Boys
Australia	507 (6.0)	532 (10.9)	531 (6.1)	529 (6.1)	519 (8.2)	542 (6.7)
Belgium (Flemish) [†]	521 (5.7)	544 (8.1)	530 (5.9)	539 (8.1)	521 (4.1)	539 (7.3)
Bulgaria	514 (6.3)	525 (7.3)	515 (8.6)	513 (7.9)	495 (6.8)	515 (6.9)
Canada	510 (8.6)	528 (3.0)	523 (5.0)	523 (4.6)	512 (4.3)	530 (4.9) ▲
Chile	420 (8.6)	451 (8.2) ▲	430 (3.6)	433 (6.4)	416 (5.9)	439 (6.8) ▲
Chinese Taipei	529 (7.4)	546 (7.0)	543 (3.8)	557 (6.5)	542 (6.6)	563 (6.8)
Cyprus	450 (6.4)	468 (6.6)	473 (4.2)	463 (5.5)	451 (5.3)	468 (2.7)
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) ▲
Finland	517 (6.1)	523 (6.1)	520 (5.5)	520 (8.2)	508 (4.6)	532 (6.0) ▲
Hong Kong, SAR [†]	499 (6.1)	513 (6.2)	512 (8.6)	520 (7.4)	514 (5.8)	532 (6.0)
Hungary	545 (6.4)	574 (7.0)	534 (6.4)	536 (4.6)	529 (6.2)	556 (5.7)
Indonesia	418 (9.6)	445 (5.5)	450 (5.0)	447 (5.3)	440 (5.2)	465 (8.2)
Iran, Islamic Rep.	439 (6.9)	472 (5.7) ▲	430 (6.8)	443 (5.1)	419 (6.5)	464 (8.2) ▲
Israel ²	462 (6.8)	481 (6.7)	463 (4.8)	463 (4.8)	475 (7.2)	493 (7.2)
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)
Jordan	450 (4.2)	443 (5.3)	463 (6.9)	435 (5.6)	462 (4.8)	456 (6.2)
Korea, Rep. of	525 (4.0)	539 (4.2)	520 (5.6)	536 (3.3)	534 (6.5)	553 (5.7)
Latvia (LSS) ¹	488 (6.6)	504 (6.4)	511 (4.0)	507 (5.5)	481 (3.9)	510 (5.0) ▲
Lithuania ^{1*}	465 (7.4)	488 (5.2)	492 (6.7)	496 (5.3)	496 (6.3)	525 (6.0)
Macedonia, Rep. of	460 (7.1)	467 (5.0)	472 (5.1)	463 (7.7)	455 (7.0)	471 (5.9) ▲
Malaysia	485 (5.1)	497 (5.2)	477 (9.5)	481 (6.1)	484 (4.6)	506 (7.5)
Moldova	461 (4.2)	471 (6.4)	476 (5.5)	478 (6.8)	446 (6.8)	470 (8.9)
Morocco	359 (4.1)	365 (3.6)	347 (3.9)	347 (3.5)	339 (6.3)	361 (5.2)
Netherlands [†]	525 (8.5)	544 (10.2)	535 (9.6)	537 (7.8)	524 (6.6)	550 (7.7) ▲
New Zealand	499 (8.6)	510 (7.9)	506 (6.4)	496 (7.7)	494 (4.9)	504 (6.4)
Philippines	391 (6.1)	388 (6.2)	390 (7.0)	364 (6.6)	389 (7.6)	397 (6.6)
Romania	471 (7.0)	479 (6.2)	476 (7.0)	473 (7.0)	460 (8.3)	469 (6.4)
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)
Slovak Republic	523 (5.1)	551 (6.4) ▲	532 (6.9)	537 (7.4)	505 (5.4)	530 (5.4) ▲
Slovenia	535 (6.4)	547 (5.8)	522 (5.4)	520 (6.5)	514 (4.5)	538 (7.3)
South Africa	338 (4.7)	359 (6.3) ▲	289 (10.3)	290 (11.4)	291 (9.1)	328 (6.7) ▲
Thailand	469 (4.4)	472 (4.7)	511 (4.9)	505 (4.8)	470 (4.7)	480 (5.6)
Tunisia	430 (6.1)	454 (7.3)	437 (6.1)	446 (4.5)	412 (8.9)	438 (4.4) ▲
Turkey	431 (6.6)	438 (7.6)	452 (6.1)	438 (5.1)	438 (8.6)	444 (6.3)
United States	490 (5.2)	518 (5.5) ▲	518 (4.4)	522 (5.0)	488 (6.7)	509 (6.8)
International Avg.	479 (1.1)	496 (1.1) ▲	487 (1.0)	488 (1.1)	477 (1.0)	498 (1.1) ▲

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

[†] Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).

¹ National Desired Population does not cover all of International Desired Population (see Exhibit A.5). 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.5).

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

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

	Average Scale Scores for Science Content Areas					
	Chemistry		Environmental and Resource Issues		Scientific Inquiry and the Nature of Science	
	Girls	Boys	Girls	Boys	Girls	Boys
Australia	504 (5.6)	536 (7.5) ▲	521 (7.0)	540 (9.0)	540 (8.3)	529 (3.9)
Belgium (Flemish) †	500 (6.6)	515 (6.4)	503 (5.3)	523 (8.1)	528 (5.7)	524 (7.2)
Bulgaria	521 (5.9)	533 (6.8)	474 (8.8)	493 (9.8)	482 (5.7)	476 (8.1)
Canada	512 (6.3)	531 (7.4)	514 (4.8)	529 (6.0)	535 (5.4)	530 (5.3)
Chile	423 (8.0)	447 (5.1)	439 (6.8)	460 (6.0)	439 (8.6)	442 (7.6)
Chinese Taipei	555 (4.1)	571 (8.3)	555 (6.7)	579 (4.9)	544 (5.3)	537 (5.4)
Cyprus	461 (4.9)	478 (3.6)	470 (5.1)	481 (4.5)	474 (4.7)	461 (6.2)
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)
Finland	526 (4.2)	544 (6.6)	513 (11.2)	515 (5.5)	532 (5.4)	524 (7.1)
Hong Kong, SAR †	508 (8.3)	522 (4.5)	510 (5.4)	526 (6.2)	535 (3.2)	527 (4.0)
Hungary	534 (6.8)	563 (5.9) ▲	488 (8.7)	515 (7.1)	522 (5.9)	531 (7.0)
Indonesia	418 (5.1)	433 (4.2)	486 (5.8)	492 (6.1)	449 (8.2)	442 (5.0)
Iran, Islamic Rep.	475 (6.4)	495 (4.1)	461 (7.6)	477 (6.7)	439 (3.8)	451 (7.9)
Israel 2	471 (6.7)	488 (8.6)	454 (5.8)	462 (6.6)	475 (10.4)	477 (8.5)
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)
Jordan	490 (6.3)	477 (6.8)	484 (6.9)	470 (8.5)	451 (5.4)	431 (8.0)
Korea, Rep. of	515 (9.1)	532 (5.5)	516 (3.0)	529 (7.5)	547 (10.1)	544 (6.5)
Latvia (LSS) 1	479 (4.6)	501 (5.0) ▲	487 (4.8)	500 (7.5)	495 (5.9)	495 (8.4)
Lithuania 1†	475 (4.9)	496 (7.1)	444 (6.6)	474 (7.4)	486 (6.0)	479 (8.0)
Macedonia, Rep. of	481 (8.2)	480 (8.0)	430 (6.0)	434 (4.3)	463 (5.0)	465 (5.5)
Malaysia	482 (7.8)	488 (6.7)	501 (5.4)	503 (8.8)	485 (6.4)	492 (7.4)
Moldova	447 (6.2)	456 (6.1)	440 (8.3)	449 (9.7)	467 (6.2)	476 (7.1)
Morocco	372 (8.7)	371 (4.3)	394 (6.9)	397 (4.9)	390 (6.5)	391 (5.9)
Netherlands †	505 (7.3)	526 (7.5)	517 (10.4)	536 (9.0)	539 (8.8)	530 (9.1)
New Zealand	497 (7.6)	509 (6.3)	499 (6.7)	506 (6.6)	530 (6.6)	513 (11.4)
Philippines	396 (6.4)	392 (10.2)	397 (7.4)	383 (10.1)	412 (6.0)	393 (6.8)
Romania	480 (9.0)	482 (6.6)	473 (6.8)	473 (8.1)	457 (6.8)	455 (6.9)
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)
Slovak Republic	514 (5.1)	536 (5.9) ▲	504 (7.0)	520 (5.0)	509 (6.0)	506 (8.0)
Slovenia	502 (6.3)	516 (9.4)	508 (6.9)	531 (7.7)	516 (4.4)	509 (6.4)
South Africa	342 (4.3)	359 (5.6)	341 (8.8)	359 (10.4)	321 (6.3)	339 (9.0)
Thailand	435 (5.3)	444 (6.8)	507 (4.2)	506 (4.6)	463 (6.7)	461 (6.3)
Tunisia	428 (4.3)	452 (6.8)	451 (4.9)	474 (6.0) ▲	448 (6.6)	454 (5.5)
Turkey	436 (5.5)	437 (6.1)	457 (6.7)	464 (7.0)	452 (8.2)	441 (5.8)
United States	495 (6.1)	520 (7.0)	500 (7.0)	519 (9.6)	521 (5.4)	523 (6.2)
International Avg.	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

What Changes Have Occurred in Content Area Achievement?

3.4



To examine changes in achievement in the science content areas, Exhibit 3.4 shows the average percent correct for eighth-grade students in 1995 and 1999 for items given in both the 1995 and 1999 TIMSS assessments, and the difference in performance between assessments. Data are presented for the four content areas of earth science, life science, physics, and chemistry.⁴ This content area trend analysis uses average percent correct rather than average scale score because there were insufficient items to reliably link the results for both assessments to the TIMSS scale.

Changes in average achievement at a national level are not easy to bring about and inevitably take place over several years. Amending official curricula, producing relevant supporting resources, and changing teacher practice all take time, even under the most favorable conditions. TIMSS 1999 is only the second in what is expected to become a series of international surveys designed to reveal trends in achievement in mathematics and science. It is not surprising, therefore, that the trend data contained in Exhibit 3.4 reveal only a few significant changes in average achievement in the content areas. It is likely that the next TIMSS administration scheduled for 2003 will show more significant changes in achievement.

Still, even during the four years between 1995 and 1999, statistically significant improvements occurred for Canada in all four content areas and for Hungary and Latvia (LSS) in two content areas. The Slovak Republic increased significantly in life science but decreased significantly in physics. Hong Kong and Japan showed significant increases in earth science and Slovenia showed a decrease. Cyprus increased in physics, and the Czech Republic decreased. A small but significant increase in the international average for life science, the only content area with a significant change between 1995 and 1999, may be a result of increasing emphasis on learning about plants and animals in the early grades.

⁴ There were insufficient items in environmental and resource issues and in scientific inquiry and the nature of science to report trends.



Exhibit 3.4 Overleaf

Exhibit 3.4 Trends in Average Percent Correct in Science Content Areas

	Average Percent Correct in Science Content Areas ¹					
	Total Science Trend Items ²		Earth Science Trend Items		Life Science Trend Items	
	(48 items)		(11 items)		(13 items)	
	1995	1999	1995	1999	1995	1999
Australia	67 (0.6)	69 (0.7) ●	64 (0.7)	64 (0.9) ●	75 (0.6)	76 (0.7) ●
Belgium (Flemish)	69 (0.8)	69 (0.4) ●	68 (0.8)	67 (0.5) ●	76 (1.0)	77 (0.5) ●
Bulgaria	74 (0.9)	72 (0.8) ●	70 (1.1)	68 (1.0) ●	82 (0.8)	80 (0.8) ●
Canada	65 (0.4)	68 (0.3) ▲	61 (0.6)	64 (0.5) ▲	72 (0.5)	75 (0.4) ▲
Cyprus	56 (0.4)	57 (0.3) ●	53 (0.5)	53 (0.4) ●	67 (0.6)	67 (0.5) ●
Czech Republic	74 (0.7)	72 (0.6) ●	73 (0.9)	69 (0.8) ●	84 (0.7)	83 (0.6) ●
England	68 (0.5)	70 (0.6) ●	63 (0.7)	65 (0.7) ●	75 (0.6)	77 (0.7) ●
Hong Kong, SAR	66 (0.8)	69 (0.5) ●	60 (0.8)	63 (0.5) ▲	77 (0.9)	79 (0.6) ●
Hungary	73 (0.5)	76 (0.5) ▲	74 (0.7)	76 (0.7) ●	81 (0.6)	82 (0.5) ●
Iran, Islamic Rep.	59 (0.5)	57 (0.7) ●	57 (0.6)	55 (0.7) ●	62 (0.6)	60 (0.6) ●
Italy	65 (0.7)	64 (0.8) ●	62 (0.9)	62 (1.0) ●	72 (0.8)	72 (0.8) ●
Japan	71 (0.3)	72 (0.3) ●	65 (0.4)	68 (0.4) ▲	77 (0.4)	78 (0.4) ●
Korea, Rep. of	71 (0.4)	72 (0.3) ●	70 (0.5)	71 (0.4) ●	76 (0.5)	76 (0.4) ●
Latvia (LSS)	63 (0.5)	65 (0.5) ▲	61 (0.8)	64 (0.8) ●	71 (0.7)	75 (0.6) ▲
Lithuania	62 (0.7)	65 (0.7) ●	58 (0.9)	60 (0.8) ●	68 (0.8)	71 (0.7) ●
Netherlands	71 (1.0)	71 (1.1) ●	65 (1.4)	68 (1.3) ●	81 (1.0)	81 (1.3) ●
New Zealand	64 (0.7)	63 (0.7) ●	59 (0.8)	59 (0.8) ●	70 (0.9)	70 (0.9) ●
Romania	62 (0.9)	62 (0.8) ●	61 (1.0)	60 (1.0) ●	69 (1.0)	68 (0.8) ●
Russian Federation	69 (0.8)	72 (1.1) ●	65 (0.7)	67 (1.2) ●	75 (0.8)	77 (1.1) ●
Singapore	74 (0.9)	71 (1.2) ●	64 (1.0)	61 (1.0) ●	80 (0.9)	78 (1.3) ●
Slovak Republic	70 (0.6)	71 (0.6) ●	67 (0.8)	67 (0.8) ●	76 (0.6)	84 (0.6) ▲
Slovenia	72 (0.5)	70 (0.5) ●	76 (0.6)	73 (0.6) ▼	76 (0.5)	76 (0.6) ●
United States	66 (0.7)	67 (0.6) ●	62 (0.8)	62 (0.7) ●	75 (0.8)	76 (0.8) ●
International Avg. [§]	68 (0.1)	68 (0.1) ●	64 (0.2)	65 (0.2) ●	75 (0.2)	76 (0.2) ▲
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995						
Israel	67 (0.9)	63 (0.8) ●	61 (1.0)	57 (0.9) ●	74 (1.1)	68 (0.9) ▼
South Africa	37 (1.1)	35 (0.7) ●	34 (1.0)	34 (0.5) ●	38 (1.4)	37 (0.9) ●
Thailand	65 (0.8)	58 (0.8) ▼	63 (0.9)	52 (0.9) ▼	79 (0.7)	72 (0.8) ▼

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

▲ 1999 significantly higher than 1995
 ● No significant difference between 1995 and 1999
 ▼ 1999 significantly lower than 1995
 Significance tests adjusted for multiple comparisons

¹ Applies only to items that appeared on both the 1995 and 1999 assessments.

² Environmental and Resource Issues and Scientific Inquiry and the Nature of Science scales had too few items for computing trends; however, the four items from these scales are included in the results for the total science trend.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

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

		Average Percent Correct in Science Content Areas ¹			
		Physics Trend Items		Chemistry Trend Items	
		(15 items)		(5 items)	
		1995	1999	1995	1999
	Australia	62 (0.6)	64 (0.7) ●	71 (0.9)	72 (1.0) ●
	Belgium (Flemish)	64 (0.9)	63 (0.4) ●	72 (0.8)	70 (0.5) ●
	Bulgaria	69 (1.1)	67 (0.9) ●	80 (1.4)	76 (1.1) ●
	Canada	61 (0.5)	64 (0.4) ▲	71 (0.6)	74 (0.6) ▲
	Cyprus	50 (0.4)	53 (0.4) ▲	62 (0.7)	61 (0.6) ●
	Czech Republic	68 (0.6)	65 (0.7) ▼	72 (1.0)	70 (0.9) ●
	England	65 (0.6)	65 (0.7) ●	72 (1.0)	73 (0.9) ●
	Hong Kong, SAR	62 (0.8)	64 (0.5) ●	68 (1.3)	72 (0.9) ●
	Hungary	63 (0.5)	69 (0.6) ▲	78 (0.8)	83 (0.6) ▲
	Iran, Islamic Rep.	56 (0.7)	54 (0.8) ●	66 (0.7)	64 (0.9) ●
	Italy	59 (0.7)	58 (0.9) ●	68 (1.1)	66 (1.2) ●
	Japan	69 (0.3)	69 (0.3) ●	74 (0.6)	74 (0.6) ●
	Korea, Rep. of	68 (0.4)	69 (0.4) ●	72 (0.7)	73 (0.5) ●
	Latvia (LSS)	56 (0.6)	57 (0.6) ●	62 (0.8)	68 (0.8) ▲
	Lithuania	58 (0.7)	61 (0.7) ●	68 (1.0)	70 (1.2) ●
	Netherlands	66 (0.8)	66 (1.0) ●	72 (1.2)	73 (1.2) ●
	New Zealand	59 (0.6)	58 (0.6) ●	70 (1.1)	68 (1.0) ●
	Romania	57 (1.0)	57 (0.9) ●	65 (1.1)	65 (1.2) ●
	Russian Federation	66 (1.1)	68 (1.3) ●	74 (1.4)	77 (1.3) ●
	Singapore	74 (0.8)	72 (1.0) ●	81 (1.1)	76 (1.6) ●
	Slovak Republic	65 (0.7)	62 (0.7) ▼	77 (0.8)	74 (1.0) ●
	Slovenia	65 (0.6)	63 (0.5) ●	72 (1.0)	71 (0.8) ●
	United States	61 (0.6)	62 (0.6) ●	72 (1.2)	72 (1.0) ●
	International Avg. [§]	63 (0.1)	63 (0.2) ●	71 (0.2)	71 (0.2) ●
Countries with Unapproved Sampling Procedures at the Classroom Level in 1995					
	Israel	62 (0.9)	62 (0.7) ●	73 (1.3)	69 (1.2) ●
	South Africa	37 (1.2)	34 (0.7) ●	38 (1.3)	35 (1.0) ●
	Thailand	59 (0.9)	53 (0.8) ▼	50 (1.1)	45 (1.0) ▼

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons



CHAPTER 4

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. Also provided is information on changes in results between 1995 and 1999.





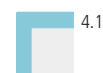
To provide an educational context for interpreting the science achievement results, TIMSS collected detailed information from students about their home backgrounds, how they spend their time out of school, and their attitudes towards science. This chapter presents eighth-grade students' responses to a subset of these questions, together with changes in results between 1995 and 1999. Specifically, one set of questions addresses home resources and support for academic achievement. Another examines how much out-of-school time students spend on their schoolwork. A third set of questions elicits information on 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 for the component questions and more detail about some topic areas are provided in the reference section of this report (see reference section R.1).

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. This has been documented most recently in a study of the eighth-grade results from TIMSS in 1995.¹ The international report for these data² showed that students from homes with large numbers of books, with a range of educational study aids, or with parents with university-level education also had higher science achievement. For the 1999 data presented in this report, student responses to these three variables were combined to form an index of home educational resources (HER).

Exhibit 4.1 summarizes the home educational resources index in a two-page display. The index is described on the first page. Students assigned to 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 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 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.



parent finished university. Students assigned to 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 country, together with the average science achievement for those students. Standard errors are also shown. Countries are ordered by the percentage of students at the high level of the index. The international average across all countries is shown at the bottom of each column. On the second page of the display, the percentage of students at the high level of the index is shown graphically for each country.

There are large differences among countries in the distribution of students across the three categories of the index. Students at the high level of the home educational resources index are relatively rare in most countries, with just nine percent in this category on average internationally. Countries with the greatest percentages included Canada, Australia, Israel, and the United States, each of which had more than one-fifth (22 percent or more) of their students at the high level. At the other extreme, Thailand, Iran, and Morocco had more than half of their students at the low level.

The educational significance of this wide divergence becomes apparent when achievement differences between the levels of the index are considered. There was a substantial difference in the average science achievement of students at the three index levels in every country for which data were available. This is reflected in the international average, where the achievement difference between students at the high level (558) and the low level (431) amounted to 127 score points.

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 some of the less wealthy countries 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, there are clearly other influences at work also. For example, Chinese Taipei had about the same percentage of students (eight percent) at the high level of the index as Latvia (LSS) and Belgium (Flemish), but the average science achievement of its students was considerably higher than that of most participating countries, including Latvia (LSS) and Belgium (Flemish).

More detailed information on the student responses that were combined in the home educational resources index is presented in Exhibits R1.1



through R1.5 in the reference section. Exhibit R1.1 shows the percentage of eighth-grade students in each country that 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. The changes in these percentages presented in Exhibit R1.2 show that between 1995 and 1999 many countries had significant increases in the percentages of students having all three educational aids as well as those with computers in their homes (10 percent increase internationally, on average, for both).



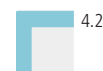
Exhibit R1.3 shows for each country the percentage of students at each of five ranges of numbers of books in the home in relation to average science achievement; changes in these results are shown in Exhibit R1.4. In most countries, the more books students reported in the home, the higher their science achievement. Interestingly, however, the trend appears to be in the direction of having fewer books in the home. Taken together with the increase in home computers, this may reflect the emerging reliance on the Internet as a source of information.



The percentages of students in each of five categories of parents' educational level are shown in Exhibit R1.5, together with their average science achievement. Although participants 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 R1.6 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 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.



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, sometimes they are still developing proficiency in the language of instruction and can be at a disadvantage in learning situations. Exhibit 4.2 contains students' reports of how frequently they spoke 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. On average



text continued
page 122



Exhibit 4.1 Index of Home Educational Resources (HER)

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, R1.5). 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 R1.6 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.

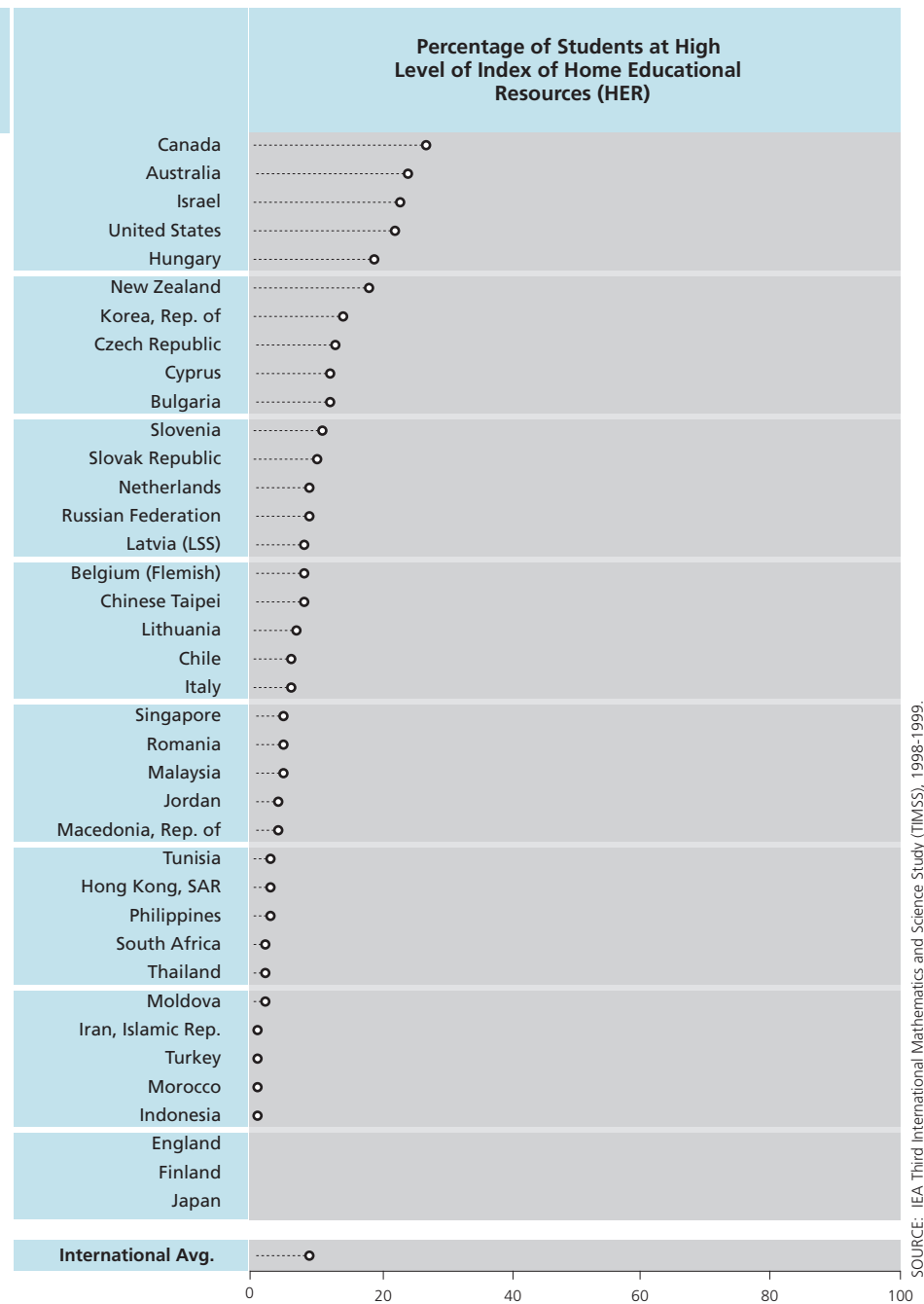
	High HER		Medium HER		Low HER	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Canada	27 (1.0)	559 (3.8)	71 (1.0)	526 (2.1)	2 (0.2)	~ ~
Australia	24 (1.5)	577 (4.7)	72 (1.4)	532 (4.4)	3 (0.4)	472 (12.9)
Israel	23 (1.2)	521 (5.4)	72 (1.1)	462 (4.4)	5 (0.6)	380 (12.4)
United States	22 (1.5)	573 (3.8)	73 (1.4)	506 (4.2)	4 (0.5)	420 (7.3)
Hungary	19 (1.2)	600 (4.9)	75 (1.2)	547 (3.6)	5 (0.7)	463 (10.7)
New Zealand	18 (1.2)	567 (5.9)	76 (1.1)	503 (4.5)	6 (0.5)	422 (11.2)
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)
Cyprus	12 (0.7)	506 (4.5)	81 (0.8)	460 (2.7)	8 (0.5)	399 (6.0)
Bulgaria	12 (1.7)	570 (10.6)	82 (1.5)	516 (4.4)	7 (0.8)	450 (8.8)
Slovenia	11 (0.8)	585 (7.9)	84 (0.8)	531 (3.1)	5 (0.5)	482 (8.0)
Slovak Republic	10 (0.9)	579 (8.3)	86 (0.9)	533 (3.0)	4 (0.5)	464 (11.1)
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)
Latvia (LSS)	8 (0.7)	545 (8.0)	88 (0.8)	501 (4.8)	4 (0.5)	444 (12.8)
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)
Lithuania [†]	7 (0.8)	555 (12.0)	83 (1.1)	488 (3.7)	10 (1.0)	437 (9.3)
Chile	6 (0.9)	502 (10.3)	56 (1.3)	438 (3.6)	38 (1.6)	382 (3.5)
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)
Romania	5 (0.7)	541 (7.2)	73 (1.6)	481 (5.4)	22 (1.7)	435 (7.9)
Malaysia	5 (0.6)	573 (9.0)	71 (0.9)	499 (4.6)	25 (1.1)	458 (4.6)
Jordan	4 (0.4)	526 (10.0)	71 (1.0)	462 (3.6)	25 (1.1)	416 (5.3)
Macedonia, Rep. of	4 (0.5)	531 (8.3)	73 (1.4)	477 (4.7)	23 (1.6)	397 (8.7)
Tunisia	3 (0.5)	464 (10.7)	59 (1.3)	434 (3.8)	38 (1.5)	420 (3.5)
Hong Kong, SAR	3 (0.3)	558 (9.6)	78 (0.8)	533 (3.7)	19 (0.9)	515 (4.5)
Philippines	3 (0.5)	446 (28.0)	67 (1.1)	356 (8.0)	30 (1.2)	314 (8.4)
South Africa	2 (0.4)	~ ~	54 (1.7)	269 (9.6)	44 (1.8)	203 (5.1)
Thailand	2 (0.3)	~ ~	47 (1.4)	496 (4.5)	51 (1.4)	468 (4.2)
Moldova	2 (0.4)	~ ~	80 (1.3)	466 (4.1)	18 (1.3)	432 (7.7)
Iran, Islamic Rep.	1 (0.4)	~ ~	45 (1.7)	468 (3.8)	54 (1.9)	431 (3.9)
Turkey	1 (0.2)	~ ~	51 (1.5)	447 (4.6)	48 (1.5)	417 (4.6)
Morocco	1 (0.2)	~ ~	36 (1.5)	339 (6.2)	63 (1.6)	319 (3.6)
Indonesia	1 (0.2)	~ ~	56 (1.6)	446 (4.4)	44 (1.7)	422 (5.2)
England	--	--	--	--	--	--
Finland	--	--	--	--	--	--
Japan	--	--	--	--	--	--
International Avg.	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.

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

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.



internationally, however, more than 20 percent of students were from homes where the language of the test was spoken only sometimes (17 percent), or never (5 percent). Many countries tested in more than one language in order to cover their whole student population. These included Canada (English and French), Finland (Finnish and Swedish), Hong Kong (Chinese and English), Israel (Hebrew and Arabic), Italy (Italian and German), Macedonia (Macedonian and Albanian), Moldova (Moldavian and Russian), the Philippines (Filipino and English), Romania (Romanian and Hungarian), and South Africa (English and Afrikaans). However, in countries like Indonesia, Morocco, the Philippines, Singapore, and South Africa, where less than one-third of students were from homes where the language of the test is routinely spoken, testing in all possible dialects and languages was prohibitive. Exhibit 4.3 displays, for countries that also took part in TIMSS in 1995, trend data for the language of the test spoken in the home. On average across countries there was very little change.

4.3



By the end of the eighth grade, students in most countries can say what their expectations are for further education. Although more than one-quarter of the students in some countries did not know, Exhibit 4.4 shows that, on average across countries, more than half of the students reported that they expected to finish university (a four-year degree program or equivalent). The highest percentages were in Canada, Korea, and the United States, where more than three-fourths expected to finish university, but the percentages were substantial in almost every country. In almost every country, also, there was a positive association between educational expectations and science achievement.

4.4



R1.7-R1.9

R



Exhibits R1.7 to R1.9 in the reference section present eighth-grade students' reports about how they themselves, their mothers, and their friends feel about the importance of doing well in various academic and non-academic activities. On average, more than 90 percent of the 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 it was important to do well in these three subjects (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). Students also were asked why they needed to do well in science (see Exhibit R1.10). In general, getting into their desired secondary school or university was a stronger motivating factor than was pleasing their parents or getting their desired job.

R1.10

R



Exhibit 4.2 Frequency with Which Students Speak Language of the Test at Home

	Always or Almost Always		Sometimes		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	89 (1.2)	547 (4.6)	10 (1.1)	506 (10.1)	1 (0.3)	~ ~
Belgium (Flemish)	86 (1.3)	542 (2.8)	8 (0.7)	504 (10.7)	6 (0.9)	496 (18.1)
Bulgaria	88 (1.9)	526 (5.6)	11 (1.7)	468 (13.1)	1 (0.3)	~ ~
Canada	91 (0.6)	537 (2.3)	8 (0.5)	494 (7.4)	2 (0.2)	~ ~
Chile ^r	94 (0.5)	423 (4.5)	6 (0.5)	368 (9.3)	1 (0.1)	~ ~
Chinese Taipei	67 (1.4)	587 (4.8)	31 (1.3)	535 (5.5)	2 (0.2)	~ ~
Cyprus	89 (1.1)	465 (3.2)	9 (1.0)	450 (8.2)	2 (0.3)	~ ~
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)	~ ~
Finland	97 (0.7)	540 (3.3)	3 (0.7)	483 (24.5)	1 (0.2)	~ ~
Hong Kong, SAR ^r	80 (2.4)	523 (4.2)	17 (1.9)	536 (8.8)	3 (0.5)	551 (11.5)
Hungary ^r	99 (0.2)	557 (4.1)	0 (0.2)	~ ~	1 (0.1)	~ ~
Indonesia	28 (2.5)	438 (8.1)	63 (2.3)	432 (4.6)	9 (0.8)	456 (9.8)
Iran, Islamic Rep.	59 (3.4)	462 (3.7)	26 (2.1)	426 (7.0)	15 (1.6)	430 (8.2)
Israel	85 (1.2)	474 (4.4)	13 (1.1)	453 (10.4)	2 (0.3)	~ ~
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)	~ ~
Jordan	85 (0.9)	457 (3.7)	13 (0.8)	436 (6.2)	2 (0.3)	~ ~
Korea, Rep. of	96 (0.3)	551 (2.6)	4 (0.3)	504 (8.6)	0 (0.0)	~ ~
Latvia (LSS)	92 (1.2)	503 (4.9)	6 (0.8)	489 (13.2)	2 (0.6)	~ ~
Lithuania [†]	99 (0.3)	490 (4.3)	1 (0.3)	~ ~	0 (0.1)	~ ~
Macedonia, Rep. of ^s	93 (1.5)	482 (5.3)	5 (0.9)	451 (13.1)	2 (0.8)	~ ~
Malaysia	61 (2.3)	483 (4.5)	30 (1.7)	504 (6.9)	10 (1.0)	515 (9.2)
Moldova	89 (1.2)	462 (4.6)	10 (1.1)	441 (12.9)	1 (0.3)	~ ~
Morocco	20 (1.0)	305 (8.5)	51 (1.6)	334 (6.1)	30 (1.6)	322 (7.6)
Netherlands	86 (2.4)	550 (6.9)	8 (1.2)	509 (14.8)	6 (1.8)	536 (11.7)
New Zealand	90 (0.9)	517 (4.6)	9 (0.7)	456 (9.9)	1 (0.3)	~ ~
Philippines	11 (1.6)	322 (8.9)	70 (1.5)	357 (8.6)	19 (0.9)	327 (11.3)
Romania	92 (2.4)	475 (5.9)	5 (1.5)	460 (18.6)	3 (0.9)	475 (21.4)
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)
Slovak Republic	87 (1.9)	540 (3.3)	9 (1.4)	504 (7.5)	3 (0.7)	493 (17.2)
Slovenia	91 (1.0)	540 (3.3)	7 (0.7)	489 (8.8)	2 (0.4)	~ ~
South Africa	23 (2.2)	368 (14.9)	53 (1.6)	222 (5.8)	24 (1.8)	177 (5.4)
Thailand	72 (2.4)	489 (4.4)	25 (2.1)	466 (5.5)	3 (0.4)	446 (10.1)
Tunisia	88 (1.5)	431 (3.6)	8 (1.0)	418 (6.1)	4 (0.7)	436 (15.1)
Turkey	92 (1.4)	438 (3.9)	7 (1.3)	394 (10.4)	1 (0.2)	~ ~
United States	90 (1.0)	524 (4.3)	9 (1.0)	456 (7.4)	1 (0.1)	~ ~
International Avg.	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.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.

[†] 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.

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

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

	Always or Almost Always		Sometimes		Never	
	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	89 (1.2)	-2 (1.6) ●	10 (1.1)	2 (1.5) ●	1 (0.3)	0 (0.4) ●
Belgium (Flemish)	86 (1.3)	-1 (1.8) ●	8 (0.7)	0 (1.1) ●	6 (0.9)	1 (1.2) ●
Canada	91 (0.6)	1 (1.1) ●	8 (0.5)	-1 (1.0) ●	2 (0.2)	0 (0.3) ●
Cyprus	89 (1.1)	-2 (1.3) ●	9 (1.0)	2 (1.2) ●	2 (0.3)	0 (0.5) ●
Czech Republic	98 (0.5)	-1 (0.5) ●	1 (0.3)	1 (0.4) ●	1 (0.2)	0 (0.2) ●
England	95 (0.9)	-1 (1.1) ●	5 (0.8)	1 (1.1) ●	0 (0.1)	0 (0.2) ●
Hong Kong, SAR	--	--	--	--	--	--
Hungary ^r	99 (0.2)	0 (0.3) ●	0 (0.2)	0 (0.2) ●	1 (0.1)	0 (0.2) ●
Iran, Islamic Rep.	59 (3.4)	6 (4.4) ●	26 (2.1)	-7 (3.0) ●	15 (1.6)	1 (2.1) ●
Israel [†]	85 (1.5)	-3 (2.4) ●	13 (1.3)	3 (2.0) ●	2 (0.4)	-1 (0.7) ●
Italy	76 (1.4)	-2 (1.9) ●	21 (1.3)	2 (1.8) ●	3 (0.4)	-1 (0.7) ●
Japan	--	--	--	--	--	--
Korea, Rep. of	96 (0.3)	0 (0.5) ●	4 (0.3)	0 (0.5) ●	0 (0.0)	0 (0.1) ●
Latvia (LSS)	92 (1.2)	-6 (1.3) ▼	6 (0.8)	4 (1.0) ▲	2 (0.6)	1 (0.6) ●
Lithuania	99 (0.3)	0 (0.6) ●	1 (0.3)	0 (0.5) ●	0 (0.1)	0 (0.2) ●
Netherlands	86 (2.4)	-5 (2.7) ●	8 (1.2)	1 (1.5) ●	6 (1.8)	4 (1.9) ●
New Zealand	90 (0.9)	-1 (1.1) ●	9 (0.7)	1 (1.0) ●	1 (0.3)	0 (0.3) ●
Romania	92 (2.4)	9 (3.1) ▲	5 (1.5)	-8 (1.8) ▼	3 (0.9)	-2 (1.9) ●
Russian Federation	94 (2.3)	-3 (2.4) ●	5 (2.3)	3 (2.3) ●	1 (0.2)	0 (0.3) ●
Singapore	27 (1.8)	7 (2.2) ●	63 (1.6)	-8 (1.9) ▼	10 (0.5)	1 (0.8) ●
Slovak Republic	87 (1.9)	-2 (2.6) ●	9 (1.4)	0 (2.0) ●	3 (0.7)	1 (0.9) ●
Slovenia	91 (1.0)	-3 (1.3) ●	7 (0.7)	2 (1.0) ●	2 (0.4)	1 (0.5) ●
Thailand [†]	72 (2.4)	-3 (3.5) ●	25 (2.1)	6 (2.9) ●	3 (0.4)	-3 (0.9) ▼
United States	90 (1.0)	0 (1.7) ●	9 (1.0)	0 (1.6) ●	1 (0.1)	0 (0.2) ●
International Avg.[§]	87 (0.3)	0 (0.4) ●	10 (0.2)	-1 (0.3) ●	3 (0.1)	0 (0.2) ●

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by students.

[†] Countries with unapproved sampling procedures at the classroom level in 1995.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 a 70-84% student response rate, based on the lower response rate in either 1995 or 1999.

Exhibit 4.4

Students' Expectations for Finishing School*

	Finish University ¹		Some Vocational/ Technical Education or University Only ²		Finish Secondary School Only ³		Some Secondary School Only		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
Australia	55 (1.8)	568 (4.6)	14 (0.7)	539 (5.5)	17 (1.0)	497 (6.9)	5 (0.5)	483 (11.2)	9 (0.7)	516 (9.3)
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)
Bulgaria	60 (2.9)	544 (6.3)	8 (0.6)	493 (8.6)	22 (2.2)	477 (5.8)	1 (0.2)	~ ~	9 (0.9)	480 (9.2)
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)
Chile	54 (1.6)	454 (4.9)	18 (0.8)	399 (4.3)	19 (1.0)	372 (4.9)	2 (0.2)	~ ~	7 (0.5)	390 (11.8)
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)
Cyprus	51 (1.0)	498 (2.6)	14 (0.7)	444 (4.7)	13 (0.6)	417 (6.2)	6 (0.5)	366 (12.0)	16 (0.9)	433 (7.4)
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	--	--	--	--	--	--	--	--	--	--
Finland	10 (0.8)	587 (8.3)	22 (1.0)	558 (6.4)	41 (1.2)	518 (3.8)	3 (0.4)	491 (9.9)	24 (0.8)	530 (4.9)
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)
Hungary	56 (1.8)	590 (3.3)	0 (0.0)	~ ~	39 (1.7)	508 (5.0)	1 (0.2)	~ ~	4 (0.4)	536 (11.2)
Indonesia	39 (1.8)	460 (4.3)	30 (1.1)	436 (5.2)	12 (0.9)	420 (8.3)	5 (0.5)	378 (9.8)	13 (1.0)	408 (9.6)
Iran, Islamic Rep.	48 (1.7)	469 (5.5)	6 (0.4)	437 (11.1)	6 (0.5)	421 (10.8)	4 (0.5)	421 (10.1)	36 (1.2)	434 (5.2)
Israel	59 (1.0)	497 (5.0)	16 (0.6)	456 (6.3)	11 (0.7)	421 (9.6)	1 (0.2)	~ ~	13 (0.7)	435 (10.1)
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)
Jordan	60 (1.1)	483 (3.3)	11 (0.6)	403 (9.1)	5 (0.5)	394 (10.6)	3 (0.3)	369 (13.3)	21 (0.8)	434 (7.8)
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)
Latvia (LSS)	65 (1.5)	521 (5.4)	13 (0.9)	476 (5.7)	8 (0.7)	475 (7.9)	1 (0.1)	~ ~	13 (1.0)	463 (7.5)
Lithuania [†]	45 (2.1)	527 (4.6)	25 (1.2)	468 (6.7)	6 (0.6)	441 (9.7)	2 (0.3)	~ ~	23 (1.2)	454 (8.5)
Macedonia, Rep. of	53 (1.8)	502 (4.3)	11 (0.7)	462 (9.6)	17 (1.1)	429 (5.6)	8 (0.6)	390 (9.2)	11 (0.9)	397 (10.4)
Malaysia	65 (1.4)	505 (4.7)	18 (0.9)	472 (6.1)	4 (0.4)	452 (11.8)	2 (0.2)	~ ~	11 (0.8)	480 (8.1)
Moldova	45 (1.7)	481 (4.6)	20 (1.1)	458 (5.3)	9 (0.8)	442 (8.5)	4 (0.6)	427 (13.4)	22 (1.2)	435 (7.8)
Morocco	43 (0.9)	349 (6.3)	22 (0.9)	308 (6.9)	6 (0.4)	314 (13.2)	6 (0.7)	285 (16.5)	23 (0.7)	322 (7.4)
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)
New Zealand	52 (1.5)	536 (5.7)	16 (0.7)	507 (4.6)	16 (0.8)	473 (6.9)	3 (0.3)	450 (14.5)	13 (0.7)	473 (8.5)
Philippines	64 (2.0)	382 (7.9)	10 (0.6)	294 (9.9)	9 (0.6)	271 (11.1)	8 (0.8)	273 (10.3)	8 (0.7)	309 (8.8)
Romania	43 (2.0)	515 (6.0)	10 (0.6)	447 (8.4)	25 (1.3)	456 (7.2)	4 (0.8)	461 (18.7)	19 (1.3)	422 (7.1)
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)
Slovak Republic	46 (2.3)	568 (3.6)	11 (0.8)	539 (7.0)	33 (1.6)	500 (4.2)	2 (0.3)	~ ~	8 (0.7)	507 (7.9)
Slovenia	40 (1.0)	576 (3.6)	32 (0.9)	514 (4.0)	18 (0.7)	501 (6.5)	4 (0.4)	454 (7.3)	6 (0.5)	510 (8.4)
South Africa	55 (1.4)	268 (10.3)	18 (0.9)	226 (11.6)	10 (0.6)	215 (12.3)	9 (0.7)	194 (11.8)	8 (0.6)	215 (9.7)
Thailand	55 (1.6)	502 (4.5)	4 (0.3)	486 (13.0)	23 (1.2)	461 (5.3)	5 (0.5)	440 (10.6)	13 (0.9)	455 (9.4)
Tunisia	59 (1.0)	434 (3.5)	23 (0.7)	423 (9.4)	6 (0.4)	414 (7.9)	2 (0.2)	~ ~	10 (0.5)	431 (8.4)
Turkey	62 (1.3)	452 (4.3)	15 (0.8)	410 (8.2)	8 (0.5)	398 (8.4)	4 (0.4)	380 (16.9)	12 (0.5)	409 (4.4)
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)
International Avg.	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 R1.6 for country modifications to the 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.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).[†] 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.

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

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

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

One of the major ways that students can consolidate and extend classroom learning is to spend time out of school studying or doing homework in school subjects. 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, TIMSS constructed an index of out-of-school study time (OST) that assigns students to a high, medium, or low level on the basis of 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 of out-of-school study.

4.5



Exhibit 4.5 presents the percentages of students at the various levels of this index across countries, and their average science achievement. On average across 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. Countries with a heavy emphasis on homework included Iran, Malaysia, Singapore, Italy, Jordan, Tunisia, Turkey, Macedonia, Romania, Moldova, and Morocco, where more than half of the students were at the high level of the index. In these countries, homework seems to be an important part of teachers' instructional strategy. In contrast, there seems to be relatively little emphasis on homework in Australia, Chile, Chinese Taipei, the Czech Republic, Hong Kong, Japan, Korea, New Zealand, and the United States, where one-fifth or more of students were at the low level of the index.

On average internationally, and in all countries, students at the low level of the index also 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 usually associated with higher achievement. On average internationally and in many countries, 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-per-



forming 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.

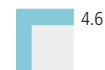
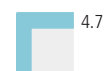


Exhibit 4.6 presents information on trends in the index of out-of-school study time from 1995 to 1999. Internationally on average there was no change. Among countries with a significant decrease in the percentage at the high level were Cyprus, Hong Kong, Japan, Korea, Singapore, and Thailand. In contrast, Canada, Latvia (LSS), Lithuania, and the Russian Federation had increased percentages at the high level of the index.

More detailed information on the amount of time students reported spending on science homework is presented in Exhibit 4.7. The results reveal that students spend one hour per day doing science homework, on average internationally. 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. Almost half the students, on average internationally, reported spending some time but less than one hour each day, and these students had higher average achievement than those spending one hour or more or those spending no time at all. On average, 36 percent of students reported spending more than one hour per day doing science homework. Countries where more than half of the students reported spending an hour or more included Iran, Jordan, Macedonia, Malaysia, Moldova, Morocco, the Philippines, the Russian Federation, Singapore, and Turkey. The countries where students reported the least science homework included Australia, Canada, Chinese Taipei, Hong Kong, Japan, Korea, and the United States. In these countries, one-fifth or more (20 to 45 percent) of students reported spending no time on science homework, and the average amount of time was about half an hour each day.



Further detail on the student data that underlie the index of out-of-school study time is provided in Exhibit R1.11 in the reference section. On average, in comparison with the one hour each day spent on science homework, they reported 2.8 hours of homework in total. Exhibit R1.12 shows essentially no change on average internationally in the amount of homework reported by students from 1995 to 1999. To provide a fuller picture of how students spend their out-of-school time on a school day, Exhibit R1.13, also in the reference section, gives students' reports on how they spend their daily leisure time. The two most popular activities are watching television or videos and playing or talking with friends (each about two hours per day).



Exhibit 4.5 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 R1.11). 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
Iran, Islamic Rep.	r	69 (1.1)	457 (4.6)	27 (0.9)	448 (5.5)	4 (0.4)	426 (13.5)
Malaysia		65 (1.2)	495 (4.6)	31 (1.0)	495 (6.0)	3 (0.3)	465 (11.8)
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)
Jordan	s	58 (1.2)	475 (4.4)	33 (0.9)	465 (6.2)	8 (0.7)	396 (12.6)
Tunisia	r	58 (0.9)	432 (3.2)	34 (0.8)	439 (5.5)	8 (0.6)	432 (7.5)
Turkey	r	56 (1.3)	444 (4.1)	39 (1.0)	433 (4.5)	6 (0.5)	408 (13.0)
Macedonia, Rep. of	r	55 (1.3)	475 (5.5)	39 (1.1)	471 (5.0)	6 (0.5)	445 (9.7)
Romania	r	55 (1.6)	488 (5.3)	33 (1.1)	467 (7.2)	12 (1.0)	444 (9.2)
Moldova	r	52 (1.3)	469 (4.3)	38 (1.1)	468 (5.8)	10 (0.8)	441 (8.5)
Morocco	s	51 (1.5)	338 (4.5)	34 (1.1)	330 (4.4)	15 (0.8)	327 (11.1)
Russian Federation		48 (1.3)	541 (6.3)	46 (1.2)	536 (7.0)	6 (0.6)	493 (9.7)
Philippines	s	48 (0.9)	364 (8.2)	45 (0.9)	375 (8.7)	7 (0.5)	329 (11.0)
Indonesia		47 (1.4)	441 (5.3)	43 (1.0)	442 (4.5)	11 (0.8)	428 (8.4)
Thailand		45 (1.2)	494 (4.7)	47 (1.0)	479 (4.7)	8 (0.5)	448 (5.6)
Bulgaria		45 (1.5)	533 (6.1)	40 (1.0)	525 (5.7)	15 (1.2)	494 (8.7)
South Africa	s	44 (1.3)	260 (9.8)	41 (0.7)	273 (11.3)	15 (1.1)	217 (13.7)
Belgium (Flemish)		41 (1.3)	529 (3.0)	52 (1.1)	545 (3.6)	7 (1.0)	514 (14.4)
Hungary		40 (1.3)	554 (3.8)	52 (1.1)	560 (3.9)	8 (0.6)	516 (9.2)
Latvia (LSS)		40 (1.2)	498 (5.3)	54 (1.2)	512 (5.3)	6 (0.5)	484 (11.2)
Cyprus		35 (1.1)	465 (4.6)	51 (1.1)	475 (3.4)	14 (0.7)	413 (8.3)
Lithuania [†]		35 (1.2)	495 (4.8)	57 (1.2)	493 (4.7)	8 (0.8)	451 (8.2)
Israel		35 (1.5)	462 (5.5)	53 (1.2)	489 (4.2)	12 (0.8)	465 (8.7)
Slovenia		32 (1.0)	522 (4.5)	55 (0.9)	544 (3.5)	13 (0.8)	532 (7.0)
Chile		29 (0.9)	424 (4.6)	51 (0.7)	432 (4.5)	20 (0.8)	416 (4.9)
Slovak Republic		24 (0.9)	526 (4.6)	65 (1.1)	541 (3.5)	10 (0.7)	536 (6.9)
Canada		24 (0.8)	519 (3.3)	59 (1.0)	542 (2.3)	18 (0.8)	531 (4.6)
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)
Netherlands		19 (1.4)	519 (12.8)	74 (1.3)	553 (6.9)	7 (1.0)	543 (11.4)
Australia		17 (0.9)	539 (5.9)	61 (1.4)	554 (4.2)	22 (1.4)	511 (5.9)
New Zealand		17 (1.0)	501 (7.3)	63 (1.3)	531 (4.7)	20 (1.2)	470 (6.4)
Japan		17 (0.9)	558 (5.9)	49 (0.9)	558 (2.7)	35 (1.3)	535 (3.7)
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)
Korea, Rep. of		16 (0.7)	574 (4.6)	43 (0.7)	561 (3.7)	41 (1.0)	527 (2.9)
Finland		9 (0.7)	516 (8.3)	82 (1.0)	541 (3.5)	9 (0.8)	520 (9.2)
England		--	--	--	--	--	--
International Avg.		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.

[†] 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.

A dash (–) indicates data are not available.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.

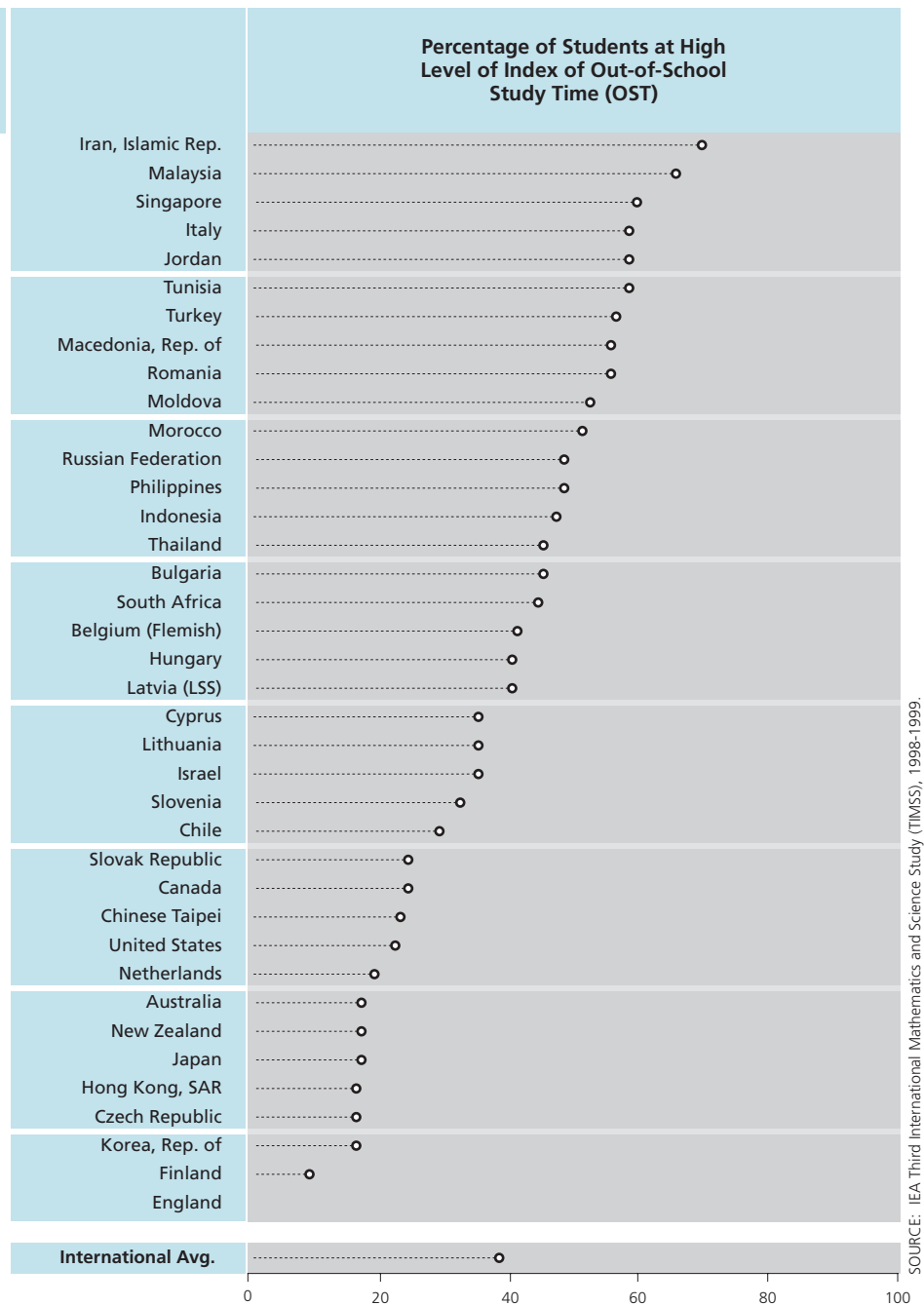


Exhibit 4.6 Trends in Index of Out-of-School Study Time (OST)

	High OST Percent of Students			Medium OST Percent of Students			Low OST Percent of Students		
	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
Australia	16 (0.7)	17 (0.9)	1 (1.1) ●	58 (1.1)	61 (1.4)	2 (1.7) ●	26 (1.2)	22 (1.4)	-3 (1.9) ●
Belgium (Flemish)	42 (1.6)	41 (1.3)	-1 (2.0) ●	52 (1.3)	52 (1.1)	-1 (1.7) ●	6 (0.7)	7 (1.0)	1 (1.2) ●
Canada	19 (0.9)	24 (0.8)	4 (1.3) ▲	55 (1.2)	59 (1.0)	4 (1.6) ●	26 (1.5)	18 (0.8)	-8 (1.7) ▼
Cyprus	41 (0.9)	35 (1.1)	-5 (1.4) ▼	44 (0.9)	51 (1.1)	7 (1.4) ▲	15 (0.8)	14 (0.7)	-2 (1.0) ●
Czech Republic	13 (0.7)	16 (1.1)	3 (1.3) ●	60 (1.3)	62 (1.4)	2 (1.9) ●	27 (1.6)	22 (1.3)	-5 (2.1) ●
England	--	--	--	--	--	--	--	--	--
Hong Kong, SAR	28 (1.1)	16 (0.8)	-12 (1.4) ▼	50 (1.0)	42 (0.9)	-8 (1.4) ▼	22 (1.4)	42 (1.4)	20 (2.0) ▲
Hungary	39 (1.4)	40 (1.3)	2 (1.9) ●	53 (1.3)	52 (1.1)	0 (1.7) ●	9 (0.7)	8 (0.6)	-1 (0.9) ●
Iran, Islamic Rep. ^s	74 (1.6)	69 (1.1)	-4 (1.9) ●	24 (1.4)	27 (0.9)	3 (1.7) ●	3 (0.4)	4 (0.4)	2 (0.6) ●
Israel [†]	31 (1.9)	33 (1.7)	2 (2.5) ●	54 (1.7)	55 (1.4)	1 (2.2) ●	14 (1.3)	12 (0.9)	-3 (1.6) ●
Italy	60 (1.6)	60 (1.6)	0 (2.2) ●	34 (1.4)	34 (1.4)	1 (2.0) ●	6 (0.7)	6 (0.7)	-1 (1.0) ●
Japan	27 (1.0)	17 (0.9)	-10 (1.3) ▼	52 (0.9)	49 (0.9)	-3 (1.3) ●	21 (1.1)	35 (1.3)	14 (1.7) ▲
Korea, Rep. of	27 (1.2)	16 (0.7)	-11 (1.4) ▼	50 (1.1)	43 (0.7)	-6 (1.3) ▼	24 (1.0)	41 (1.0)	17 (1.4) ▲
Latvia (LSS)	26 (1.2)	40 (1.2)	13 (1.6) ▲	60 (1.3)	54 (1.2)	-5 (1.7) ▼	14 (1.0)	6 (0.5)	-8 (1.2) ▼
Lithuania	26 (1.4)	35 (1.2)	10 (1.8) ▲	60 (1.3)	57 (1.2)	-3 (1.8) ●	15 (1.0)	8 (0.8)	-7 (1.3) ▼
Netherlands	16 (0.8)	19 (1.4)	3 (1.6) ●	76 (1.2)	74 (1.3)	-2 (1.7) ●	8 (1.0)	7 (1.0)	-1 (1.4) ●
New Zealand	16 (0.8)	17 (1.0)	1 (1.3) ●	64 (1.2)	63 (1.3)	-1 (1.8) ●	21 (1.2)	20 (1.2)	-1 (1.7) ●
Romania ^r	51 (1.5)	55 (1.6)	4 (2.2) ●	28 (1.1)	33 (1.1)	5 (1.6) ●	21 (1.3)	12 (1.0)	-9 (1.7) ▼
Russian Federation	36 (1.4)	48 (1.3)	13 (1.9) ▲	54 (1.4)	46 (1.2)	-8 (1.8) ▼	10 (0.7)	6 (0.6)	-4 (0.9) ▼
Singapore	76 (1.0)	59 (1.2)	-18 (1.5) ▼	21 (0.8)	35 (0.9)	14 (1.3) ▲	3 (0.4)	7 (0.6)	4 (0.7) ▲
Slovak Republic	22 (0.9)	24 (0.9)	2 (1.3) ●	64 (1.1)	65 (1.1)	2 (1.5) ●	14 (1.0)	10 (0.7)	-4 (1.2) ▼
Slovenia	35 (1.0)	32 (1.0)	-3 (1.4) ●	53 (1.0)	55 (0.9)	2 (1.4) ●	12 (0.7)	13 (0.8)	1 (1.1) ●
Thailand [†]	51 (1.6)	45 (1.2)	-6 (2.0) ▼	43 (1.3)	47 (1.0)	4 (1.6) ●	6 (0.5)	8 (0.5)	2 (0.7) ▲
United States	22 (0.8)	22 (0.8)	0 (1.1) ●	54 (1.1)	56 (0.9)	2 (1.5) ●	25 (1.3)	23 (1.3)	-2 (1.8) ●
International Avg. [§]	34 (0.3)	33 (0.2)	0 (0.4) ●	51 (0.3)	51 (0.2)	0 (0.4) ●	15 (0.2)	16 (0.2)	0 (0.3) ●

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

▲	1999 significantly higher than 1995
●	No significant difference between 1995 and 1999
▼	1999 significantly lower than 1995
Significance tests adjusted for multiple comparisons	

Background data provided by students.

[†] Countries with unapproved sampling procedures at the classroom level in 1995.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999. Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 a 70-84% student response rate, based on the lower response rate in either 1995 or 1999. An "s" indicates a 50-69% student response rate, based on the lower response rate in either 1995 or 1999.

Exhibit 4.7

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

TIMSS¹⁹⁹⁹
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	
Australia	14 (0.8)	533 (6.9)	65 (1.4)	553 (4.4)	21 (1.4)	510 (6.6)	0.6 (0.02)
Belgium (Flemish)	31 (1.4)	520 (3.7)	55 (1.2)	543 (3.9)	14 (1.1)	538 (8.8)	0.8 (0.03)
Bulgaria	45 (1.5)	528 (7.0)	38 (1.2)	523 (6.7)	17 (1.6)	505 (8.7)	1.1 (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)
Chile	30 (1.0)	417 (5.4)	53 (0.8)	431 (4.7)	17 (0.7)	415 (4.9)	0.9 (0.02)
Chinese Taipei	20 (0.9)	607 (4.7)	42 (0.9)	588 (4.4)	38 (1.3)	530 (5.7)	0.6 (0.02)
Cyprus	25 (1.0)	461 (5.0)	57 (0.9)	474 (3.1)	18 (0.7)	425 (6.6)	0.7 (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	--	--	--	--	--	--	--
Finland	8 (0.6)	511 (10.8)	84 (0.9)	541 (3.5)	8 (0.8)	514 (9.7)	0.5 (0.01)
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)
Hungary	45 (1.3)	554 (4.0)	49 (1.2)	558 (4.0)	6 (0.6)	505 (8.6)	1.1 (0.02)
Indonesia	47 (1.1)	435 (5.9)	40 (0.9)	442 (4.9)	13 (0.8)	432 (6.7)	1.1 (0.02)
Iran, Islamic Rep.	68 (1.1)	451 (4.6)	29 (1.0)	453 (4.1)	3 (0.3)	432 (16.0)	1.6 (0.03)
Israel	23 (1.1)	450 (6.5)	60 (1.1)	487 (4.6)	17 (0.8)	449 (7.8)	0.8 (0.02)
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)
Jordan	56 (1.1)	465 (3.7)	37 (1.0)	466 (5.0)	7 (0.5)	396 (9.2)	1.5 (0.03)
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)
Latvia (LSS)	25 (1.0)	496 (6.3)	66 (1.0)	509 (5.4)	9 (0.6)	480 (9.9)	0.8 (0.02)
Lithuania [†]	25 (1.2)	494 (4.9)	66 (1.2)	493 (4.8)	10 (0.9)	456 (8.2)	0.8 (0.02)
Macedonia, Rep. of	72 (1.2)	470 (5.3)	25 (1.0)	453 (5.9)	3 (0.3)	428 (15.3)	2.0 (0.05)
Malaysia	60 (1.2)	495 (4.9)	36 (1.1)	493 (5.1)	4 (0.3)	460 (10.6)	1.3 (0.02)
Moldova	63 (1.2)	467 (4.2)	29 (1.0)	460 (5.8)	7 (0.6)	439 (10.8)	1.7 (0.04)
Morocco ^r	51 (1.7)	335 (6.4)	35 (1.2)	330 (4.9)	14 (0.8)	323 (12.4)	1.5 (0.06)
Netherlands	15 (1.3)	507 (12.9)	80 (1.5)	555 (6.4)	6 (0.8)	530 (11.6)	0.6 (0.02)
New Zealand	15 (1.0)	491 (7.7)	66 (1.2)	528 (4.8)	18 (1.1)	472 (6.8)	0.6 (0.02)
Philippines	54 (0.9)	348 (7.7)	41 (0.8)	365 (9.7)	5 (0.4)	294 (14.4)	1.7 (0.04)
Romania	48 (1.3)	484 (5.6)	36 (1.0)	479 (7.8)	16 (0.9)	451 (8.4)	1.2 (0.03)
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)
Slovak Republic	25 (1.2)	532 (4.8)	67 (1.2)	539 (3.7)	8 (0.7)	521 (7.5)	0.8 (0.02)
Slovenia	38 (1.1)	521 (4.2)	52 (1.1)	546 (3.7)	10 (0.8)	526 (6.7)	0.9 (0.02)
South Africa	47 (1.3)	237 (8.7)	39 (1.1)	269 (11.1)	15 (1.8)	211 (14.0)	1.5 (0.05)
Thailand	42 (1.2)	493 (5.2)	50 (1.1)	480 (4.8)	8 (0.5)	455 (4.8)	1.0 (0.02)
Tunisia	48 (1.0)	425 (2.8)	39 (0.9)	434 (5.3)	13 (0.8)	438 (8.2)	1.2 (0.03)
Turkey	51 (1.2)	444 (4.4)	44 (0.9)	433 (4.0)	6 (0.5)	409 (12.9)	1.2 (0.02)
United States	16 (0.8)	502 (5.9)	60 (1.3)	532 (4.6)	24 (1.4)	495 (6.4)	0.6 (0.01)
International Avg.	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.[†] 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.

A dash (–) indicates data are not available.

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

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). This index 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 possible combinations of responses. (As an example of one of the components of the index, Exhibit R1.14 in the reference section provides the percentages of agreement for the statement “science is not one of my strengths.”)

R1.14



4.8



The percentages of eighth-grade students at each level of this index, 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, and in separate panels for earth science, biology, physics, and chemistry for countries that teach the sciences separately. On average internationally, 26 percent of students in the single-science countries had a high self-concept in the sciences. The percentages ranged from a high of 45 percent in the United States to a low of eight percent in Indonesia and the Philippines. Although there was a clear positive association between self-concept and science achievement internationally and in every country, at the country level the relationship was more complex. Several countries with high average science achievement, including Singapore, Japan, Hong Kong, Chinese Taipei, and Korea, had relatively low percentages (21 percent or less) of students 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.

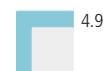
In countries teaching the sciences as separate subjects, the percentage of students at the high level of the science self-concept index was greatest for biology and earth science, with more than 40 percent of students in the high category on average for these subjects. The percentage was lower for



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 in all subjects.³ The smallest percentages were in Romania and Morocco for earth science and biology, and in Romania and Lithuania for physics and chemistry. 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 1995 TIMSS data by gender⁴ 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 compared with language, and to doing well in science in order to get a good job. It is not surprising, therefore, to find differences in science self-concept between boys and girls in many countries.

Exhibit 4.9 presents the percentages of girls and of boys in each country at the high, medium, and low levels of the science self-concept index. Among countries teaching science as a single subject, there was a slightly greater percentage of boys at the high level and girls at the low level on average across countries. This overall difference was largely the result of relatively large gender differences in fewer than half of the single-science countries, including Australia, Chinese Taipei, England, Hong Kong, Japan, Korea, New Zealand, Singapore, and the United States.



Gender differences in science self-concept were both more pronounced and more differentiated for the separate science subjects. In biology, a greater percentage of girls than boys, on average, was found at the high level of the index. Countries with significantly greater percentages of girls reporting a high level of self-concept in biology included the Czech Republic, Hungary, Latvia (LSS), Macedonia, Romania, the Russian Federation, and Slovenia. In contrast, greater percentages of boys reported high levels of self-concept in physics, and to a lesser extent in earth science and chemistry. In all of the separate-subject countries except Belgium (Flemish), Bulgaria, Macedonia, Moldova, Morocco, and the Russian Federation, the percentages of boys with high self-concept in physics were significantly greater than the percentages of girls, often substantially so. In earth science, significantly greater percentages of boys with high self-concept were found in Finland and the Netherlands, and significantly greater percentages of girls in Macedonia and Romania. Significantly greater percentages of boys with high self-concept in chemistry were found in Finland, Hungary, and Latvia (LSS).

³ Physics and chemistry are taught as one subject in the Netherlands. Student responses are reported in the physics panel of Exhibit 4.8.

⁴ 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.

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

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.



General/Integrated Science (SCS-G)

	High SCS		Medium SCS		Low SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
United States	45 (1.2)	550 (4.5)	40 (0.8)	505 (4.4)	15 (0.7)	459 (6.2)
England	42 (1.3)	573 (5.8)	45 (1.2)	528 (4.6)	13 (0.8)	486 (8.6)
Israel	40 (1.1)	515 (3.5)	47 (0.9)	457 (5.5)	13 (0.8)	399 (10.5)
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)
Australia	37 (1.2)	581 (4.4)	45 (1.0)	531 (4.8)	19 (1.0)	486 (5.3)
Tunisia	36 (0.9)	445 (4.5)	55 (0.8)	424 (3.2)	9 (0.5)	408 (5.0)
Iran, Islamic Rep.	35 (1.1)	478 (3.6)	53 (1.0)	443 (4.0)	12 (0.7)	398 (6.3)
Turkey	33 (1.0)	461 (5.4)	48 (0.7)	431 (4.2)	19 (0.7)	410 (5.7)
New Zealand	32 (1.2)	553 (5.4)	49 (1.1)	502 (4.4)	19 (0.8)	467 (6.5)
Chile	27 (1.0)	461 (5.3)	51 (0.9)	420 (4.0)	22 (0.9)	381 (6.0)
Jordan	25 (1.0)	513 (3.7)	53 (0.9)	451 (3.7)	21 (0.8)	413 (5.3)
Cyprus	23 (1.0)	511 (3.5)	55 (1.1)	460 (3.5)	22 (0.9)	412 (4.0)
Malaysia	23 (1.0)	524 (5.7)	69 (1.0)	486 (4.4)	8 (0.6)	461 (6.9)
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)
South Africa	12 (1.1)	358 (19.2)	58 (0.9)	243 (7.5)	30 (1.1)	202 (6.2)
Thailand	12 (0.6)	512 (6.0)	53 (0.9)	488 (4.5)	35 (1.0)	466 (4.7)
Korea, Rep. of	12 (0.5)	601 (5.0)	80 (0.6)	547 (2.6)	8 (0.4)	490 (4.5)
Indonesia ^b	8 (0.6)	465 (6.3)	73 (0.7)	438 (4.5)	19 (0.8)	416 (5.2)
Philippines	8 (0.6)	424 (11.5)	67 (0.9)	354 (7.6)	25 (0.9)	319 (8.5)
International Avg.	26 (0.2)	521 (1.4)	56 (0.2)	475 (1.0)	18 (0.2)	439 (1.3)



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)
Slovak Republic	49 (1.7)	551 (4.9)	39 (1.2)	531 (3.9)	12 (0.9)	495 (8.3)
Czech Republic	48 (1.5)	552 (4.8)	43 (1.2)	533 (4.6)	9 (0.7)	506 (8.2)
Macedonia, Rep. of	48 (1.5)	501 (4.4)	39 (1.2)	444 (5.3)	13 (0.9)	390 (10.0)
Finland	47 (1.4)	555 (3.9)	36 (1.0)	530 (3.9)	16 (1.1)	495 (7.6)
Hungary	47 (1.4)	566 (3.8)	41 (1.2)	551 (4.3)	13 (0.8)	516 (7.4)
Moldova	40 (1.6)	486 (4.4)	47 (1.3)	452 (4.8)	13 (0.8)	427 (7.9)
Bulgaria	38 (1.7)	539 (4.8)	42 (1.4)	521 (7.6)	20 (1.0)	491 (6.5)
Belgium (Flemish)	36 (1.1)	555 (4.5)	49 (1.3)	535 (3.5)	15 (0.9)	511 (5.3)
Romania	23 (1.3)	511 (6.3)	52 (1.1)	479 (6.3)	25 (1.1)	436 (6.8)
Morocco ^c	14 (0.8)	351 (7.4)	57 (1.2)	324 (5.7)	29 (1.0)	317 (6.3)
Latvia (LSS)	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--
Slovenia	--	--	--	--	--	--
International Avg.	42 (0.4)	522 (1.5)	43 (0.3)	496 (1.5)	15 (0.3)	467 (2.0)

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

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

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

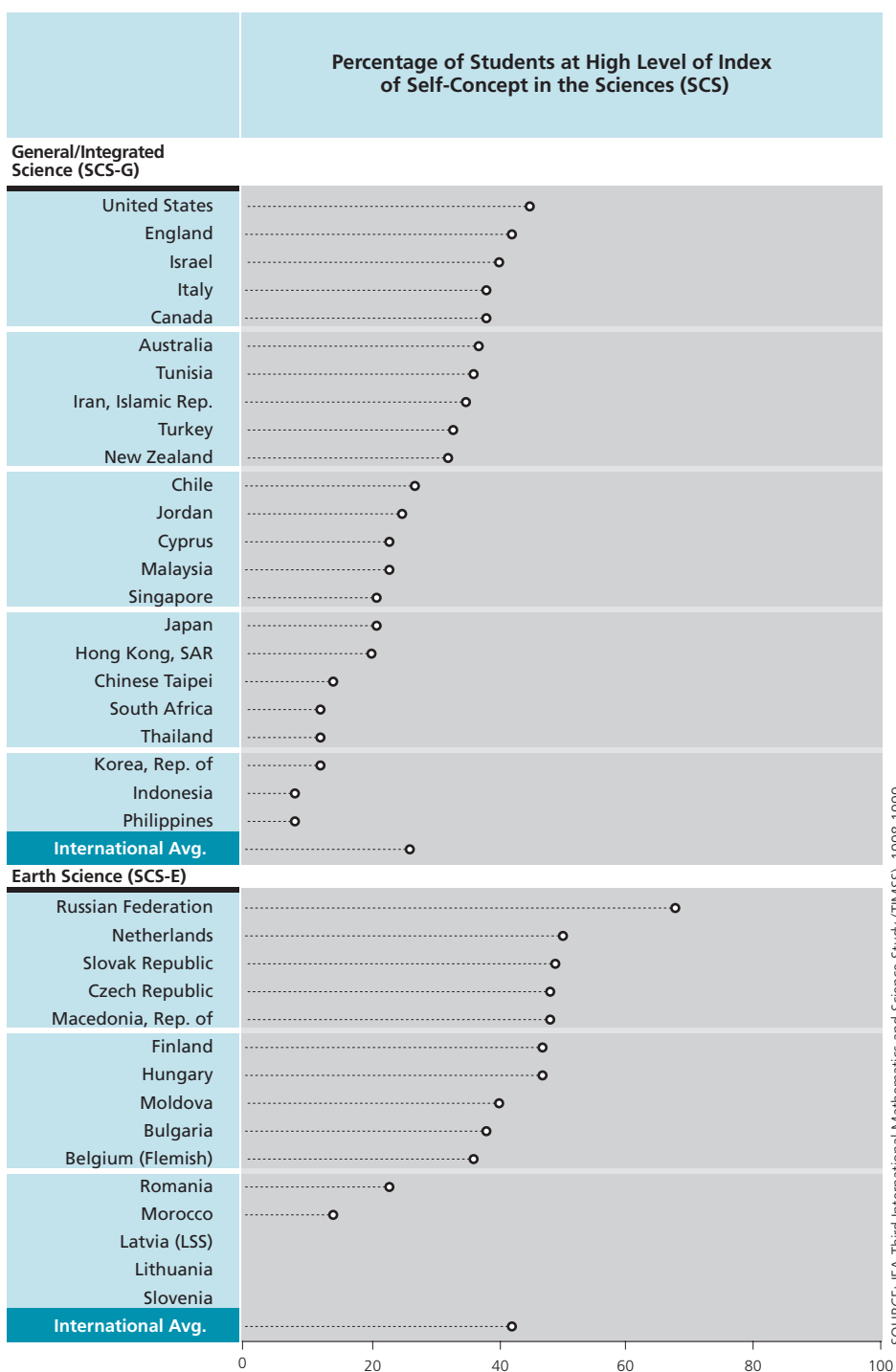
^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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



	High SCS		Medium SCS		Low SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
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)
Hungary	53 (1.5)	568 (4.1)	39 (1.2)	544 (5.1)	9 (0.7)	501 (8.5)
Slovenia	52 (1.3)	547 (3.8)	42 (1.2)	524 (3.7)	6 (0.5)	496 (8.4)
Czech Republic	52 (1.5)	551 (4.8)	40 (1.2)	532 (4.8)	8 (0.8)	506 (7.3)
Latvia (LSS)	49 (1.5)	515 (5.9)	44 (1.4)	495 (5.1)	6 (0.7)	465 (8.2)
Finland	49 (1.3)	554 (4.0)	39 (1.0)	528 (3.6)	12 (0.9)	489 (7.9)
Macedonia, Rep. of	45 (1.1)	503 (4.0)	42 (1.0)	445 (6.1)	12 (0.9)	386 (8.6)
Bulgaria	42 (1.9)	543 (6.9)	43 (1.5)	515 (5.4)	15 (1.4)	484 (5.9)
Belgium (Flemish)	40 (1.2)	557 (3.9)	48 (1.2)	529 (2.9)	12 (0.8)	496 (6.3)
Lithuania *	39 (1.6)	513 (4.6)	52 (1.4)	480 (4.5)	8 (0.7)	438 (10.3)
Slovak Republic	39 (1.7)	557 (4.6)	46 (1.3)	535 (3.1)	15 (1.0)	488 (5.6)
Moldova	35 (1.5)	486 (5.1)	52 (1.3)	455 (4.3)	13 (1.0)	429 (8.5)
Romania	24 (1.3)	509 (7.4)	55 (1.0)	477 (5.7)	20 (1.2)	432 (5.9)
Morocco r	16 (0.7)	358 (7.2)	58 (0.8)	325 (3.7)	27 (0.8)	318 (7.1)
International Avg.	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 c	44 (2.4)	563 (8.2)	45 (1.8)	533 (6.9)	11 (1.2)	526 (8.4)
Bulgaria	35 (1.8)	546 (6.3)	41 (0.9)	520 (7.1)	24 (1.6)	491 (5.1)
Slovenia	35 (1.2)	557 (4.1)	49 (1.1)	532 (4.1)	16 (0.8)	494 (4.8)
Hungary	34 (1.4)	579 (5.8)	46 (1.1)	549 (4.0)	20 (0.9)	519 (5.5)
Macedonia, Rep. of	33 (1.3)	498 (4.6)	44 (1.0)	461 (5.4)	22 (1.0)	419 (7.6)
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)
Finland	31 (1.2)	559 (5.2)	40 (1.2)	534 (5.2)	29 (1.1)	504 (3.4)
Moldova	28 (1.3)	488 (5.2)	54 (1.4)	457 (4.9)	18 (1.1)	440 (7.6)
Slovak Republic	27 (1.3)	568 (6.0)	48 (1.1)	536 (3.2)	25 (1.0)	502 (4.4)
Latvia (LSS)	24 (1.4)	526 (5.3)	49 (1.1)	505 (5.4)	26 (1.3)	480 (6.2)
Morocco r	22 (1.0)	372 (7.3)	56 (0.8)	324 (3.8)	22 (0.9)	299 (8.3)
Lithuania *	22 (1.2)	526 (6.5)	55 (1.1)	488 (4.3)	23 (1.2)	458 (4.9)
Romania	13 (0.9)	496 (10.2)	47 (1.2)	483 (6.8)	40 (1.2)	462 (5.5)
International Avg.	32 (0.4)	530 (1.6)	46 (0.3)	501 (1.5)	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)
Finland	40 (1.3)	562 (4.9)	40 (1.2)	529 (4.6)	20 (1.0)	498 (3.8)
Slovak Republic	35 (1.5)	558 (5.1)	46 (1.1)	535 (2.9)	19 (1.2)	500 (4.6)
Czech Republic	32 (1.7)	561 (5.6)	48 (1.3)	537 (3.8)	20 (1.4)	511 (5.9)
Macedonia, Rep. of	30 (1.2)	498 (5.3)	45 (0.9)	464 (5.4)	25 (1.2)	424 (7.9)
Slovenia	29 (1.1)	562 (4.3)	51 (0.9)	531 (3.9)	20 (0.9)	502 (5.3)
Bulgaria	28 (1.4)	541 (6.2)	43 (1.2)	524 (6.3)	29 (1.4)	503 (6.6)
Hungary	27 (1.3)	577 (4.9)	48 (1.0)	552 (3.8)	26 (1.1)	528 (5.0)
Moldova	25 (1.2)	481 (4.9)	56 (1.1)	461 (4.9)	20 (0.9)	444 (6.8)
Latvia (LSS)	24 (1.4)	525 (6.4)	51 (1.0)	506 (6.0)	25 (1.3)	479 (4.3)
Morocco r	17 (0.8)	363 (8.7)	57 (0.8)	324 (5.2)	27 (0.7)	309 (6.7)
Romania	15 (0.9)	498 (9.5)	47 (1.1)	481 (6.2)	39 (1.2)	462 (6.1)
Lithuania *	15 (0.9)	517 (6.3)	57 (1.1)	494 (4.4)	28 (1.2)	465 (5.0)
Belgium (Flemish)	--	--	--	--	--	--
Netherlands	--	--	--	--	--	--
International Avg.	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.

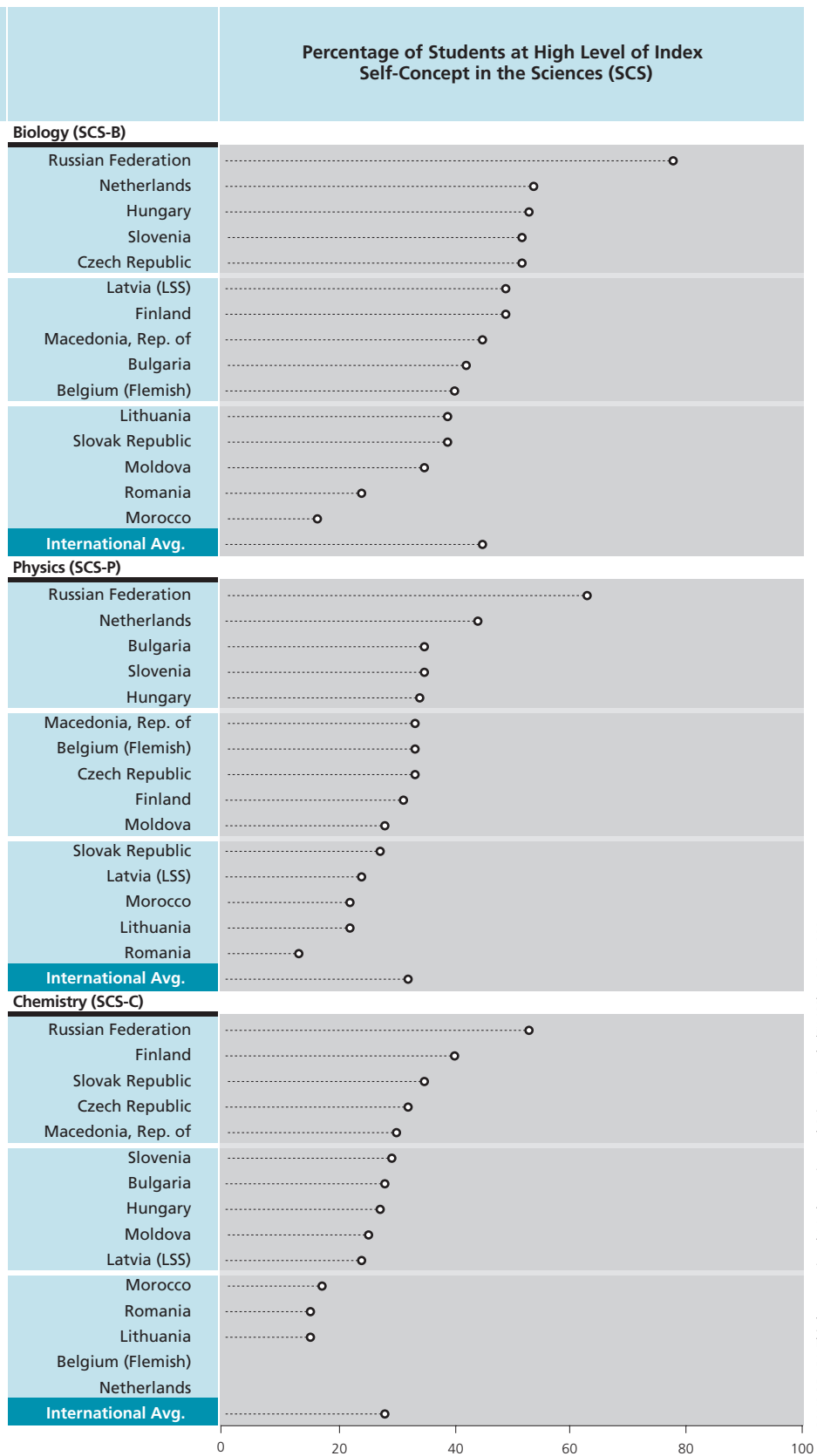


Exhibit 4.9 Index of Students' Self-Concept in the Sciences (SCS) by Gender*

		High SCS		Medium SCS		Low SCS		
		Percent of Students		Percent of Students		Percent of Students		
	General/Integrated Science (SCS-G)	Girls	Boys	Girls	Boys	Girls	Boys	
	Australia	33 (1.5)	41 (1.7) ▲	48 (1.2) ▲	41 (1.5)	20 (1.2)	17 (1.4)	
	Canada	35 (1.3)	41 (1.3)	49 (1.4) ▲	42 (1.1)	16 (0.7)	17 (0.8)	
	Chile	29 (1.5)	25 (1.4)	52 (1.3)	51 (1.2)	20 (1.1)	24 (1.1)	
	Chinese Taipei ^a	10 (0.6)	18 (0.9) ▲	60 (0.9)	62 (1.1)	30 (1.0) ▲	20 (1.1)	
	Cyprus	23 (1.3)	24 (1.4)	54 (1.4)	56 (1.5)	23 (1.2)	20 (1.3)	
	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)	
	Indonesia ^b	8 (0.7)	8 (0.8)	73 (1.0)	73 (1.1)	18 (1.0)	19 (1.0)	
	Iran, Islamic Rep.	36 (2.0)	34 (1.3)	52 (1.5)	54 (1.2)	12 (1.1)	12 (0.9)	
	Israel	39 (1.6)	42 (1.3)	48 (1.3)	46 (1.2)	14 (1.2)	12 (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)	
	Jordan	26 (1.5)	25 (1.6)	55 (1.4)	52 (1.2)	19 (1.1)	24 (1.3)	
	Korea, Rep. of	8 (0.5)	15 (0.8) ▲	83 (0.7) ▲	78 (0.9)	9 (0.6)	7 (0.5)	
	Malaysia	24 (1.2)	23 (1.4)	69 (1.2)	68 (1.2)	7 (0.7)	9 (0.7)	
	New Zealand	29 (1.6)	35 (1.4) ▲	49 (1.3)	48 (1.4)	21 (1.0) ▲	17 (1.0)	
	Philippines	8 (0.7)	8 (0.8)	69 (1.1)	65 (1.2)	23 (1.1)	26 (1.2)	
	Singapore	17 (1.0)	26 (1.5) ▲	61 (1.0)	58 (1.2)	23 (1.1) ▲	16 (1.0)	
	South Africa	12 (1.1)	12 (1.1)	57 (1.3)	58 (1.0)	31 (1.5)	30 (1.3)	
	Thailand	12 (0.7)	12 (0.7)	54 (1.1)	51 (1.2)	34 (1.2)	37 (1.3)	
	Tunisia	36 (1.1)	36 (1.3)	54 (1.1)	55 (1.1)	9 (0.7)	9 (0.7)	
	Turkey	34 (1.5)	33 (1.3)	47 (1.3)	48 (0.9)	18 (1.1)	19 (0.9)	
	United States	42 (1.2)	48 (1.6) ▲	42 (1.0) ▲	38 (1.1)	16 (0.7)	14 (0.9)	
	International Avg.	25 (0.3)	28 (0.3) ▲	57 (0.3) ▲	55 (0.2)	19 (0.2) ▲	18 (0.2)	
		Earth Science (SCS-E)						
		Belgium (Flemish)	33 (1.6)	38 (1.8)	50 (1.2)	48 (1.8)	17 (1.5)	14 (0.7)
		Bulgaria	40 (2.4)	36 (2.0)	41 (2.4)	45 (2.1)	20 (1.4)	20 (1.5)
		Czech Republic	48 (2.1)	48 (1.9)	43 (1.8)	43 (1.4)	9 (0.8)	9 (1.1)
Finland		40 (1.9)	54 (1.6) ▲	40 (1.8) ▲	32 (1.1)	19 (1.6) ▲	13 (1.1)	
Hungary		46 (1.7)	47 (1.7)	42 (1.6)	39 (1.5)	12 (0.9)	14 (1.1)	
Latvia (LSS)		--	--	--	--	--	--	
Lithuania [†]		--	--	--	--	--	--	
Macedonia, Rep. of		51 (1.9) ▲	44 (1.6)	39 (1.7)	39 (1.3)	10 (1.0)	17 (1.2)	
Moldova		40 (1.9)	41 (1.9)	49 (1.7)	45 (1.5)	11 (1.0)	15 (1.2)	
Morocco ^s		16 (1.3)	13 (0.9)	55 (1.6)	58 (1.5)	30 (1.6)	28 (1.7)	
Netherlands		43 (2.3)	57 (2.3) ▲	48 (2.0) ▲	37 (1.8)	9 (0.9)	6 (1.0)	
Romania		25 (1.5) ▲	21 (1.5)	52 (1.6)	52 (1.4)	23 (1.4)	27 (1.5)	
Russian Federation		70 (1.7)	66 (1.1)	21 (1.3)	23 (0.9)	9 (0.8)	11 (0.8)	
Slovak Republic		48 (2.1)	50 (2.0)	41 (1.6)	37 (1.5)	11 (1.1)	12 (1.3)	
Slovenia		--	--	--	--	--	--	
International Avg.		42 (0.5)	43 (0.5) ▲	43 (0.5) ▲	42 (0.4)	15 (0.3)	16 (0.3)	

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

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.

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

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

b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

c 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.

An "r" indicates a 70–84% student response rate. An "s" indicates a 50–69% student response rate.

		High SCS		Medium SCS		Low SCS		
		Percent of Students		Percent of Students		Percent of Students		
		Girls	Boys	Girls	Boys	Girls	Boys	
	Biology (SCS-B)							
	Belgium (Flemish)	42 (2.1)	39 (1.6)	47 (2.3)	49 (1.6)	10 (1.4)	13 (1.3)	
	Bulgaria	48 (2.9)	36 (2.9)	40 (2.2)	47 (3.2)	13 (1.5)	17 (1.8)	
	Czech Republic	57 (1.9) ▲	47 (1.5)	38 (1.7)	43 (1.3)	6 (0.9)	10 (1.1) ▲	
	Finland	47 (1.9)	50 (1.8)	41 (1.5)	37 (1.3)	11 (1.2)	13 (1.3)	
	Hungary	59 (1.9) ▲	46 (1.7)	35 (1.6)	42 (1.4) ▲	6 (0.8)	12 (1.0) ▲	
	Latvia (LSS)	53 (2.0) ▲	45 (1.8)	42 (1.9)	47 (1.6)	5 (0.7)	8 (1.1)	
	Lithuania [†]	42 (1.9)	37 (1.8)	52 (1.7)	53 (1.7)	6 (0.8)	11 (1.0) ▲	
	Macedonia, Rep. of	53 (1.7) ▲	37 (1.4)	39 (1.6)	46 (1.3) ▲	8 (0.8)	17 (1.2) ▲	
	Moldova	36 (1.9)	34 (1.8)	54 (1.7)	50 (1.5)	11 (1.0)	16 (1.4) ▲	
	Morocco ^s	18 (1.2)	14 (0.9)	54 (1.3)	60 (1.1) ▲	28 (1.6)	25 (1.1)	
	Netherlands	56 (1.7)	52 (1.9)	39 (1.5)	40 (1.9)	5 (0.8)	8 (1.1)	
	Romania	29 (1.8) ▲	20 (1.4)	55 (1.5)	55 (1.5)	16 (1.4)	25 (1.5) ▲	
	Russian Federation	82 (1.3) ▲	73 (1.5)	16 (1.0)	19 (1.1)	2 (0.4)	8 (0.8) ▲	
	Slovak Republic	42 (2.2)	36 (2.1)	45 (1.8)	47 (1.7)	13 (1.1)	17 (1.2) ▲	
	Slovenia	61 (1.7) ▲	43 (1.5)	36 (1.7)	50 (1.5) ▲	4 (0.6)	7 (0.7) ▲	
	International Avg.	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)
		Bulgaria	34 (2.5)	36 (1.9)	41 (1.6)	42 (1.5)	25 (1.9)	22 (1.8)
		Czech Republic	26 (1.8)	40 (1.8) ▲	51 (1.7) ▲	43 (1.4)	23 (1.4)	17 (1.8)
Finland		17 (1.3)	46 (1.6) ▲	45 (1.5) ▲	36 (1.5)	39 (1.7) ▲	18 (1.2)	
Hungary		28 (1.7)	40 (1.7) ▲	50 (1.6) ▲	41 (1.3)	22 (1.2)	19 (1.1)	
Latvia (LSS)		15 (1.3)	34 (2.0) ▲	52 (1.3)	47 (1.7)	33 (1.8) ▲	19 (1.3)	
Lithuania [†]		17 (1.5)	27 (1.7) ▲	56 (1.6)	55 (1.6)	27 (1.8) ▲	18 (1.2)	
Macedonia, Rep. of		35 (1.5)	32 (1.5)	44 (1.2)	45 (1.4)	21 (1.2)	24 (1.2)	
Moldova		25 (1.5)	31 (1.6)	55 (1.6)	53 (1.7)	19 (1.3)	16 (1.4)	
Morocco ^r		24 (1.7)	21 (1.0)	54 (1.4)	57 (1.1)	22 (1.3)	22 (1.0)	
Netherlands ^c		35 (3.4)	53 (3.1) ▲	52 (2.4) ▲	38 (2.6)	13 (1.6)	9 (1.6)	
Romania		11 (1.0)	15 (1.1) ▲	48 (1.4)	46 (1.6)	41 (1.7)	39 (1.5)	
Russian Federation		62 (1.2)	64 (1.3)	25 (1.0)	24 (1.0)	14 (0.9)	13 (0.9)	
Slovak Republic		21 (1.4)	34 (2.1) ▲	51 (1.5)	45 (1.8)	29 (1.5) ▲	21 (1.3)	
Slovenia		30 (1.5)	40 (1.5) ▲	50 (1.3)	48 (1.4)	19 (1.3) ▲	12 (0.9)	
International Avg.		27 (0.5)	36 (0.5) ▲	48 (0.4) ▲	44 (0.4)	25 (0.4) ▲	19 (0.3)	
		Chemistry (SCS-C)						
		Belgium (Flemish)	--	--	--	--	--	--
		Bulgaria	30 (1.8)	26 (1.5)	44 (1.4)	43 (1.6)	27 (1.8)	32 (1.4)
		Czech Republic	31 (2.1)	32 (1.8)	49 (1.6)	47 (1.7)	20 (1.5)	21 (1.7)
	Finland	27 (1.6)	53 (1.7) ▲	46 (1.6) ▲	34 (1.5)	27 (1.5) ▲	13 (1.1)	
	Hungary	24 (1.3)	30 (1.6) ▲	49 (1.4)	46 (1.4)	27 (1.4)	24 (1.3)	
	Latvia (LSS)	21 (1.6)	26 (1.6) ▲	52 (1.5)	50 (1.3)	28 (1.7)	23 (1.7)	
	Lithuania [†]	13 (1.0)	17 (1.3)	57 (1.6)	58 (1.6)	30 (1.7)	25 (1.4)	
	Macedonia, Rep. of	32 (1.6)	27 (1.4)	46 (1.2)	45 (1.3)	22 (1.4)	28 (1.4) ▲	
	Moldova	24 (1.6)	25 (1.5)	57 (1.4)	54 (1.5)	18 (1.1)	21 (1.2)	
	Morocco ^r	18 (1.4)	15 (1.1)	53 (1.8)	59 (1.6)	29 (1.4)	25 (1.1)	
	Netherlands	--	--	--	--	--	--	
	Romania	16 (1.3)	14 (1.1)	47 (1.5)	47 (1.5)	38 (1.9)	39 (1.3)	
	Russian Federation	53 (1.7)	52 (2.0)	29 (1.1)	28 (1.1)	18 (1.3)	20 (1.4)	
	Slovak Republic	35 (1.8)	36 (2.0)	46 (1.2)	45 (1.8)	19 (1.5)	19 (1.5)	
	Slovenia	29 (1.4)	29 (1.4)	52 (1.3)	49 (1.4)	19 (1.3)	22 (1.1)	
	International Avg.	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.

What Are Students' Attitudes Towards the Sciences?

Generating positive attitudes towards science among students is an important goal of science education in many countries. To gain some understanding about eighth-graders' view 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 boring⁵
- 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 on average. 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 and in separate panels for earth science, biology, physics, and chemistry for countries that teach the sciences separately.⁶

4.10



In countries where science is taught as a single subject, students generally had positive attitudes towards the sciences, with 40 percent on average across countries in the high category, and a further 49 percent in the medium category. Only 10 percent of students were in the low category. Countries with large percentages of students at the high level included Malaysia, the Philippines, Tunisia, Jordan, South Africa, Iran, and Indonesia, with more than half the students in this category. The countries with the least positive attitudes were Japan and Korea. Also low were Australia, Chinese Taipei, and Hong Kong. Since these are all countries with high average science achievement, it may be that the students follow

⁵ The response categories for this statement were reversed in constructing the index.

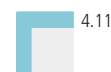
⁶ Additional information on students' liking science, one of the components of the index, is provided in Exhibit R1.15 in the reference section.



a demanding science curriculum, one 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 overall and in many of the countries.

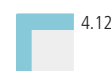
Attitudes towards the science subject areas were somewhat less positive among the separate science countries. Attitudes were most positive towards biology (32 percent in the high category, on average) and earth science (27 percent positive), and least positive towards physics and chemistry (19 and 23 percent, respectively). Macedonia had the largest percentage of students at the high level in all subject areas except chemistry. Bulgaria, Moldova, and the Russian Federation also had relatively large percentages of students at the high level in all subject areas. Romania was amongst the most positive in earth science and biology, but was less positive in physics and chemistry. 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, but this was not the case for earth science and biology.

Exhibit 4.11 presents the percentages of girls and boys in each country at each level of the positive attitudes towards the sciences index. For the single-science countries, internationally on average there was a significantly greater percentage of boys than girls at the high level of the index. For the separate-science countries, 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.



4.11

Exhibit 4.12 provides information on trends in the index of positive attitudes towards the sciences from 1995 to 1999. Again, data are presented separately for science as a single subject and for the separate science subject areas. There was little change overall among the general-science countries. Australia had an increase in the percentage of students at the high level in 1999, and Iran had a decrease. Among the separate-science countries, the Russian Federation had increases in the percentages at the high level in earth science, physics and chemistry, the Czech Republic had increases in biology and chemistry, and the Slovak Republic had an increase in chemistry. Decreased percentages of students at the high level of the index were found in Belgium (Flemish) and Latvia (LSS) in biology, in Latvia (LSS) and Romania in physics, and in Romania in chemistry.



4.12



4.13



Exhibit 4.13 displays trends from 1995 to 1999 in the percentages of girls and boys at the high level of the index. There was very little change over time in the relative attitudes of girls and boys towards science; no country experienced a significant change, positive or negative, in the gender difference in attitudes. For most countries that had a gender difference in 1995, the difference persisted in 1999.



Exhibits 4.10–4.13 Overleaf

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

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
Malaysia	72 (1.0)	498 (4.7)	28 (1.0)	480 (5.8)	1 (0.1)	~ ~
Philippines	63 (1.4)	372 (7.3)	35 (1.3)	314 (8.9)	2 (0.2)	~ ~
Tunisia	63 (1.1)	430 (3.8)	33 (0.9)	430 (4.2)	4 (0.4)	429 (6.3)
Jordan	59 (1.4)	472 (3.7)	35 (1.1)	438 (5.1)	5 (0.6)	447 (11.1)
South Africa	58 (1.7)	251 (8.7)	35 (1.1)	234 (9.4)	6 (1.0)	232 (17.9)
Iran, Islamic Rep.	56 (1.4)	454 (4.5)	40 (1.3)	444 (5.1)	4 (0.3)	445 (10.8)
Indonesia ^a	52 (1.3)	435 (4.9)	47 (1.2)	438 (4.5)	0 (0.1)	~ ~
Chile	49 (1.3)	425 (4.5)	45 (1.0)	419 (4.3)	5 (0.5)	428 (8.6)
Singapore	46 (1.4)	594 (8.1)	49 (1.2)	549 (7.8)	5 (0.6)	509 (12.3)
Turkey	45 (1.2)	443 (5.3)	49 (0.9)	431 (4.0)	5 (0.5)	428 (7.3)
Thailand	43 (1.3)	492 (4.9)	55 (1.3)	476 (4.6)	1 (0.2)	~ ~
England	39 (1.1)	559 (5.5)	53 (1.1)	532 (5.6)	8 (0.6)	514 (10.2)
Cyprus	33 (0.9)	494 (2.9)	53 (0.8)	448 (2.7)	13 (0.8)	434 (6.4)
United States	32 (0.9)	543 (5.9)	51 (0.8)	515 (4.5)	16 (0.6)	489 (4.3)
Israel	30 (1.2)	484 (7.2)	50 (0.9)	474 (4.7)	20 (1.1)	461 (6.8)
Canada	30 (0.8)	556 (2.8)	52 (0.8)	530 (2.6)	18 (0.8)	511 (4.0)
Italy	29 (1.2)	514 (4.9)	58 (1.1)	489 (4.2)	13 (0.9)	475 (6.1)
New Zealand	28 (1.0)	525 (7.3)	56 (0.8)	511 (5.3)	16 (0.9)	493 (5.7)
Australia	27 (1.1)	569 (5.5)	53 (1.0)	541 (4.6)	20 (1.2)	507 (6.6)
Chinese Taipei ^a	27 (0.8)	607 (4.7)	64 (0.7)	561 (4.4)	10 (0.6)	528 (6.7)
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.	40 (0.2)	499 (1.1)	49 (0.2)	473 (1.0)	10 (0.1)	467 (2.4)

Earth Science (PATS-E)

Macedonia, Rep. of	58 (1.6)	464 (5.9)	40 (1.4)	466 (5.5)	3 (0.4)	484 (14.9)
Romania	40 (1.5)	488 (6.1)	56 (1.3)	468 (5.8)	4 (0.6)	454 (16.4)
Bulgaria	35 (1.8)	522 (5.9)	54 (1.5)	514 (5.3)	11 (2.1)	533 (17.1)
Moldova	33 (1.1)	468 (5.5)	65 (1.1)	459 (4.2)	2 (0.3)	~ ~
Russian Federation	28 (1.8)	542 (10.2)	65 (1.6)	529 (6.2)	7 (0.6)	526 (8.7)
Slovak Republic	24 (1.2)	539 (6.2)	66 (1.0)	535 (3.3)	11 (1.1)	541 (6.0)
Czech Republic	23 (1.4)	544 (6.1)	64 (1.2)	538 (4.4)	13 (1.0)	547 (7.6)
Finland	19 (0.9)	547 (6.7)	65 (1.1)	536 (3.8)	15 (1.1)	518 (5.3)
Hungary	14 (0.8)	565 (6.1)	67 (1.0)	549 (3.7)	18 (1.0)	563 (5.0)
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)
Morocco	x x	x x	x x	x x	x x	x x
Latvia (LSS)	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--
Slovenia	--	--	--	--	--	--
International Avg.	27 (0.4)	524 (2.1)	60 (0.4)	517 (1.4)	13 (0.4)	525 (3.3)

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

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

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

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

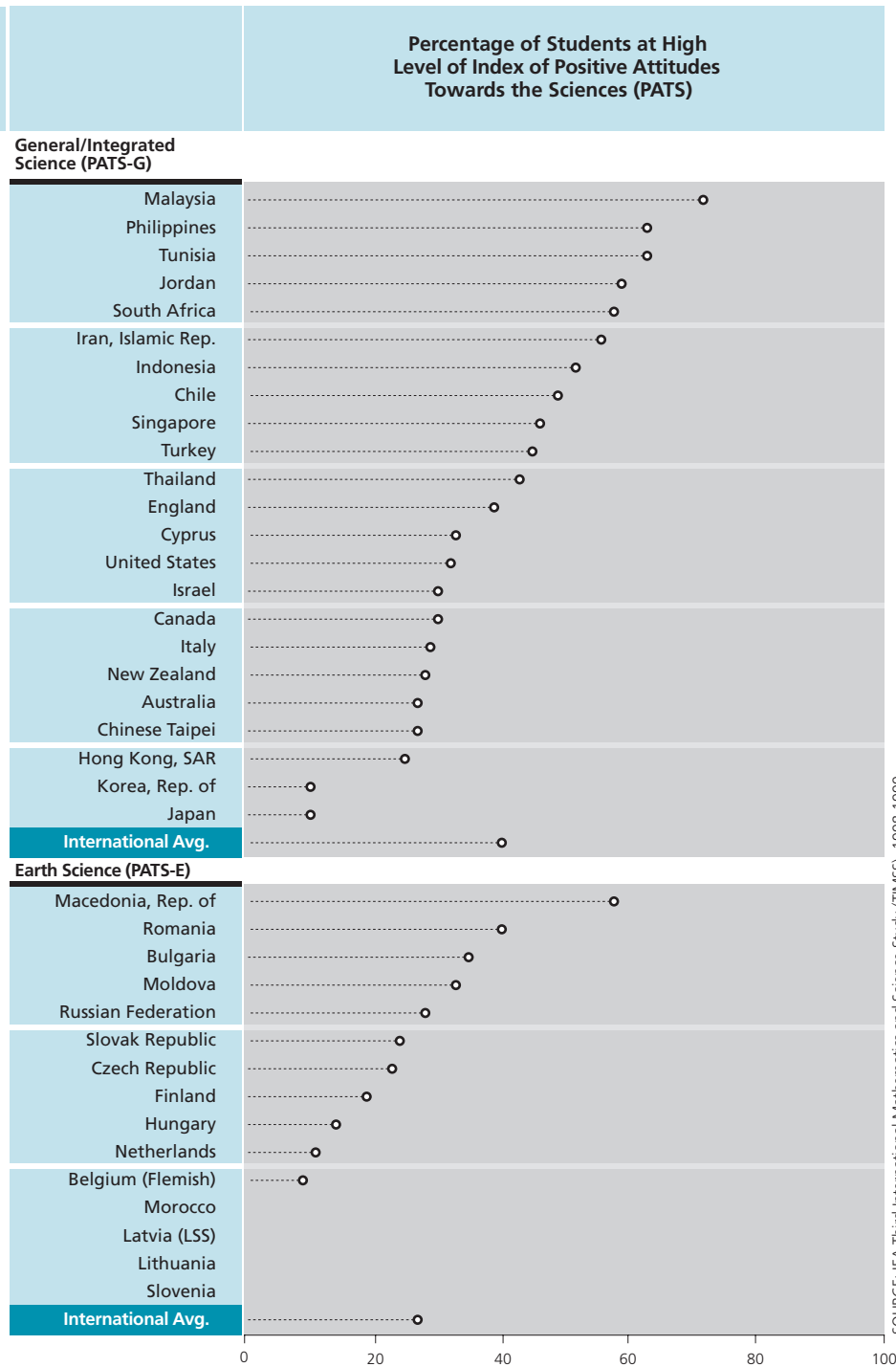


Exhibit 4.10: Index of Students' Positive Attitudes Towards the Sciences (PATS) (Continued 2)

	High PATS		Medium PATS		Low PATS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Biology (PATS-B)						
 Macedonia, Rep. of	65 (1.2)	466 (5.3)	34 (1.2)	458 (6.5)	1 (0.2)	~ ~
Bulgaria	52 (1.4)	520 (7.2)	43 (1.3)	519 (6.1)	5 (0.5)	500 (9.4)
Morocco ^s	48 (1.3)	335 (7.0)	46 (1.1)	327 (3.9)	7 (0.6)	312 (14.5)
Russian Federation	41 (1.6)	536 (7.6)	55 (1.5)	529 (6.6)	4 (0.3)	530 (11.9)
Romania	37 (1.4)	479 (7.4)	55 (1.2)	473 (5.5)	7 (0.7)	473 (10.5)
Moldova	35 (1.5)	459 (6.1)	64 (1.4)	462 (4.2)	1 (0.3)	~ ~
Czech Republic	27 (1.5)	546 (5.1)	60 (1.1)	537 (4.5)	12 (1.2)	541 (7.3)
Lithuania [†]	27 (1.3)	493 (6.2)	65 (1.2)	488 (4.8)	8 (0.7)	486 (8.4)
Latvia (LSS)	26 (1.5)	502 (8.0)	66 (1.3)	503 (4.9)	8 (0.8)	508 (6.2)
Hungary	23 (1.1)	566 (6.2)	65 (1.1)	548 (3.6)	12 (0.8)	553 (7.9)
Slovenia	22 (1.1)	538 (5.4)	64 (1.0)	532 (3.9)	14 (1.0)	540 (5.3)
Netherlands	21 (1.8)	543 (11.7)	63 (1.4)	541 (9.1)	16 (1.3)	550 (8.3)
Slovak Republic	19 (1.2)	549 (5.0)	70 (1.2)	532 (3.5)	11 (0.9)	539 (6.0)
Finland	18 (0.7)	549 (6.2)	65 (1.1)	536 (3.8)	18 (1.1)	519 (5.5)
Belgium (Flemish)	17 (0.9)	555 (3.4)	61 (1.2)	541 (3.6)	23 (1.1)	518 (4.5)
International Avg.	32 (0.3)	509 (1.7)	58 (0.3)	502 (1.2)	10 (0.2)	505 (3.0)
Physics (PATS-P)						
 Macedonia, Rep. of	45 (1.5)	461 (6.1)	47 (1.2)	468 (5.4)	9 (0.8)	481 (8.4)
Bulgaria	35 (2.0)	527 (6.8)	53 (1.9)	515 (5.6)	12 (1.3)	509 (13.1)
Russian Federation	31 (1.4)	551 (8.0)	63 (1.3)	526 (6.7)	6 (0.6)	516 (9.3)
Moldova	24 (1.1)	461 (5.0)	72 (1.0)	463 (4.4)	4 (0.4)	462 (13.4)
Latvia (LSS)	18 (1.1)	511 (6.8)	68 (1.1)	502 (4.8)	14 (1.1)	500 (7.9)
Lithuania [†]	17 (1.0)	509 (6.6)	65 (1.2)	486 (4.7)	18 (1.2)	481 (4.7)
Romania	17 (1.2)	479 (9.0)	64 (1.0)	474 (5.6)	18 (1.3)	480 (7.6)
Czech Republic	15 (1.3)	565 (9.2)	59 (1.5)	539 (4.6)	26 (1.8)	533 (4.5)
Slovak Republic	14 (0.8)	559 (7.5)	64 (1.1)	531 (3.4)	22 (1.2)	539 (3.8)
Slovenia	12 (0.7)	558 (7.4)	60 (1.2)	532 (4.1)	28 (1.3)	530 (4.0)
Belgium (Flemish)	11 (0.9)	564 (7.9)	58 (1.5)	548 (5.1)	31 (1.9)	533 (6.8)
Hungary	11 (0.7)	580 (8.1)	62 (1.1)	548 (4.2)	27 (1.2)	557 (4.7)
Finland	11 (0.8)	563 (9.5)	55 (1.2)	536 (4.0)	34 (1.4)	518 (4.8)
Netherlands ^c	11 (0.8)	564 (12.8)	59 (1.7)	550 (7.9)	30 (2.0)	532 (7.2)
Morocco	x x	x x	x x	x x	x x	x x
International Avg.	19 (0.3)	532 (2.2)	61 (0.3)	516 (1.3)	20 (0.4)	512 (2.3)
Chemistry (PATS-C)						
 Morocco ^s	53 (1.6)	334 (6.5)	42 (1.3)	318 (8.6)	5 (0.5)	328 (20.3)
Macedonia, Rep. of	42 (1.6)	458 (6.4)	50 (1.3)	467 (4.8)	8 (0.8)	481 (10.0)
Russian Federation	28 (1.2)	546 (8.4)	62 (1.0)	528 (6.5)	10 (0.9)	522 (8.2)
Bulgaria	26 (1.3)	519 (6.5)	56 (1.3)	517 (5.4)	18 (1.7)	521 (10.6)
Moldova	24 (1.2)	459 (6.1)	71 (1.1)	462 (4.2)	6 (0.6)	469 (10.4)
Latvia (LSS)	21 (1.2)	507 (6.1)	67 (1.0)	503 (5.2)	12 (1.0)	505 (8.2)
Romania	20 (1.0)	482 (7.8)	61 (1.1)	472 (5.7)	18 (1.1)	479 (7.8)
Slovak Republic	20 (1.2)	554 (6.7)	65 (1.2)	531 (3.3)	16 (1.3)	537 (4.7)
Finland	15 (1.0)	563 (6.9)	62 (1.1)	536 (3.9)	23 (1.1)	515 (4.4)
Czech Republic	14 (1.0)	560 (8.5)	60 (1.5)	538 (4.2)	25 (1.7)	533 (5.1)
Lithuania [†]	12 (0.9)	509 (8.9)	65 (1.2)	487 (4.5)	23 (1.4)	485 (5.2)
Slovenia	11 (0.7)	564 (6.8)	58 (1.3)	531 (3.7)	31 (1.3)	530 (5.1)
Hungary	9 (0.6)	573 (9.3)	61 (1.3)	549 (4.3)	30 (1.5)	556 (5.7)
Belgium (Flemish)	--	--	--	--	--	--
Netherlands	--	--	--	--	--	--
International Avg.	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.

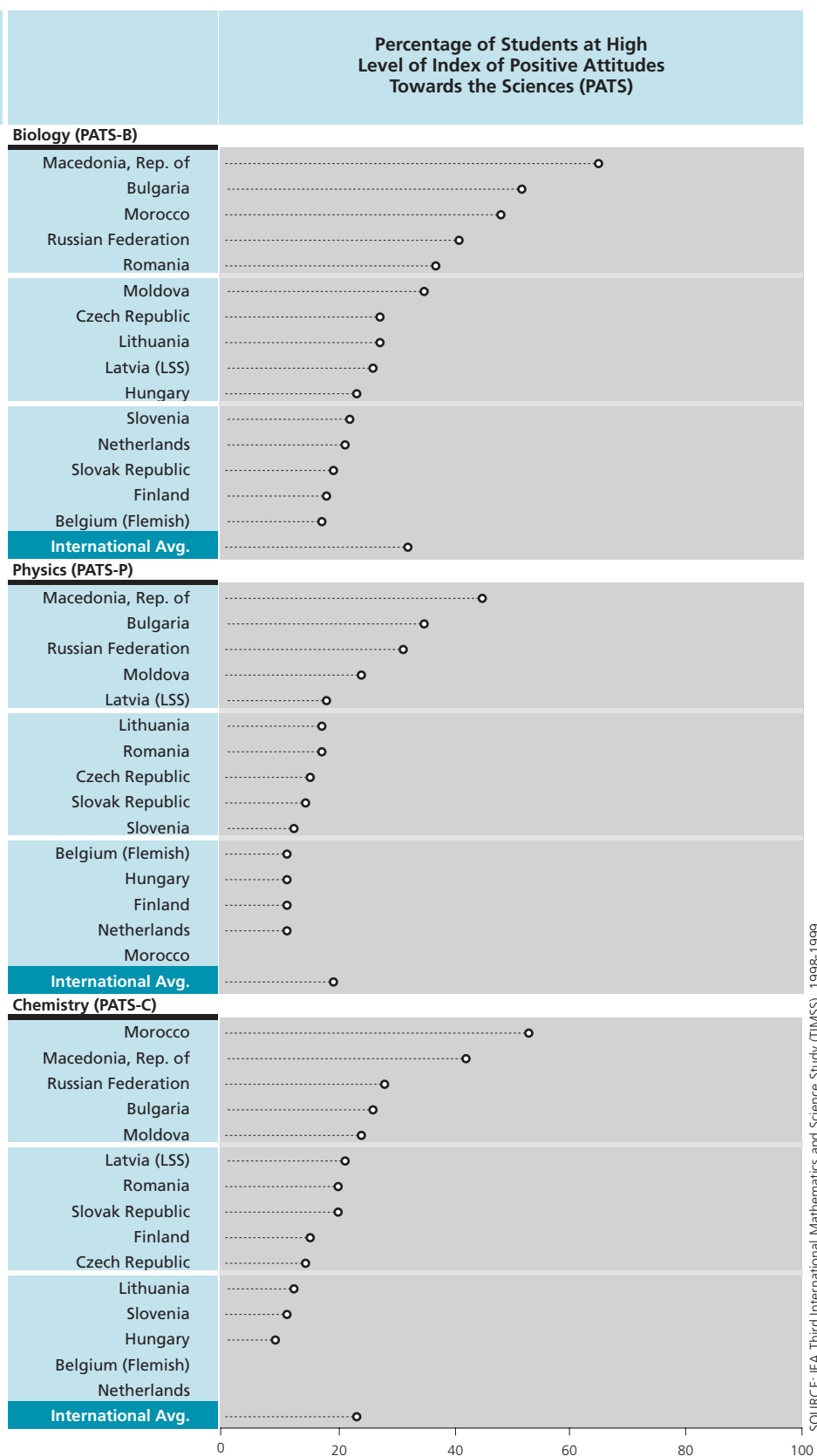


Exhibit 4.11 Index of Positive Attitudes Towards the Sciences (PATS) by Gender*

	High PATS		Medium PATS		Low PATS	
	Percent of Students		Percent of Students		Percent of Students	
	Girls	Boys	Girls	Boys	Girls	Boys
General/Integrated Science (PATS-G)						
 Australia	25 (1.4)	29 (1.5)	53 (1.2)	54 (1.5)	23 (1.5) ▲	17 (1.5)
Canada	28 (1.1)	32 (1.1)	55 (1.3) ▲	49 (0.9)	17 (0.9)	19 (1.2)
Chile	53 (1.7) ▲	46 (1.3)	43 (1.4)	48 (1.1) ▲	4 (0.6)	6 (0.6)
Chinese Taipei ^a	19 (0.9)	34 (1.2) ▲	69 (0.8) ▲	59 (1.1)	12 (0.8) ▲	7 (0.6)
Cyprus	29 (1.6)	37 (1.3) ▲	57 (1.4)	50 (1.3)	14 (1.0)	12 (1.0)
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)
Indonesia ^b	54 (1.4)	51 (1.6)	46 (1.4)	49 (1.6)	0 (0.2)	0 (0.1)
Iran, Islamic Rep.	59 (2.5)	54 (1.7)	38 (2.5)	42 (1.6)	3 (0.4)	4 (0.5)
Israel	26 (1.4)	35 (1.4) ▲	52 (1.5)	48 (1.0)	22 (1.4) ▲	17 (1.2)
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)
Jordan	57 (2.0)	62 (1.7)	38 (1.7)	33 (1.4)	5 (0.9)	5 (0.7)
Korea, Rep. of	7 (0.6)	14 (0.7) ▲	65 (1.0)	67 (0.9)	28 (1.1) ▲	19 (0.9)
Malaysia	71 (1.2)	72 (1.3)	28 (1.2)	28 (1.3)	1 (0.2)	1 (0.2)
New Zealand	24 (1.0)	32 (1.4) ▲	58 (1.0)	54 (1.3)	18 (1.3)	14 (1.2)
Philippines	66 (1.6) ▲	60 (1.5)	32 (1.6)	38 (1.5) ▲	2 (0.2)	3 (0.3)
Singapore	39 (1.7)	52 (1.5) ▲	55 (1.4) ▲	44 (1.3)	6 (0.7)	4 (0.6)
South Africa	57 (2.0)	60 (1.6)	37 (1.3)	34 (1.2)	7 (1.1)	6 (0.9)
Thailand	44 (1.6)	43 (1.6)	55 (1.6)	56 (1.5)	1 (0.2)	2 (0.3)
Tunisia	64 (1.2)	62 (1.6)	32 (1.0)	34 (1.3)	4 (0.5)	4 (0.6)
Turkey	44 (1.6)	47 (1.4)	50 (1.3)	49 (1.2)	6 (1.0)	5 (0.5)
United States	29 (1.1)	35 (1.2) ▲	54 (0.9) ▲	49 (1.0)	17 (0.8)	15 (0.9)
International Avg.	38 (0.3)	42 (0.3) ▲	50 (0.3) ▲	48 (0.3)	11 (0.2) ▲	9 (0.2)
Earth Science (PATS-E)						
 Belgium (Flemish)	7 (0.7)	11 (0.9) ▲	53 (1.7)	59 (1.4)	40 (2.0) ▲	30 (1.6)
Bulgaria	31 (2.7)	39 (2.5)	58 (2.1)	51 (2.4)	12 (2.4)	11 (2.2)
Czech Republic	21 (1.9)	26 (2.0)	64 (1.5)	63 (2.0)	14 (1.3)	12 (1.1)
Finland	17 (1.5)	22 (1.2)	67 (1.5)	64 (1.5)	16 (1.6)	15 (1.2)
Hungary	11 (1.0)	17 (1.1) ▲	70 (1.3) ▲	65 (1.3)	19 (1.2)	18 (1.4)
Latvia (LSS)	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--
Macedonia, Rep. of	54 (2.2)	62 (1.6) ▲	44 (2.0) ▲	36 (1.4)	2 (0.4)	3 (0.5)
Moldova	33 (1.3)	34 (1.4)	66 (1.3)	64 (1.5)	2 (0.3)	2 (0.6)
Morocco	x x	x x	x x	x x	x x	x x
Netherlands	8 (1.0)	15 (1.8) ▲	64 (2.0)	66 (1.9)	28 (2.3) ▲	18 (1.8)
Romania	40 (2.1)	40 (1.8)	56 (1.9)	55 (1.6)	4 (0.7)	4 (0.7)
Russian Federation	24 (1.9)	33 (2.0) ▲	69 (1.8) ▲	61 (1.9)	7 (0.8)	7 (0.8)
Slovak Republic	19 (1.3)	29 (1.6) ▲	69 (1.3) ▲	62 (1.4)	12 (1.3)	9 (1.3)
Slovenia	--	--	--	--	--	--
International Avg.	24 (0.5)	30 (0.5) ▲	62 (0.5) ▲	59 (0.5)	14 (0.4) ▲	12 (0.4)

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

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.

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

^a Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.^c 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.

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

Exhibit 4.11: Index of Positive Attitudes Towards the Sciences (PATS) by Gender* (Continued)

		High PATS		Medium PATS		Low PATS	
		Percent of Students		Percent of Students		Percent of Students	
		Girls	Boys	Girls	Boys	Girls	Boys
Biology (PATS-B)							
	Belgium (Flemish)	19 (1.4) ▲	14 (0.9)	61 (1.3)	60 (1.6)	20 (1.3)	25 (1.6)
	Bulgaria	56 (1.8) ▲	49 (1.8)	41 (1.7)	44 (1.7)	3 (0.7)	7 (0.7) ▲
	Czech Republic	34 (2.0) ▲	20 (1.8)	57 (1.6)	64 (1.5)	9 (1.3)	16 (1.4) ▲
	Finland	21 (1.2) ▲	14 (1.1)	64 (1.3)	65 (1.6)	15 (1.4)	20 (1.6)
	Hungary	28 (1.6) ▲	18 (1.2)	65 (1.5)	66 (1.4)	7 (0.8)	16 (1.4) ▲
	Latvia (LSS)	27 (1.7)	25 (1.8)	65 (1.6)	67 (1.7)	8 (0.9)	8 (0.9)
	Lithuania †	31 (1.6) ▲	23 (1.6)	63 (1.6)	67 (1.7)	6 (0.8)	10 (1.0) ▲
	Macedonia, Rep. of	70 (1.3) ▲	60 (1.5)	29 (1.3)	38 (1.4) ▲	1 (0.2)	2 (0.4) ▲
	Moldova	37 (1.8)	32 (1.5)	63 (1.8)	66 (1.5)	1 (0.2)	2 (0.5)
	Morocco s	50 (1.5)	46 (1.9)	44 (1.4)	47 (1.5)	6 (0.8)	7 (0.8)
	Netherlands	27 (2.6) ▲	14 (1.6)	61 (2.0)	66 (1.7)	12 (1.5)	20 (1.8) ▲
	Romania	41 (1.9)	34 (1.8)	53 (1.7)	58 (1.7)	6 (0.9)	8 (1.0)
	Russian Federation	44 (1.9)	39 (1.7)	53 (1.9)	57 (1.5)	3 (0.4)	4 (0.5)
	Slovak Republic	21 (1.5)	16 (1.4)	69 (1.7)	71 (1.4)	10 (1.0)	12 (1.4)
	Slovenia	27 (1.5) ▲	17 (1.2)	62 (1.4)	65 (1.5)	11 (1.0)	18 (1.3) ▲
	International Avg.	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)
	Bulgaria	26 (2.3)	44 (1.9) ▲	59 (2.8) ▲	46 (1.9)	15 (1.6)	9 (1.6)
	Czech Republic	8 (1.4)	22 (1.6) ▲	58 (1.8)	60 (1.9)	34 (2.2) ▲	18 (1.8)
	Finland	4 (0.6)	18 (1.4) ▲	52 (1.7)	58 (1.6)	44 (1.7) ▲	24 (1.4)
	Hungary	5 (0.7)	17 (1.2) ▲	62 (1.4)	62 (1.5)	33 (1.5) ▲	20 (1.4)
	Latvia (LSS)	10 (0.9)	26 (1.8) ▲	71 (1.4)	66 (1.8)	20 (1.5) ▲	8 (1.0)
	Lithuania †	11 (1.1)	24 (1.4) ▲	66 (1.5)	64 (1.6)	23 (1.6) ▲	12 (1.5)
	Macedonia, Rep. of	39 (1.6)	50 (1.8) ▲	51 (1.5) ▲	43 (1.5)	10 (1.0) ▲	7 (0.8)
	Moldova	23 (1.2)	26 (1.5)	73 (1.2)	71 (1.5)	4 (0.5)	3 (0.5)
	Morocco	x x	x x	x x	x x	x x	x x
	Netherlands c	5 (1.1)	17 (1.4) ▲	56 (2.4)	62 (1.7)	38 (2.6) ▲	21 (2.0)
	Romania	13 (1.3)	21 (1.6) ▲	65 (1.3)	64 (1.5)	22 (1.6) ▲	15 (1.5)
	Russian Federation	24 (1.7)	39 (1.6) ▲	68 (1.5) ▲	57 (1.6)	8 (0.9) ▲	4 (0.5)
	Slovak Republic	6 (0.7)	22 (1.4) ▲	66 (1.5)	62 (1.3)	28 (1.6) ▲	16 (1.3)
	Slovenia	6 (0.6)	18 (1.2) ▲	56 (1.7)	65 (1.5) ▲	37 (1.8) ▲	17 (1.2)
	International Avg.	14 (0.3)	29 (0.4) ▲	61 (0.5) ▲	58 (0.4)	25 (0.5) ▲	14 (0.4)
Chemistry (PATS-C)							
	Belgium (Flemish)	--	--	--	--	--	--
	Bulgaria	25 (1.6)	27 (1.7)	59 (1.5)	53 (1.8)	17 (1.7)	20 (2.3)
	Czech Republic	15 (1.4)	14 (1.3)	61 (2.2)	60 (1.9)	24 (2.2)	27 (1.8)
	Finland	9 (1.2)	21 (1.3) ▲	62 (1.5)	62 (1.4)	29 (1.6) ▲	17 (1.3)
	Hungary	8 (0.8)	10 (0.9)	62 (1.7)	61 (1.6)	30 (1.8)	29 (1.8)
	Latvia (LSS)	20 (1.3)	23 (1.7)	68 (1.2)	66 (1.5)	13 (1.2)	11 (1.2)
	Lithuania †	12 (1.2)	12 (1.2)	65 (1.6)	66 (1.6)	24 (1.6)	22 (1.8)
	Macedonia, Rep. of	41 (2.0)	43 (1.8)	51 (1.7)	49 (1.5)	8 (0.9)	8 (0.9)
	Moldova	24 (1.3)	23 (1.7)	72 (1.3)	69 (1.7)	4 (0.5)	8 (0.9) ▲
	Morocco	x x	x x	x x	x x	x x	x x
	Netherlands	--	--	--	--	--	--
	Romania	22 (1.5)	19 (1.2)	60 (1.6)	63 (1.5)	18 (1.4)	18 (1.4)
	Russian Federation	28 (1.5)	28 (1.3)	63 (1.3)	61 (1.2)	9 (1.2)	10 (0.9)
	Slovak Republic	18 (1.4)	21 (1.6)	67 (1.5)	63 (1.6)	16 (1.7)	16 (1.4)
	Slovenia	11 (1.0)	11 (0.9)	58 (1.7)	58 (1.5)	32 (1.7)	31 (1.4)
	International Avg.	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.

Exhibit 4.12 Trends in Index of Positive Attitudes Towards the Sciences (PATS)*

	High PATS Percent of Students			Medium PATS Percent of Students			Low PATS Percent of Students		
	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
General/Integrated Science (PATS-G)									
 Australia	22 (0.8)	27 (1.1)	5 (1.4) ▲	53 (0.9)	53 (1.0)	0 (1.4) ●	25 (1.0)	20 (1.2)	-5 (1.5) ▼
Canada	29 (1.1)	30 (0.8)	1 (1.4) ●	52 (1.2)	52 (0.8)	0 (1.4) ●	19 (1.1)	18 (0.8)	-1 (1.4) ●
Cyprus	31 (1.2)	33 (0.9)	2 (1.5) ●	53 (1.0)	53 (0.8)	0 (1.3) ●	15 (1.0)	13 (0.8)	-2 (1.2) ●
England	36 (1.4)	39 (1.1)	3 (1.8) ●	52 (1.3)	53 (1.1)	1 (1.7) ●	12 (0.9)	8 (0.6)	-4 (1.1) ▼
Hong Kong, SAR	21 (1.1)	25 (1.0)	4 (1.5) ●	65 (1.1)	65 (0.8)	0 (1.4) ●	13 (1.0)	9 (0.6)	-4 (1.2) ▼
Iran, Islamic Rep.	63 (1.2)	56 (1.4)	-7 (1.8) ▼	34 (1.2)	40 (1.3)	7 (1.8) ▲	3 (0.4)	4 (0.3)	1 (0.5) ●
Israel †	25 (2.4)	26 (1.3)	1 (2.7) ●	55 (2.0)	52 (1.0)	-3 (2.2) ●	20 (1.6)	22 (1.3)	2 (2.0) ●
Italy	30 (1.4)	29 (1.4)	-1 (2.0) ●	58 (1.2)	58 (1.3)	0 (1.8) ●	12 (1.3)	13 (1.1)	0 (1.7) ●
Japan	10 (0.6)	10 (0.5)	0 (0.8) ●	64 (1.0)	60 (0.9)	-3 (1.3) ●	26 (1.0)	30 (1.0)	4 (1.5) ●
Korea, Rep. of	12 (0.7)	10 (0.5)	-2 (0.9) ●	72 (0.9)	66 (0.7)	-6 (1.1) ▼	16 (0.9)	24 (0.8)	7 (1.2) ▲
New Zealand	27 (1.3)	28 (1.0)	1 (1.6) ●	55 (0.9)	56 (0.8)	1 (1.2) ●	17 (0.9)	16 (0.9)	-1 (1.2) ●
Singapore	48 (1.7)	46 (1.4)	-2 (2.2) ●	48 (1.5)	49 (1.2)	1 (1.9) ●	3 (0.4)	5 (0.6)	2 (0.7) ●
Thailand †	49 (1.4)	43 (1.3)	-5 (1.9) ●	50 (1.3)	55 (1.3)	5 (1.8) ●	1 (0.2)	1 (0.2)	0 (0.3) ●
United States	33 (1.2)	32 (0.9)	-1 (1.5) ●	51 (1.0)	51 (0.8)	0 (1.3) ●	16 (0.7)	16 (0.6)	0 (0.9) ●
International Avg. §	30 (0.3)	31 (0.3)	0 (0.5) ●	55 (0.3)	55 (0.3)	0 (0.4) ●	15 (0.3)	15 (0.2)	0 (0.4) ●
Earth Science (PATS-E)									
 Belgium (Flemish)	12 (1.0)	9 (0.7)	-3 (1.2) ●	56 (1.6)	56 (1.2)	0 (2.0) ●	32 (1.9)	35 (1.5)	3 (2.4) ●
Czech Republic	19 (1.2)	23 (1.4)	4 (1.9) ●	66 (1.1)	64 (1.2)	-2 (1.6) ●	15 (1.5)	13 (1.0)	-2 (1.8) ●
Hungary	13 (0.8)	14 (0.8)	1 (1.1) ●	67 (1.1)	67 (1.0)	1 (1.5) ●	20 (1.3)	18 (1.0)	-2 (1.7) ●
Latvia (LSS)	--	--	--	--	--	--	--	--	--
Lithuania	--	--	--	--	--	--	--	--	--
Netherlands	9 (0.9)	11 (1.3)	2 (1.6) ●	63 (1.9)	65 (1.5)	3 (2.4) ●	28 (2.4)	23 (1.7)	-5 (2.9) ●
Romania	37 (1.3)	40 (1.5)	3 (2.0) ●	56 (1.2)	56 (1.3)	0 (1.7) ●	7 (0.5)	4 (0.6)	-3 (0.8) ▼
Russian Federation	21 (1.1)	28 (1.8)	7 (2.1) ▲	67 (0.9)	65 (1.6)	-3 (1.9) ●	11 (0.9)	7 (0.6)	-4 (1.1) ▼
Slovak Republic	21 (1.1)	24 (1.2)	3 (1.6) ●	67 (0.9)	66 (1.0)	-2 (1.4) ●	12 (0.9)	11 (1.1)	-2 (1.4) ●
Slovenia	--	--	--	--	--	--	--	--	--
International Avg. §	20 (0.4)	21 (0.5)	2 (0.6) ●	64 (0.5)	63 (0.5)	-1 (0.7) ●	17 (0.5)	16 (0.4)	-1 (0.7) ●

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

c Netherlands: Data in physics panel pertain to physics/chemistry course.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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.

		High PATS			Medium PATS			Low PATS		
		Percent of Students			Percent of Students			Percent of Students		
		1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
Biology (PATS-B)										
	Belgium (Flemish)	24 (1.6)	17 (0.9)	-7 (1.8) ▼	57 (1.2)	61 (1.2)	3 (1.7) ●	19 (1.8)	23 (1.1)	3 (2.1) ●
	Czech Republic	16 (1.2)	27 (1.5)	11 (1.9) ▲	66 (1.0)	60 (1.1)	-5 (1.5) ▼	19 (1.4)	12 (1.2)	-6 (1.8) ▼
	Hungary	22 (1.1)	23 (1.1)	1 (1.6) ●	66 (1.1)	65 (1.1)	-1 (1.6) ●	12 (1.0)	12 (0.8)	0 (1.3) ●
	Latvia (LSS)	41 (1.6)	26 (1.5)	-15 (2.1) ▼	45 (1.2)	66 (1.3)	21 (1.8) ▲	13 (1.1)	8 (0.8)	-6 (1.3) ▼
	Lithuania	32 (1.3)	27 (1.3)	-5 (1.8) ●	60 (1.1)	65 (1.2)	5 (1.6) ▲	8 (0.6)	8 (0.7)	0 (1.0) ●
	Netherlands	23 (1.3)	21 (1.8)	-2 (2.2) ●	62 (1.2)	63 (1.4)	1 (1.8) ●	15 (1.3)	16 (1.3)	1 (1.8) ●
	Romania	40 (1.5)	37 (1.4)	-2 (2.0) ●	54 (1.3)	55 (1.2)	2 (1.8) ●	7 (0.6)	7 (0.7)	1 (1.0) ●
	Russian Federation	36 (1.3)	41 (1.6)	5 (2.1) ●	59 (1.2)	55 (1.5)	-4 (1.9) ●	5 (0.5)	4 (0.3)	-1 (0.6) ●
	Slovak Republic	18 (1.0)	19 (1.2)	1 (1.6) ●	69 (1.1)	70 (1.2)	1 (1.6) ●	13 (0.9)	11 (0.9)	-2 (1.3) ●
	Slovenia	25 (1.5)	22 (1.1)	-3 (1.9) ●	59 (1.2)	64 (1.0)	4 (1.6) ●	15 (1.3)	14 (1.0)	-1 (1.7) ●
	International Avg. [§]	28 (0.4)	26 (0.4)	-2 (0.6) ●	60 (0.4)	63 (0.4)	3 (0.5) ▲	13 (0.4)	11 (0.3)	-1 (0.5) ●
Physics (PATS-P)										
	Belgium (Flemish)	13 (1.3)	11 (0.9)	-2 (1.6) ●	58 (2.2)	58 (1.5)	0 (2.6) ●	29 (2.2)	31 (1.9)	2 (2.9) ●
	Czech Republic	11 (0.8)	15 (1.3)	3 (1.5) ●	57 (1.5)	59 (1.5)	1 (2.1) ●	31 (1.6)	26 (1.8)	-5 (2.4) ●
	Hungary	10 (0.8)	11 (0.7)	1 (1.0) ●	62 (1.1)	62 (1.1)	0 (1.5) ●	28 (1.3)	27 (1.2)	-2 (1.8) ●
	Latvia (LSS)	23 (1.2)	18 (1.1)	-5 (1.7) ▼	66 (1.2)	68 (1.1)	2 (1.6) ●	11 (1.0)	14 (1.1)	3 (1.5) ●
	Lithuania	15 (1.0)	17 (1.0)	2 (1.4) ●	66 (1.1)	65 (1.2)	-1 (1.6) ●	18 (1.2)	18 (1.2)	-1 (1.7) ●
	Netherlands ^c	14 (1.3)	11 (0.8)	-3 (1.5) ●	60 (1.6)	59 (1.7)	-1 (2.3) ●	26 (2.0)	30 (2.0)	4 (2.8) ●
	Romania	25 (1.2)	17 (1.2)	-7 (1.7) ▼	62 (1.1)	64 (1.0)	2 (1.5) ●	13 (1.0)	18 (1.3)	5 (1.6) ▲
	Russian Federation	26 (1.1)	31 (1.4)	5 (1.8) ▲	63 (1.4)	63 (1.3)	0 (1.9) ●	11 (1.1)	6 (0.6)	-5 (1.2) ▼
	Slovak Republic	13 (0.8)	14 (0.8)	1 (1.1) ●	59 (1.2)	64 (1.1)	5 (1.6) ▲	28 (1.4)	22 (1.2)	-6 (1.9) ▼
	Slovenia	13 (0.8)	12 (0.7)	-1 (1.0) ●	62 (1.3)	60 (1.2)	-2 (1.8) ●	25 (1.4)	28 (1.3)	3 (1.9) ●
	International Avg. [§]	16 (0.3)	16 (0.3)	-1 (0.5) ●	62 (0.4)	62 (0.4)	1 (0.6) ●	22 (0.5)	22 (0.4)	0 (0.6) ●
Chemistry (PATS-C)										
	Belgium (Flemish)	--	--	--	--	--	--	--	--	--
	Czech Republic	9 (0.6)	14 (1.0)	5 (1.2) ▲	57 (1.4)	60 (1.5)	3 (2.1) ●	33 (1.7)	25 (1.7)	-8 (2.4) ▼
	Hungary	10 (0.8)	9 (0.6)	-1 (1.0) ●	60 (1.3)	61 (1.3)	2 (1.8) ●	30 (1.4)	30 (1.5)	-1 (2.0) ●
	Latvia (LSS)	25 (1.3)	21 (1.2)	-4 (1.7) ●	65 (1.1)	67 (1.0)	2 (1.5) ●	10 (0.9)	12 (1.0)	2 (1.4) ●
	Lithuania	15 (0.8)	12 (0.9)	-3 (1.3) ●	68 (1.1)	65 (1.2)	-3 (1.6) ●	17 (1.1)	23 (1.4)	6 (1.8) ▲
	Netherlands	--	--	--	--	--	--	--	--	--
	Romania	25 (1.1)	20 (1.0)	-5 (1.5) ▼	61 (1.1)	61 (1.1)	0 (1.5) ●	14 (0.9)	18 (1.1)	4 (1.5) ▲
	Russian Federation	19 (0.6)	28 (1.2)	9 (1.3) ▲	69 (1.0)	62 (1.0)	-7 (1.4) ▼	11 (1.0)	10 (0.9)	-1 (1.3) ●
	Slovak Republic	8 (0.6)	20 (1.2)	11 (1.3) ▲	65 (1.2)	65 (1.2)	0 (1.7) ●	27 (1.3)	16 (1.3)	-11 (1.9) ▼
	Slovenia	11 (0.7)	11 (0.7)	0 (1.0) ●	60 (1.3)	58 (1.3)	-2 (1.9) ●	29 (1.4)	31 (1.3)	2 (1.9) ●
	International Avg. [§]	15 (0.3)	17 (0.4)	2 (0.5) ▲	63 (0.4)	62 (0.4)	-1 (0.6) ●	21 (0.4)	21 (0.5)	-1 (0.6) ●

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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

Exhibit 4.13 Trends in Gender Differences in Percentages of Students at High Level of Index of Positive Attitudes Towards the Sciences (PATS)*

	1995			1999			Change in Gender Difference ¹	
	Girls	Boys	Difference (Absolute Value)	Girls	Boys	Difference (Absolute Value)		
General/Integrated Science (PATS-G)								
G	Thailand [†]	48 (1.4)	50 (1.8)	2 (1.7)	44 (1.6)	43 (1.6)	1 (1.9)	↔
	Italy	26 (1.9)	34 (1.5) ▲	8 (2.2)	29 (2.1)	30 (1.5)	2 (2.2)	↔
	Canada	26 (1.2)	31 (1.4) ▲	5 (1.3)	28 (1.1)	32 (1.1)	4 (1.5)	↔
	Australia	20 (1.0)	24 (1.1)	4 (1.3)	25 (1.4)	29 (1.5)	5 (1.9)	↔
	Iran, Islamic Rep.	62 (1.7)	64 (2.0)	2 (2.9)	59 (2.5)	54 (1.7)	5 (3.2)	↔
	United States	31 (1.2)	34 (1.6)	3 (1.4)	29 (1.1)	35 (1.2) ▲	6 (1.4)	↔
	Korea, Rep. of	8 (0.8)	15 (1.0) ▲	7 (1.2)	7 (0.6)	14 (0.7) ▲	7 (0.8)	↔
	Japan	6 (0.5)	14 (0.9) ▲	9 (0.9)	6 (0.6)	13 (0.8) ▲	7 (0.9)	↔
	New Zealand	23 (1.6)	32 (1.6) ▲	9 (2.0)	24 (1.0)	32 (1.4) ▲	8 (1.6)	↔
	Cyprus	30 (1.4)	33 (1.5)	3 (1.7)	29 (1.6)	37 (1.3) ▲	8 (2.3)	↔
	Hong Kong, SAR	15 (1.1)	27 (1.5) ▲	12 (1.5)	20 (1.2)	31 (1.3) ▲	12 (1.6)	↔
	Israel [†]	21 (3.0)	29 (2.6)	8 (3.0)	20 (1.4)	32 (1.6) ▲	13 (1.5)	↔
	Singapore	43 (1.8)	54 (2.1) ▲	11 (2.1)	39 (1.7)	52 (1.5) ▲	13 (1.6)	↔
	England	28 (1.7)	44 (1.9) ▲	16 (2.4)	33 (1.7)	46 (1.4) ▲	14 (2.1)	↔
	International Avg. [§]	28 (0.4)	35 (0.4) ▲	7 (0.5)	28 (0.4)	34 (0.4) ▲	6 (0.5)	↔
Earth Science (PATS-E)								
	Latvia (LSS)	--	--	--	--	--	--	↔
	Lithuania	--	--	--	--	--	--	↔
	Slovenia	--	--	--	--	--	--	↔
	Romania	34 (1.6)	39 (1.5) ▲	6 (1.8)	40 (2.1)	40 (1.8)	0 (2.5)	↔
	Czech Republic	16 (1.6)	22 (1.5) ▲	6 (1.8)	21 (1.9)	26 (2.0)	4 (2.6)	↔
	Belgium (Flemish)	7 (0.8)	16 (1.4) ▲	9 (1.5)	7 (0.7)	11 (0.9) ▲	5 (0.9)	↔
	Hungary	12 (1.1)	15 (1.1)	3 (1.4)	11 (1.0)	17 (1.1) ▲	6 (1.3)	↔
	Netherlands	7 (1.0)	12 (1.3) ▲	5 (1.4)	8 (1.0)	15 (1.8) ▲	7 (1.3)	↔
	Russian Federation	17 (1.0)	26 (1.8) ▲	10 (1.8)	24 (1.9)	33 (2.0) ▲	9 (1.7)	↔
	Slovak Republic	18 (1.4)	23 (1.5) ▲	5 (1.8)	19 (1.3)	29 (1.6) ▲	10 (1.7)	↔
	International Avg. [§]	16 (0.5)	22 (0.5) ▲	6 (0.6)	18 (0.6)	24 (0.6) ▲	6 (0.7)	↔

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

Increased

Decreased

No change

SOURCE: IEA Third International Mathematics and Science Study (TIMSS) 1998–1999

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.

¹ Indicates whether 1999 gender difference is significantly different than 1995 gender difference.

[†] Countries with unapproved sampling procedures at the classroom level in 1995.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

^c Netherlands: Data in physics panel pertain to physics/chemistry course.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 4.13: Trends in Gender Differences in Percentages of Students at High Level of Index of Positive Attitudes Towards the Sciences (PATS)* (Continued)

		1995			1999			Change in Gender Difference ¹
		Girls	Boys	Difference (Absolute Value)	Girls	Boys	Difference (Absolute Value)	
	Biology (PATS-B)							
	Latvia (LSS)	44 (2.0)	38 (1.8)	6 (2.3)	27 (1.7)	25 (1.8)	2 (2.1)	↔
	Belgium (Flemish)	25 (2.5)	22 (1.4)	2 (2.6)	19 (1.4) ▲	14 (0.9)	5 (1.5)	↔
	Slovak Republic	21 (1.2) ▲	15 (1.3)	6 (1.3)	21 (1.5)	16 (1.4)	5 (1.7)	↔
	Russian Federation	39 (1.7) ▲	33 (1.5)	6 (1.8)	44 (1.9) ▲	39 (1.7)	5 (1.8)	↔
	Romania	42 (1.7)	38 (1.6)	4 (1.6)	41 (1.9)	34 (1.8)	6 (2.3)	↔
	Lithuania	33 (1.9)	31 (1.3)	2 (2.2)	31 (1.6) ▲	23 (1.6)	7 (1.9)	↔
	Slovenia	31 (1.8) ▲	20 (1.6)	11 (1.6)	27 (1.5) ▲	17 (1.2)	10 (1.7)	↔
	Hungary	26 (1.5) ▲	18 (1.4)	9 (1.7)	28 (1.6) ▲	18 (1.2)	10 (1.8)	↔
	Netherlands	28 (2.0) ▲	17 (1.8)	10 (2.7)	27 (2.6) ▲	14 (1.6)	13 (2.9)	↔
	Czech Republic	19 (1.8) ▲	13 (1.1)	7 (1.8)	34 (2.0) ▲	20 (1.8)	14 (2.2)	↔
	International Avg. [§]	31 (0.6) ▲	24 (0.5)	6 (0.6)	30 (0.6) ▲	22 (0.5)	8 (0.6)	↔
	Physics (PATS-P)							
	Belgium (Flemish)	8 (2.1)	18 (1.6) ▲	10 (2.8)	9 (1.2)	13 (1.4)	5 (1.7)	↔
	Romania	21 (1.3)	29 (1.7) ▲	8 (1.9)	13 (1.3)	21 (1.6) ▲	9 (1.7)	↔
	Netherlands ^c	6 (0.9)	22 (2.0) ▲	16 (1.9)	5 (1.1)	17 (1.4) ▲	11 (1.8)	↔
	Slovenia	6 (0.7)	20 (1.4) ▲	14 (1.5)	6 (0.6)	18 (1.2) ▲	12 (1.4)	↔
	Hungary	5 (0.7)	15 (1.3) ▲	9 (1.4)	5 (0.7)	17 (1.2) ▲	13 (1.3)	↔
	Lithuania	11 (1.3)	21 (1.5) ▲	10 (1.9)	11 (1.1)	24 (1.4) ▲	13 (1.5)	↔
	Czech Republic	5 (0.7)	18 (1.3) ▲	13 (1.3)	8 (1.4)	22 (1.6) ▲	14 (2.0)	↔
	Russian Federation	18 (1.2)	35 (1.7) ▲	17 (1.9)	24 (1.7)	39 (1.6) ▲	15 (1.8)	↔
	Slovak Republic	5 (0.7)	22 (1.2) ▲	17 (1.2)	6 (0.7)	22 (1.4) ▲	16 (1.5)	↔
	Latvia (LSS)	13 (1.4)	33 (1.9) ▲	19 (2.3)	10 (0.9)	26 (1.8) ▲	17 (1.9)	↔
	International Avg. [§]	10 (0.4)	23 (0.5) ▲	13 (0.6)	10 (0.4)	22 (0.5) ▲	12 (0.5)	↔
	Chemistry (PATS-C)							
	Netherlands	--	--	--	--	--	--	↔
	Belgium (Flemish)	--	--	--	--	--	--	↔
	Slovenia	11 (1.0)	10 (1.0)	1 (1.3)	11 (1.0)	11 (0.9)	0 (1.4)	↔
	Lithuania	14 (1.1)	17 (1.2)	3 (1.6)	12 (1.2)	12 (1.2)	1 (1.5)	↔
	Czech Republic	9 (0.7)	9 (0.9)	0 (1.0)	15 (1.4)	14 (1.3)	1 (1.8)	↔
	Russian Federation	17 (1.1)	22 (1.0)	4 (1.7)	28 (1.5)	28 (1.3)	1 (1.4)	↔
	Hungary	7 (0.9)	13 (1.1) ▲	5 (1.2)	8 (0.8)	10 (0.9)	2 (1.2)	↔
	Romania	25 (1.4)	26 (1.6)	1 (1.9)	22 (1.5)	19 (1.2)	2 (1.6)	↔
	Latvia (LSS)	24 (1.6)	27 (1.7)	3 (2.1)	20 (1.3)	23 (1.7)	3 (1.9)	↔
	Slovak Republic	7 (0.6)	9 (0.9)	2 (1.0)	18 (1.4)	21 (1.6)	4 (1.9)	↔
	International Avg. [§]	14 (0.4)	17 (0.4) ▲	2 (0.5)	16 (0.5)	17 (0.5) ▲	1 (0.6)	↔

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

▲ Significantly higher than other gender

Significance tests adjusted for multiple comparisons

Increased



Decreased



No change



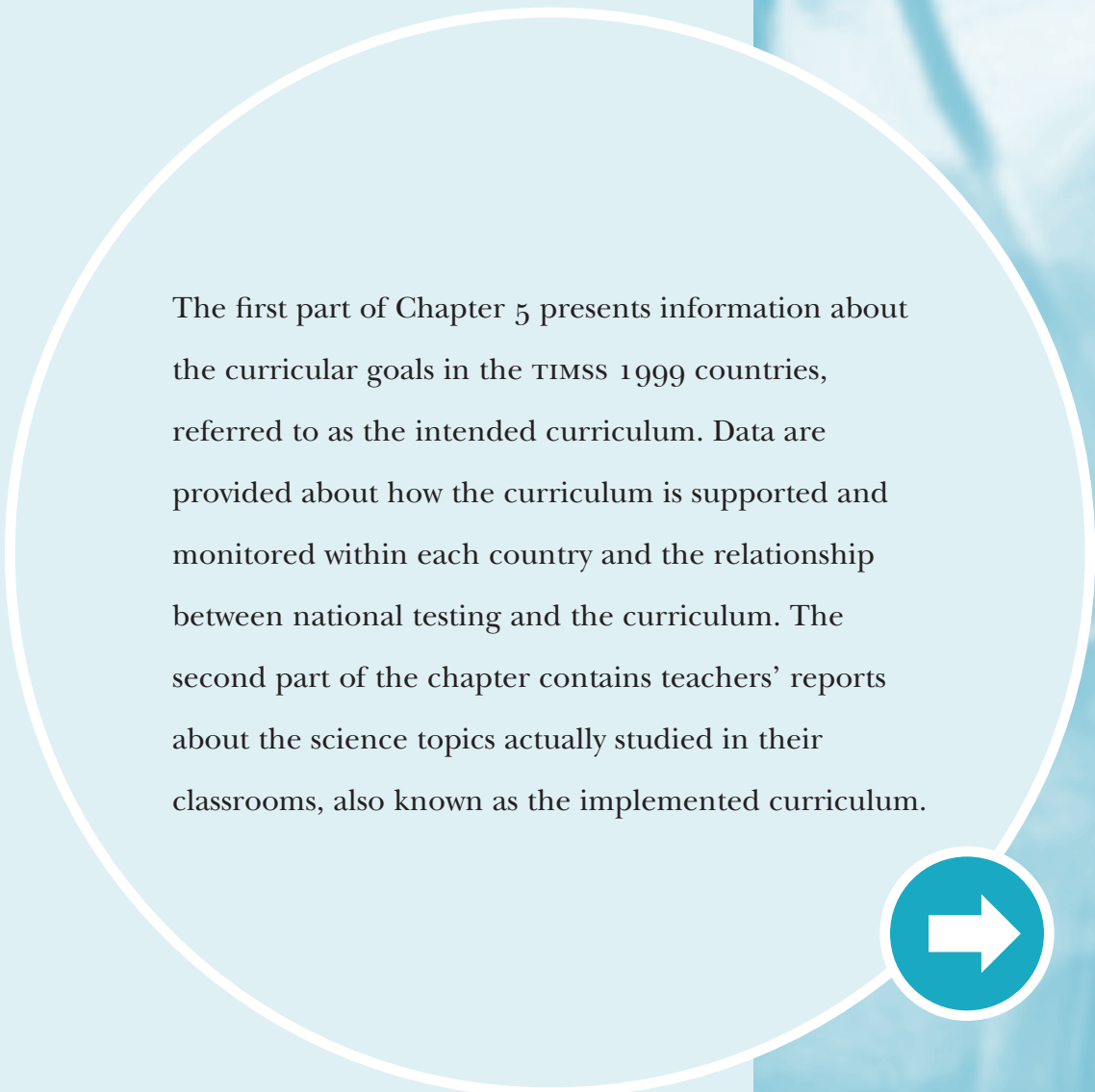


CHAPTER 5

The Science Curriculum



5



The first part of Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries, referred to as the intended curriculum. Data are provided about how the curriculum is supported and monitored within each country and the relationship between national testing and the curriculum. The second part of the chapter contains teachers' reports about the science topics actually studied in their classrooms, also known as the implemented curriculum.





In comparing achievement across countries, 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 country's policies for science education. Just as important as what students are expected to learn, however, is what their teachers choose to teach them. The lessons provided by the teacher ultimately determine what science students are taught.

Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries and teachers' reports about the science content studied. Teacher's instructional programs for their classes are usually guided by an "official curriculum" that describes the science education that should be provided. The official curriculum can be communicated by means of documents or statements of various sorts (often called guides, guidelines, or frameworks) prepared by the education ministry or by national or regional education departments. These documents or statements, 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 in each of the TIMSS 1999 countries, the National Research Coordinators responsible for implementing the study completed questionnaires and participated in interviews. As part of the process, information was gathered about factors related to supporting and monitoring the implementation of the official curriculum, including the availability of teacher training, instructional materials, assessments, and audits 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 the implemented curriculum, even in highly regulated educational systems, is not identical to the intended curriculum. 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.

Science Subjects Offered Up To and Including Eighth Grade

5.1



The most striking difference among science curricula of the TIMSS 1999 countries in 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. 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. Elsewhere, the common practice was to integrate the sciences into a general science curriculum.

At lower grade levels, science topics in some countries were incorporated in broader curriculum areas, such as “knowledge about nature and society” in Slovenia. Additional areas of study are included in grade 8 in some countries. For instance, Belgium (Flemish) included “technological education,” “scientific work,” and “applied science” in grades 7 and 8 science programs.

Exhibit 5.1 Science Subjects Offered Up to and Including Eighth Grade

	Separate Science Courses Offered	Science Subjects and Grades Taught
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)
United States	No	General/integrated science course

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 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.

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

Depending on the educational system, students' learning goals are commonly set at three levels: the national or regional level, the school level, and the classroom level. Some countries 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.

5.2  Exhibit 5.2 presents information for each TIMSS 1999 country about the highest level of authority responsible for making decisions about the curriculum 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 levels, with variability across states; and Canada determined what students are expected to learn 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 curriculum 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 or provincial level, and some science curricula were in revision at the time of testing. The science curricula in these three countries were relatively recent, having been developed within ten years prior to the study.

Exhibit 5.2 Science Curriculum

	National or Regional Curriculum	Year Curriculum Introduced	Status of Curriculum
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
United States	Regional & Local	1990-1999	As of 1999, 47 out of 50 states have completed content standards

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).

How Do Countries Support and Monitor Curriculum Implementation?

5.3



Education systems use different ways to achieve the best match between the intended and the implemented curriculum. 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 by means of school inspection or audit. The different methods used by the TIMSS 1999 countries are shown in Exhibit 5.3. It is assumed that monitoring implementation encourages teachers to use the official curriculum in planning their teaching programs. Testing and assessment of the intended curriculum are also widely used to support and monitor curriculum implementation; these are addressed in Exhibits 5.4 and 5.5

Of the methods for supporting and monitoring curriculum implementation shown in Exhibit 5.3, 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 noted by 24 of the 38 countries, and nearly all reported using in-service teacher education for this purpose. A system of school inspection or audit was used by 31 countries.

Exhibit 5.3

Methods Used to Support or Monitor Curriculum Implementation*

TIMSS 1999
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
Australia ¹	●	●		●	●	
Belgium (Flemish)	●	●		●	●	●
Bulgaria	●	●	●		●	●
Canada ²	●	●	●	●	●	
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		●	●		●	●
United States ³	+	+	+	+	+	+

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

● Country reported that method is used to support or monitor the implementation of the national/regional curriculum at grade 8

+ Not applicable nationally

Background data provided by National Research Coordinators.

* Other than public examinations and system-wide assessments described in Exhibits 5.4 and 5.5, respectively.

¹ Australia: Results are shown for the majority of states/territories.

² Canada: Results are for the majority of provinces.

³ United States: Methods are implemented by individual states and vary from state to state. As of 1998, 13 of 50 states have policies on textbook/materials selection; 8 of 50 states have policies recommending textbook/materials.

What Countries Have Public Examinations in Science?

5.4



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. Exhibit 5.4 shows information on public examinations and their purpose. Thirty-six countries reported having public examinations or awards, at one or more grades, that include 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). Certification also provides students not going on to full-time post-secondary education with evidence of educational attainment for prospective employers. In about one-third of the countries, public examinations were also reported to be used to select students for entry to different types of secondary school, or to assign them to different tracks or courses within secondary schools. Providing feedback to policy makers in the educational system, schools, or both was also an important use of assessments in some countries.

Two countries reported having no public examinations in science. Belgium (Flemish) and Chinese Taipei were the only countries where decisions about promotion from one grade to the next, certification, and qualification for entrance to university were made at the school level without reliance on system-wide public examinations.

Exhibit 5.4 Public Examinations in Science

	Public Exams/ Awards	Grade(s)	Purpose/Consequences
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 ¹	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)
United States ²	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

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

Background data provided by National Research Coordinators.

¹ Canada: Public examinations are administered in 3 of 10 provinces.

² United States: As of 1997-1998, public examinations are administered in 36 of 50 states at grades 7-8 or 9-12.

What Countries Have System-Wide Assessments in Science?

Although national public examinations can provide information of interest to national and regional policy makers, their main purpose is to make decisions about individual students. In comparison, 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.

5.5



Exhibit 5.5 summarizes information about national assessments in science. Such assessments were conducted in 23 of the participating countries. Seven of these – Malaysia, Morocco, the Netherlands, the Philippines, Singapore, Tunisia, and Turkey – reported using public examinations as system-wide assessments, and therefore the same examination is featured in Exhibits 5.4 and 5.5. Of the 23 countries that reported conducting system-wide assessments, nine reported testing all students in the grade and 11 reported testing a sample from the grade. One of these countries, the Netherlands, reported testing both the entire grade level and a sample. Australia and Canada reported state- and provincial-level testing both for the entire grade and for a sample. In addition, two countries, Indonesia and the Russian Federation, reported administering periodic sample-based assessments at various grades for system-level feedback and research purposes, respectively. Most countries tested from two to four grades; Korea tested at six grades.

Generally, the purpose of the system-wide assessments was to provide feedback to government policy makers and the public. Several countries that reported assessing all students in a grade used these results in a variety of ways, including providing feedback to individual schools. England and Hungary also used information about individual students for course placement or guidance.

In addition to collecting information about examinations and assessments, questionnaires and interviews were used to determine whether, and to what extent, explicit achievement standards were a feature of intended curricula (see Exhibit R2.1 in the reference section). About two-thirds of the countries reported that such standards were incorporated in their curricula or related documents. However, the term “achievement standards” means different things in different countries and was unfamiliar to some. Some countries regard them as learning objectives, and others include in this category performance indicators that describe levels of required or desired performance. Exhibit R2.1 includes countries that reported learning objectives or performance objectives as a component of their curriculum documents.

R2.1



Exhibit 5.5 System-Wide Assessments in Science

	System-Wide Assessments ¹	Grades		Purpose/Consequences
		Entire Grade Level	Sample from Grade Level	
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
United States	Yes		4, 8, 12	National and state-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.

How Much Instructional Time Is Recommended for Science?

The different percentages of time devoted to mathematics instruction at different grades highlight one of the difficulties in investigating the relationship between achievement and instructional time across countries. If instructional time is measured only for the eighth grade, the total time for which students in a country have been exposed to instruction in science during their schooling may be under- or over-estimated. These data for grades 4, 6, and 8 provide a better estimate of students' intended instructional time for science across the school years.

5.6



Percentages of instructional time designated for the sciences specified in the intended curricula for grades 4, 6, and 8 are shown in Exhibit 5.6. The pattern across countries shows that the percentage of time intended for science instruction stays relatively the same or increases from grade 4 to grade 6, and increases from grade 6 to grade 8. Interestingly, the reverse pattern holds for mathematics.¹ Average percentages of time for science instruction across all countries were 11, 13, and 16 percent for grades 4, 6, and 8, respectively. Percentages of total instructional time for the sciences ranged from five to 30 percent at grade 4 and from six to 30 percent at grade 6. At the eighth grade, the percentage of instructional time specified for science ranged from five to 10 percent in Italy to 32 percent in Moldova, which also reported the largest percentages at grades 4 and 6. The percentage of instructional time for science exceeded 15 percent in two countries at grade 4, five countries at grade 6, and 12 countries at grade 8; of the latter, eight countries reported that 25 percent or more of instructional time was intended for science. Schools' and teachers' reports of the percentage of instructional time actually devoted to the sciences at grade 8, shown in Exhibit 6.4 in the next chapter, generally correspond with the intended percentages reported in Exhibit 5.6.

¹ 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.



Exhibit 5.6 Overleaf

Exhibit 5.6 Instructional Time for Science

	Instructional Time Specified for Science			Comments
	Grade 4	Grade 6	Grade 8	
Australia	N/S	N/S	N/S	There is a minor emphasis on science at primary school level. Science instruction is mandatory for the first 3 or 4 years of secondary education with time allocation similar to that of other subjects. Up to grade 10, general science is usually taught. In the final 2 years of secondary school, science subjects are no longer mandatory but strands of biology, chemistry, physics are taught.
Belgium (Flemish)	12-15%	12-15%	12-15%	During the last years of secondary education, students choose between scientific (= 23%) and non-scientific (= 19%) programs.
Bulgaria	8%	20%	26%	At grade 3, science receives only 2% of instructional time. From grades 6-10, the time varies from 20-30%. After grade 10, science receives less than 5% of instructional time.
Canada ¹	9-12%	12-15%	12-15%	Science is a core subject in grades K-6 and time allotment depends on the teacher. General science is a mandatory subject in junior high school. Separate science courses by discipline (e.g., chemistry, physics, biology, earth science) are electives at the senior high school level.
Chile	N/S	N/S	N/S	Although the national curriculum does not specify the amount of instructional time to be devoted to the sciences, schools usually assign 3 hours of instruction per week from 5th grade on.
Chinese Taipei	12%	11%	11%	
Cyprus	6%	6%	14%	
Czech Republic	13%	22%	27%	At grade 6, separate science subjects are introduced.
England	N/S	N/S	N/S	The national curriculum does not specify the amount of time to be spent. The proposed curriculum assumes 2 hours per week at grade 4 (year 5), and 2-5 hours per week for grades 6 and 8 (years 7 and 9). In practice, teaching time for grade 8 (year 9) is slightly greater than this.
Finland	11%	11%	14%	The curriculum framework indicates the minimum amount of instructional time on average for grade spans 1-6 and 7-9. Schools decide on instructional time for specific grades.
Hong Kong, SAR	6-8%	6-8%	8-13%	
Hungary	17%	20%	25%	Biology and physics are first taught as separate subjects at grade 6. Chemistry is first taught as a separate subject at grade 7.
Indonesia	14%	14%	14%	
Iran, Islamic Rep.	11%	13%	11%	A newly proposed plan for primary level suggests greater emphasis on science.
Israel	7-10%	10-13%	14-16%	Instructional time increases in junior high school (grades 7-9) and receives greater emphasis at the high school level for students specializing in the sciences.
Italy	N/S	5-10%	5-10%	The curriculum indicates 20% instructional time be devoted to mathematics and science as one subject. The exact distribution of time for each of these subjects is decided by the teacher.
Japan	10%	10%	10%	There is no change in instructional time in elementary and lower secondary school.
Jordan	12%	12%	15%	The relative emphasis on the sciences compared to other subjects increases as students progress through school due to the teaching of the sciences as separate subjects. On average, the instructional time for science is 15% at grades 9-10 and 20% at grade 12.
Korea, Rep. of	11%	13%	12%	
Latvia (LSS)	5%	6%	19%	
Lithuania ²	9%	14%	23%	At grade 4, students receive 2 classes per week of integrated science. At grade 6, students take 2 classes per week of both integrated science and geography. At grade 8, students take 1-2 classes per week in both biology and geography and 2 classes per week in both chemistry and physics.
Macedonia, Rep. of	N/S	10%	25%	Some science is taught in Life and Society in grades 1-4, biology in grades 5-8, and chemistry and physics in grades 7-8. In addition, geography includes science topics in grade 5.
Malaysia	8%	8%	11%	The instructional time from grade 4 through secondary school remains about the same.
Moldova	30%	30%	32%	
Morocco	6%	6%	12%	

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

Background data provided by National Research Coordinators.
All data rounded to the nearest whole number.

¹ Canada: Results shown are for the majority of provinces.

² Lithuania: The instructional time specified for science includes geography. At grade 6, 7% of the total instructional time is for geography; at grade 8, 3-7% of the total instructional time is for geography.

N/S indicates instructional time not specified in the national/regional curriculum.

A dash (–) indicates data are not available.

		Instructional Time Specified for Science			Comments
		Grade 4	Grade 6	Grade 8	
	Netherlands	N/S	N/S	18%	At grade 8, students take the following sciences: earth science is included in geography 6%; physics/chemistry 6%; biology 6%.
	New Zealand	N/S	N/S	N/S	All schools are required to teach science as part of a "balanced curriculum". Schools decide on instructional time. Usually in primary school, language (which includes reading) and mathematics are allocated considerably more time than science. Time for science, mathematics, and English are about the same in secondary school.
	Philippines	12%	11%	20%	In secondary school, instructional time in sciences is doubled. In addition, science-based materials are used in the English courses.
	Romania	7%	21%	25%	
	Russian Federation	5%	14%	25%	
	Singapore	8%	10%	15%	As students progress through school, there is more curriculum time allocated for science with more investigative, hands-on, and project-based activities.
	Slovak Republic	—	—	—	
	Slovenia	14%	15%	27%	The emphasis on science is relatively equal to other subjects up to grade 7. In grades 7-8, three separate science courses are introduced with a greater percentage of instructional time. Science is taught as an integrated course focusing on life and society in grades 1-3. Subject knowledge about nature is introduced as an integrated course in grades 4-5. Specialist courses are introduced in grades 6-8. In grade 6, earth science is integrated in "geography." In grade 7, biology, chemistry, and physics are introduced. Geography does not include any science topics after grade 6.
	South Africa	N/S	N/S	N/S	
	Thailand	6%	6%	9%	As students progress through school, there is an increased focus on problem-solving, science projects, and thinking processes.
	Tunisia	5%	5%	8%	
	Turkey	10%	10%	10%	As students progress through school, there is an increased focus on project-based curricula.
	United States	N/S	N/S	N/S	States do not generally specify; it is largely a local decision.

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

How Do Countries Deal with Individual Differences?

5.7



The challenge of maximizing opportunity to learn for students with widely differing abilities and interests is met differently in different countries. Exhibit 5.7 summarizes questionnaire and interview data on how countries dealt with this issue in organizing the intended curricula.

Some countries 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. The most common approach, found in 25 countries, was to have the same intended curriculum for all students, but to recommend that teachers adapt the level and scope of their teaching to the abilities and needs of their students. Adaptations for individuals and classes were also recommended in the intended curricula of some countries with different levels of curricula or different curricula for different groups.

In the Czech Republic and England, science topics were taught at different levels with different groups. The Czech Republic had two levels and England nine. In England's curriculum, the levels were defined in terms of progressively more complex performance to be demonstrated. Among the countries with different curricula for different groups of students, Belgium (Flemish) provided two different levels, Singapore three, and the Netherlands four.

R2.2



National Research Coordinators from nine countries reported that their official science curricula did not address the issue of differentiating instruction for grade 8 students with different abilities or interests, but this does not necessarily mean that schools and teachers in those countries did not make allowance for individual differences. Schools' reports on how they organize to accommodate students with different abilities or interests are shown in Exhibit R2.2 in the reference section. Substantial percentages of students in many countries were in schools that offered remedial and enrichment sciences, including several of the countries without specific curricular statements about differentiation.

Exhibit 5.7

Differentiation of Instruction for Students with Different Abilities or Interests

	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
Australia	Yes	Yes	No	No	1
Belgium (Flemish)	Yes	No	No	Yes	2
Bulgaria	Yes	Yes	No	No	1
Canada	Yes	Yes	No	No	1
Chile	No				
Chinese Taipei	Yes	Yes	No	No	1
Cyprus	Yes	Yes	No	No	1
Czech Republic ¹	Yes	Yes	Yes	No	2
England ²	Yes	No	Yes	No	9
Finland	Yes	Yes	No	No	1
Hong Kong, SAR	Yes	Yes	No	No	1
Hungary	Yes	Yes	No	No	1
Indonesia	No				
Iran, Islamic Rep.	Yes	Yes	No	No	1
Israel	Yes	Yes	No	No	1
Italy	No				
Japan	No				
Jordan	Yes	Yes	No	No	1
Korea, Rep. of	No				
Latvia (LSS)	No				
Lithuania	No				
Macedonia, Rep. of	Yes	Yes	No	No	1
Malaysia	Yes	Yes	No	No	1
Moldova	No				
Morocco	Yes	Yes	No	No	1
Netherlands	Yes	No	No	Yes	4
New Zealand	Yes	Yes	No	No	1
Philippines	Yes	Yes	No	No	1
Romania	Yes	Yes	No	No	1
Russian Federation	Yes	Yes	No	No	1
Singapore	Yes	No	No	Yes	3
Slovak Republic	Yes	Yes	No	No	1
Slovenia	Yes	Yes	No	No	1
South Africa	No				
Thailand	Yes	Yes	No	No	1
Tunisia	Yes	Yes	No	No	1
Turkey	Yes	Yes	No	No	1
United States ³	Yes	Yes	No	No	1

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

Background data provided by National Research Coordinators.

¹ 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.

² 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.

³ United States: Most state standards are designed for all students.

What Are the Major Characteristics of the Intended Curriculum?

5.8



Exhibit 5.8 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. Few countries gave major emphasis to using laboratory equipment and performing science experiments, but there were some notable exceptions. Top-performing Singapore, Korea, and Japan were among the 10 countries that reported major emphasis for both. The Czech Republic's intended curriculum had minor or no emphasis on any aspect of practical work, and several other countries' curricula had minor or no emphasis on performing experiments.

The increasing importance of technology in school curricula is reflected in the major emphasis given by 12 countries and the moderate emphasis given by 14 to “science, technology, and society.” Thematic approaches were more common in science than in mathematics and received major emphasis in 13 countries. Multicultural approaches and integration of science with school subjects other than mathematics were the approaches least likely to be given major or moderate emphasis.

It is possible that in some countries some of the approaches and processes reported as having minor or no emphasis in the intended curriculum may receive more emphasis in the implemented curriculum. For example, although assessing student learning in science was reported to receive minor or no emphasis in the intended curriculum of five countries – Chile, Indonesia, Malaysia, Romania, and South Africa – teachers there nevertheless regularly assess their students' learning in science. In these five countries, the teachers of 60 percent or more of the students reported giving quite a lot or a great deal of weight to either teacher-made tests requiring explanations or teacher-made objective tests (see Exhibit R3.18 in the reference section).

Exhibit 5.8 Emphasis on Approaches and Processes

TIMSS 1999
8th grade
 Science

	Knowing Basic Science Facts	Understanding Science Concepts	Applying Science Concepts to Solve Problems and Develop Explanations	Using Laboratory Equipment	Performing Science 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
Australia ¹	●	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish) ²	●	●	●	●	●	●	●	●	●	●	●	●	●
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 ²	●	●	●	●	●	●	●	●	●	●	●	●	●
Singapore	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	—	—	—	—	—	—	—	—	—	—	—	—	—
Slovenia	●	●	●	●	●	●	●	●	●	●	●	●	●
South Africa	●	●	●	●	●	●	●	●	●	●	●	●	●
Thailand	●	●	●	●	●	●	●	●	●	●	●	●	●
Tunisia	●	●	●	●	●	●	●	●	●	●	●	●	●
Turkey	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	●	●	●	●	●	●	●	●	●	●	●	●	●

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

Background data provided by National Research Coordinators.

¹ Australia: Results shown are for the majority of states/territories.

² Belgium (Flemish) and Russian Federation: The single codes are derived from a combination of codes for individual sciences.

³ Canada: Results shown are for the majority of provinces.

What Science Content Do Teachers Emphasize at the Eighth Grade?

5.9



Teachers from countries in which eighth-grade science was taught as a general or integrated course were asked what subject matter they had emphasized with their classes. Their responses are shown in Exhibit 5.9. In six of the 21 countries, at least 80 percent of students were in classes that emphasized science as a general/integrated subject. In Canada, Italy, and the United States, earth science was emphasized in considerably more classrooms than in other countries. Biology was more likely than the other sciences to be emphasized in Italy and Tunisia. Countries where relatively high proportions of students had seen emphasis on physics, chemistry, or both were Cyprus, Iran, Israel, Jordan, Korea, and South Africa.

Exhibit 5.9

Subject Matter Emphasized Most in General/Integrated Science Class

	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
Australia r	83 (2.6)	0 (0.3)	5 (1.6)	1 (0.4)	4 (1.3)	2 (0.7)	4 (1.2)
Canada r	55 (3.5)	14 (2.3)	6 (1.7)	1 (0.7)	1 (0.6)	19 (2.7)	3 (1.2)
Chile	71 (4.0)	1 (0.9)	22 (3.4)	1 (0.9)	0 (0.0)	2 (1.1)	2 (1.2)
Cyprus s	17 (3.6)	1 (1.3)	17 (3.2)	39 (4.5)	13 (2.6)	6 (2.3)	6 (2.8)
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)
Iran, Islamic Rep.	53 (4.6)	0 (0.0)	13 (2.7)	14 (3.1)	3 (1.4)	16 (2.9)	1 (0.8)
Israel s	34 (4.4)	1 (0.0)	21 (3.9)	3 (1.3)	7 (2.5)	28 (4.5)	6 (2.1)
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)
Jordan	30 (4.1)	3 (1.4)	12 (3.0)	19 (3.5)	14 (3.2)	21 (3.6)	1 (0.8)
Korea, Rep. of	49 (4.0)	2 (1.0)	10 (2.0)	5 (1.6)	5 (1.7)	26 (3.2)	4 (1.6)
Malaysia	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
New Zealand	94 (1.7)	1 (0.5)	2 (0.9)	1 (0.6)	0 (0.0)	2 (1.6)	1 (0.6)
Philippines	88 (2.7)	6 (2.1)	3 (1.2)	0 (0.0)	1 (0.8)	2 (1.2)	1 (0.0)
Singapore	69 (4.1)	0 (0.0)	5 (2.0)	4 (1.8)	7 (2.3)	11 (2.5)	4 (1.6)
South Africa r	48 (5.0)	1 (0.8)	7 (2.5)	8 (2.8)	5 (2.3)	31 (4.0)	1 (0.9)
Thailand	81 (3.2)	7 (2.0)	4 (1.6)	1 (0.8)	3 (1.3)	3 (1.4)	1 (1.0)
Tunisia	8 (2.4)	8 (2.1)	81 (3.4)	1 (0.0)	0 (0.0)	0 (0.0)	3 (1.5)
Turkey	74 (3.1)	0 (0.3)	3 (1.3)	8 (2.1)	2 (1.0)	11 (2.7)	2 (0.9)
United States r	41 (4.7)	28 (4.8)	5 (1.5)	2 (0.8)	3 (1.0)	21 (3.1)	1 (0.4)
International Avg.	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.

() 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.

What Science Topics Are Included in the Intended Curriculum?

5.10



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. This list of topics, presented in Exhibit 5.10, built on the topics covered in the TIMSS 1995 science test and included in the teacher questionnaire. It represents a comprehensive list of the topics likely to have been included in the curricula of the participating countries up to and including eighth grade. From the following choices, the National Research Coordinators indicated the percentage of students in their own countries expected to have been taught each topic:

- 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)

5.11



Exhibit 5.11 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 country, across the entire list of topics and for each content area. There was marked variation between content areas and between countries. In 21 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 20 countries, while in six countries none of these topics were intended for all or almost all students. On average, biology topics were most likely, and chemistry topics least likely, to have been included in the intended curricula up to and including eighth grade.

In four countries – Moldova, Slovenia, Turkey, and the United States – it was intended that all of the topics in five content areas and some in the sixth be taught to all students. On the other hand, intended curricula in Belgium (Flemish), Chinese Taipei, Macedonia, Morocco, and South Africa included no content area in which all topics were to be taught to all students. Information on specific topics in the intended curricula for each content area is presented in Exhibits R2.3 through R2.8 in the reference section of this report.

R2.3-R2.8



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 5.7. 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. In addition, if content within a topic area required different responses, National Research Coordinators chose the response that best represented the entire topic area and noted the discrepancy (see Exhibit A.11 in the appendix for details).

Exhibit 5.10 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).

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 5.11 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
Australia	79	100	71	80	58	100	100
Belgium (Flemish)	38	0	71	40	0	67	83
Bulgaria	90	100	57	100	100	100	83
Canada	48	75	86	20	17	100	67
Chile	60	100	100	30	25	100	83
Chinese Taipei	69	25	86	80	58	67	83
Cyprus	62	75	86	40	50	100	67
Czech Republic	79	100	86	90	83	33	50
England	71	75	71	80	42	100	100
Finland	55	25	100	30	50	33	83
Hong Kong, SAR	50	25	100	60	42	0	33
Hungary	83	100	100	100	100	0	33
Indonesia	55	100	86	90	8	100	0
Iran, Islamic Rep.	57	100	100	60	50	33	0
Israel	57	0	43	40	75	67	100
Italy	67	75	100	70	25	100	83
Japan	62	100	57	70	50	0	83
Jordan	88	100	86	100	67	100	100
Korea, Rep. of	60	100	71	70	50	0	50
Latvia (LSS)	36	100	14	30	33	100	0
Lithuania	76	100	86	90	83	33	33
Macedonia, Rep. of	69	25	86	90	92	67	0
Malaysia	57	50	86	50	33	33	100
Moldova	95	100	100	100	83	100	100
Morocco	5	0	0	20	0	0	0
Netherlands	24	0	43	20	0	100	33
New Zealand	52	100	43	60	25	100	50
Philippines	55	100	71	50	42	67	33
Romania	81	100	100	70	92	100	33
Russian Federation	71	100	29	70	100	100	33
Singapore	79	100	100	70	58	100	83
Slovak Republic	–	–	–	–	–	–	–
Slovenia	95	100	100	80	100	100	100
South Africa	21	25	29	30	25	0	0
Thailand	64	50	100	40	42	100	100
Tunisia	45	25	100	40	0	67	83
Turkey	95	100	100	100	100	100	67
United States	86	100	100	100	50	100	100
International Avg.	63	72	77	64	52	69	60

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

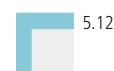
Background data provided by National Research Coordinators according to the national curriculum. NRCs indicated the percentage of students who should have been taught each of the topics listed in exhibit 5.10. The response categories were: all or almost all of the students (at least 90%); about half 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 R2.3-R2.8 for detail by topic.)

A dash (–) indicates data are not available.

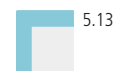
Have Students Been Taught the Topics Tested by TIMSS?

In interpreting the achievement results, it is important to consider how extensively the topics tested are taught in the participating countries. As shown in Exhibits 5.12 through 5.17, 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, 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 5.12 through 5.17 show the percentages of students in each country reported to have been taught each topic before or during the year of the testing.

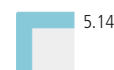
Although the international average percentage of students whose teachers reported that earth science topics (see Exhibit 5.12) were taught before or during the year of testing was greater than 70 percent for each topic, countries varied greatly in topic coverage. For example, in 19 countries at least 80 percent of students had been taught about “earth’s physical features,” but in two countries (Hong Kong and Japan) fewer than 20 percent of the students were reported to have been taught this topic. Topics from this content area may be taught in subjects other than science in some countries, so the percentage of students having been taught these topics may be underestimated for a few countries.



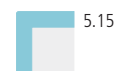
With the exception of “reproduction, genetics, evolution, and speciation,” biology topics (see Exhibit 5.13) had been taught to the great majority of students in most countries. Teachers in nine countries reported that 80 percent or more of their students were taught all of the biology topics. In comparison, teachers in four countries – Canada, Finland, South Africa and Tunisia – reported that less than 55 percent of their students were taught four of the six topics.



Of the physics topics (see Exhibit 5.14), “physical properties and the physical changes of matter” had the greatest coverage, with 91 percent of students, on average internationally, having been taught this topic. Lowest was “wave phenomena, sound, and vibration,” with an international average of 52 percent. At the extremes were the Netherlands, where all students were reported to have been taught all of the physics topics, and Tunisia, where very small percentages of students had been taught any of them.



Instructional coverage was high for three of the four chemistry topics (see Exhibit 5.15), but only 58 percent of students, internationally on average, were taught “energy and chemical change.” Teachers in 12 countries, including high-performing Chinese Taipei, Hungary, Korea,





and the Netherlands, reported having taught “classification of matter” and “structure of matter” to 97 percent or more of their students. Most of these countries reported that over 90 percent of their students were taught “chemical reactivity and transformations” as well. Furthermore, in both Hungary and the Netherlands, 97 percent or more of the students were reported to have been taught all the topic areas. In contrast, in Belgium (Flemish) and Tunisia, teachers reported that fewer than 15 percent of their students were taught each of the chemistry topic areas.

5.16



Most students in most countries were taught environmental and resource issues topics (see Exhibit 5.16), especially “pollution” and “conservation,” with 21 countries teaching these topics to 75 percent or more of their students. One country, Japan, reported teaching fewer than 30 percent of their students each of the topics in this area.

5.17



Each of the scientific inquiry and the nature of science topics (see Exhibit 5.17) was taught to 75 percent or more of the students, on average internationally. Ninety percent or more of the students in four countries – England, the Netherlands, Romania, and Singapore – were taught all six topic areas. Teachers in all countries taught each topic to more than 60 percent of their students except in seven countries: Belgium (Flemish), Iran, Israel, Jordan, South Africa, Tunisia, and Turkey.

Exhibit 5.12

Percentages of Students Taught Earth Science Topics*

		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 cycle, plate tectonics, fossils)	Earth in the solar system and the universe (interactions between earth, sun, and moon; relationship to planets and stars)			
Australia	r	73 (3.4)	r	65 (3.5)	r	67 (3.4)	r	80 (3.3)
Belgium (Flemish)	r	93 (3.0)	r	45 (4.3)	r	64 (5.2)	r	16 (3.4)
Bulgaria		99 (0.6)	r	99 (0.6)	r	99 (0.6)	r	99 (0.8)
Canada	s	91 (1.9)	s	83 (2.1)	s	86 (2.3)	s	80 (3.1)
Chile		95 (1.5)		95 (1.8)	r	81 (2.9)		94 (1.9)
Chinese Taipei ¹		--		--		--		--
Cyprus	s	45 (6.6)	s	38 (6.0)	s	39 (5.6)	s	88 (3.6)
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)
Finland		65 (4.0)	r	38 (4.0)		62 (3.5)	r	45 (4.1)
Hong Kong, SAR	s	17 (3.2)	r	61 (5.0)	s	17 (4.0)	s	15 (3.8)
Hungary		83 (3.1)		72 (3.9)		88 (2.8)		79 (3.8)
Indonesia		98 (1.2)		97 (1.5)		88 (3.1)		97 (1.5)
Iran, Islamic Rep.		95 (2.4)		72 (4.4)		69 (3.7)		68 (3.9)
Israel		x x		x x		x x		x x
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)
Jordan		98 (1.1)		84 (3.4)		88 (3.1)		82 (3.7)
Korea, Rep. of		91 (2.4)		98 (1.2)		95 (1.5)		52 (4.0)
Latvia (LSS)	s	92 (3.1)	r	83 (4.0)	s	78 (4.6)	r	86 (3.4)
Lithuania [‡]		--		--		--		--
Macedonia, Rep. of		88 (2.9)		88 (2.2)	r	86 (2.6)		85 (2.4)
Malaysia		32 (4.1)		32 (3.9)		14 (3.0)		16 (3.2)
Moldova		--		--		--		--
Morocco		--		--		--		--
Netherlands		76 (5.6)		91 (2.7)		92 (4.1)	r	82 (4.8)
New Zealand		40 (3.9)		45 (3.9)	r	40 (3.9)		63 (3.5)
Philippines		99 (0.6)		98 (1.1)		98 (1.0)		74 (3.8)
Romania		100 (0.0)		100 (0.0)		99 (1.0)		99 (0.8)
Russian Federation		--		--		--		--
Singapore		x x		x x		x x		x x
South Africa	s	72 (5.2)	s	68 (5.9)		x x	s	62 (6.0)
Thailand		99 (0.7)		63 (3.8)		95 (1.8)		88 (2.6)
Tunisia		82 (3.5)	r	12 (3.0)		16 (3.4)	r	4 (1.9)
Turkey		42 (3.7)		60 (4.0)		37 (4.2)		73 (3.4)
United States	r	87 (2.5)	r	84 (2.7)	r	92 (2.0)	r	84 (2.3)
International Avg.		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.

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

¹ Data for grade 9 earth science teachers not available.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 5.13 Percentages of Students Taught Biology Topics*

		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	
Australia	r	80 (3.3)	r	75 (3.3)	r	84 (2.7)	r	39 (3.8)
Belgium (Flemish)		98 (1.0)		100 (0.0)	r	91 (2.6)	r	94 (2.2)
Bulgaria		94 (3.4)		95 (3.3)	r	96 (2.2)	r	36 (5.2)
Canada	s	54 (3.0)	s	54 (3.8)	s	70 (3.2)	s	45 (3.7)
Chile		95 (1.8)		94 (1.7)		96 (1.2)		92 (2.2)
Chinese Taipei ¹		--	--	--	--	--	--	
Cyprus	r	100(0.0)	r	100 (0.0)	s	82 (4.1)	r	30 (4.1)
Czech Republic		99 (0.4)		98 (1.1)		96 (2.1)		57 (5.4)
England	s	96 (1.9)	s	99 (0.8)	s	91 (3.2)	s	80 (3.6)
Finland		30 (4.0)		28 (3.5)		90 (2.6)		21 (3.4)
Hong Kong, SAR		79 (3.8)		76 (3.6)	r	69 (4.6)	r	61 (4.6)
Hungary		93 (2.2)		94 (2.1)		99 (1.0)		87 (2.8)
Indonesia		100(0.0)		99 (1.1)		100 (0.3)		50 (4.4)
Iran, Islamic Rep.		99 (0.7)		99 (0.8)		91 (2.5)		95 (1.8)
Israel	r	77 (3.6)	r	57 (3.9)	r	66 (3.9)	r	76 (3.3)
Italy		99 (0.9)		99 (0.9)		100 (0.0)		87 (2.9)
Japan		97 (1.7)		96 (1.8)		86 (3.0)		8 (2.5)
Jordan		96 (2.0)		98 (1.1)		87 (3.3)	r	61 (5.1)
Korea, Rep. of		91 (2.2)		92 (2.2)		76 (3.7)		54 (4.3)
Latvia (LSS)		49 (4.4)		46 (4.3)		98 (1.3)		49 (4.8)
Lithuania [*]		--	--	--	--	--	--	
Macedonia, Rep. of		99 (0.8)		99 (1.0)		96 (1.6)		90 (2.7)
Malaysia		96 (1.8)		93 (2.1)		75 (4.0)		15 (2.9)
Moldova		--		--	--	--	--	
Morocco		--		--	--	--	--	
Netherlands	r	100(0.0)	r	100 (0.0)	r	100 (0.0)	r	99 (0.9)
New Zealand		58 (4.1)		55 (4.4)		85 (3.0)		28 (3.3)
Philippines		46 (4.0)		61 (4.1)		63 (3.9)		44 (4.4)
Romania		99 (0.6)		99 (0.6)		99 (1.2)		96 (1.6)
Russian Federation		--		--		--		--
Singapore		97 (1.5)		97 (1.6)	r	86 (3.8)	r	92 (2.7)
South Africa	r	43 (5.4)	s	44 (5.6)	r	80 (4.1)	r	49 (5.6)
Thailand		93 (2.3)		94 (2.0)		79 (3.2)		91 (2.8)
Tunisia		53 (4.1)		49 (4.6)		92 (2.4)		24 (3.4)
Turkey		93 (2.9)		93 (2.6)		92 (2.0)		63 (3.9)
United States	r	90 (2.6)	r	90 (2.1)	r	92 (1.9)	r	83 (2.8)
International Avg.		84 (0.5)		83 (0.5)		87 (0.5)		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.

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

¹ Data for grade 7 biology teachers not available.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit 5.14

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)
Australia	r 91 (2.4)	r 80 (3.2)	r 71 (3.2)	r 76 (3.3)	r 39 (4.1)	r 48 (4.4)	r 72 (3.2)	r 45 (4.0)
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)	s 33 (4.5)
Bulgaria	r 97 (1.7)	r 89 (2.9)	r 98 (1.0)	r 97 (1.3)	r 87 (3.3)	r 84 (6.9)	r 97 (1.4)	r 96 (1.9)
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)	s 56 (3.1)
Chile	96 (1.7)	85 (3.0)	92 (2.2)	96 (1.4)	r 52 (4.3)	r 61 (4.8)	r 57 (4.1)	52 (3.7)
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)
Cyprus	r 100 (0.0)	r 28 (5.4)	r 96 (2.5)	r 100 (0.0)	s 11 (3.9)	s 88 (3.4)	s 20 (4.5)	s 12 (3.9)
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)	s 98 (1.1)
Finland	80 (3.4)	83 (3.0)	14 (2.8)	49 (4.0)	44 (3.7)	17 (3.2)	35 (4.1)	51 (3.6)
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)	r 41 (4.9)
Hungary	98 (1.2)	92 (2.3)	100 (0.2)	97 (1.5)	87 (3.1)	58 (4.0)	97 (1.5)	98 (1.2)
Indonesia	93 (2.2)	79 (3.7)	85 (3.4)	91 (2.5)	90 (2.4)	90 (2.4)	60 (4.5)	85 (3.6)
Iran, Islamic Rep.	100 (0.0)	99 (0.9)	100 (0.0)	96 (1.2)	r 48 (4.8)	97 (1.5)	97 (1.2)	69 (3.8)
Israel	94 (1.9)	89 (2.6)	r 40 (4.7)	r 35 (4.0)	r 7 (2.6)	r 11 (3.2)	r 76 (4.1)	r 19 (3.8)
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)
Jordan	99 (0.8)	99 (0.8)	92 (2.2)	94 (2.4)	97 (1.4)	98 (1.1)	88 (2.9)	99 (0.8)
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)
Latvia (LSS)	98 (1.2)	55 (4.4)	71 (4.1)	77 (3.9)	83 (3.4)	90 (2.2)	8 (2.5)	71 (4.5)
Lithuania [†]	--	--	--	--	--	--	--	--
Macedonia, Rep. of	r 98 (1.2)	r 95 (2.1)	r 98 (1.3)	97 (1.5)	r 19 (3.8)	92 (2.3)	98 (1.1)	97 (0.9)
Malaysia	83 (3.4)	29 (4.1)	81 (3.6)	80 (3.4)	87 (2.6)	89 (2.6)	36 (4.3)	76 (3.5)
Moldova	--	--	--	--	--	--	--	--
Morocco	--	--	--	--	--	--	--	--
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)
New Zealand	94 (1.9)	74 (3.6)	78 (3.4)	78 (3.3)	24 (3.3)	69 (4.0)	34 (4.0)	51 (4.2)
Philippines	95 (1.8)	77 (3.5)	94 (2.0)	89 (2.6)	58 (4.7)	70 (4.4)	63 (4.6)	85 (2.8)
Romania	100 (0.0)	91 (2.5)	96 (1.8)	99 (0.7)	16 (3.5)	98 (1.2)	98 (1.5)	98 (1.1)
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)	r 82 (4.2)
South Africa	88 (2.8)	r 48 (4.5)	75 (3.7)	r 56 (4.9)	r 27 (4.3)	r 35 (4.4)	89 (2.5)	r 39 (5.2)
Thailand	r 76 (4.2)	r 76 (4.1)	r 53 (4.9)	r 60 (4.6)	r 34 (4.2)	r 27 (4.4)	r 49 (5.0)	r 26 (4.4)
Tunisia	s 9 (3.1)	s 3 (1.8)	s 7 (2.6)	s 15 (4.0)	s 6 (2.5)	s 9 (3.1)	s 12 (3.6)	s 13 (3.4)
Turkey	99 (0.5)	96 (1.9)	98 (1.4)	100 (0.0)	r 46 (4.5)	93 (2.4)	96 (1.8)	99 (0.6)
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)	r 75 (3.4)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit 5.15 Percentages of Students Taught Chemistry Topics*

		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)
Australia		98 (1.1)	r 89 (2.6)	r 65 (4.1)	r 42 (3.8)
Belgium (Flemish)	s	13 (2.9)	s 8 (2.6)	s 8 (3.0)	s 4 (1.9)
Bulgaria		99 (0.8)	99 (1.1)	99 (0.5)	r 87 (2.8)
Canada	r	80 (2.3)	s 63 (3.1)	s 54 (4.2)	s 36 (3.6)
Chile		95 (1.8)	90 (2.1)	86 (3.0)	r 83 (3.2)
Chinese Taipei		100 (0.0)	97 (1.4)	100 (0.0)	84 (2.9)
Cyprus	r	95 (1.7)	r 80 (4.2)	r 68 (4.4)	r 53 (4.9)
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)
Finland		95 (1.7)	89 (2.6)	79 (2.7)	51 (3.6)
Hong Kong, SAR		90 (2.7)	r 66 (4.6)	r 57 (5.0)	r 71 (4.8)
Hungary		100 (0.0)	100 (0.0)	97 (1.4)	99 (1.0)
Indonesia		x x	x x	x x	x x
Iran, Islamic Rep.		100 (0.0)	97 (1.6)	97 (1.1)	66 (4.8)
Israel		95 (2.1)	94 (2.2)	62 (4.1)	r 29 (4.0)
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)
Jordan		99 (0.6)	99 (0.9)	98 (1.1)	62 (4.5)
Korea, Rep. of		99 (0.8)	97 (1.4)	91 (2.3)	51 (3.8)
Latvia (LSS)		99 (0.9)	99 (0.9)	89 (2.6)	54 (4.8)
Lithuania [†]		--	--	--	--
Macedonia, Rep. of		98 (1.0)	99 (0.9)	99 (0.7)	87 (3.0)
Malaysia		82 (3.2)	71 (3.7)	57 (4.4)	39 (4.3)
Moldova		--	--	--	--
Morocco		--	--	--	--
Netherlands	r	99 (1.0)	r 99 (0.9)	r 99 (0.9)	r 99 (0.8)
New Zealand		96 (1.5)	89 (2.6)	61 (4.1)	35 (3.6)
Philippines		92 (2.2)	87 (2.7)	83 (3.2)	72 (3.8)
Romania		100 (0.0)	99 (0.7)	84 (4.0)	36 (4.9)
Russian Federation		--	--	--	--
Singapore		98 (1.3)	93 (2.5)	r 89 (2.9)	x x
South Africa		96 (1.8)	72 (3.5)	65 (4.0)	r 43 (4.5)
Thailand		86 (3.6)	86 (3.5)	r 51 (4.8)	r 52 (4.3)
Tunisia	s	9 (3.1)	s 1 (0.9)	s 3 (1.8)	s 1 (1.1)
Turkey		97 (1.5)	96 (1.9)	94 (2.1)	95 (1.8)
United States	r	88 (2.2)	r 88 (2.6)	r 76 (3.4)	r 66 (3.9)
International Avg.		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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 5.16

Percentages of Students Taught Environmental and Resource Issues Topics*

TIMSS 1999
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
Australia	r	62 (3.6)	r 45 (3.9)	r 40 (3.6)
Belgium (Flemish)	r	89 (3.3)	r 82 (3.7)	r 63 (4.3)
Bulgaria	s	92 (2.9)	s 89 (3.3)	s 84 (4.0)
Canada	s	92 (1.4)	s 90 (2.2)	s 83 (2.9)
Chile		97 (1.3)	97 (1.3)	90 (2.3)
Chinese Taipei	r	73 (3.5)	r 48 (4.4)	r 41 (4.7)
Cyprus	s	93 (3.2)	s 89 (3.7)	s 50 (5.0)
Czech Republic		92 (2.6)	92 (2.5)	82 (4.1)
England	s	79 (4.5)	s 71 (5.1)	s 71 (4.6)
Finland		78 (3.2)	77 (4.0)	55 (4.2)
Hong Kong, SAR		74 (4.3)	r 54 (5.3)	r 30 (4.7)
Hungary		99 (1.0)	99 (1.0)	89 (2.8)
Indonesia		79 (4.0)	85 (3.0)	79 (3.8)
Iran, Islamic Rep.		39 (4.3)	88 (2.9)	69 (3.8)
Israel	r	44 (4.8)	s 37 (4.5)	r 35 (4.4)
Italy		84 (2.6)	80 (2.8)	70 (3.4)
Japan		26 (3.4)	7 (2.4)	7 (2.4)
Jordan		87 (2.9)	81 (3.6)	r 72 (4.4)
Korea, Rep. of		75 (3.8)	58 (4.5)	49 (4.4)
Latvia (LSS)	r	88 (3.4)	r 87 (3.3)	r 75 (4.4)
Lithuania [†]		--	--	--
Macedonia, Rep. of	r	86 (3.1)	r 89 (2.7)	r 84 (3.5)
Malaysia		82 (3.5)	75 (3.7)	77 (3.9)
Moldova		--	--	--
Morocco		--	--	--
Netherlands		99 (1.0)	98 (1.0)	r 98 (1.1)
New Zealand		60 (3.9)	61 (4.0)	r 40 (4.1)
Philippines		95 (1.9)	97 (1.4)	90 (2.3)
Romania		94 (2.5)	94 (2.3)	96 (2.2)
Russian Federation		--	--	--
Singapore		93 (2.4)	r 86 (3.5)	s 64 (5.0)
South Africa	s	60 (4.2)	s 66 (4.6)	s 59 (4.9)
Thailand		83 (3.4)	92 (2.3)	89 (2.3)
Tunisia	r	37 (4.2)	r 52 (4.7)	r 42 (4.8)
Turkey		87 (3.3)	84 (3.4)	74 (3.5)
United States	r	83 (2.4)	r 79 (2.5)	s 81 (2.9)
International Avg.		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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit 5.17 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
Australia	98 (0.7)	r 95 (1.2)	r 78 (3.5)	98 (1.2)	99 (0.5)	96 (2.0)
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)
Bulgaria	x x	x x	x x	x x	x x	x x
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)
Chile	98 (1.2)	86 (3.1)	r 71 (3.6)	78 (3.2)	93 (2.0)	91 (1.9)
Chinese Taipei	85 (3.2)	71 (4.0)	83 (3.3)	90 (2.7)	68 (4.0)	69 (3.9)
Cyprus	r 100 (0.0)	r 93 (3.0)	r 85 (3.5)	r 93 (2.5)	s 88 (3.0)	r 92 (2.3)
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)
Finland	89 (2.8)	89 (2.5)	82 (2.9)	84 (2.7)	90 (2.6)	92 (2.2)
Hong Kong, SAR	85 (3.4)	68 (4.5)	63 (4.8)	88 (3.1)	81 (3.4)	r 80 (3.3)
Hungary	96 (1.7)	93 (1.9)	80 (3.5)	77 (3.7)	97 (1.7)	99 (0.7)
Indonesia	90 (2.8)	63 (4.1)	67 (4.6)	78 (4.2)	80 (3.8)	71 (4.0)
Iran, Islamic Rep.	r 64 (4.3)	77 (3.5)	r 54 (4.5)	83 (3.3)	r 57 (4.4)	r 60 (4.1)
Israel	r 91 (2.6)	91 (2.7)	r 55 (4.6)	r 84 (3.5)	82 (3.7)	88 (3.0)
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)
Jordan	r 58 (4.7)	r 55 (4.8)	r 53 (5.0)	83 (3.2)	r 78 (4.0)	75 (4.2)
Korea, Rep. of	93 (2.1)	89 (2.6)	84 (3.1)	99 (0.7)	92 (2.1)	86 (2.9)
Latvia (LSS)	r 82 (3.8)	r 95 (2.1)	r 61 (5.3)	r 82 (3.9)	r 92 (2.9)	r 91 (2.8)
Lithuania [‡]	--	--	--	--	--	--
Macedonia, Rep. of	s 87 (3.9)	x x	x x	x x	s 84 (4.8)	s 85 (4.7)
Malaysia	87 (3.2)	76 (4.2)	68 (4.0)	95 (2.3)	83 (3.3)	83 (3.4)
Moldova	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
Netherlands	92 (3.7)	96 (3.0)	99 (0.7)	100 (0.0)	100 (0.0)	100 (0.0)
New Zealand	99 (0.8)	96 (1.7)	85 (3.3)	97 (1.8)	99 (0.6)	99 (1.0)
Philippines	100 (0.4)	96 (1.7)	87 (2.9)	90 (2.7)	97 (1.4)	98 (1.1)
Romania	r 94 (2.5)	r 92 (3.0)	r 90 (3.0)	r 94 (2.3)	r 95 (2.2)	r 96 (2.1)
Russian Federation	--	--	--	--	--	--
Singapore	94 (2.2)	r 93 (2.6)	r 91 (3.0)	97 (1.7)	95 (2.1)	96 (1.9)
South Africa	r 66 (4.1)	r 65 (4.1)	r 53 (4.8)	r 73 (4.2)	r 68 (4.8)	r 69 (3.9)
Thailand	90 (2.2)	89 (2.4)	76 (4.0)	93 (2.0)	87 (3.1)	82 (3.2)
Tunisia	r 85 (3.4)	r 84 (3.5)	r 47 (5.2)	r 73 (4.1)	r 70 (3.8)	79 (3.7)
Turkey	r 58 (4.3)	r 76 (3.4)	r 55 (4.0)	r 65 (4.4)	r 67 (4.6)	r 59 (4.7)
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)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Can Meaningful Comparisons Between Intended and Implemented Curricula Be Made?

The TIMSS 1999 results indicate some discrepancies in a number of countries between the intended curriculum in science and the implemented curriculum as reported by teachers. There are many cases of topics intended to be taught to all, or almost all, students in a country for which teachers reported lower coverage. Interestingly, there are even more cases for which teachers reported greater topic coverage than would be expected from the intended curriculum. Such discrepancies are consistent with previous IEA studies.² However, considering the broad nature of the topic areas, care should be taken in interpreting the results. Further analysis will need to be done within each country to strengthen the match between the intended and implemented curricula.

² Livingstone, I.D., (1986), *Second International Mathematics Study: Perceptions of the Intended and Implemented Mathematics Curriculum*, Washington, D.C., Center for Statistics, U.S. Department of Education.



CHAPTER 6

6

Teachers and Instruction

To provide information about science teachers and instruction, Chapter 6 presents teachers' reports on their background and training and their instructional practices. Information also is presented about 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 approaches.





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 science concepts being studied. Teachers may help students use technology and tools to investigate scientific ideas, analyze students' work for misconceptions, and promote positive attitudes toward science. They may also assign homework and conduct informal as well as formal assessments to evaluate achievement outcomes.

To collect information about science instruction, TIMSS administered a two-part questionnaire in which teachers were first asked to provide information about their background and training and how they think about science. The questionnaire then asked about instructional practices, including how teachers spend their time related to teaching tasks and their instructional approaches. Information was also collected about the materials used in instruction, the activities of students in class, the use of calculators and computers in science lessons, the role of homework, and the reliance on different types of assessment. Chapter 6 presents teachers' responses to some of these questions.

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. In countries with separate science teachers, all science teachers of the students in the sampled mathematics classes were to complete questionnaires.¹ Thus, the information about instruction is tied directly to the students tested and the specific science classes in which they were taught. The data obtained from the science teacher background questionnaires appear in two types of displays. For some of the general information, data are presented together for all science teachers in all countries. For information that may be specific to the science subject, such as preparation to teach the sciences, instructional time in the sciences, and emphasis on experimental methods, the data are presented separately for the teachers of general/integrated science and of separate science subject areas. The latter type of display permits comparisons across the different science subjects taught in each country.

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 country. Rather, they represent teachers of the representative samples of students assessed.

¹ In Slovenia and the Slovak Republic, background questionnaires were administered to only one of the separate science subject-area teachers for the sampled mathematics classes. As a result, science teacher background data are not available for more than half of the relevant science teachers, and Slovenia and the Slovak Republic are not included in the exhibits based on these data.



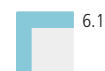
It is important to note that when information from the teachers' questionnaires is being reported, the student is always the unit of analysis. That is, the data shown are the percentages of students whose teachers reported on various characteristics or instructional strategies. Using the student as the unit of analysis makes it possible to describe the 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 providing information about the educational contexts and performance of students.

In some cases, teachers did not complete the questionnaire assigned to them, so most countries had some percentage of students for whom no teacher questionnaire information is available. The exhibits in this chapter have special notations regarding the availability of teacher responses. For a country where teacher responses are available for 70 to 84 percent of the students, an "r" is included next to its data. Where teacher responses are available for 50 to 69 percent of students, an "s" is included. Where teacher responses are available for less than 50 percent, an "x" replaces the data.

What Preparation Do Teachers Have for Teaching Science?

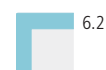
This section provides information about background characteristics of science teachers, including age and gender, major area of study, and certification. Teachers' confidence in teaching various science topics is also discussed.

As shown in Exhibit 6.1, internationally on average, 61 percent of students 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. The distribution in the age of teachers varies markedly from country to country. An aging teacher population is most evident in the following countries, where two-thirds or more of students had science teachers age 40 or older: Chile, Cyprus, the Czech Republic, Finland, Italy, Macedonia, and Moldova. In contrast, several countries had younger science teachers. Hong Kong, Iran, Jordan, South Africa, and Tunisia each had at least 30 percent of their students taught by teachers younger than age 30. Further, countries where at least 70 percent of students had teachers younger than age 40 were Hong Kong, Indonesia, Jordan, Malaysia, the Philippines, South Africa and Tunisia.



Internationally on average, 58 percent of eighth-grade students had female science teachers, and the majority of students in 21 countries were taught by females. At the extreme is the Russian Federation, where 88 percent of students were taught by female teachers. Other countries where at least 70 percent had female teachers were Bulgaria, Chile, the Czech Republic, Hungary, Israel, Italy, Latvia (LSS), Lithuania, Moldova, the Philippines, and Romania. In contrast, in Japan, Morocco, and the Netherlands, three-fourths or more of students had male science teachers. Interestingly, the countries where the majority of students had male teachers include several that have a common history or traditions: Australia, Canada, England, Hong Kong, New Zealand, South Africa, and the United States.

Science teaching is a complex activity requiring well-educated and skilled instructors. Exhibit 6.2 presents teachers' reports about their educational preparation and certification. In countries where general/integrated science is taught, the educational preparation reflects teachers with a major in any area of science, including biology, physics, chemistry, or science education. In countries where the sciences are taught by separate subject area teachers, the educational preparation in the sciences reflects teachers with a major in their area of specialization.² Teachers can have dual majors, or different majors at



² For earth science teachers, majors in all science fields were included. In Chinese Taipei, Finland, Morocco, and the Netherlands, data for the physical science teachers are reported in the physics panel; relevant science majors for these teachers were either physics or chemistry.



Exhibit 6.1 Age and Gender of Teachers

	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
Australia	16 (2.7)	31 (3.4)	34 (3.3)	19 (2.7)	43 (4.0)	57 (4.0)
Belgium (Flemish)	25 (2.8)	24 (3.1)	34 (3.5)	17 (2.5)	64 (3.9)	36 (3.9)
Bulgaria	13 (3.0)	27 (2.8)	33 (2.8)	27 (2.8)	81 (2.5)	19 (2.5)
Canada	21 (3.1)	31 (2.6)	31 (2.9)	18 (2.6)	41 (3.3)	59 (3.3)
Chile	5 (1.7)	23 (2.4)	46 (4.1)	26 (3.4)	72 (3.4)	28 (3.4)
Chinese Taipei	17 (3.0)	40 (3.9)	32 (3.7)	11 (2.6)	40 (3.7)	60 (3.7)
Cyprus	0 (0.0)	26 (1.5)	37 (2.5)	37 (2.0)	60 (2.6)	40 (2.6)
Czech Republic	12 (1.8)	20 (2.0)	21 (2.2)	47 (3.1)	74 (2.4)	26 (2.4)
England	24 (4.0)	23 (3.6)	31 (4.0)	22 (3.4)	43 (4.3)	57 (4.3)
Finland	8 (1.9)	22 (2.6)	34 (2.7)	35 (2.8)	63 (2.9)	37 (2.9)
Hong Kong, SAR	34 (4.3)	38 (4.6)	19 (3.6)	9 (2.7)	39 (4.2)	61 (4.2)
Hungary	11 (1.7)	25 (2.0)	37 (2.3)	27 (2.2)	72 (1.9)	28 (1.9)
Indonesia	21 (2.5)	55 (3.0)	18 (2.7)	6 (1.6)	49 (3.6)	51 (3.6)
Iran, Islamic Rep.	34 (3.9)	28 (4.5)	38 (4.1)	1 (0.7)	38 (4.3)	62 (4.3)
Israel	21 (3.0)	34 (4.0)	32 (3.6)	13 (2.9)	83 (2.7)	17 (2.7)
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)
Jordan	40 (4.4)	41 (4.2)	16 (3.1)	3 (1.4)	48 (4.5)	52 (4.5)
Korea, Rep. of	17 (2.6)	49 (3.4)	22 (3.3)	12 (2.6)	59 (3.3)	41 (3.3)
Latvia (LSS)	10 (1.8)	29 (2.6)	27 (2.6)	34 (3.2)	77 (2.7)	23 (2.7)
Lithuania [†]	9 (1.5)	30 (2.3)	32 (2.4)	29 (2.4)	82 (1.9)	18 (1.9)
Macedonia, Rep. of	3 (0.7)	19 (1.9)	29 (2.6)	49 (2.6)	53 (2.1)	47 (2.1)
Malaysia	28 (3.1)	45 (4.4)	22 (3.2)	5 (1.8)	69 (3.8)	31 (3.8)
Moldova	12 (1.6)	20 (1.9)	28 (1.9)	40 (2.4)	72 (1.7)	28 (1.7)
Morocco	18 (2.1)	46 (3.4)	36 (3.0)	0 (0.0)	22 (2.3)	78 (2.3)
Netherlands	19 (2.9)	23 (3.3)	34 (3.8)	25 (3.2)	20 (2.6)	80 (2.6)
New Zealand	16 (2.7)	29 (3.8)	32 (3.3)	24 (3.6)	45 (3.8)	55 (3.8)
Philippines	29 (3.3)	41 (4.1)	21 (3.2)	10 (2.6)	80 (3.5)	20 (3.5)
Romania	16 (1.7)	23 (1.9)	24 (2.0)	38 (2.4)	75 (2.1)	25 (2.1)
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)
South Africa	36 (4.2)	52 (4.6)	11 (2.1)	1 (0.5)	47 (3.5)	53 (3.5)
Thailand	24 (3.6)	34 (4.0)	32 (3.6)	10 (2.3)	63 (4.5)	37 (4.5)
Tunisia	31 (3.3)	41 (4.2)	21 (3.2)	7 (2.0)	60 (4.2)	40 (4.2)
Turkey	26 (3.4)	28 (3.9)	43 (4.1)	4 (1.2)	39 (4.0)	61 (4.0)
United States	20 (2.6)	19 (2.2)	29 (2.8)	32 (2.7)	48 (3.5)	52 (3.5)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.



the undergraduate and graduate level. Exhibit R3.1 in the reference section provides detail for each of the following major areas of study: biology, physics, chemistry, science education, mathematics or mathematics education, education (other than mathematics or science education), and other, which includes majors in any other areas.



Typically, a high percentage of students in countries with separate science courses were taught by teachers with a major in their area of specialization. Internationally, 95 percent of earth science, 87 percent of biology, 86 percent of physics, and 89 percent of chemistry students had teachers who had majors in the relevant science. In most countries, at least 80 percent of students in most subjects were taught by teachers with the relevant major. In particular, in the Czech Republic, Hungary, Latvia (LSS), Lithuania, Macedonia, and the Russian Federation, 90 percent or more of students in all subject areas had teachers with majors in the corresponding field of science.

In the countries with general/integrated science courses, there was more variation in the percentage of students taught by teachers with a major in any area of science. Internationally on average, 82 percent of students had teachers with a major in science, with less than 80 percent in nine countries: Canada, Chile, Italy, Malaysia, New Zealand, the Philippines, South Africa, Thailand, and the United States. In another nine countries, however, more than 90 percent of students had teachers with a major in science: Cyprus, England, Islamic Republic of Iran, Israel, Jordan, Korea, Singapore, Tunisia, and Turkey.

In most countries, the vast majority of students were taught science by teachers having a teaching certificate. Internationally on average, the percentage of students taught by certified teachers was 86 percent in countries where general/integrated science is taught, and ranged from 85 percent for chemistry to 89 percent for earth science in countries with separate sciences. In TIMSS 1995, detailed information collected about certification indicated a wide range of criteria across countries.³ For example, the number of years of post-secondary education required for a teaching qualification ranged from two years in Iran to as many as six years in Canada; many countries reported four years. Almost all countries reported that teaching practice was required, and a large number reported that an evaluation or examination was required for certification. In some countries, such as the United States, the types of certification varied according to the policies of different states. Despite difficulties in interpretation illustrated by the 1995 data, however, it is interesting to note that in TIMSS 1999 the

³ 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.



Exhibit 6.2 Preparation to Teach the Sciences

		Percent of Students Taught by Teachers Having Science as the Major Area of Study in Their BA, MA, or Teacher Training Program ¹	Percent of Students Taught by Certified Teachers ²	Percent of Students Taught by Teachers Having Both Teacher Certification and Science as the Major Area of Study
General/Integrated Science				
	Australia	87 (2.4)	100 (0.0)	87 (2.4)
	Canada	50 (2.7)	98 (0.9)	48 (2.8)
	Chile	73 (3.1)	99 (0.6)	73 (3.2)
	Cyprus	95 (1.4)	29 (2.0)	27 (2.5)
	England	s 95 (1.8)	s 95 (1.2)	s 90 (2.0)
	Hong Kong, SAR	84 (3.2)	84 (3.1)	73 (3.6)
	Iran, Islamic Rep.	s 91 (2.4)	68 (4.5)	59 (4.3)
	Israel	95 (1.7)	91 (2.2)	86 (2.8)
	Italy ³	66 (3.4)	--	--
	Japan	r 86 (3.2)	100 (0.0)	r 86 (3.2)
	Jordan	91 (2.3)	48 (4.2)	42 (4.4)
	Korea, Rep. of	93 (1.7)	98 (1.1)	91 (2.0)
	Malaysia	74 (4.0)	96 (1.5)	72 (4.0)
	New Zealand	74 (3.6)	97 (1.1)	71 (3.7)
	Philippines	69 (3.8)	90 (2.5)	60 (4.1)
	Singapore	94 (2.3)	100 (0.0)	94 (2.3)
	South Africa	78 (3.7)	92 (2.2)	71 (4.0)
	Thailand	75 (3.6)	85 (3.1)	64 (4.2)
	Tunisia	90 (2.6)	89 (2.7)	79 (3.6)
	Turkey	97 (1.8)	84 (2.7)	80 (3.3)
	United States	71 (2.8)	r --	r --
	International Avg.	82 (0.6)	86 (0.5)	71 (0.8)
Earth Science				
	Belgium (Flemish)	98 (1.4)	99 (0.5)	97 (1.2)
	Bulgaria	89 (6.6)	99 (0.6)	89 (6.6)
	Chinese Taipei	--	--	--
	Czech Republic	98 (1.3)	96 (2.6)	94 (2.9)
	Finland	--	--	--
	Hungary	99 (0.8)	98 (1.3)	97 (1.6)
	Indonesia	--	--	--
	Latvia (LSS)	--	--	--
	Lithuania ⁴	--	--	--
	Macedonia, Rep. of	93 (2.4)	99 (1.0)	91 (2.6)
	Moldova	r 83 (4.0)	42 (4.3)	32 (4.3)
	Morocco	--	--	--
	Netherlands	r 99 (0.6)	99 (0.5)	r 99 (0.8)
	Romania	r 98 (1.1)	72 (4.0)	70 (4.1)
	Russian Federation	100 (0.0)	95 (1.7)	95 (1.8)
	International Avg.	95 (0.9)	89 (0.8)	85 (1.1)

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

Background data provided by teachers.

¹ Countries are classified as having either general/integrated science or separate science subject classes. Teachers having science as the major area of study in each subject are those who reported having a bachelor's degree (BA) or equivalent, master's degree (MA), or teacher training certificate in the relevant field(s). For general/integrated science teachers, majors in biology, physics, chemistry, or science education are included; for earth science teachers, majors in biology, physics, chemistry, science education, or other are included; for biology teachers, a major in biology is included; for physics or physical science teachers, majors in physics or chemistry are included; for chemistry teachers, a major in chemistry is included.

² Includes teachers certified to teach any subject.

³ Italy: Teacher training certificate not required but teachers must excel on a national exam.

⁴ 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.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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.

		Percent of Students Taught by Teachers Having Science as the Major Area of Study in Their BA, MA, or Teacher Training Program ¹	Percent of Students Taught by Certified Teachers ²	Percent of Students Taught by Teachers Both Certified and Having Science as the Major Area of Study
Biology				
	Belgium (Flemish)	79 (4.2)	99 (0.7)	79 (4.3)
	Bulgaria	93 (2.0)	100 (0.0)	93 (2.0)
	Chinese Taipei ^a	--	--	--
	Czech Republic	96 (2.1)	96 (2.1)	92 (2.9)
	Finland ^b	70 (4.0)	88 (3.4)	61 (4.7)
	Hungary	94 (1.8)	99 (0.9)	94 (1.9)
	Indonesia	68 (4.8)	93 (1.9)	64 (4.8)
	Latvia (LSS)	97 (1.7)	r 63 (5.3)	r 62 (5.4)
	Lithuania [†]	93 (2.2)	85 (3.0)	80 (3.5)
	Macedonia, Rep. of	92 (2.4)	99 (0.9)	90 (2.5)
	Moldova	70 (2.7)	r 41 (4.5)	r 32 (4.1)
	Morocco ^c	r 89 (2.5)	r 84 (2.2)	r 75 (3.1)
	Netherlands	r 91 (3.1)	95 (2.8)	r 85 (4.5)
	Romania	92 (3.4)	91 (2.3)	84 (3.9)
	Russian Federation	93 (2.0)	94 (2.5)	88 (3.0)
	International Avg.	87 (0.8)	88 (0.7)	77 (1.0)
	Physics			
	Belgium (Flemish)	82 (4.4)	100 (0.0)	82 (4.5)
	Bulgaria	88 (2.8)	99 (0.8)	87 (2.8)
	Chinese Taipei ^a	97 (1.5)	93 (2.2)	91 (2.5)
	Czech Republic	95 (2.5)	95 (2.5)	89 (3.5)
	Finland ^b	59 (3.2)	94 (2.0)	55 (3.4)
	Hungary	94 (2.0)	100 (0.0)	94 (2.0)
	Indonesia	58 (4.7)	94 (2.1)	54 (4.4)
	Latvia (LSS)	r 95 (1.7)	61 (4.2)	59 (4.2)
	Lithuania [†]	90 (2.5)	89 (2.3)	82 (3.1)
	Macedonia, Rep. of	98 (1.1)	99 (0.9)	96 (1.5)
	Moldova	83 (3.0)	30 (3.6)	22 (3.4)
	Morocco ^c	94 (2.1)	93 (1.9)	87 (2.8)
	Netherlands ^d	r 69 (7.0)	87 (4.9)	r 60 (7.4)
	Romania	96 (1.7)	86 (2.9)	84 (3.2)
	Russian Federation	95 (2.1)	93 (2.2)	89 (2.9)
	International Avg.	86 (0.8)	88 (0.7)	75 (0.9)
	Chemistry			
	Belgium (Flemish)	--	--	--
	Bulgaria	89 (2.7)	99 (0.6)	89 (2.8)
	Chinese Taipei	--	--	--
	Czech Republic	92 (3.0)	97 (1.8)	91 (3.2)
	Finland	--	--	--
	Hungary	90 (2.2)	99 (0.7)	90 (2.2)
	Indonesia	--	--	--
	Latvia (LSS)	94 (2.6)	72 (3.8)	68 (4.2)
	Lithuania [†]	92 (2.5)	82 (3.0)	77 (3.3)
	Macedonia, Rep. of	96 (1.7)	99 (0.7)	95 (1.8)
	Moldova	69 (3.6)	44 (4.3)	29 (3.8)
	Morocco	--	--	--
	Netherlands	--	--	--
	Romania	86 (2.8)	85 (2.8)	75 (3.6)
	Russian Federation	90 (2.7)	89 (3.6)	80 (4.3)
	International Avg.	89 (0.9)	85 (0.9)	77 (1.1)

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

^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 Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.

^c Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.

^d Netherlands: Data for physics/chemistry teachers are reported in physics panel.

percentages of students taught by teachers reporting that they had a certificate ranged from 29 percent in Cyprus to 100 percent in Australia, Japan, and Singapore, and in Belgium (Flemish) and Hungary for physics students and Bulgaria for biology students.

When both certification and having had science as a major were considered, there was even more variation among countries, from 22 percent of physics students in Moldova to 99 percent of earth science students in the Netherlands. On average internationally in countries with general/integrated science, 71 percent of students had teachers both certified and with a major in science. For countries with separate science courses, the international averages ranged from 75 percent in physics to 85 percent in earth science. In countries where a majority of students were taught by teachers not certified, most of their teachers reported having a science degree. In particular, 95 percent of students in Cyprus had teachers with a science major, but only 29 percent were taught by certified teachers. In contrast, only 50 percent of Canadian students had teachers with a science major, while 98 percent were taught by certified teachers.

6.3



To gauge teachers' confidence 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). Responses were given on a three-point scale; "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 that they felt 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 reported being 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 for each teacher, any topics that a teacher did not teach were excluded from the average.

In general, teachers reported only a moderate level of 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 more than half the students in nine countries – Chile, Hong Kong, Hungary, Japan, Korea, Latvia (LSS), Malaysia,

Thailand, and Tunisia – had teachers who felt only somewhat prepared or less. Interestingly, this group includes some of the highest-performing countries. In only one country, Macedonia, were more than half the students taught by teachers with a high level of confidence.

The detail for the 10 topics included in the index is provided in Exhibit R3.2 in the reference section. Teachers were most confident in their preparation to teach biology topics, with more than 50 percent of students, both internationally on average and in most countries, having teachers who reported feeling very well prepared to teach these topics. Teachers had less confidence in their preparation to teach earth science topics, particularly about the solar system and the universe, for which only 32 percent of students had teachers who felt they were very well prepared to teach it. 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.



Exhibit R3.3 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. In comparison, in countries with separate science subjects the percentages of students in schools reporting such shortages ranged from 25 percent for earth science teachers to 28 percent for physics. Bulgaria, Jordan, Malaysia, Moldova, Slovenia, Thailand, Tunisia, and Turkey reported shortages of qualified teachers affecting more than half their students.



Teachers' beliefs about science learning and instruction are to some degree related to their preparation. Exhibits R3.4 and R3.5 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, 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. In nearly all countries, the majority of students had teachers who agreed that some students have a natural talent for science, and that all of the skills shown in Exhibit R3.5 (thinking in a sequential and procedural manner, being able to think creatively, understanding how science is



text continued
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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 R3.2) 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
Macedonia, Rep. of	53 (2.8)	463 (5.8)	35 (2.6)	457 (6.9)	12 (1.5)	442 (10.4)
Czech Republic	40 (2.8)	538 (4.8)	46 (2.8)	544 (5.8)	15 (2.4)	533 (6.2)
Indonesia	39 (4.4)	441 (7.7)	32 (3.6)	442 (7.5)	29 (3.3)	421 (6.9)
Turkey	36 (4.0)	443 (6.3)	47 (4.4)	430 (6.3)	17 (2.9)	420 (6.1)
Jordan	32 (4.1)	449 (7.7)	42 (4.3)	461 (6.0)	26 (4.1)	434 (8.7)
Cyprus	31 (2.4)	460 (3.4)	42 (2.2)	464 (3.2)	27 (2.1)	458 (6.2)
New Zealand	29 (3.6)	510 (9.0)	53 (3.9)	515 (7.4)	19 (3.2)	499 (8.7)
Romania	29 (2.5)	478 (7.9)	50 (2.5)	465 (6.4)	22 (2.3)	479 (7.9)
South Africa	29 (4.7)	240 (18.6)	38 (4.8)	265 (14.4)	33 (3.7)	225 (12.7)
United States	27 (3.0)	526 (8.7)	55 (3.5)	519 (5.8)	18 (2.5)	511 (9.2)
Morocco	26 (3.0)	326 (7.2)	47 (2.5)	321 (5.7)	27 (2.4)	321 (5.0)
Bulgaria	23 (1.9)	520 (9.1)	42 (3.4)	511 (5.3)	35 (3.4)	506 (5.8)
Australia	22 (2.9)	548 (8.5)	56 (3.5)	540 (5.7)	22 (3.1)	535 (6.4)
Belgium (Flemish)	20 (2.5)	536 (9.2)	44 (3.2)	542 (4.7)	36 (3.3)	525 (7.1)
Iran, Islamic Rep.	20 (4.4)	434 (10.5)	40 (4.2)	452 (5.1)	40 (4.3)	450 (5.5)
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)
Finland	16 (2.3)	534 (7.0)	51 (3.2)	535 (4.2)	32 (2.9)	536 (3.9)
Moldova	16 (1.8)	451 (6.7)	38 (2.6)	466 (5.9)	46 (2.6)	458 (5.1)
Canada	16 (2.4)	542 (5.3)	47 (3.2)	534 (3.6)	37 (2.8)	533 (4.6)
Israel	15 (2.4)	485 (8.7)	61 (3.8)	466 (7.2)	23 (3.2)	466 (9.8)
Philippines	15 (2.9)	384 (13.8)	43 (4.4)	337 (11.5)	42 (4.3)	340 (11.2)
Chinese Taipei	14 (3.0)	573 (7.9)	46 (4.8)	576 (5.9)	40 (4.5)	559 (6.3)
Italy	13 (2.8)	487 (11.6)	54 (3.9)	491 (5.6)	33 (3.4)	499 (5.9)
Thailand	13 (2.9)	499 (12.9)	30 (3.8)	486 (7.8)	58 (3.6)	476 (5.8)
Malaysia	9 (2.2)	498 (14.1)	30 (3.8)	500 (7.1)	61 (4.1)	488 (6.7)
Hong Kong, SAR	9 (2.3)	552 (12.4)	34 (4.1)	526 (6.1)	57 (4.3)	529 (5.4)
Hungary	8 (1.5)	575 (7.2)	34 (2.4)	546 (5.7)	58 (2.2)	552 (3.4)
Latvia (LSS)	8 (1.8)	515 (8.7)	40 (2.7)	508 (5.5)	52 (2.8)	500 (5.3)
Chile	7 (2.0)	419 (17.3)	27 (3.1)	450 (7.2)	66 (3.2)	411 (4.5)
Korea, Rep. of	6 (1.8)	543 (8.8)	32 (3.3)	552 (3.8)	62 (3.5)	548 (3.3)
Tunisia	6 (2.0)	441 (11.3)	21 (3.8)	429 (6.1)	73 (4.0)	429 (3.7)
Japan	3 (1.5)	564 (7.3)	15 (3.1)	548 (6.0)	82 (3.1)	549 (2.6)
England	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--
Russian Federation	--	--	--	--	--	--
International Avg.	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.

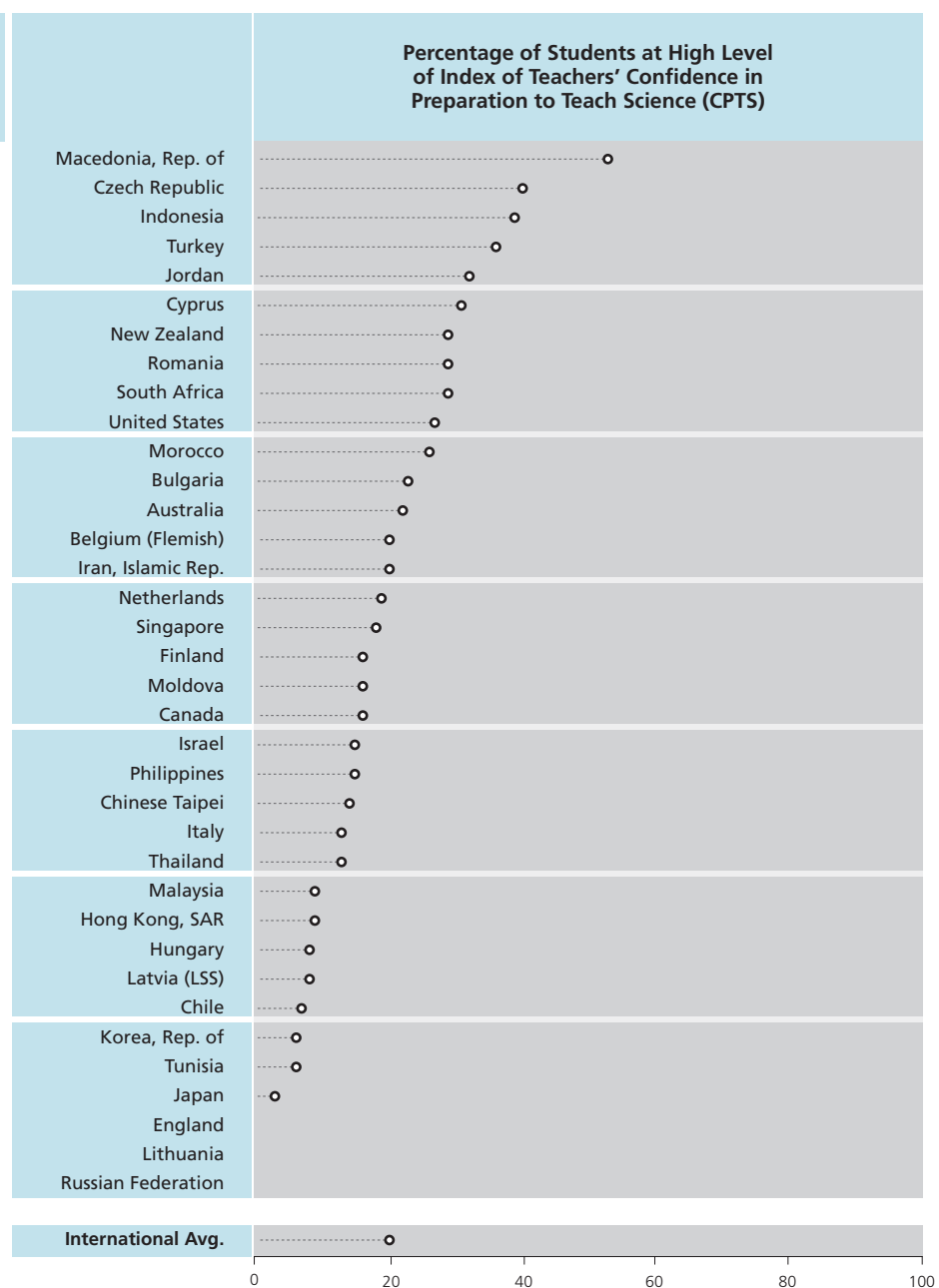
[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning at the next school year.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students.





*continued from
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used in the real world, and being able to provide reasons to support conclusions) are very important for students' success in science. The greatest variation in views was about whether science is primarily a formal way of representing the real world. While the majority of students in most countries had science teachers who agreed with this statement, this was the case for less than a majority in 10 European countries: Romania, Finland, Italy, the Netherlands, Latvia (LSS), Macedonia, Bulgaria, the Czech Republic, Hungary, and the Russian Federation.

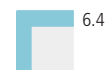
How Much School Time Is Devoted to Science Instruction?

Exhibit 6.4 presents information about the amount of instruction in the sciences given to eighth-grade students in the TIMSS 1999 countries. Since different systems have school years of different lengths (see reference Exhibit R3.6) and different arrangements of weekly and daily instruction, the comparisons are given in terms of the average number of hours of science instruction over the school year as reported by science teachers.

In general, students in countries with separate science subjects had more total instructional hours in the sciences. Since these students study all of the subjects offered, the total time is the sum of the hours reported by each subject area teacher. Based on these sums, instructional hours for students with separate science courses ranged from 123 in Chinese Taipei to 269 in Moldova. Most countries where science is taught as separate subjects had over 150 hours of science instruction per year, and many had over 200 hours. In contrast, in countries where science is taught as a single subject, the total science instructional time ranged from 65 hours in Tunisia to 252 in the Philippines, with many countries reporting between 90 and 150 hours.

In countries with separate science subjects, the amount of science instruction varied across subjects. In most countries, more time was devoted to the physical sciences: on average, 71 hours to physics and 68 hours to chemistry. When physics and chemistry are considered together, the average total instructional time in the physical sciences was between 90 and 150 hours in most countries, compared with about 50 to 70 hours in biology. In Chinese Taipei, 123 hours of instruction were devoted to an integrated physics/chemistry course, the only science course taught in the eighth grade; since biology is taught there in the seventh grade, instructional time in biology is not reported. In a few countries, such as Finland, Indonesia, and the Netherlands, the amount of instruction is more balanced between biology and the physical sciences. In general, the least amount of instruction was given in earth science, with an average of 56 hours.

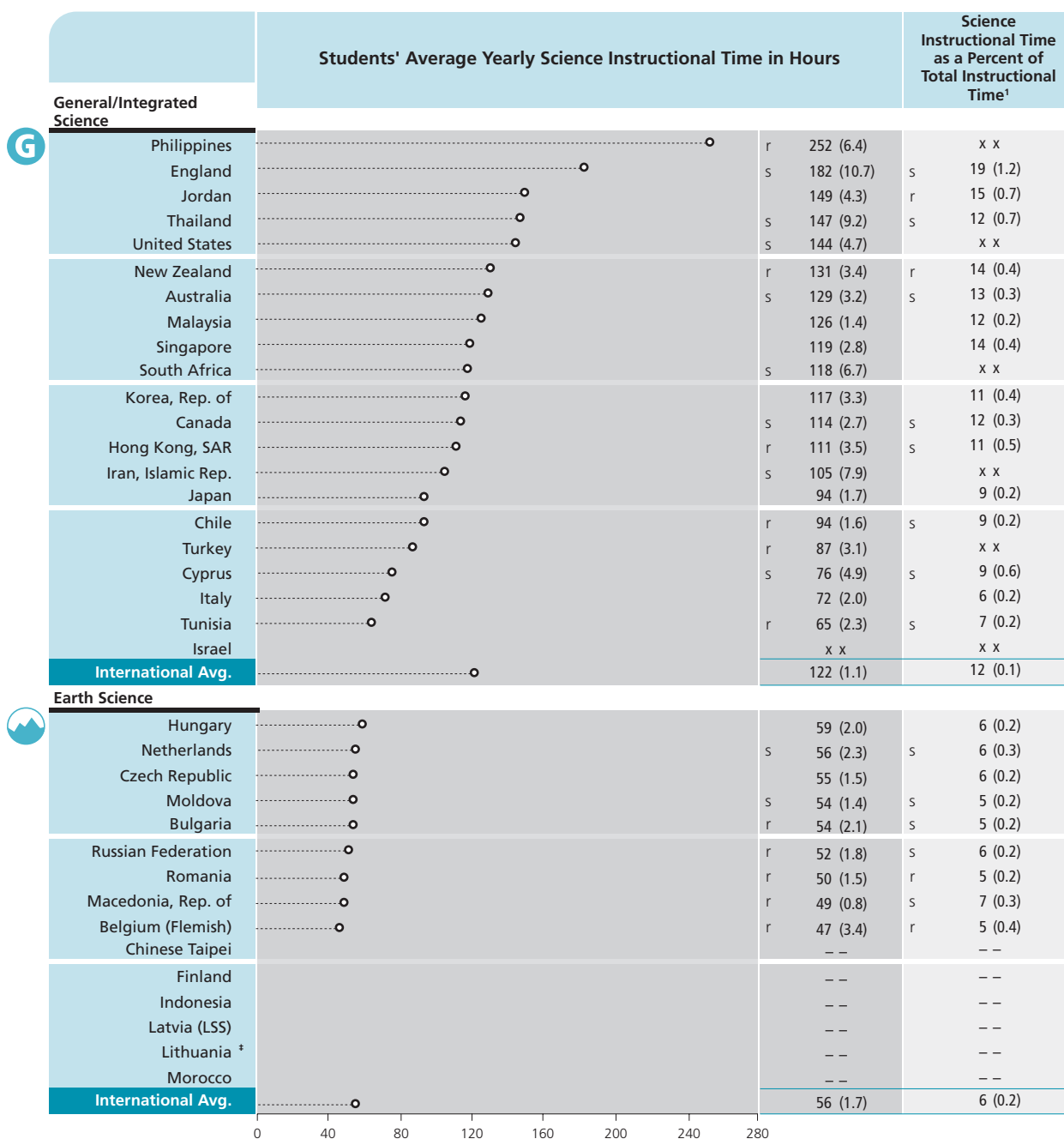
Among countries that teach general/integrated science, the percentage of instructional time at the eighth grade devoted to the sciences ranged from six percent in Italy to 19 percent in England (see reference Exhibit R3.7 for details on total instructional time in each country). For the separate-science countries, the percentage of total science instruction ranged from nine percent in Chinese Taipei to 33 percent in Macedonia.



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Exhibit 6.4 Instructional Time in the Sciences at Grade 8*



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.

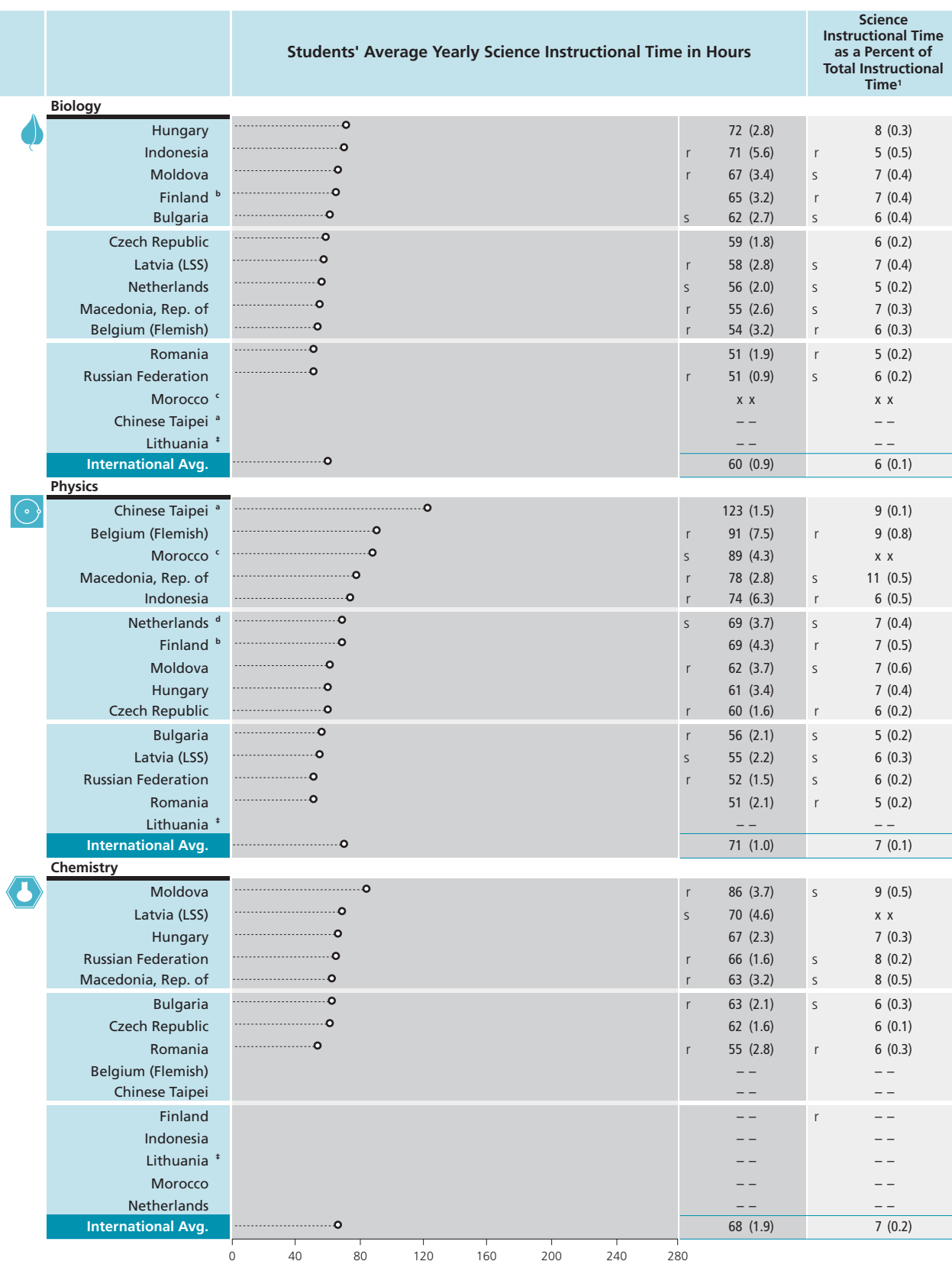
[‡] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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.



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

^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 Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.

^c Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.

^d Netherlands: Data for physics/chemistry teachers are reported in physics panel.

For most countries, the percentages of time devoted to science reported by teachers correspond with the percentages targeted in the intended curriculum (see Exhibit 5.6).

6.5  The number of hours science is taught weekly is shown in Exhibit 6.5. Internationally on average, 59 percent of students in the single-science countries had at least two but fewer than three and a half hours of science instruction each week. Another 17 percent had at least three and a half but fewer than five hours, and 15 percent had fewer than two hours. Only nine percent of students, on average, received five or more hours of science instruction per week. In most general/integrated science countries, the majority of students had fewer than three and a half hours of weekly instruction. Exceptions were Jordan, the Philippines, Singapore, and the United States, where the majority of students received three and a half hours or more. In countries that teach science as separate subjects, most students had fewer than two hours per week for each science subject. Given that students typically take two to four science subjects in these countries, the total amount of science instruction is comparable to or higher than that reported for countries with a single integrated science course, as was also shown in Exhibit 6.4.

Although in some countries the number of in-class instructional hours is related to science achievement, the data reveal no clear pattern either across or within countries. 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.

6.6  Outside interruptions can disrupt the flow of a lesson and detract from instructional time. The frequency of outside interruptions during science lessons reported by students is shown in Exhibit 6.6. On average internationally, 23 percent of students in the general/integrated science countries reported that such interruptions occur pretty often or almost always. This was the case for one-third or more of students in Jordan, New Zealand, the Philippines, and South Africa. Less frequent interruptions were reported in countries with separate sciences, with less than 20 percent of students in most of these countries reporting this level of interruption. Among all countries, more than half the students in Hungary, Japan, Korea, and Tunisia were in science classes that were never interrupted. Internationally, the frequency of interruption appears to be related to



achievement, both for general/integrated and separate sciences. While students who reported interruptions once in a while or never had similar achievement, they tended to outperform those who reported interruptions pretty often or almost always.

Across countries, students' science teachers spent only about 60 percent of their formally scheduled school time teaching science (see Exhibit R3.8 in the reference section). This varies considerably across countries, however, ranging from 31 percent in Italy to 84 percent in England. Of the remaining time, about 10 percent on average was spent teaching subjects other than science, about 10 percent on curriculum planning, and about 20 percent on various administrative and other duties. In a few countries, such as Canada, Hungary, and Italy, teachers reported spending 25 percent or more of their time teaching subjects other than science. In Italy, with more than 50 percent of time spent teaching other subjects, the same teachers teach both mathematics and science at the eighth grade.



Exhibit 6.5 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
 General/Integrated Science	Australia ^r	3 (1.2)	526 (16.0)	28 (3.5)	555 (8.2)	64 (3.9)	535 (5.5)	6 (1.8)	523 (15.2)
	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)
	Chile	0 (0.0)	~ ~	2 (1.2)	~ ~	93 (1.9)	422 (4.2)	4 (1.5)	419 (9.9)
	Cyprus ^s	0 (0.0)	~ ~	0 (0.0)	~ ~	28 (3.7)	463 (5.5)	72 (3.7)	462 (3.3)
	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)
	Iran, Islamic Rep.	8 (2.3)	454 (9.9)	9 (2.5)	458 (11.5)	54 (4.6)	445 (6.4)	29 (4.3)	455 (6.8)
	Israel ^r	0 (0.0)	~ ~	9 (2.5)	467 (23.8)	68 (3.7)	472 (6.9)	23 (3.2)	460 (11.6)
	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)
	Jordan	11 (2.8)	441 (15.2)	63 (4.1)	449 (4.8)	25 (3.6)	458 (9.4)	1 (0.0)	~ ~
	Korea, Rep. of	1 (0.8)	~ ~	4 (1.7)	531 (8.6)	84 (2.6)	550 (2.8)	10 (1.9)	546 (4.7)
	Malaysia	0 (0.0)	~ ~	3 (1.5)	497 (26.7)	96 (1.8)	493 (4.6)	1 (0.9)	~ ~
	New Zealand	2 (1.0)	~ ~	41 (4.0)	516 (8.9)	55 (4.1)	508 (6.5)	2 (1.0)	~ ~
	Philippines	92 (2.4)	347 (7.8)	2 (1.3)	~ ~	2 (1.3)	~ ~	4 (1.4)	368 (35.3)
	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)
	South Africa	8 (2.4)	259 (31.6)	33 (4.2)	251 (18.9)	33 (4.3)	256 (17.4)	26 (3.9)	235 (15.5)
	Thailand ^r	23 (4.1)	461 (10.8)	0 (0.0)	~ ~	76 (4.2)	491 (5.5)	1 (1.0)	~ ~
	Tunisia	0 (0.0)	~ ~	1 (0.0)	~ ~	36 (4.1)	425 (4.3)	63 (4.1)	432 (4.2)
	Turkey	4 (1.4)	416 (17.8)	1 (0.7)	~ ~	82 (3.0)	432 (4.3)	12 (2.8)	439 (12.4)
	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)
International Avg.		9 (0.4)	475 (4.2)	17 (0.6)	500 (4.9)	59 (0.8)	484 (2.7)	15 (0.5)	474 (3.8)
 Earth Science	Belgium (Flemish)	2 (1.1)	~ ~	0 (0.0)	~ ~	14 (4.2)	530 (13.0)	84 (4.4)	541 (5.4)
	Bulgaria	1 (1.0)	~ ~	2 (1.1)	~ ~	4 (1.9)	519 (48.1)	93 (2.4)	512 (5.3)
	Chinese Taipei	--	--	--	--	--	--	--	--
	Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	3 (1.7)	561 (13.4)	97 (1.7)	539 (4.5)
	Finland	--	--	--	--	--	--	--	--
	Hungary	0 (0.0)	~ ~	2 (1.1)	~ ~	19 (3.6)	553 (11.6)	79 (3.6)	551 (4.5)
	Indonesia	--	--	--	--	--	--	--	--
	Latvia (LSS)	--	--	--	--	--	--	--	--
	Lithuania [†]	--	--	--	--	--	--	--	--
	Macedonia, Rep. of	0 (0.0)	~ ~	0 (0.0)	~ ~	3 (1.6)	376 (28.7)	96 (1.6)	461 (5.3)
	Moldova	1 (0.9)	~ ~	1 (0.0)	~ ~	8 (2.6)	444 (13.9)	90 (2.8)	463 (4.7)
	Morocco	--	--	--	--	--	--	--	--
	Netherlands	0 (0.0)	~ ~	5 (0.4)	466 (7.8)	6 (3.3)	590 (33.0)	89 (5.7)	550 (6.4)
	Romania	1 (0.7)	~ ~	1 (0.7)	~ ~	13 (2.9)	500 (14.9)	86 (3.0)	467 (6.5)
	Russian Federation	0 (0.5)	~ ~	0 (0.0)	~ ~	8 (2.0)	558 (21.6)	91 (2.1)	526 (6.4)
	International Avg.	1 (0.2)	~ ~	1 (0.2)	~ ~	9 (0.9)	514 (8.3)	90 (1.1)	512 (1.9)

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.

† 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.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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.

		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		
	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)		
	Bulgaria ^r	1 (1.0)	~ ~	2 (1.1)	~ ~	21 (3.8)	508 (10.8)	76 (4.4)	515 (7.4)		
	Chinese Taipei ^a	--	--	--	--	--	--	--	--		
	Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	4 (2.1)	562 (16.7)	95 (2.1)	540 (4.6)		
	Finland ^b	1 (0.5)	~ ~	3 (1.5)	537 (9.3)	15 (2.9)	539 (8.4)	82 (3.2)	535 (3.5)		
	Hungary	1 (0.6)	~ ~	3 (1.4)	575 (23.6)	33 (4.1)	560 (7.1)	64 (4.3)	547 (4.9)		
	Indonesia	14 (3.2)	417 (14.4)	0 (0.3)	~ ~	8 (2.4)	434 (10.8)	78 (4.0)	440 (5.6)		
	Latvia (LSS)	0 (0.0)	~ ~	1 (1.4)	~ ~	17 (4.0)	498 (7.1)	82 (4.2)	513 (5.5)		
	Lithuania [†]	--	--	--	--	--	--	--	--		
	Macedonia, Rep. of	1 (0.0)	~ ~	1 (0.8)	~ ~	11 (2.6)	426 (21.0)	87 (2.7)	465 (5.2)		
	Moldova	2 (1.0)	~ ~	6 (2.0)	468 (23.7)	19 (3.2)	445 (9.9)	74 (3.8)	461 (4.8)		
	Morocco ^c	0 (0.0)	~ ~	2 (1.0)	~ ~	81 (2.7)	320 (4.6)	17 (2.5)	335 (7.2)		
	Netherlands	0 (0.0)	~ ~	0 (0.0)	~ ~	1 (1.2)	~ ~	99 (1.2)	540 (8.9)		
	Romania	0 (0.3)	~ ~	1 (0.0)	~ ~	12 (3.0)	458 (15.0)	87 (3.1)	474 (6.2)		
	Russian Federation	0 (0.0)	~ ~	1 (0.5)	~ ~	9 (2.2)	548 (14.2)	90 (2.3)	526 (6.3)		
	International Avg.	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)	
Bulgaria		1 (0.6)	~ ~	1 (0.7)	~ ~	11 (2.7)	499 (19.1)	88 (2.9)	507 (5.0)		
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)		
Finland ^b		3 (1.7)	544 (12.9)	6 (2.1)	521 (11.9)	11 (2.4)	530 (9.8)	81 (3.6)	535 (3.7)		
Hungary		3 (1.4)	528 (16.3)	2 (1.2)	~ ~	10 (2.3)	548 (10.0)	85 (2.8)	554 (4.0)		
Indonesia		14 (3.3)	421 (14.1)	1 (0.7)	~ ~	8 (2.5)	418 (13.5)	76 (4.1)	440 (5.7)		
Latvia (LSS)		1 (0.5)	~ ~	2 (1.3)	~ ~	16 (3.2)	502 (10.8)	82 (3.5)	503 (5.3)		
Lithuania [†]		--	--	--	--	--	--	--	--		
Macedonia, Rep. of		3 (1.9)	424 (107.2)	0 (0.5)	~ ~	91 (2.7)	458 (5.6)	6 (1.9)	457 (13.2)		
Moldova		3 (1.6)	437 (18.4)	3 (1.5)	422 (29.9)	8 (2.5)	478 (21.2)	86 (3.3)	460 (4.7)		
Morocco ^c		0 (0.0)	~ ~	1 (0.6)	~ ~	82 (4.3)	323 (5.5)	17 (4.4)	335 (16.3)		
Netherlands ^d		1 (0.9)	~ ~	0 (0.0)	~ ~	15 (3.9)	543 (6.3)	84 (4.0)	547 (8.7)		
Romania		0 (0.4)	~ ~	2 (1.3)	~ ~	9 (2.7)	435 (12.8)	88 (3.1)	479 (7.1)		
Russian Federation		1 (0.8)	~ ~	0 (0.0)	~ ~	6 (1.7)	554 (17.2)	92 (2.1)	527 (6.7)		
International Avg.		2 (0.4)	~ ~	4 (0.4)	507 (6.6)	27 (0.9)	500 (3.4)	67 (1.0)	495 (2.3)		
		Chemistry									
		Belgium (Flemish)	--	--	--	--	--	--	--	--	
	Bulgaria	1 (1.1)	~ ~	1 (0.8)	~ ~	22 (3.5)	505 (11.2)	75 (3.9)	520 (7.4)		
	Chinese Taipei	--	--	--	--	--	--	--	--		
	Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	8 (2.7)	585 (18.5)	92 (2.7)	536 (4.0)		
	Finland	--	--	--	--	--	--	--	--		
	Hungary	1 (0.6)	~ ~	3 (1.0)	587 (10.6)	18 (3.1)	554 (9.0)	78 (3.2)	549 (4.4)		
	Indonesia	--	--	--	--	--	--	--	--		
	Latvia (LSS) ^s	2 (1.1)	~ ~	4 (1.9)	489 (8.9)	17 (3.7)	479 (9.1)	78 (3.9)	510 (5.4)		
	Lithuania [†]	--	--	--	--	--	--	--	--		
	Macedonia, Rep. of	1 (0.9)	~ ~	1 (0.7)	~ ~	20 (3.3)	435 (15.2)	77 (3.1)	472 (5.7)		
	Moldova	2 (1.2)	~ ~	7 (2.2)	465 (21.0)	78 (3.0)	460 (4.4)	14 (2.4)	442 (11.2)		
	Morocco	--	--	--	--	--	--	--	--		
	Netherlands	--	--	--	--	--	--	--	--		
	Romania	1 (0.7)	~ ~	1 (1.1)	~ ~	13 (3.7)	446 (13.9)	84 (3.3)	477 (7.1)		
	Russian Federation	0 (0.0)	~ ~	1 (0.6)	~ ~	63 (3.8)	526 (6.0)	36 (3.9)	532 (11.6)		
	International Avg.	1 (0.3)	~ ~	2 (0.4)	~ ~	30 (1.2)	499 (4.2)	67 (1.2)	505 (2.8)		

^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 Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.

^c Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.

^d Netherlands: Data for physics/chemistry teachers are reported in physics panel.

Exhibit 6.6 Frequency of Outside Interruption During Science Lessons*

		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
 General/Integrated Science	Australia	16 (1.0)	537 (6.8)	63 (1.2)	553 (4.4)	16 (0.9)	526 (6.4)	6 (0.5)	487 (9.2)
	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)
	Chile	21 (0.7)	431 (6.4)	47 (0.8)	435 (4.2)	16 (0.5)	408 (4.6)	15 (0.6)	387 (6.1)
	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)
	Cyprus	27 (1.1)	465 (4.6)	50 (1.0)	471 (3.1)	17 (0.8)	448 (5.8)	6 (0.5)	414 (6.8)
	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)
	Indonesia ^b	16 (1.0)	422 (6.4)	73 (1.1)	446 (4.0)	9 (0.6)	397 (8.7)	2 (0.2)	~ ~
	Iran, Islamic Rep.	34 (0.9)	451 (4.7)	38 (0.7)	458 (5.5)	15 (0.6)	435 (5.3)	13 (0.6)	443 (6.5)
	Israel	23 (0.9)	469 (7.4)	46 (1.0)	495 (4.3)	18 (0.7)	467 (6.0)	13 (0.7)	446 (8.5)
	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)	~ ~
	Jordan	28 (0.9)	469 (4.7)	38 (1.0)	478 (4.3)	18 (0.6)	431 (8.0)	17 (0.8)	427 (5.6)
	Korea, Rep. of	61 (0.9)	544 (2.8)	34 (0.8)	561 (3.3)	4 (0.3)	536 (9.3)	2 (0.2)	~ ~
	Malaysia	32 (0.9)	485 (5.4)	60 (0.9)	499 (4.3)	6 (0.4)	477 (8.6)	2 (0.2)	~ ~
	New Zealand	8 (0.6)	502 (9.7)	55 (1.6)	535 (4.9)	24 (1.1)	494 (5.2)	13 (0.9)	459 (6.6)
	Philippines	12 (0.6)	352 (8.6)	35 (1.1)	375 (9.5)	27 (0.6)	352 (10.0)	26 (1.0)	309 (6.8)
	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)
	South Africa	23 (0.9)	225 (9.5)	26 (1.2)	319 (13.8)	23 (0.8)	229 (10.3)	28 (1.2)	206 (8.2)
	Thailand	24 (0.7)	480 (6.7)	63 (1.0)	490 (4.3)	11 (0.7)	459 (8.1)	3 (0.3)	459 (16.7)
	Tunisia	58 (1.1)	434 (3.1)	26 (0.9)	430 (6.4)	9 (0.5)	419 (4.5)	8 (0.5)	417 (6.9)
	Turkey	50 (1.3)	447 (5.8)	37 (0.9)	435 (4.2)	7 (0.5)	397 (9.7)	6 (0.4)	404 (9.5)
	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)
	International Avg.	28 (0.2)	479 (1.3)	49 (0.2)	494 (1.1)	14 (0.1)	462 (1.6)	9 (0.1)	440 (2.8)
 Earth Science	Belgium (Flemish)	35 (1.3)	541 (4.2)	53 (1.2)	551 (3.6)	8 (0.6)	524 (9.4)	5 (0.5)	503 (10.8)
	Bulgaria	23 (1.2)	529 (9.0)	60 (1.3)	525 (5.4)	9 (0.8)	488 (12.6)	9 (0.7)	477 (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)
	Finland	39 (1.4)	538 (3.9)	50 (1.4)	542 (4.2)	7 (0.6)	509 (9.5)	4 (0.4)	472 (12.2)
	Hungary	58 (1.4)	559 (4.4)	33 (1.2)	550 (4.2)	5 (0.5)	529 (12.1)	3 (0.3)	526 (10.0)
	Latvia (LSS)	--	--	--	--	--	--	--	--
	Lithuania [†]	--	--	--	--	--	--	--	--
	Macedonia, Rep. of	43 (1.3)	486 (5.4)	36 (1.1)	476 (6.6)	10 (0.6)	425 (7.9)	11 (0.7)	407 (10.8)
	Moldova	35 (1.6)	476 (6.4)	46 (1.4)	466 (4.4)	10 (0.7)	432 (7.2)	9 (0.7)	426 (12.2)
	Morocco	x x	x x	x x	x x	x x	x x	x x	x x
	Netherlands	44 (1.5)	541 (8.3)	48 (1.7)	555 (6.8)	5 (0.6)	521 (15.8)	2 (0.5)	~ ~
	Romania	46 (1.7)	490 (6.2)	43 (1.5)	476 (6.2)	6 (0.6)	431 (15.3)	6 (0.5)	411 (12.8)
	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)
	Slovak Republic	52 (1.4)	540 (4.0)	42 (1.3)	535 (3.7)	4 (0.4)	518 (8.2)	2 (0.3)	~ ~
	Slovenia	--	--	--	--	--	--	--	--
	International Avg.	40 (0.4)	526 (2.1)	47 (0.4)	523 (1.6)	7 (0.2)	491 (2.9)	6 (0.2)	473 (3.5)

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.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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. A tilde (–) indicates insufficient data to report achievement.

An "x" indicates a <50% student response rate.

		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	
	Biology									
	Belgium (Flemish)	36 (1.3)	538 (5.2)	55 (1.4)	543 (3.1)	6 (0.5)	542 (10.0)	4 (0.7)	485 (10.3)	
	Bulgaria	22 (1.2)	524 (8.0)	63 (1.6)	523 (5.5)	8 (0.9)	509 (11.3)	7 (0.6)	470 (10.4)	
	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)	
	Finland	37 (1.5)	538 (3.9)	53 (1.3)	540 (4.0)	7 (0.6)	508 (9.9)	3 (0.3)	490 (13.2)	
	Hungary	54 (1.2)	558 (4.2)	37 (1.1)	550 (4.2)	5 (0.5)	537 (12.2)	3 (0.4)	527 (10.7)	
	Latvia (LSS)	46 (1.5)	503 (6.0)	47 (1.5)	508 (6.6)	5 (0.5)	479 (11.6)	2 (0.4)	~ ~	
	Lithuania [†]	--	--	--	--	--	--	--	--	
	Macedonia, Rep. of	39 (1.3)	480 (5.8)	42 (1.1)	476 (5.8)	10 (0.6)	413 (12.2)	9 (0.6)	412 (12.1)	
	Moldova	33 (1.5)	471 (5.8)	48 (1.4)	468 (4.8)	11 (0.7)	433 (8.2)	8 (0.7)	431 (9.0)	
	Morocco	x x	x x	x x	x x	x x	x x	x x	x x	
	Netherlands	41 (1.8)	537 (9.0)	53 (2.0)	551 (8.1)	4 (0.7)	520 (16.1)	2 (0.6)	~ ~	
	Romania	44 (1.7)	487 (6.7)	45 (1.5)	476 (5.5)	6 (0.6)	436 (10.3)	4 (0.4)	408 (11.8)	
	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)	
	Slovak Republic	46 (1.6)	539 (4.2)	48 (1.5)	538 (4.0)	4 (0.5)	506 (9.2)	2 (0.3)	~ ~	
	Slovenia	12 (0.9)	513 (5.6)	60 (1.2)	542 (3.4)	18 (0.9)	535 (5.6)	10 (0.6)	512 (7.7)	
	International Avg.	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 (6.5)	58 (1.7)	545 (4.6)	7 (0.7)	539 (16.0)	4 (0.7)	529 (22.4)
Bulgaria		22 (1.2)	523 (7.9)	59 (1.4)	525 (5.5)	11 (0.7)	503 (12.5)	9 (0.8)	478 (10.2)	
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)	
Finland		40 (1.3)	543 (4.8)	48 (1.3)	536 (4.3)	7 (0.7)	488 (11.2)	5 (0.5)	493 (8.8)	
Hungary		58 (1.3)	560 (4.1)	33 (1.1)	551 (4.8)	5 (0.5)	523 (9.9)	4 (0.3)	539 (9.6)	
Latvia (LSS)		50 (1.4)	504 (5.4)	41 (1.3)	509 (6.2)	6 (0.5)	476 (11.0)	3 (0.4)	463 (14.6)	
Lithuania [†]		--	--	--	--	--	--	--	--	
Macedonia, Rep. of		41 (1.3)	488 (5.9)	37 (1.0)	478 (6.4)	11 (0.6)	415 (8.9)	12 (0.7)	408 (8.7)	
Moldova		35 (1.5)	475 (6.2)	45 (1.5)	466 (4.4)	11 (0.7)	445 (8.2)	8 (0.6)	429 (8.1)	
Morocco		x x	x x	x x	x x	x x	x x	x x	x x	
Netherlands ^c		42 (1.7)	544 (8.3)	50 (1.6)	550 (6.6)	5 (0.8)	533 (14.5)	3 (0.5)	521 (16.9)	
Romania		45 (1.5)	488 (6.3)	42 (1.4)	477 (5.8)	7 (0.6)	446 (10.2)	6 (0.6)	432 (12.1)	
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)	
Slovak Republic		50 (1.4)	543 (4.0)	43 (1.3)	535 (3.6)	5 (0.5)	509 (10.1)	2 (0.4)	~ ~	
Slovenia		13 (1.0)	519 (5.8)	60 (1.2)	543 (3.7)	17 (0.9)	527 (6.2)	10 (0.7)	516 (6.7)	
International Avg.		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)	--	--	--	--	--	--	--	--
	Bulgaria	22 (1.1)	527 (8.0)	60 (1.2)	523 (5.4)	10 (0.8)	501 (10.7)	9 (0.7)	482 (11.3)	
	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)	
	Finland	40 (1.4)	542 (5.1)	50 (1.3)	538 (3.9)	6 (0.7)	498 (9.7)	4 (0.5)	496 (10.8)	
	Hungary	56 (1.6)	558 (4.1)	35 (1.3)	553 (4.9)	5 (0.5)	521 (10.2)	4 (0.5)	538 (11.0)	
	Latvia (LSS)	48 (1.3)	506 (5.3)	44 (1.3)	508 (6.1)	4 (0.4)	476 (13.8)	3 (0.4)	459 (13.9)	
	Lithuania [†]	--	--	--	--	--	--	--	--	
	Macedonia, Rep. of	40 (1.3)	481 (5.7)	39 (1.0)	477 (6.2)	10 (0.7)	410 (9.0)	11 (0.6)	413 (12.6)	
	Moldova	34 (1.4)	472 (6.2)	47 (1.5)	465 (4.6)	10 (0.6)	431 (8.9)	8 (0.5)	441 (10.5)	
	Morocco	x x	x x	x x	x x	x x	x x	x x	x x	
	Netherlands	--	--	--	--	--	--	--	--	
	Romania	46 (1.5)	485 (6.3)	41 (1.4)	479 (6.1)	8 (0.6)	440 (10.6)	5 (0.5)	423 (14.6)	
	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)	
	Slovak Republic	51 (1.5)	541 (3.8)	42 (1.3)	535 (4.3)	5 (0.5)	513 (9.1)	2 (0.3)	~ ~	
	Slovenia	12 (0.9)	514 (5.9)	60 (1.1)	542 (3.5)	18 (1.0)	534 (6.2)	10 (0.6)	515 (8.2)	
	International Avg.	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?

6.7



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.

6.8



6.9



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.

6.10



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
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Exhibit 6.7 Science Class Size

		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
Australia	r	26 (0.2)	11 (2.2)	485 (8.8)	88 (2.3)	546 (4.7)	1 (0.3)	~ ~
Belgium (Flemish)	r	20 (0.5)	61 (3.9)	527 (5.1)	38 (3.9)	540 (7.2)	1 (1.0)	~ ~
Bulgaria	r	22 (0.4)	40 (4.7)	493 (5.4)	59 (5.2)	525 (7.5)	1 (0.9)	~ ~
Canada	s	27 (0.3)	12 (2.1)	525 (7.8)	86 (2.2)	535 (3.1)	2 (0.8)	~ ~
Chile		34 (0.6)	6 (1.4)	376 (10.7)	47 (4.1)	415 (6.3)	48 (4.0)	428 (5.6)
Chinese Taipei		39 (0.5)	0 (0.0)	~ ~	14 (2.9)	564 (12.4)	86 (2.9)	569 (4.8)
Cyprus	s	29 (0.2)	1 (0.3)	~ ~	99 (0.3)	462 (3.4)	0 (0.0)	~ ~
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
Finland		18 (0.3)	80 (2.6)	533 (4.2)	20 (2.6)	543 (4.6)	0 (0.3)	~ ~
Hong Kong, SAR		39 (0.3)	1 (0.0)	~ ~	13 (3.1)	487 (8.2)	86 (3.2)	537 (4.1)
Hungary	r	23 (0.4)	39 (3.6)	531 (6.7)	61 (3.6)	561 (4.2)	1 (0.5)	~ ~
Indonesia	r	44 (0.8)	1 (0.1)	~ ~	12 (2.8)	425 (13.3)	88 (2.8)	443 (5.6)
Iran, Islamic Rep.		33 (0.5)	4 (1.3)	446 (10.0)	63 (4.2)	456 (4.2)	34 (4.4)	439 (8.6)
Israel	r	28 (0.7)	17 (3.6)	489 (11.3)	62 (4.6)	470 (9.3)	21 (3.8)	472 (9.1)
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)
Jordan		36 (0.6)	4 (1.3)	463 (45.9)	42 (3.8)	444 (7.0)	54 (3.6)	454 (4.3)
Korea, Rep. of		43 (0.7)	0 (0.0)	~ ~	10 (2.2)	537 (6.1)	90 (2.2)	550 (2.7)
Latvia (LSS)	s	23 (0.4)	36 (3.4)	495 (8.0)	64 (3.5)	510 (5.5)	0 (0.2)	~ ~
Lithuania [†]		23 (0.3)	30 (2.6)	476 (6.6)	70 (2.6)	494 (4.9)	0 (0.0)	~ ~
Macedonia, Rep. of		28 (0.4)	10 (2.3)	413 (16.9)	84 (3.0)	458 (5.5)	7 (2.3)	492 (13.8)
Malaysia		38 (0.4)	0 (0.0)	~ ~	25 (3.6)	496 (7.3)	75 (3.6)	491 (5.7)
Moldova	r	25 (0.4)	17 (2.3)	454 (13.2)	82 (2.4)	460 (4.6)	1 (0.5)	~ ~
Morocco		30 (0.7)	19 (3.4)	326 (10.7)	60 (3.1)	322 (4.9)	21 (2.9)	321 (6.1)
Netherlands	r	25 (0.4)	11 (3.3)	492 (20.1)	89 (3.3)	554 (8.1)	0 (0.0)	~ ~
New Zealand		26 (0.5)	14 (2.4)	468 (15.4)	84 (2.6)	520 (5.5)	2 (1.2)	~ ~
Philippines		50 (0.8)	0 (0.0)	~ ~	4 (1.5)	316 (28.5)	96 (1.5)	349 (7.9)
Romania		24 (0.4)	31 (2.8)	449 (9.7)	64 (2.9)	479 (7.8)	5 (1.4)	493 (11.3)
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)
Slovenia		22 (0.3)	29 (3.2)	535 (7.0)	71 (3.2)	533 (3.3)	0 (0.0)	~ ~
South Africa	r	49 (1.3)	1 (0.6)	~ ~	14 (2.6)	284 (25.2)	85 (2.6)	248 (10.8)
Thailand	r	42 (0.9)	2 (0.8)	~ ~	25 (4.0)	473 (7.7)	73 (3.8)	486 (5.1)
Tunisia		34 (0.4)	3 (1.5)	431 (13.0)	53 (4.2)	426 (4.5)	44 (4.3)	431 (4.6)
Turkey	s	44 (1.2)	2 (1.2)	~ ~	22 (3.1)	436 (12.1)	76 (3.4)	429 (4.5)
United States	r	26 (0.5)	15 (2.1)	530 (9.4)	80 (2.4)	522 (5.4)	5 (1.4)	493 (14.9)
International Avg.		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.

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

Science teacher background data for Slovak Republic are unavailable.

() 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 Trends in Science Class Size

	Overall Average Class Size		1 - 20 Students		21 - 35 Students		36 or More Students	
	Average	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	x x	x x	x x	x x	x x	x x	x x	x x
Belgium (Flemish) r	20 (0.5)	-1 (0.7) ●	61 (3.9)	15 (6.0) ●	38 (3.9)	-17 (6.0) ●	1 (1.0)	1 (1.0) ●
Canada s	27 (0.3)	-1 (0.8) ●	12 (2.1)	1 (3.4) ●	86 (2.2)	-1 (3.6) ●	2 (0.8)	0 (1.2) ●
Cyprus s	29 (0.2)	-2 (0.5) ▼	1 (0.3)	-1 (1.0) ●	99 (0.3)	1 (1.0) ●	0 (0.0)	—
Czech Republic r	24 (0.4)	-1 (0.6) ●	19 (3.8)	8 (4.6) ●	81 (3.8)	-8 (4.6) ●	0 (0.0)	0 (0.0) ▲
England	x x	x x	x x	x x	x x	x x	x x	x x
Hong Kong, SAR	39 (0.3)	-1 (0.5) ●	1 (0.0)	1 (0.0) ▲	13 (3.1)	6 (4.3) ●	86 (3.2)	-6 (4.4) ●
Hungary r	23 (0.4)	1 (0.6) ●	39 (3.6)	-1 (5.5) ●	61 (3.6)	1 (5.5) ●	1 (0.5)	1 (0.5) ●
Iran, Islamic Rep. r	33 (0.5)	-4 (1.5) ●	4 (1.3)	1 (1.9) ●	63 (4.2)	18 (7.3) ●	34 (4.4)	-19 (7.5) ●
Israel † s	27 (0.9)	-5 (1.8) ●	19 (4.2)	8 (7.0) ●	64 (5.2)	17 (12.3) ●	17 (4.2)	-25 (11.2) ●
Italy	20 (0.4)	1 (0.6) ●	53 (4.8)	-9 (7.0) ●	47 (4.7)	8 (6.9) ●	1 (0.0)	1 (0.0) ▲
Japan	36 (0.3)	-1 (0.4) ●	1 (0.0)	0 (0.0) ▲	41 (3.1)	8 (5.2) ●	58 (3.0)	-9 (5.1) ●
Korea, Rep. of	43 (0.7)	-6 (1.3) ▼	0 (0.0)	-6 (1.8) ▼	10 (2.2)	8 (2.6) ▲	90 (2.2)	-2 (3.1) ●
Latvia (LSS) s	23 (0.4)	-1 (0.9) ●	36 (3.4)	-1 (5.8) ●	64 (3.5)	10 (6.0) ●	0 (0.2)	-9 (2.2) ▼
Lithuania r	23 (0.3)	1 (0.6) ●	30 (2.6)	-8 (5.1) ●	70 (2.6)	10 (5.1) ●	0 (0.0)	-2 (1.0) ●
Netherlands r	25 (0.4)	0 (0.8) ●	11 (3.3)	-5 (6.2) ●	89 (3.3)	5 (6.2) ●	0 (0.0)	—
New Zealand	26 (0.5)	-1 (0.7) ●	14 (2.4)	8 (3.1) ●	84 (2.6)	-9 (3.4) ●	2 (1.2)	1 (1.2) ●
Romania	24 (0.4)	-2 (0.8) ●	31 (2.8)	10 (4.7) ●	64 (2.9)	-4 (5.0) ●	5 (1.4)	-6 (3.3) ●
Russian Federation	24 (0.5)	-1 (0.6) ●	19 (3.1)	4 (4.2) ●	81 (3.1)	-4 (4.2) ●	0 (0.0)	-1 (0.2) ▼
Singapore	37 (0.3)	0 (0.5) ●	1 (0.4)	1 (0.4) ●	32 (3.8)	-1 (5.9) ●	68 (3.8)	0 (5.9) ●
Slovenia r	22 (0.3)	-2 (0.4) ▼	29 (3.2)	14 (4.2) ▲	71 (3.2)	-14 (4.2) ▼	0 (0.0)	0 (0.0) ▼
Thailand †	x x	x x	x x	x x	x x	x x	x x	x x
United States	x x	x x	x x	x x	x x	x x	x x	x x
International Avg. §	27 (0.1)	-1 (0.2) ▼	19 (0.6)	1 (1.0) ●	63 (0.7)	3 (1.2) ●	18 (0.4)	-4 (0.7) ▼

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by teachers.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

Science teacher background data for Slovak Republic are unavailable.

() 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, based on the lower response rate in either 1995 or 1999. An "s" indicates teacher response data available for 50-69% of students, based on the lower response rate in either 1995 or 1999. An "x" indicates teacher response data available for <50% of students, based on the lower response rate in either 1995 or 1999.

Exhibit 6.9

Time Spent on Various Activities in Science Class

	Average Percentage of Class Time Spent in a Typical Month of Lessons									
	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
Australia	5 (0.4)	7 (0.3)	18 (0.8)	16 (0.8)	9 (0.5)	11 (0.5)	7 (0.4)	6 (0.3)	23 (1.0)	r 3 (0.3)
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)
Bulgaria	r 2 (0.3)	r 4 (0.3)	r 43 (0.6)	r 9 (0.4)	r 8 (0.3)	r 9 (0.4)	r 16 (0.4)	r 6 (0.4)	r 3 (0.2)	r 1 (0.2)
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)
Chile	5 (0.4)	12 (0.6)	21 (1.1)	12 (0.8)	15 (0.7)	7 (0.8)	11 (0.4)	7 (0.6)	13 (1.0)	r 3 (0.4)
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)
Cyprus	s 3 (0.3)	s 10 (0.5)	s 17 (1.1)	s 15 (0.7)	s 9 (0.5)	s 6 (0.6)	s 9 (0.4)	16 (0.7)	s 12 (1.1)	s 2 (0.4)
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
Finland	2 (0.2)	9 (0.3)	20 (0.8)	16 (0.7)	8 (0.3)	11 (0.5)	6 (0.2)	5 (0.2)	21 (0.8)	2 (0.2)
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)
Hungary	3 (0.1)	8 (0.3)	23 (0.8)	18 (0.5)	12 (0.3)	10 (0.3)	10 (0.3)	9 (0.3)	5 (0.2)	4 (0.3)
Indonesia	6 (0.5)	13 (1.3)	14 (1.1)	17 (1.0)	13 (0.9)	13 (0.9)	14 (1.1)	14 (1.0)	14 (1.1)	3 (0.3)
Iran, Islamic Rep.	6 (0.5)	12 (1.0)	29 (1.9)	13 (1.1)	13 (1.1)	9 (0.9)	16 (1.2)	15 (0.8)	9 (0.8)	6 (0.7)
Israel	r 4 (0.4)	r 11 (0.9)	r 23 (1.0)	r 16 (0.8)	r 11 (0.7)	r 14 (1.0)	r 8 (0.4)	r 12 (1.0)	r 12 (1.0)	s 3 (0.6)
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)
Jordan	9 (1.1)	23 (2.2)	26 (1.7)	28 (2.3)	19 (1.7)	16 (1.7)	20 (2.1)	29 (2.5)	22 (2.1)	7 (1.3)
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)
Latvia (LSS)	r 3 (0.3)	r 9 (0.4)	r 24 (0.8)	r 15 (0.5)	r 11 (0.5)	r 8 (0.4)	r 8 (0.3)	r 11 (0.4)	r 8 (0.4)	r 6 (0.5)
Lithuania [†]	2 (0.2)	8 (0.2)	31 (0.7)	22 (0.6)	11 (0.3)	12 (0.5)	12 (0.4)	—	—	2 (0.2)
Macedonia, Rep. of	5 (0.3)	6 (0.3)	42 (1.0)	12 (0.5)	6 (0.4)	7 (0.3)	6 (0.4)	9 (0.3)	7 (0.4)	3 (0.3)
Malaysia	5 (0.4)	9 (0.5)	15 (1.0)	12 (0.6)	9 (0.6)	6 (0.4)	8 (0.5)	10 (0.5)	23 (1.5)	r 4 (0.5)
Moldova	4 (0.4)	15 (0.5)	21 (0.8)	16 (0.6)	9 (0.4)	14 (0.4)	8 (0.2)	8 (0.3)	6 (0.3)	4 (0.2)
Morocco	2 (0.2)	12 (0.6)	17 (0.9)	18 (1.2)	10 (0.4)	6 (0.4)	12 (0.3)	18 (0.7)	14 (0.6)	5 (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)
New Zealand	5 (0.3)	6 (0.3)	16 (0.9)	16 (0.9)	9 (0.4)	11 (0.7)	7 (0.3)	7 (0.4)	23 (1.0)	1 (0.2)
Philippines	7 (0.9)	10 (1.1)	21 (1.2)	15 (1.5)	12 (1.2)	13 (1.3)	13 (0.9)	14 (1.1)	19 (1.1)	4 (0.9)
Romania	4 (0.2)	7 (0.3)	24 (0.7)	14 (0.4)	9 (0.3)	11 (0.4)	12 (0.4)	10 (0.7)	8 (0.4)	4 (0.5)
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)
South Africa	10 (1.1)	18 (1.7)	22 (1.8)	17 (2.1)	19 (2.0)	16 (1.5)	21 (2.3)	17 (1.4)	14 (2.1)	r 6 (1.3)
Thailand	10 (1.1)	14 (1.4)	19 (1.4)	14 (1.4)	15 (1.4)	17 (1.6)	15 (1.5)	13 (1.4)	28 (1.8)	3 (0.8)
Tunisia	2 (0.2)	11 (0.7)	12 (0.9)	18 (1.0)	8 (0.7)	5 (0.5)	10 (0.7)	13 (0.8)	21 (1.3)	3 (0.5)
Turkey	5 (0.7)	7 (0.5)	41 (1.1)	11 (0.8)	11 (0.9)	7 (0.7)	8 (0.7)	12 (0.8)	7 (0.7)	3 (0.5)
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)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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% students.

Exhibit 6.10 Students Doing Various Activities in Science Class*

		Percentage of Students Reporting Almost Always or Pretty Often				
		We Discuss Our Completed Homework	Teachers 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
	General/Integrated Science					
	Australia	48 (1.6)	73 (1.4)	75 (1.2)	51 (1.6)	40 (1.5)
	Canada	56 (1.4)	74 (1.2)	76 (1.1)	62 (1.5)	68 (1.8)
	Chile	50 (1.1)	84 (0.9)	51 (1.0)	72 (1.2)	57 (1.1)
	Chinese Taipei ^a	50 (1.4)	88 (0.7)	61 (1.3)	52 (1.3)	29 (0.9)
	Cyprus	76 (0.9)	86 (0.9)	66 (1.0)	52 (1.1)	47 (1.2)
	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)
	Indonesia ^b	46 (1.1)	87 (0.8)	48 (1.7)	76 (1.1)	11 (0.8)
	Iran, Islamic Rep.	49 (1.0)	89 (0.7)	43 (1.1)	38 (1.3)	33 (1.1)
	Israel	63 (1.2)	62 (1.3)	67 (1.5)	49 (1.5)	55 (1.5)
	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)
	Jordan	71 (1.2)	91 (0.8)	50 (1.2)	55 (1.4)	57 (1.0)
	Korea, Rep. of	14 (0.8)	73 (1.1)	27 (0.8)	36 (1.0)	12 (0.6)
	Malaysia	51 (1.0)	89 (0.6)	56 (1.2)	41 (1.5)	45 (1.3)
	New Zealand	53 (1.4)	81 (1.0)	70 (1.6)	57 (1.6)	35 (1.8)
	Philippines	77 (0.7)	86 (0.8)	64 (0.8)	64 (1.1)	51 (1.0)
	Singapore	58 (0.9)	85 (0.9)	75 (0.9)	39 (1.5)	44 (1.6)
	South Africa	71 (0.7)	84 (1.1)	68 (0.9)	66 (1.4)	67 (1.1)
	Thailand	36 (1.2)	75 (1.2)	56 (1.1)	42 (1.7)	81 (0.8)
	Tunisia	54 (1.2)	79 (0.8)	44 (1.2)	69 (0.9)	29 (1.0)
	Turkey	32 (1.0)	90 (0.7)	38 (1.0)	29 (1.0)	22 (1.2)
	United States	63 (1.9)	69 (1.4)	76 (1.5)	59 (1.3)	57 (2.0)
	International Avg.	51 (0.3)	80 (0.2)	56 (0.3)	51 (0.3)	41 (0.3)
	Earth Science					
	Belgium (Flemish)	22 (1.4)	21 (1.0)	46 (1.3)	15 (0.9)	10 (0.8)
	Bulgaria	34 (1.9)	52 (2.3)	34 (1.4)	37 (1.9)	20 (1.4)
	Czech Republic	27 (1.8)	96 (0.7)	49 (2.6)	15 (1.3)	13 (1.2)
	Finland	37 (1.4)	59 (1.3)	63 (1.8)	39 (1.4)	41 (1.8)
	Hungary	45 (1.8)	60 (1.4)	60 (2.0)	66 (2.0)	20 (1.0)
	Latvia (LSS)	--	--	--	--	--
	Lithuania [†]	--	--	--	--	--
	Macedonia, Rep. of	50 (1.8)	85 (1.1)	64 (2.0)	41 (1.4)	31 (1.5)
	Moldova	59 (1.4)	78 (1.4)	67 (1.2)	37 (1.5)	47 (1.5)
	Morocco	x x	x x	x x	x x	x x
	Netherlands	70 (2.3)	43 (2.4)	80 (1.9)	14 (1.6)	74 (2.1)
	Romania	39 (1.8)	66 (1.7)	43 (1.6)	36 (1.6)	25 (1.6)
	Russian Federation	39 (1.2)	44 (1.6)	62 (1.3)	29 (1.3)	21 (0.8)
	Slovak Republic	24 (1.2)	58 (1.5)	44 (1.8)	17 (1.3)	16 (1.2)
	Slovenia	--	--	--	--	--
	International Avg.	41 (0.5)	60 (0.5)	56 (0.5)	31 (0.5)	29 (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 area form, students were asked about each subject area separately.

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

^a Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.^c 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.

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

		Percentage of Students Reporting Almost Always or Pretty Often					
		We Discuss Our Completed Homework	Teachers 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	
 Biology							
	Belgium (Flemish)	22 (1.1)	21 (1.7)	42 (1.5)	24 (1.3)	7 (0.9)	
	Bulgaria	31 (1.9)	35 (1.7)	32 (1.6)	23 (1.4)	13 (1.3)	
	Czech Republic	25 (1.6)	98 (0.6)	41 (2.5)	15 (1.2)	15 (1.2)	
	Finland	37 (1.3)	45 (1.2)	58 (2.2)	37 (1.6)	39 (2.0)	
	Hungary	45 (1.9)	52 (1.7)	55 (2.4)	58 (2.1)	14 (0.9)	
	Latvia (LSS)	33 (1.4)	35 (1.6)	54 (1.6)	--	35 (1.6)	
	Lithuania [*]	--	--	--	--	--	
	Macedonia, Rep. of	52 (1.3)	85 (1.0)	60 (1.8)	48 (1.5)	26 (1.2)	
	Moldova	63 (1.2)	61 (1.5)	66 (1.3)	38 (1.5)	41 (1.6)	
	Morocco	^s 67 (1.5)	^s 79 (1.1)	^s 57 (1.4)	^s 48 (1.8)	^s 51 (1.4)	
	Netherlands	57 (4.0)	45 (2.1)	79 (3.6)	17 (1.7)	70 (3.1)	
	Romania	39 (1.7)	62 (1.8)	40 (1.6)	34 (1.8)	23 (1.5)	
	Russian Federation	38 (1.2)	36 (1.5)	64 (1.5)	27 (1.4)	18 (1.1)	
	Slovak Republic	25 (1.5)	60 (1.7)	42 (1.9)	21 (1.3)	15 (1.2)	
	Slovenia	24 (1.6)	44 (1.6)	27 (1.2)	24 (1.1)	14 (1.0)	
	International Avg.	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)
Bulgaria		39 (1.4)	87 (0.9)	37 (1.9)	35 (1.5)	22 (1.2)	
Czech Republic		29 (1.7)	98 (0.4)	40 (1.6)	27 (1.4)	14 (1.4)	
Finland		41 (1.7)	72 (1.2)	60 (1.8)	42 (1.4)	41 (2.0)	
Hungary		57 (1.9)	88 (1.0)	46 (1.5)	87 (0.7)	23 (1.1)	
Latvia (LSS)		37 (1.4)	86 (1.2)	54 (1.3)	--	29 (1.3)	
Lithuania [*]		--	--	--	--	--	
Macedonia, Rep. of		61 (1.7)	90 (0.8)	56 (1.6)	56 (1.6)	34 (1.2)	
Moldova		60 (1.2)	94 (0.5)	72 (1.0)	39 (1.6)	46 (1.5)	
Morocco		x x	^s 92 (0.7)	x x	x x	x x	
Netherlands ^c		64 (2.9)	55 (2.5)	81 (1.9)	17 (1.5)	73 (2.7)	
Romania		50 (1.6)	84 (1.0)	42 (1.4)	47 (1.9)	32 (1.7)	
Russian Federation		44 (1.2)	89 (0.9)	64 (1.3)	33 (1.1)	24 (1.0)	
Slovak Republic		43 (1.5)	86 (0.9)	42 (1.6)	38 (1.8)	31 (1.7)	
Slovenia		38 (1.5)	60 (1.3)	36 (1.3)	28 (1.1)	24 (1.3)	
International Avg.		45 (0.5)	81 (0.3)	52 (0.4)	40 (0.4)	31 (0.4)	
 Chemistry							
		Belgium (Flemish)	--	--	--	--	--
	Bulgaria	41 (1.6)	90 (1.1)	40 (1.5)	42 (1.9)	24 (1.7)	
	Czech Republic	30 (1.9)	97 (0.9)	40 (2.1)	35 (1.4)	13 (1.2)	
	Finland	40 (1.5)	69 (1.2)	59 (1.9)	44 (1.5)	39 (1.9)	
	Hungary	56 (2.1)	86 (0.9)	57 (2.2)	84 (1.2)	21 (1.2)	
	Latvia (LSS)	45 (1.7)	93 (0.8)	56 (1.4)	--	38 (1.6)	
	Lithuania [*]	--	--	--	--	--	
	Macedonia, Rep. of	52 (1.4)	89 (0.9)	43 (1.2)	54 (1.5)	27 (1.1)	
	Moldova	62 (1.3)	92 (0.6)	75 (1.0)	40 (1.5)	44 (1.6)	
	Morocco	x x	^s 89 (0.8)	x x	x x	x x	
	Netherlands	--	--	--	--	--	
	Romania	51 (1.7)	85 (1.0)	46 (1.6)	46 (1.9)	32 (1.8)	
	Russian Federation	48 (1.2)	89 (0.8)	64 (1.6)	30 (1.2)	21 (1.1)	
	Slovak Republic	39 (1.8)	87 (0.8)	39 (1.7)	42 (1.8)	24 (1.6)	
	Slovenia	33 (1.5)	60 (1.4)	35 (1.3)	28 (1.2)	20 (1.3)	
	International Avg.	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.

in earth science and biology. About a majority of students, on average, reported that they work on worksheets or textbooks on their own almost always or pretty often in general/integrated science and all four science subjects.

6.11



Students were also asked to indicate the frequency of use of three presentational modes in their classroom: the board, an overhead projector, and a computer. As shown in Exhibit 6.11, the most commonly used presentational mode was the board, with 86 percent of students in general/integrated science and 65 to 87 percent in the separate sciences reporting that their teacher uses the board almost always or pretty often. Teachers' use of computers to demonstrate ideas was low, with 10 percent or less of students internationally reporting that teachers do so almost always or pretty often. In comparison, 20 percent or more of the students in Israel, the Philippines, and the United States reported this level of computer use by their science teachers.

6.12



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 6.12, 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 the activities only in some lessons or rarely.

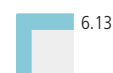
On average internationally, 16 percent of students had teachers who placed a high emphasis on scientific reasoning and problem-solving, with a range from four percent in Belgium (Flemish) and New Zealand to about one-third in Japan and the Philippines. While the level of emphasis on scientific reasoning and problem-solving was associated with achievement in some countries, there was no strong or consistent relationship internationally or across countries.



Exhibit R3.9 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. Internationally, 68 percent of students had teachers who asked them to do this in most or every lesson. This activity was relatively infrequent in the top-performing Asian countries; between 42 and 69 percent of the students in Chinese Taipei, Hong Kong, Japan, Korea, and Singapore were asked to explain the reasoning behind an idea in most or every lesson. Across countries, 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.



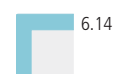
The trends in the index of teachers' emphasis on scientific reasoning and problem-solving are shown in Exhibit 6.13. Internationally, the trend is toward more emphasis on scientific reasoning and problem-solving, as the percentage of students in the high category rose from nine to 13 percent between 1995 and 1999. Canada and Lithuania had a significant increase in the percentage of the students in the high category and a decrease in the low category, and Japan and the Russian Federation had increases in the high category.



The trends in the problem-solving activities included in the index are shown in Exhibit R3.10. Internationally, there was a significant increase in the percentages of students asked to do four of the five activities in most or every science lesson (all except put events or objects in order and give a reason for the organization). Canada, Iran, Lithuania, and the Russian Federation had significant increases in the percentage of students asked to write explanations about what was observed and why it happened, while the Czech Republic, Hong Kong, and Latvia (LSS) had significant decreases. Japan and Lithuania had significant increases in the percentage of students asked to work on problems for which there is no immediately obvious solution. Finally, Canada and Romania had significant increases in the percentage of students asked to put events or objects in order and give a reason for the organization, while Korea and Lithuania had significant decreases.



An important aspect of teaching science is the emphasis placed on scientific investigation. In order to measure this, TIMSS computed an index of emphasis on conducting experiments in science classes (ECES), shown in Exhibit 6.14. The index is based on students' and teachers' reports of the frequency of the teacher demonstrating experi-



text continued
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Exhibit 6.11 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
 General/Integrated Science	Australia	93 (0.7)	44 (2.1)	7 (0.8)	18 (1.0)	7 (0.7)
	Canada	81 (1.0)	55 (1.8)	10 (0.7)	19 (0.8)	11 (0.6)
	Chile	87 (1.1)	18 (1.7)	14 (1.1)	66 (1.2)	12 (1.0)
	Chinese Taipei ^a	92 (0.6)	7 (1.0)	5 (0.4)	39 (1.1)	3 (0.4)
	Cyprus	90 (0.7)	40 (2.3)	10 (0.6)	60 (1.6)	12 (0.8)
	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)
	Indonesia ^b	80 (1.0)	12 (0.9)	3 (0.6)	42 (1.1)	5 (0.6)
	Iran, Islamic Rep.	86 (0.8)	13 (0.8)	0 (0.2)	71 (0.8)	8 (0.6)
	Israel	83 (1.2)	28 (1.4)	22 (1.2)	29 (1.1)	17 (0.9)
	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)
	Jordan	87 (0.9)	34 (1.6)	r 15 (1.4)	76 (1.0)	r 26 (1.3)
	Korea, Rep. of	86 (1.1)	26 (2.4)	13 (1.7)	23 (1.1)	7 (0.8)
	Malaysia	87 (0.9)	35 (2.4)	1 (0.2)	37 (1.0)	10 (0.8)
	New Zealand	94 (0.6)	53 (2.3)	12 (1.0)	22 (1.2)	13 (0.9)
	Philippines	85 (0.8)	39 (1.5)	r 24 (1.8)	63 (1.1)	33 (1.4)
	Singapore	92 (0.9)	81 (1.5)	19 (2.0)	40 (1.6)	22 (1.0)
	South Africa	83 (1.1)	48 (1.6)	—	55 (1.7)	38 (1.4)
	Thailand	86 (1.0)	14 (1.5)	9 (0.8)	30 (1.0)	7 (0.7)
	Tunisia	78 (1.0)	44 (1.8)	2 (0.6)	52 (1.2)	16 (1.1)
	Turkey	77 (0.9)	15 (1.1)	4 (0.4)	75 (1.0)	12 (0.9)
	United States	75 (1.6)	59 (2.3)	20 (1.4)	29 (1.0)	19 (1.1)
	International Avg.	86 (0.2)	32 (0.4)	10 (0.2)	42 (0.2)	13 (0.2)
 Earth Science	Belgium (Flemish)	68 (2.2)	57 (2.4)	3 (0.4)	12 (0.7)	6 (0.6)
	Bulgaria	61 (1.8)	13 (1.1)	6 (0.8)	49 (2.1)	10 (1.0)
	Czech Republic	65 (2.8)	12 (1.6)	3 (0.5)	40 (2.2)	5 (0.7)
	Finland	81 (1.5)	68 (2.0)	7 (0.7)	23 (1.5)	13 (0.9)
	Hungary	55 (2.1)	24 (2.3)	4 (0.4)	30 (1.4)	7 (0.7)
	Latvia (LSS)	—	—	—	—	—
	Lithuania [†]	—	—	—	—	—
	Macedonia, Rep. of	58 (2.3)	22 (1.5)	r 8 (1.0)	47 (1.6)	15 (0.9)
	Moldova	62 (1.6)	31 (1.7)	15 (1.2)	61 (1.5)	27 (1.5)
	Morocco	x x	x x	x x	x x	x x
	Netherlands	71 (2.5)	19 (3.0)	6 (1.0)	8 (1.1)	5 (1.1)
	Romania	73 (1.4)	13 (0.9)	3 (0.6)	60 (1.6)	9 (0.8)
	Russian Federation	78 (1.1)	8 (0.7)	2 (0.4)	65 (1.3)	5 (0.5)
	Slovak Republic	41 (2.6)	8 (1.4)	1 (0.4)	30 (2.0)	3 (0.5)
	Slovenia	—	—	—	—	—
	International Avg.	65 (0.6)	25 (0.6)	5 (0.2)	39 (0.5)	10 (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.

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

^a Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.^c 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.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate. An "x" indicates a <50% student response rate.

		Percentage of Students Reporting Almost Always of 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	
 Biology	Belgium (Flemish)	75 (1.9)	50 (2.3)	3 (0.6)	13 (0.9)	4 (0.7)	
	Bulgaria	68 (2.2)	12 (1.2)	4 (0.7)	43 (1.9)	9 (0.8)	
	Czech Republic	79 (2.3)	17 (2.1)	3 (1.0)	40 (2.2)	4 (0.5)	
	Finland	83 (1.5)	75 (1.9)	7 (0.7)	20 (1.4)	11 (0.9)	
	Hungary	73 (1.9)	29 (2.4)	4 (0.7)	33 (1.5)	6 (0.6)	
	Latvia (LSS)	59 (2.1)	5 (0.6)	5 (0.7)	29 (1.6)	3 (0.5)	
	Lithuania [†]	--	--	--	--	--	
	Macedonia, Rep. of	73 (1.9)	32 (2.0)	6 (0.7)	49 (1.7)	18 (1.3)	
	Moldova	69 (1.2)	33 (1.6)	13 (1.0)	65 (1.4)	27 (1.5)	
	Morocco ^s	77 (1.5)	x x	x x	x x	x x	
	Netherlands	75 (2.4)	14 (2.7)	3 (0.7)	7 (0.9)	3 (0.6)	
	Romania	75 (1.6)	13 (0.9)	2 (0.4)	58 (1.7)	8 (0.8)	
	Russian Federation	80 (1.3)	10 (1.0)	2 (0.2)	61 (1.6)	5 (0.6)	
	Slovak Republic	64 (2.6)	12 (1.5)	1 (0.4)	32 (2.0)	3 (0.4)	
	Slovenia	71 (1.6)	68 (1.9)	9 (0.8)	32 (1.5)	14 (0.9)	
	International Avg.	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)
		Bulgaria	83 (1.1)	16 (1.6)	7 (0.8)	71 (1.2)	12 (1.3)
		Czech Republic	87 (1.1)	18 (1.8)	5 (0.7)	66 (2.1)	6 (0.6)
Finland		87 (1.1)	48 (1.8)	7 (0.7)	25 (1.3)	10 (0.8)	
Hungary		85 (1.1)	19 (2.0)	5 (0.5)	53 (1.4)	7 (0.7)	
Latvia (LSS)		81 (1.1)	11 (1.4)	7 (0.9)	57 (1.9)	4 (0.4)	
Lithuania [†]		--	--	--	--	--	
Macedonia, Rep. of		87 (0.8)	29 (1.8)	r 9 (1.1)	76 (1.1)	18 (1.0)	
Moldova		79 (0.9)	35 (1.7)	16 (1.2)	79 (0.8)	29 (1.6)	
Morocco		x x	x x	x x	x x	x x	
Netherlands ^c		73 (2.0)	13 (2.1)	5 (1.0)	9 (1.3)	3 (0.5)	
Romania		85 (0.8)	16 (1.0)	4 (0.7)	79 (1.1)	11 (0.9)	
Russian Federation		91 (0.6)	10 (0.9)	3 (0.4)	82 (1.0)	6 (0.5)	
Slovak Republic		79 (1.6)	14 (1.3)	3 (0.7)	60 (1.7)	4 (0.4)	
Slovenia		80 (1.1)	42 (1.7)	17 (1.1)	48 (1.3)	14 (1.0)	
International Avg.		83 (0.3)	23 (0.5)	7 (0.2)	56 (0.4)	10 (0.2)	
 Chemistry		Belgium (Flemish)	--	--	--	--	--
		Bulgaria	89 (0.9)	14 (1.0)	6 (0.8)	80 (1.4)	11 (0.8)
		Czech Republic	90 (1.3)	19 (2.3)	3 (0.8)	67 (2.2)	5 (0.8)
	Finland	90 (1.0)	48 (1.7)	6 (0.6)	26 (1.3)	9 (0.7)	
	Hungary	90 (0.8)	16 (1.4)	3 (0.4)	54 (1.5)	6 (0.6)	
	Latvia (LSS)	86 (0.9)	7 (0.7)	5 (0.7)	69 (1.9)	4 (0.5)	
	Lithuania [†]	--	--	--	--	--	
	Macedonia, Rep. of	88 (1.0)	24 (1.6)	8 (0.9)	80 (1.2)	16 (1.0)	
	Moldova	80 (0.9)	34 (1.7)	13 (1.1)	81 (0.8)	28 (1.5)	
	Morocco	x x	x x	x x	x x	x x	
	Netherlands	--	--	--	--	--	
	Romania	87 (0.8)	16 (1.0)	4 (0.7)	84 (0.9)	11 (0.9)	
	Russian Federation	93 (0.6)	9 (0.7)	2 (0.3)	84 (1.2)	5 (0.5)	
	Slovak Republic	82 (1.7)	13 (1.8)	2 (0.4)	69 (1.8)	4 (0.4)	
	Slovenia	81 (1.1)	57 (2.3)	10 (0.9)	54 (1.3)	15 (0.9)	
	International Avg.	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 6.12 Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving (ESRPS)

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 R3.9). 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
Philippines	33 (3.8)	344 (10.9)	48 (3.9)	348 (11.4)	19 (3.2)	339 (15.2)
Japan	32 (4.0)	555 (3.1)	37 (4.4)	549 (3.5)	31 (3.9)	545 (3.7)
Tunisia	29 (3.6)	427 (4.5)	52 (4.2)	428 (4.1)	19 (3.5)	436 (6.6)
Turkey	28 (3.7)	445 (7.2)	45 (4.1)	430 (6.2)	27 (3.9)	427 (5.2)
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)
Malaysia	25 (3.4)	490 (9.7)	54 (3.8)	498 (6.5)	21 (3.5)	482 (9.4)
Indonesia	24 (3.1)	446 (8.4)	39 (3.4)	438 (6.5)	37 (3.5)	432 (7.5)
Cyprus ^s	22 (3.2)	458 (5.4)	44 (4.1)	469 (4.3)	34 (4.4)	458 (4.9)
Romania	21 (1.9)	480 (7.7)	51 (2.3)	471 (7.0)	27 (2.1)	469 (7.6)
South Africa	20 (3.1)	236 (19.4)	41 (3.5)	229 (14.5)	39 (3.9)	264 (12.0)
Thailand	18 (3.4)	495 (10.4)	44 (3.9)	485 (7.6)	38 (3.9)	473 (6.4)
Macedonia, Rep. of	18 (1.9)	465 (11.6)	48 (2.3)	456 (6.2)	34 (2.2)	458 (6.4)
Bulgaria ^r	17 (1.8)	517 (8.4)	57 (2.2)	511 (4.7)	26 (2.2)	505 (9.5)
United States ^r	16 (2.3)	519 (9.7)	51 (3.2)	524 (6.3)	33 (3.7)	514 (6.5)
Jordan	16 (2.8)	471 (7.7)	49 (4.2)	449 (6.0)	35 (4.1)	442 (6.9)
Morocco	15 (1.6)	317 (4.6)	41 (3.1)	323 (5.7)	44 (3.8)	324 (6.9)
Israel	15 (3.3)	426 (18.8)	55 (4.0)	475 (6.7)	30 (3.9)	479 (8.1)
Iran, Islamic Rep.	14 (4.0)	440 (15.8)	37 (3.6)	447 (5.0)	49 (4.4)	453 (4.8)
Lithuania [†]	14 (1.7)	508 (8.6)	50 (2.6)	489 (4.5)	36 (2.5)	479 (5.4)
Hungary	14 (1.6)	560 (5.6)	53 (2.0)	552 (5.0)	34 (1.9)	548 (3.9)
Chile	14 (2.3)	423 (11.4)	53 (3.5)	431 (5.8)	33 (3.3)	404 (5.4)
Moldova	13 (1.5)	463 (7.1)	51 (2.2)	462 (4.8)	35 (2.1)	456 (4.8)
Russian Federation	13 (1.5)	548 (13.0)	50 (2.6)	530 (7.1)	37 (2.5)	523 (5.7)
Finland	11 (2.1)	533 (6.4)	40 (3.1)	538 (4.4)	49 (2.9)	533 (4.5)
Chinese Taipei	11 (2.5)	589 (13.5)	34 (4.3)	576 (7.4)	54 (4.4)	559 (4.9)
Australia	11 (2.3)	524 (11.1)	38 (3.5)	541 (5.4)	51 (3.3)	541 (6.7)
Czech Republic	9 (1.7)	543 (8.2)	42 (3.1)	543 (6.1)	48 (3.4)	537 (4.5)
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)
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)
Latvia (LSS) ^r	5 (1.3)	505 (9.9)	47 (2.9)	508 (5.2)	48 (2.9)	504 (5.6)
Belgium (Flemish)	4 (0.8)	550 (7.4)	20 (2.6)	537 (11.5)	77 (2.6)	533 (4.7)
New Zealand	4 (1.3)	521 (14.6)	46 (4.1)	516 (7.5)	51 (4.1)	504 (6.6)
International Avg.	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.

[†] 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.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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 6.13 Trends in Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving (ESRPS)

		High ESRPS			Medium ESRPS			Low ESRPS		
		Percent of Students			Percent of Students			Percent of Students		
		1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
Australia		x x	x x	x x	x x	x x	x x	x x	x x	x x
Belgium (Flemish)	r	2 (1.2)	4 (0.8)	2 (1.4) ●	20 (4.0)	20 (2.6)	-1 (4.7) ●	78 (4.0)	77 (2.6)	-1 (4.8) ●
Canada	r	2 (0.9)	26 (3.1)	24 (3.2) ▲	50 (5.7)	48 (3.4)	-2 (6.6) ●	48 (5.9)	26 (2.7)	-23 (6.5) ▼
Cyprus	s	13 (3.9)	22 (3.2)	9 (5.0) ●	37 (5.9)	44 (4.1)	7 (7.2) ●	50 (6.0)	34 (4.4)	-16 (7.4) ●
Czech Republic		6 (1.7)	9 (1.7)	3 (2.4) ●	50 (2.6)	42 (3.1)	-8 (4.0) ●	43 (2.6)	48 (3.4)	5 (4.3) ●
England	s	8 (2.2)	7 (2.3)	-1 (3.2) ●	46 (3.3)	41 (4.6)	-5 (5.6) ●	46 (3.5)	51 (4.7)	5 (5.8) ●
Hong Kong, SAR		8 (3.9)	8 (2.5)	0 (4.6) ●	30 (5.9)	29 (4.4)	-2 (7.3) ●	62 (5.9)	63 (4.6)	1 (7.5) ●
Hungary		13 (1.8)	14 (1.6)	1 (2.4) ●	49 (2.5)	53 (2.0)	4 (3.2) ●	39 (2.5)	34 (1.9)	-5 (3.1) ●
Iran, Islamic Rep.		8 (6.6)	14 (4.0)	6 (7.8) ●	22 (4.1)	37 (3.6)	15 (5.4) ●	70 (6.4)	49 (4.4)	-20 (7.8) ●
Israel †	r	9 (4.9)	13 (3.6)	4 (6.1) ●	56 (9.2)	54 (4.6)	-2 (10.3) ●	36 (10.1)	33 (4.6)	-3 (11.0) ●
Italy		19 (3.6)	22 (4.1)	3 (5.4) ●	32 (4.7)	52 (4.9)	20 (6.8) ●	49 (4.7)	26 (4.3)	-22 (6.4) ▼
Japan		15 (3.1)	32 (4.0)	17 (5.0) ▲	46 (4.8)	37 (4.4)	-9 (6.5) ●	39 (4.5)	31 (3.9)	-8 (6.0) ●
Korea, Rep. of		13 (2.6)	6 (1.9)	-6 (3.2) ●	50 (4.0)	48 (4.1)	-3 (5.8) ●	37 (4.2)	46 (3.9)	9 (5.7) ●
Latvia (LSS)	s	7 (1.5)	5 (1.3)	-2 (1.9) ●	52 (2.6)	47 (2.9)	-5 (3.9) ●	41 (2.4)	48 (2.9)	7 (3.8) ●
Lithuania	r	5 (1.1)	14 (1.7)	9 (2.0) ▲	43 (2.3)	50 (2.6)	7 (3.5) ●	52 (2.4)	36 (2.5)	-16 (3.4) ▼
Netherlands	r	4 (1.3)	5 (1.4)	1 (1.9) ●	24 (2.8)	35 (4.3)	10 (5.2) ●	72 (3.2)	60 (4.6)	-11 (5.6) ●
New Zealand		2 (1.1)	4 (1.3)	1 (1.7) ●	38 (3.9)	46 (4.1)	7 (5.7) ●	59 (4.1)	51 (4.1)	-9 (5.8) ●
Romania		18 (1.9)	21 (1.9)	3 (2.7) ●	54 (2.7)	51 (2.3)	-2 (3.5) ●	28 (2.2)	27 (2.1)	-1 (3.1) ●
Russian Federation		5 (1.2)	13 (1.5)	7 (2.0) ▲	53 (3.6)	50 (2.6)	-3 (4.5) ●	42 (3.4)	37 (2.5)	-5 (4.2) ●
Singapore		5 (2.1)	8 (2.4)	3 (3.2) ●	31 (4.4)	29 (3.8)	-2 (5.8) ●	63 (4.4)	63 (4.2)	0 (6.1) ●
Thailand †	r	14 (4.0)	18 (3.4)	4 (5.2) ●	52 (5.8)	44 (3.9)	-8 (7.0) ●	34 (6.0)	38 (3.9)	4 (7.1) ●
United States		x x	x x	x x	x x	x x	x x	x x	x x	x x
International Avg. §		9 (0.6)	13 (0.5)	5 (0.8) ▲	40 (1.0)	42 (0.8)	2 (1.3) ●	51 (1.0)	45 (0.8)	-6 (1.3) ▼

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

- ▲ 1999 significantly higher than 1995
 - No significant difference between 1995 and 1999
 - ▼ 1999 significantly lower than 1995
- Significance tests adjusted for multiple comparisons

Background data provided by teachers.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

An "r" indicates teacher response data available for 70-84% of students, based on the lower response rate in either 1995 or 1999. An "s" indicates teacher response data available for 50-69% of students, based on the lower response rate in either 1995 or 1999. An "x" indicates teacher response data available for <50% of students, based on the lower response rate in either 1995 or 1999.



ments 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 teachers demonstrate experiments or students conduct experiments or practical investigations in class 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 experiments are demonstrated or conducted in class once in a while or never. The middle category includes all other possible combinations of responses.

Internationally on average, 38 percent of students in countries with general/integrated science had classes with high emphasis on experiments, with a range from two percent in Italy to 78 percent in Hong Kong. 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 R3.11 and R3.13 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 over 90 percent of the students in Cyprus and England. For the separate sciences, the percentages of students who reported that their teachers demonstrate experiments almost always or pretty often were, on average, 19 percent for earth science, 42 percent for biology, 61 percent for physics, and 68 percent for chemistry. Students' reports on the frequency with which they conduct experiments or practical investigations in class show a similar trend across science subjects but a lower frequency than those reported 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.

R3.12, R3.14



Trends in students' reports on the frequency with which teachers demonstrate experiments and students conduct experiments are shown in Exhibits R3.12 and R3.14, respectively. On average for the integrated science countries, there was a small but significant increase (two percentage points) from 1995 to 1999 in the percentage of students who reported that their teachers demonstrate experiments almost always or pretty often. For the separate-science countries, the only subject that had a significant change was physics, for which the international average declined by four percentage points.



Exhibit 6.14 Overleaf

Exhibit 6.14 Index of Emphasis on Conducting Experiments in Science Classes (ECES)

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 6.9, R3.11, and R3.13). 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 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 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)

	High ECES		Medium ECES		Low ECES	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
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)	~ ~
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)	~ ~
Malaysia	53 (3.8)	509 (6.6)	46 (3.8)	470 (5.8)	1 (0.7)	~ ~
Thailand	52 (3.8)	485 (5.7)	47 (3.6)	481 (6.3)	1 (0.6)	~ ~
New Zealand	52 (4.1)	517 (5.9)	48 (4.1)	511 (7.9)	0 (0.2)	~ ~
Tunisia	51 (3.9)	432 (3.8)	49 (3.8)	429 (4.8)	0 (0.2)	~ ~
Jordan	47 (3.7)	451 (5.8)	52 (3.6)	463 (4.8)	1 (0.3)	~ ~
Canada r	47 (3.8)	539 (4.1)	52 (3.9)	533 (3.6)	1 (0.5)	~ ~
Cyprus s	46 (3.9)	469 (4.4)	54 (3.9)	462 (4.0)	0 (0.1)	~ ~
Australia	45 (3.9)	544 (6.1)	54 (3.9)	536 (5.3)	1 (0.3)	~ ~
Philippines	44 (3.9)	335 (11.4)	56 (3.9)	355 (8.8)	0 (0.0)	~ ~
United States r	31 (2.6)	531 (6.8)	64 (2.6)	523 (5.3)	4 (1.1)	529 (7.5)
Korea, Rep. of	27 (3.1)	558 (3.4)	71 (3.0)	546 (3.0)	2 (0.7)	~ ~
South Africa	26 (3.6)	214 (10.5)	72 (3.4)	257 (11.1)	2 (0.4)	~ ~
Israel r	26 (3.5)	490 (8.8)	71 (3.2)	471 (6.2)	3 (0.9)	443 (18.4)
Indonesia b	18 (1.6)	435 (8.7)	78 (2.0)	439 (4.6)	5 (1.5)	430 (22.7)
Iran, Islamic Rep.	16 (2.4)	447 (7.1)	79 (2.6)	449 (4.4)	4 (1.2)	473 (13.4)
Chinese Taipei a	14 (2.8)	574 (9.2)	84 (2.9)	570 (4.9)	2 (0.6)	~ ~
Turkey	14 (2.2)	434 (7.2)	79 (2.4)	436 (4.9)	8 (1.5)	431 (8.4)
Chile	12 (1.8)	435 (11.0)	81 (2.1)	422 (3.9)	7 (1.4)	410 (10.3)
Italy	2 (0.6)	~ ~	73 (3.0)	493 (4.3)	25 (2.9)	498 (6.7)
International Avg.	38 (0.7)	483 (1.7)	59 (0.7)	478 (1.3)	3 (0.2)	459 (5.3)



Earth Science (ECES-E)

Romania	2 (0.9)	~ ~	67 (2.7)	465 (6.1)	31 (2.8)	495 (8.1)
Belgium (Flemish) r	2 (0.6)	~ ~	43 (3.6)	530 (5.3)	56 (3.8)	549 (5.9)
Macedonia, Rep. of	1 (0.5)	~ ~	74 (2.6)	459 (5.9)	25 (2.5)	487 (7.6)
Moldova r	1 (0.6)	~ ~	72 (2.9)	460 (4.7)	27 (2.9)	478 (7.4)
Bulgaria r	0 (0.0)	~ ~	50 (4.9)	508 (7.5)	50 (4.9)	522 (5.6)
Hungary	0 (0.1)	~ ~	43 (3.1)	547 (5.7)	57 (3.2)	557 (4.9)
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)
Finland	--	--	--	--	--	--
Latvia (LSS)	--	--	--	--	--	--
Lithuania †	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
International Avg.	1 (0.2)	~ ~	48 (1.1)	505 (2.7)	52 (1.1)	525 (2.2)

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

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

b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

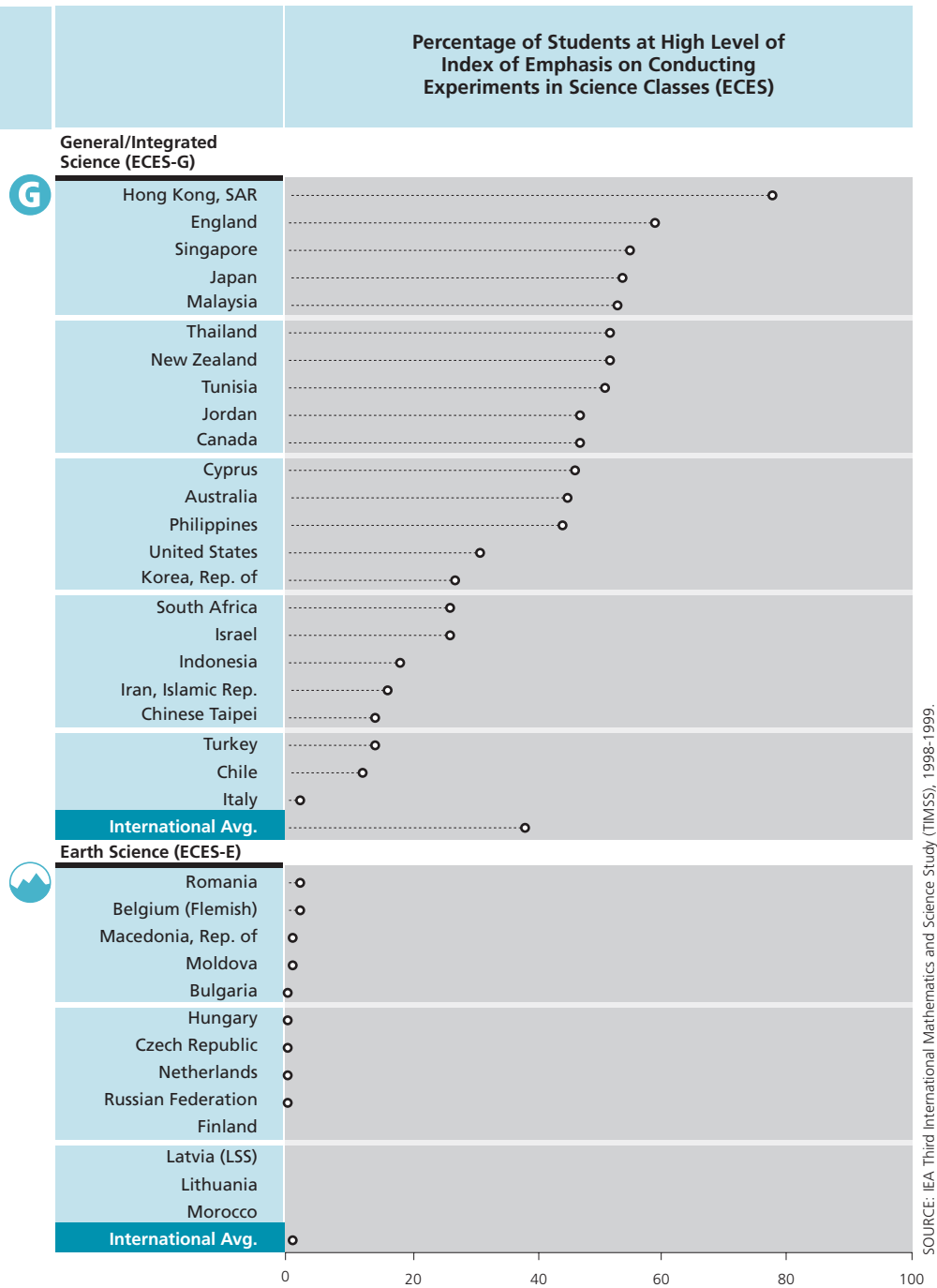
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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. 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.

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



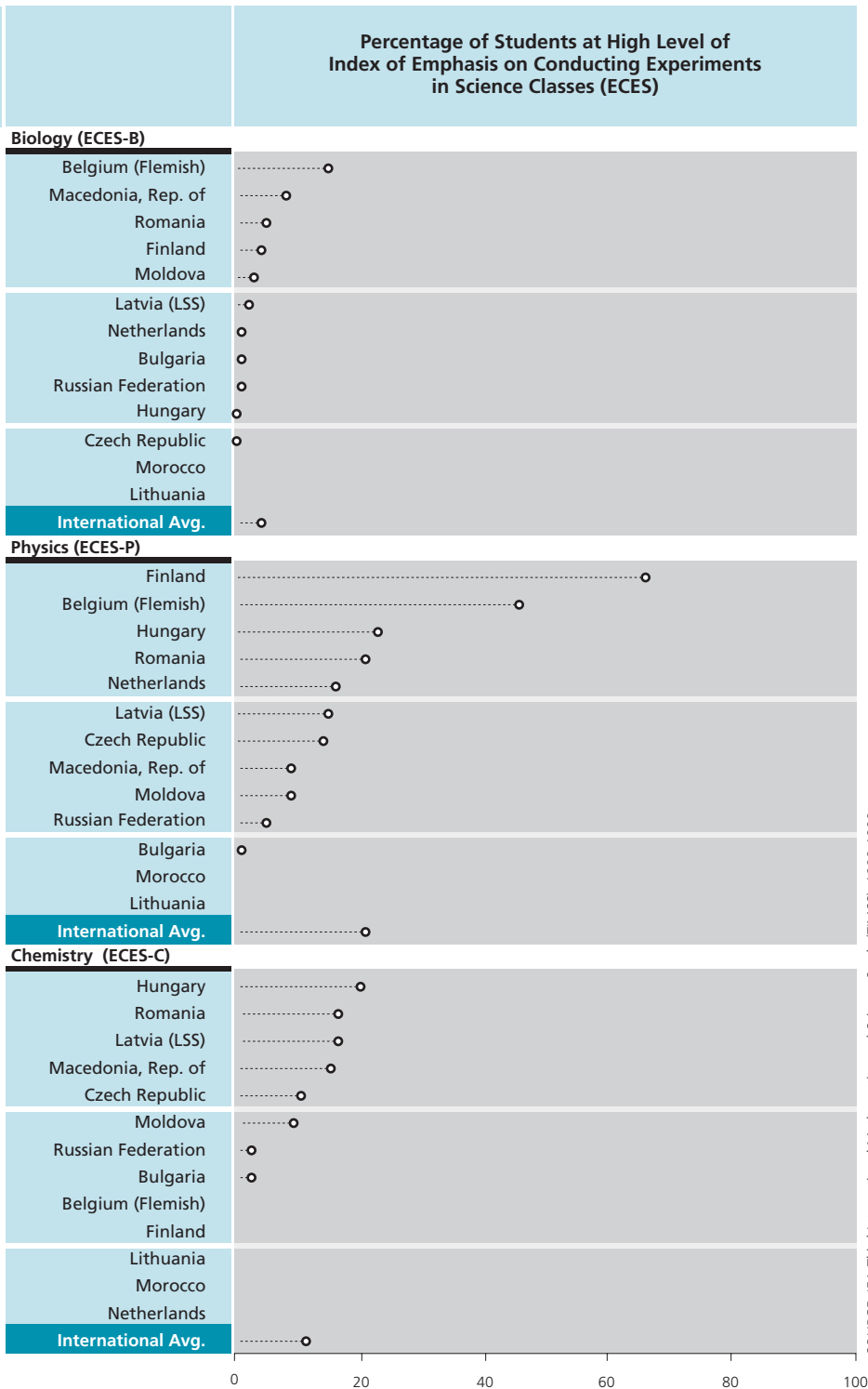
		High ECES		Medium ECES		Low ECES	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Biology (ECES-B)							
	Belgium (Flemish) ^r	15 (2.7)	543 (5.6)	77 (3.1)	549 (4.6)	8 (1.7)	537 (11.7)
	Macedonia, Rep. of	8 (1.9)	464 (15.1)	88 (2.0)	464 (5.2)	4 (0.7)	473 (14.1)
	Romania	5 (1.2)	498 (20.2)	85 (2.0)	472 (5.9)	9 (2.1)	474 (13.8)
	Finland ^c	4 (1.0)	526 (11.3)	70 (2.9)	534 (4.2)	26 (3.0)	543 (4.4)
	Moldova	3 (1.4)	438 (30.5)	85 (2.1)	460 (4.6)	12 (1.6)	477 (8.1)
Latvia (LSS) ^r	2 (0.9)	~ ~	78 (3.8)	508 (5.0)	21 (3.8)	526 (11.4)	
Netherlands ^r	1 (0.7)	~ ~	76 (5.1)	545 (12.1)	23 (5.1)	533 (10.3)	
Bulgaria ^r	1 (0.5)	~ ~	58 (4.2)	511 (6.5)	41 (4.3)	520 (8.1)	
Russian Federation	1 (0.4)	~ ~	79 (2.5)	530 (6.7)	20 (2.5)	540 (9.0)	
Hungary	0 (0.2)	~ ~	65 (3.2)	554 (4.0)	34 (3.3)	551 (6.4)	
Czech Republic	0 (0.0)	~ ~	72 (3.5)	538 (5.0)	28 (3.5)	547 (7.3)	
Morocco ^d	x x	x x	x x	x x	x x	x x	
Lithuania ^e	--	--	--	--	--	--	
International Avg.		4 (0.4)	494 (10.9)	76 (1.0)	515 (1.9)	21 (0.9)	520 (2.9)
Physics (ECES-P)							
	Finland ^c	67 (2.4)	541 (4.7)	33 (2.4)	517 (4.1)	0 (0.2)	~ ~
	Belgium (Flemish) ^r	46 (6.6)	557 (10.5)	52 (6.7)	549 (6.6)	2 (0.2)	~ ~
	Hungary	23 (2.8)	557 (6.5)	73 (2.8)	552 (4.6)	4 (1.3)	568 (13.2)
	Romania	21 (3.0)	482 (9.7)	75 (3.2)	479 (6.3)	4 (1.3)	450 (26.2)
	Netherlands ^e ^r	16 (4.4)	550 (11.8)	78 (5.0)	551 (7.9)	6 (3.2)	497 (36.9)
Latvia (LSS) ^r	15 (2.6)	520 (10.6)	80 (2.9)	500 (5.2)	5 (1.7)	525 (11.9)	
Czech Republic	14 (2.9)	536 (10.9)	82 (2.8)	544 (4.7)	5 (1.4)	555 (12.8)	
Macedonia, Rep. of	9 (2.1)	482 (11.9)	86 (2.2)	462 (5.8)	5 (1.0)	467 (12.3)	
Moldova	9 (2.2)	477 (14.6)	88 (2.3)	463 (4.3)	3 (0.7)	464 (16.5)	
Russian Federation	5 (1.9)	538 (18.4)	90 (2.1)	533 (6.2)	5 (1.0)	516 (16.9)	
Bulgaria	1 (0.4)	~ ~	84 (2.4)	508 (5.4)	15 (2.4)	520 (9.4)	
Morocco ^d	x x	x x	x x	x x	x x	x x	
Lithuania ^e	--	--	--	--	--	--	
International Avg.		21 (1.0)	524 (3.3)	74 (1.0)	514 (1.7)	5 (0.5)	507 (5.3)
Chemistry (ECES-C)							
	Hungary	20 (3.1)	563 (6.2)	79 (3.2)	549 (3.8)	2 (1.0)	~ ~
	Romania	16 (2.7)	486 (13.1)	81 (2.7)	473 (6.2)	3 (1.0)	444 (26.1)
	Latvia (LSS) ^s	16 (3.0)	503 (7.5)	80 (3.1)	509 (6.1)	3 (1.2)	486 (22.7)
	Macedonia, Rep. of	15 (2.6)	474 (11.6)	81 (2.7)	465 (6.0)	4 (0.8)	465 (13.9)
	Czech Republic	10 (3.0)	556 (13.9)	87 (3.0)	538 (4.2)	3 (0.9)	545 (14.0)
Moldova	9 (2.2)	464 (15.7)	86 (2.4)	460 (4.3)	5 (1.1)	480 (13.6)	
Russian Federation	2 (1.5)	~ ~	93 (1.5)	532 (6.3)	5 (0.9)	532 (17.4)	
Bulgaria	2 (0.7)	~ ~	88 (1.9)	518 (6.5)	11 (1.8)	513 (7.6)	
Belgium (Flemish)	--	--	--	--	--	--	
Finland	--	--	--	--	--	--	
Lithuania ^e	--	--	--	--	--	--	
Morocco	--	--	--	--	--	--	
Netherlands	--	--	--	--	--	--	
International Avg.		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.

^c Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.

^d Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.

^e Netherlands: Data for physics/chemistry teachers are reported in physics panel.



How Are Computers Used?

6.15



Students' reports on the frequency of computer use in science class are presented in Exhibit 6.15. Internationally, very few students reported frequent use of computers in any of the science subjects, although somewhat higher percentages were found across the countries with general/integrated science. Only in Israel and the United States did at least 20 percent of students report using computers almost always or pretty often in science class.

6.16



Internationally, computer use increased from 1995 to 1999 in general/integrated science and decreased in all of the separate science subjects (see Exhibit 6.16). Canada, England, Korea, New Zealand, Singapore, and the United States all had significant increases in students' use of computers in science class, while Cyprus and Iran has significant decreases. In the separate sciences, Romania had the most pronounced change, with decreases of more than 10 percentage points in all of the separate science subjects. Other separate-science countries with significant changes were the Slovak Republic, with a decrease in earth science; the Russian Federation, with a decrease in physics and chemistry; and Slovenia, with an increase in biology, physics, and chemistry.

6.17



In order to assess the degree to which students use information technology in doing science, TIMSS asked students about their access to the Internet and whether they used the Internet (e-mail or World Wide Web) for science projects. As shown in Exhibit 6.17, internationally close to one-fifth of students reported having access to the Internet at home and close to one-quarter at school, although this varied widely across countries. Five percent or less of students in Indonesia, Latvia (LSS), Moldova, Romania, the Russian Federation, the Slovak Republic, South Africa, Thailand, and Turkey reported having access to the Internet at home. In contrast, more than half the students in Canada and the United States reported having access at home. In general, somewhat higher percentages of students reported having access to the Internet at school, although there were small percentages in many countries. Nearly half or more of students reported having access to the Internet at school in Australia, Canada, Chinese Taipei, England, Finland, Israel, the Netherlands, New Zealand, Singapore, Slovenia, and the United States. Even in countries with little access at home or at school, much larger percentages of students reported having access elsewhere. While it is possible that students have access through libraries, "Internet cafes," and other public buildings, it is also likely that some students do not have a clear idea of what is meant by having Internet access.



Few students reported using the Internet for science projects, even in countries where Internet access is common. Across countries, no more than 15 percent reported using e-mail to work with students in other schools, and no more than 29 percent reported using the World Wide Web to access information.

Exhibit 6.15 Frequency of Computer Use in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	10 (1.2)	Belgium (Flemish)	2 (0.4)	2 (0.6)	3 (0.5)	— —
Canada	14 (0.7)	Bulgaria	r 6 (0.8)	3 (0.6)	6 (0.9)	5 (0.6)
Chile	10 (1.0)	Czech Republic	2 (0.4)	2 (0.8)	2 (0.6)	1 (0.5)
Chinese Taipei ^a	5 (0.3)	Finland	5 (0.6)	4 (0.6)	5 (0.7)	4 (0.6)
Cyprus	8 (0.5)	Hungary	3 (0.4)	2 (0.4)	4 (0.5)	3 (0.4)
England	10 (1.1)	Latvia (LSS)	— —	2 (0.3)	3 (0.5)	3 (0.4)
Hong Kong, SAR	6 (0.6)	Lithuania [†]	— —	— —	— —	— —
Indonesia ^b	1 (0.3)	Macedonia, Rep. of	5 (0.7)	4 (0.6)	r 6 (0.8)	5 (0.6)
Iran, Islamic Rep.	1 (0.2)	Moldova	10 (0.9)	10 (0.9)	12 (1.0)	11 (0.9)
Israel	21 (1.7)	Morocco	x x	x x	x x	x x
Italy	10 (1.2)	Netherlands ^c	5 (0.7)	2 (0.3)	3 (0.4)	— —
Japan	2 (0.8)	Romania	2 (0.5)	2 (0.4)	3 (0.5)	2 (0.5)
Jordan ^r	15 (1.5)	Russian Federation	2 (0.3)	1 (0.2)	2 (0.3)	2 (0.2)
Korea, Rep. of	7 (0.9)	Slovak Republic	1 (0.2)	1 (0.3)	2 (0.5)	1 (0.2)
Malaysia	1 (0.2)	Slovenia	— —	7 (0.9)	17 (1.3)	9 (0.8)
New Zealand	10 (1.0)	International Avg.	4 (0.2)	3 (0.2)	5 (0.2)	4 (0.2)
Philippines	9 (0.9)					
Singapore	15 (1.4)					
South Africa	— —					
Thailand	5 (0.5)					
Tunisia	2 (0.4)					
Turkey	3 (0.2)					
United States	21 (1.4)					
International Avg.	8 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

An "r" indicates a 70-84% student response rate. An "x" indicates a <50% student response rate.

Exhibit 6.16

Trends in Frequency of Computer Use in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often

Countries with General/ Integrated Science		Countries with Separate Science Subjects							
		Earth Science		Biology		Physics		Chemistry	
	Percent of Students 1999	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	10 (1.2)	2 (0.4)	-2 (0.8)	2 (0.6)	-2 (1.1)	3 (0.5)	-4 (1.8)	--	--
Canada	14 (0.7)	2 (0.4)	-1 (1.9)	2 (0.8)	1 (0.9)	2 (0.6)	0 (1.0)	1 (0.5)	1 (0.5)
Cyprus	8 (0.5)	3 (0.4)	0 (0.6)	2 (0.4)	0 (0.5)	4 (0.5)	0 (0.7)	3 (0.4)	-1 (0.6)
England	10 (1.1)	--	--	2 (0.3)	0 (0.4)	3 (0.5)	-1 (1.0)	3 (0.4)	-1 (0.6)
Hong Kong, SAR	6 (0.6)	--	--	--	--	--	--	--	--
Iran, Islamic Rep.	1 (0.2)	5 (0.7)	1 (1.1)	2 (0.3)	0 (0.6)	3 (0.4)	-1 (1.3)	--	--
Israel †	19 (2.0)	2 (0.5)	-13 (0.9)	2 (0.4)	-13 (1.0)	3 (0.5)	-14 (1.2)	2 (0.5)	-13 (1.0)
Italy	10 (1.5)	2 (0.3)	-1 (0.5)	1 (0.2)	-1 (0.5)	2 (0.3)	-2 (0.7)	2 (0.2)	-4 (0.6)
Japan	2 (0.8)	1 (0.2)	-1 (0.3)	1 (0.3)	0 (0.4)	2 (0.5)	-1 (0.8)	1 (0.2)	-1 (0.3)
Korea, Rep. of	7 (0.9)	--	--	7 (0.9)	3 (1.0)	17 (1.3)	8 (1.5)	9 (0.8)	3 (1.0)
New Zealand	10 (1.0)	2 (0.2)	-2 (0.3)	2 (0.2)	-1 (0.2)	5 (0.2)	-1 (0.4)	3 (0.2)	-2 (0.3)
Singapore	15 (1.4)								
Thailand †	5 (0.5)								
United States	21 (1.4)								
International Avg. §	9 (0.3)								

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

● Netherlands: Data in physics panel pertain to physics/chemistry course.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 50-60% student response rate, based on the lower response rate in either 1995 or 1999.

Exhibit 6.17 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
Australia	38 (1.4)	80 (2.3)	69 (0.9)	5 (0.5)	18 (1.0)
Belgium (Flemish)	27 (0.9)	44 (2.7)	64 (1.1)	3 (0.4)	10 (0.9)
Bulgaria	8 (1.1)	7 (1.5)	43 (1.8)	7 (0.6)	9 (0.6)
Canada	57 (1.3)	87 (1.5)	84 (0.8)	6 (0.4)	25 (0.9)
Chile	7 (0.8)	12 (1.8)	40 (1.2)	7 (0.5)	10 (0.6)
Chinese Taipei	32 (1.1)	61 (3.2)	41 (0.8)	9 (0.4)	15 (0.6)
Cyprus	27 (0.8)	3 (0.4)	50 (1.0)	10 (0.6)	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)
Finland	43 (1.6)	75 (2.3)	87 (0.8)	4 (0.5)	5 (0.6)
Hong Kong, SAR	34 (1.1)	26 (2.2)	34 (0.8)	8 (0.6)	13 (0.7)
Hungary	7 (0.6)	35 (3.2)	36 (1.2)	4 (0.4)	5 (0.4)
Indonesia	2 (0.3)	0 (0.3)	12 (0.9)	4 (0.5)	4 (0.5)
Iran, Islamic Rep.	--	--	--	--	--
Israel	42 (1.6)	47 (2.8)	54 (1.2)	9 (0.7)	18 (0.9)
Italy	13 (0.7)	20 (2.2)	27 (1.1)	5 (0.5)	8 (0.7)
Japan	13 (0.9)	6 (1.6)	2 (0.3)	7 (0.8)	7 (0.8)
Jordan	7 (0.5)	1 (0.5)	30 (1.2)	15 (1.0)	16 (0.9)
Korea, Rep. of	23 (0.7)	6 (1.2)	36 (1.0)	4 (0.3)	6 (0.4)
Latvia (LSS)	3 (0.4)	35 (3.4)	51 (1.4)	4 (0.4)	6 (0.6)
Lithuania [†]	7 (0.8)	13 (1.6)	46 (1.5)	x x	x x
Macedonia, Rep. of	7 (0.5)	1 (0.4)	34 (1.4)	11 (0.7)	13 (0.7)
Malaysia	14 (0.9)	5 (1.3)	40 (1.5)	15 (0.8)	17 (0.8)
Moldova	3 (0.5)	2 (0.7)	22 (1.4)	6 (0.5)	7 (0.5)
Morocco	6 (0.4)	0 (0.2)	38 (0.9)	13 (0.6)	18 (0.8)
Netherlands	41 (1.8)	53 (5.4)	74 (1.8)	4 (0.7)	8 (0.8)
New Zealand	34 (1.1)	62 (2.7)	64 (1.1)	6 (0.6)	14 (0.8)
Philippines	--	--	--	--	--
Romania	3 (0.3)	1 (0.7)	21 (1.2)	4 (0.4)	5 (0.5)
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)
Slovak Republic	5 (0.5)	5 (1.2)	36 (1.6)	2 (0.3)	4 (0.5)
Slovenia	23 (0.9)	49 (2.9)	61 (1.0)	8 (0.6)	14 (0.9)
South Africa	5 (0.5)	4 (1.1)	23 (1.5)	10 (0.8)	11 (0.7)
Thailand	3 (0.5)	8 (1.5)	22 (0.9)	8 (0.4)	8 (0.6)
Tunisia	8 (0.7)	1 (0.6)	46 (1.2)	13 (0.7)	14 (0.8)
Turkey	3 (0.3)	1 (0.6)	16 (1.0)	5 (0.4)	4 (0.4)
United States	59 (1.7)	76 (3.2)	81 (0.9)	9 (0.5)	29 (1.3)
International Avg.	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.

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

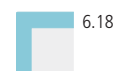
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (--) indicates data are not available.

An "r" indicates a 70-84% student response rate. An "x" indicates a <50% 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 6.18 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 possible combinations of responses. The data reveal wide variation across countries in the emphasis placed on science homework. Internationally on average, 19 percent of students were in the high category, 62 percent the medium, and 18 percent the low. The percentage of students in the high category ranged from one percent in Belgium (Flemish) to 61 percent in Iran. Countries with more than half their students in the high category were Iran, Italy, Thailand, and Indonesia. Only in Belgium (Flemish) were more than half the students in the low category. Internationally and within countries, there is no apparent relationship between teachers' emphasis on science homework and student achievement.



Summaries of teachers' reports about the length and frequency of their homework assignments are found in the reference section in Exhibit R3.16. Internationally, most students were assigned homework once or twice a week (52 percent) or three or more times a week (20 percent). Only three percent of students reported never being assigned homework, although 14 percent in Belgium (Flemish) and 20 percent in Japan did so.



The trend data for the index of teachers' emphasis on science homework are presented in Exhibit 6.19. Internationally, there was a small but significant increase (three percent) in the percentage of students in the high category and a decrease by the same amount in the low category. The Russian Federation, Thailand, and the United States had significant increases in the percentage of students at the high level.

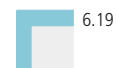


Exhibit R3.17 in the reference section shows teachers' reports of the frequency of assigning science homework based on projects and investigation. Internationally on average, about one-third of students were assigned this type of homework sometimes or always. While the percentage of students in this category ranged from 20 to 50 percent in most countries, more than half the students in Canada, Chile, the Philippines, Thailand, Tunisia, and the United States were assigned



homework based on projects and investigations with this frequency. In many countries the students who were assigned such homework sometimes or always performed slightly better than those who were rarely or never assigned it.

6.20



One theme in recommendations for educational reform is to make assessment a continuous process that relies on a variety of sources of data and methods, rather than a few high-stakes tests. Exhibit 6.20 shows teachers' reports about the weight given to various types of assessment.

Internationally, the least weight reportedly was given to external standardized tests, and the most to teacher-made tests, students' responses in class, observations of students, and projects or practical exercises. The weight given to each type varied greatly from country to country. For example, in Australia teacher-made tests and projects or practical exercises were given by far the most weight. In contrast, Iranian science teachers tended to give similar weight to all types of assessment reported.

R3.18



As shown in Exhibit R3.18, 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. However, this level of testing was found for only a third or less of students in Finland, Hungary, Japan, Korea, and Turkey. Among the single-science countries, more than 70 percent of students reported this frequency of testing in Chile, Chinese Taipei, Cyprus, the Philippines, South Africa, and the United States. Countries where about 70 percent or more of students were tested this frequently in the separate sciences were Moldova, Morocco, Romania, and the Russian Federation.



Exhibits 6.18–6.20 Overleaf

Exhibit 6.18 Index of Teachers' Emphasis on Science Homework (ESH)

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 R3.16). 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
Iran, Islamic Rep.	61 (4.4)	449 (4.1)	32 (4.5)	447 (8.3)	7 (2.1)	449 (13.3)
Italy	58 (3.3)	493 (5.9)	34 (3.2)	495 (5.5)	8 (1.8)	486 (12.0)
Thailand	56 (4.0)	480 (5.0)	42 (3.9)	487 (6.7)	1 (1.0)	~ ~
Indonesia	53 (3.8)	436 (6.3)	42 (3.6)	438 (6.0)	5 (1.4)	405 (15.7)
Malaysia	46 (4.2)	486 (6.0)	51 (4.2)	497 (7.5)	3 (1.5)	497 (41.6)
Moldova	40 (2.6)	460 (5.0)	59 (2.7)	459 (4.9)	1 (0.5)	~ ~
Singapore	35 (4.3)	570 (12.3)	55 (4.1)	575 (11.2)	11 (2.4)	524 (19.3)
Russian Federation	32 (2.6)	527 (8.3)	66 (2.6)	530 (6.6)	3 (0.8)	542 (18.4)
Chile	26 (3.6)	424 (8.1)	47 (3.7)	421 (5.3)	26 (3.8)	418 (8.4)
Chinese Taipei	26 (3.8)	584 (7.8)	54 (4.4)	566 (5.5)	20 (3.3)	558 (7.9)
Turkey	24 (3.5)	430 (8.4)	64 (4.2)	434 (5.3)	11 (2.4)	432 (9.5)
South Africa	22 (3.6)	205 (14.0)	70 (4.0)	253 (10.5)	8 (2.6)	255 (31.8)
England	22 (2.9)	563 (11.3)	74 (3.1)	533 (5.2)	4 (1.3)	511 (12.4)
Morocco	16 (2.0)	319 (5.2)	54 (2.6)	324 (5.1)	30 (3.0)	324 (6.3)
Philippines	16 (3.0)	398 (15.5)	84 (3.0)	335 (8.0)	0 (0.0)	~ ~
United States	15 (1.8)	507 (9.5)	77 (2.4)	517 (5.2)	8 (1.7)	505 (15.6)
Israel	15 (2.7)	446 (13.3)	71 (3.6)	472 (6.3)	14 (2.5)	483 (9.0)
Cyprus	14 (2.4)	463 (4.9)	82 (2.7)	459 (2.6)	4 (1.7)	466 (15.3)
Hong Kong, SAR	14 (2.8)	527 (8.3)	68 (4.0)	533 (4.2)	19 (3.6)	521 (11.6)
Jordan	12 (2.8)	439 (12.7)	84 (2.9)	451 (4.1)	3 (1.5)	456 (38.5)
Macedonia, Rep. of	11 (1.6)	460 (8.9)	57 (3.1)	465 (6.9)	32 (2.7)	479 (6.5)
Canada	10 (2.3)	542 (8.9)	80 (2.8)	534 (2.6)	10 (1.9)	515 (6.4)
Lithuania [†]	9 (1.5)	497 (10.9)	81 (2.1)	487 (4.1)	9 (1.6)	484 (7.6)
Tunisia	9 (2.6)	436 (10.1)	54 (4.1)	429 (4.0)	37 (3.8)	427 (4.7)
Korea, Rep. of	8 (2.2)	559 (7.9)	55 (3.9)	549 (3.3)	37 (3.8)	547 (3.4)
New Zealand	7 (2.1)	513 (13.2)	78 (3.1)	512 (5.5)	14 (2.9)	497 (13.2)
Romania	7 (1.6)	479 (14.0)	58 (2.5)	469 (6.7)	35 (2.3)	475 (6.6)
Australia	7 (1.7)	528 (13.7)	75 (3.0)	545 (4.7)	18 (2.8)	522 (9.4)
Finland	6 (1.5)	531 (7.3)	83 (2.1)	537 (3.6)	11 (1.6)	526 (7.8)
Latvia (LSS)	5 (1.2)	508 (11.6)	81 (2.2)	501 (4.8)	14 (1.9)	513 (9.2)
Netherlands	5 (1.3)	573 (9.5)	82 (3.0)	548 (6.6)	13 (3.1)	514 (11.3)
Hungary	5 (0.9)	566 (7.9)	70 (1.9)	552 (4.1)	25 (1.9)	551 (5.8)
Japan	4 (1.7)	546 (11.0)	53 (4.1)	551 (3.0)	43 (4.2)	548 (2.9)
Bulgaria	3 (0.9)	521 (38.0)	54 (3.0)	526 (7.5)	43 (2.9)	507 (5.9)
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.	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.

[†] 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.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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

An "r" indicates teacher response data available for 70-84% of students.

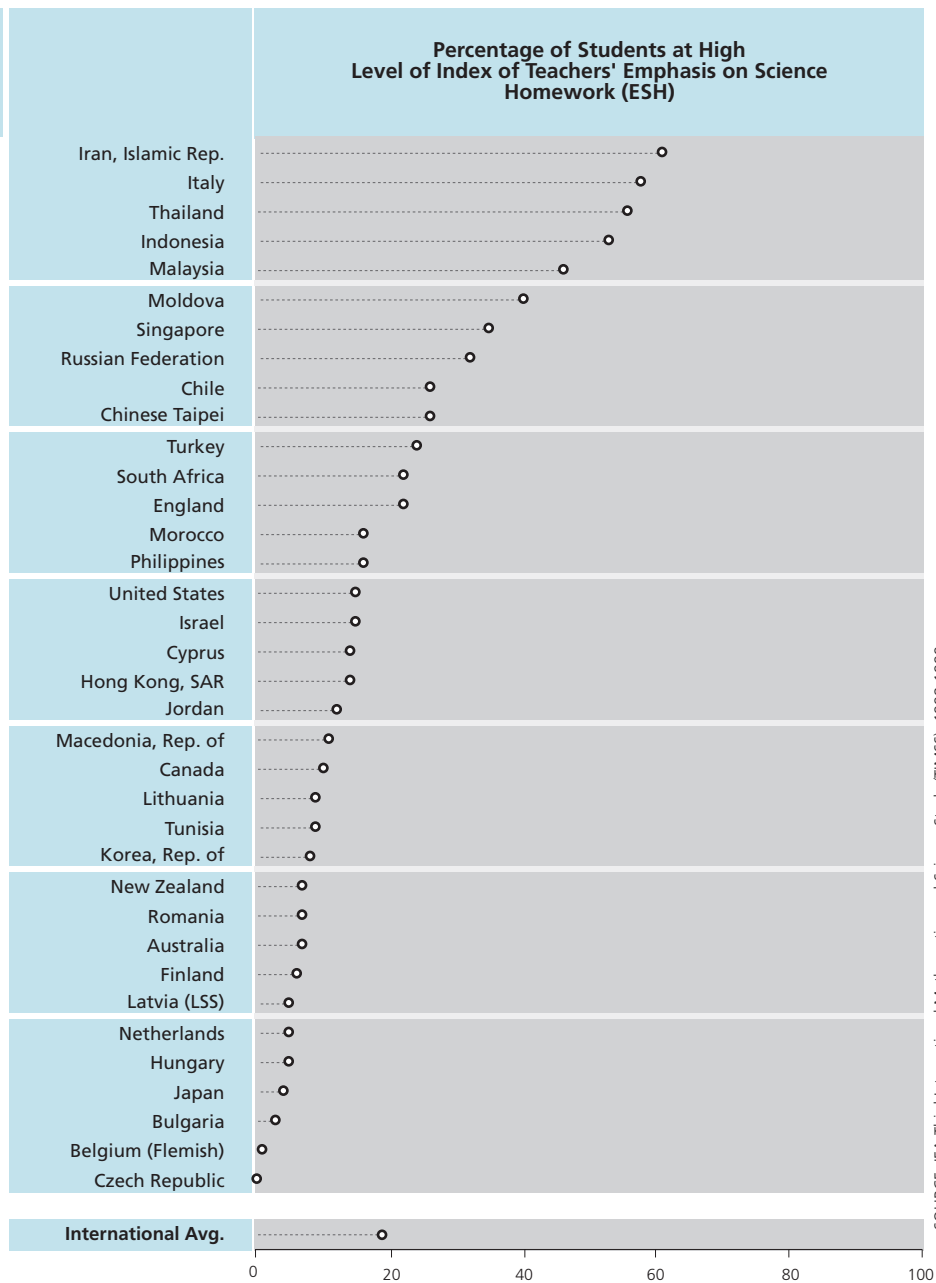


Exhibit 6.19 Trends in Index of Teachers' Emphasis on Science Homework (ESH)

	High ESH Percent of Students			Medium ESH Percent of Students			Low ESH Percent of Students		
	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
Australia	2 (0.6)	7 (1.7)	5 (1.8) ●	87 (2.3)	75 (3.0)	-12 (3.8) ▼	11 (2.3)	18 (2.8)	7 (3.6) ●
Belgium (Flemish)	0 (0.0)	1 (0.5)	1 (0.5) ●	29 (4.4)	39 (3.5)	10 (5.6) ●	71 (4.4)	60 (3.4)	-11 (5.6) ●
Canada	7 (1.6)	10 (2.3)	3 (2.8) ●	77 (2.6)	80 (2.8)	3 (3.8) ●	16 (2.4)	10 (1.9)	-6 (3.1) ●
Cyprus	17 (3.4)	14 (2.4)	-3 (4.1) ●	82 (3.4)	82 (2.7)	0 (4.4) ●	1 (0.9)	4 (1.7)	3 (1.9) ●
Czech Republic	0 (0.0)	0 (0.3)	0 (0.3) ●	32 (3.3)	29 (2.9)	-3 (4.4) ●	68 (3.3)	70 (2.9)	3 (4.4) ●
England ^s	31 (2.9)	22 (2.9)	-9 (4.1) ●	59 (3.1)	74 (3.1)	14 (4.4) ▲	9 (2.0)	4 (1.3)	-5 (2.4) ●
Hong Kong, SAR	4 (2.1)	14 (2.8)	10 (3.5) ●	60 (5.7)	68 (4.0)	7 (7.0) ●	36 (5.6)	19 (3.6)	-17 (6.6) ●
Hungary	7 (1.2)	5 (0.9)	-2 (1.5) ●	67 (2.4)	70 (1.9)	3 (3.0) ●	26 (2.1)	25 (1.9)	-1 (2.8) ●
Iran, Islamic Rep.	50 (4.9)	61 (4.4)	11 (6.6) ●	40 (5.2)	32 (4.5)	-8 (6.8) ●	10 (3.2)	7 (2.1)	-3 (3.9) ●
Israel [†] r	14 (5.1)	11 (2.7)	-3 (5.7) ●	70 (8.5)	73 (4.0)	3 (9.4) ●	17 (6.4)	16 (3.0)	0 (7.1) ●
Italy	50 (4.5)	57 (3.9)	7 (5.9) ●	35 (4.2)	34 (3.8)	-2 (5.7) ●	15 (4.0)	10 (2.4)	-5 (4.7) ●
Japan	5 (2.0)	4 (1.7)	-1 (2.6) ●	31 (3.9)	53 (4.1)	22 (5.7) ▲	64 (4.2)	43 (4.2)	-21 (5.9) ▼
Korea, Rep. of	10 (2.1)	8 (2.2)	-3 (3.1) ●	50 (4.0)	55 (3.9)	5 (5.6) ●	40 (4.1)	37 (3.8)	-2 (5.6) ●
Latvia (LSS)	3 (0.7)	5 (1.2)	2 (1.4) ●	81 (2.1)	81 (2.2)	1 (3.0) ●	16 (2.0)	14 (1.9)	-3 (2.7) ●
Lithuania	4 (1.0)	9 (1.5)	5 (1.8) ●	80 (1.9)	81 (2.1)	1 (2.8) ●	16 (1.6)	9 (1.6)	-6 (2.3) ●
Netherlands	3 (1.0)	5 (1.3)	2 (1.6) ●	87 (2.5)	82 (3.0)	-5 (3.9) ●	10 (2.2)	13 (3.1)	3 (3.8) ●
New Zealand	2 (1.7)	7 (2.1)	5 (2.7) ●	86 (3.4)	78 (3.1)	-8 (4.6) ●	12 (3.1)	14 (2.9)	2 (4.2) ●
Romania	12 (1.4)	7 (1.6)	-5 (2.1) ●	50 (2.1)	58 (2.5)	8 (3.3) ●	38 (2.1)	35 (2.3)	-3 (3.1) ●
Russian Federation	21 (2.1)	32 (2.6)	10 (3.3) ▲	78 (2.2)	66 (2.6)	-12 (3.4) ▼	1 (0.4)	3 (0.8)	2 (0.9) ●
Singapore	28 (4.4)	35 (4.3)	7 (6.2) ●	59 (4.9)	55 (4.1)	-4 (6.4) ●	13 (3.1)	11 (2.4)	-3 (3.9) ●
Thailand [†]	34 (4.7)	56 (4.0)	23 (6.2) ▲	61 (4.8)	42 (3.9)	-19 (6.2) ▼	5 (2.2)	1 (1.0)	-3 (2.4) ●
United States	5 (1.3)	15 (1.8)	10 (2.2) ▲	87 (1.8)	77 (2.4)	-11 (2.9) ▼	7 (1.6)	8 (1.7)	1 (2.3) ●
International Avg.[§]	13 (0.5)	16 (0.5)	3 (0.8) ▲	63 (0.8)	63 (0.7)	0 (1.1) ●	24 (0.7)	21 (0.6)	-3 (0.9) ▼

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

▲ 1999 significantly higher than 1995
● No significant difference between 1995 and 1999
▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by teachers.

[†] Countries with unapproved sampling procedures at the classroom level in 1995.

[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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

Types of Assessment Teachers Give Quite A Lot or A Great Deal of Weight

	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
Australia	16 (2.6)	71 (3.6)	67 (3.4)	37 (3.8)	66 (2.9)	38 (3.8)	30 (3.3)
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)
Bulgaria	r 67 (3.0)	r 90 (1.7)	r 38 (3.4)	r 69 (2.0)	r 66 (2.6)	r 84 (2.1)	r 96 (1.2)
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)
Chile	27 (3.3)	78 (3.0)	87 (2.5)	56 (3.8)	68 (3.7)	77 (3.4)	80 (3.1)
Chinese Taipei	36 (4.1)	43 (4.5)	69 (4.1)	67 (3.6)	55 (4.1)	67 (3.8)	76 (3.4)
Cyprus	s 24 (4.3)	s 94 (2.1)	s 45 (4.6)	s 87 (2.6)	s 82 (3.9)	s 90 (2.5)	s 96 (1.6)
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)
Finland	9 (1.6)	47 (2.6)	37 (2.5)	70 (2.4)	83 (2.2)	85 (1.9)	94 (1.4)
Hong Kong, SAR	17 (3.1)	58 (4.2)	76 (3.5)	33 (3.8)	23 (3.8)	23 (3.6)	30 (4.1)
Hungary	52 (2.7)	80 (1.9)	31 (2.0)	29 (2.0)	47 (2.2)	72 (2.3)	92 (1.3)
Indonesia	53 (4.0)	83 (2.7)	48 (4.3)	64 (3.6)	61 (3.6)	71 (3.9)	72 (3.9)
Iran, Islamic Rep.	69 (3.9)	79 (3.9)	80 (3.5)	72 (3.8)	52 (3.9)	61 (4.2)	91 (2.3)
Israel	r 15 (3.5)	75 (3.7)	80 (3.4)	46 (3.9)	r 64 (3.3)	r 28 (3.7)	63 (3.6)
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)
Jordan	28 (4.4)	84 (3.3)	41 (4.2)	59 (4.3)	49 (5.0)	72 (3.6)	84 (2.9)
Korea, Rep. of	51 (4.1)	84 (2.8)	76 (3.6)	89 (2.5)	99 (0.6)	92 (2.2)	81 (3.1)
Latvia (LSS)	r 81 (2.2)	r 92 (1.4)	r 59 (3.3)	r 59 (2.8)	r 93 (1.4)	r 78 (2.7)	r 97 (0.9)
Lithuania [‡]	34 (2.1)	68 (2.8)	26 (2.1)	30 (2.3)	55 (2.1)	32 (2.5)	78 (2.2)
Macedonia, Rep. of	36 (2.6)	62 (2.5)	68 (2.5)	83 (2.1)	52 (2.5)	96 (1.3)	98 (0.6)
Malaysia	18 (3.2)	42 (4.2)	78 (3.6)	74 (4.0)	69 (4.0)	78 (3.2)	81 (3.2)
Moldova	58 (2.3)	93 (1.0)	76 (2.0)	89 (1.4)	76 (1.9)	90 (1.4)	92 (1.4)
Morocco	33 (2.5)	86 (1.5)	77 (2.1)	67 (2.0)	62 (2.1)	72 (2.0)	85 (2.3)
Netherlands	24 (3.2)	97 (1.0)	73 (4.6)	17 (2.6)	32 (3.6)	24 (3.5)	23 (3.1)
New Zealand	9 (2.2)	65 (4.0)	46 (3.8)	31 (4.1)	71 (3.9)	57 (3.9)	45 (4.4)
Philippines	42 (4.0)	84 (3.3)	89 (2.4)	77 (3.6)	83 (3.3)	87 (2.8)	91 (2.5)
Romania	51 (2.7)	87 (1.6)	81 (2.1)	62 (2.8)	65 (2.8)	87 (1.7)	99 (0.6)
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)
South Africa	39 (3.2)	65 (4.2)	61 (4.6)	66 (3.9)	50 (4.3)	62 (4.5)	70 (3.6)
Thailand	29 (4.1)	73 (4.1)	70 (3.9)	83 (3.2)	70 (4.2)	77 (3.6)	82 (3.4)
Tunisia	20 (3.7)	82 (3.0)	77 (3.3)	47 (4.2)	71 (3.8)	85 (3.1)	88 (2.5)
Turkey	20 (3.4)	64 (3.6)	43 (3.8)	44 (4.0)	46 (4.5)	61 (3.7)	93 (1.8)
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)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.



CHAPTER 7

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 extent of school resources in each country, including computers and Internet access. Data also are provided about the role of the school principal and issues related to school climate and environment, including attendance problems and school safety.

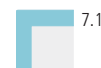




What School Resources Are Available to Support Science Learning?

Some school resources are specific to science, which is unique among school subjects in that it requires an emphasis on laboratory exploration. Many other school resources are general ones that improve learning opportunities across the curriculum. All the available resources can work together to support science learning and instruction.

To measure the extent of school resources in each of the participating countries, TIMSS created an index of availability of school resources for science instruction (ASRSI). As described in Exhibit 7.1, the index is based on schools' average response to five questions about shortages that affect 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.



On average internationally, only 18 percent of the students were in schools reporting that both shortages had little effect on instruction, and 63 percent were in the middle category. Only in two countries – Belgium (Flemish) and Singapore – were the majority of students in the high category. In very few countries – Moldova, the Russian Federation, and Thailand – were the majority of students in schools where across-the-board shortages affect science instructional capacity some or a lot. In many countries, students in schools in the high category had higher average science achievement than students 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.

At the international level, the availability of school resources for instruction appears to be related to science achievement. Of the 17 countries with 20 percent or more of their students in schools where both types of shortage have little effect on science instruction, only Chile, Indonesia, Israel, Italy, and Malaysia did not score above the international average. However, the relationship between a country's average science achievement and availability of resources for instruction is complex. For example, among some countries that performed significantly above the international average, including Korea, Chinese Taipei, the Slovak Republic, the Russian Federation, and Bulgaria, 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, Finland, Japan, the Netherlands, New Zealand, and Singapore, five percent or less of the students were in schools with low availability of resources.

R4.1



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 instruction was negatively affected by shortages or inadequacies in instructional materials, the budget for supplies, school buildings, and instructional space. Countries that were significantly below the international average in science achievement tended to report a majority of students in schools where instruction was affected by shortages. Eight of the 13 countries that performed below the international average had shortages affecting 50 percent or more of the students in at least four of the five areas. This compares with only three of the 19 high-performing countries with the same pattern.

R4.2



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 internationally, were in schools where shortages or inadequacies in computers and computer software affected the capacity to provide science instruction. Half the students were in schools where the lack of library materials relevant to science instruction affected instruction, and 53 percent were in schools needing more audio-visual resources. A full 58 percent of students, on average internationally, were in schools where shortages of science laboratory equipment and materials adversely affected the capacity to provide instruction. At the country level, 11 of the 13 low-performing countries, five of the six countries at about the international average, and seven of the 19 high-performing countries had the majority of their students in schools where this was the case.

R4.3–R4.4



Exhibits R4.3 and R4.4 in the reference section present more data on access to computers and the Internet for instructional purposes. Countries seem to have computers either in nearly all of their schools or in only a fraction of them. Internationally on average, 60 percent of the students were in schools with a student to computer ratio of less than 15 to one, and 25 percent were in schools having no computers. Forty-one percent of the students, on average across countries, attended schools with access to the World Wide Web, and another 29 percent were in schools planning to have access to the Internet by 2001.



Exhibit 7.2 presents trends in the index of availability of school resources for science instruction. Internationally on average, there was little or no change between 1995 and 1999 in the percentages of students at the three index levels. Four countries – Israel, Italy, New Zealand, and the United States – had significant increases in the percentages of students in the high category. The United States, in addition to having a significant increase in the high category, had effectively no change in the low category and a significant decrease in the middle category.

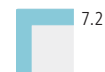


Exhibit 7.1 Index of Availability of School Resources for Science Instruction (ASRSI)

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
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)
Czech Republic		43 (4.3)	542 (6.5)	57 (4.3)	538 (4.9)	0 (0.1)	~ ~
New Zealand		37 (4.1)	521 (7.2)	62 (4.1)	501 (6.7)	1 (1.0)	~ ~
Israel		36 (4.1)	486 (6.8)	59 (4.1)	461 (8.3)	5 (1.7)	399 (20.0)
United States	r	34 (3.3)	531 (8.5)	60 (3.2)	508 (6.2)	6 (2.4)	512 (12.0)
Netherlands	r	33 (6.5)	542 (9.7)	66 (6.5)	547 (11.8)	1 (0.7)	~ ~
Australia		31 (3.8)	553 (8.3)	60 (4.0)	535 (6.0)	9 (2.5)	526 (20.1)
Japan		30 (3.7)	556 (3.5)	65 (4.1)	547 (3.1)	5 (1.9)	545 (6.6)
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)
Finland		25 (3.9)	540 (7.0)	71 (4.0)	534 (4.1)	4 (2.0)	531 (10.0)
Hungary		24 (3.6)	547 (7.5)	69 (3.9)	555 (4.6)	7 (2.2)	540 (16.8)
Malaysia		23 (3.7)	508 (11.4)	70 (4.1)	486 (5.4)	7 (2.0)	507 (15.0)
Italy		23 (3.2)	495 (9.4)	71 (3.8)	494 (4.5)	7 (2.0)	483 (8.5)
Indonesia		22 (3.9)	453 (10.9)	66 (4.7)	432 (5.7)	12 (3.1)	420 (14.4)
Chile		20 (3.0)	456 (10.4)	69 (3.4)	413 (3.8)	10 (2.2)	397 (6.5)
Hong Kong, SAR		19 (3.3)	524 (12.2)	73 (3.5)	533 (4.5)	8 (2.3)	521 (11.6)
Cyprus		15 (0.1)	444 (5.8)	80 (0.2)	465 (2.8)	5 (0.2)	474 (8.9)
Slovenia		13 (2.8)	525 (7.3)	64 (4.1)	536 (4.4)	23 (3.2)	529 (5.9)
Philippines		11 (2.5)	372 (20.3)	55 (4.1)	348 (10.0)	34 (3.9)	332 (12.5)
Korea, Rep. of		7 (2.2)	555 (12.1)	76 (3.7)	550 (2.7)	17 (3.2)	542 (5.5)
South Africa		7 (1.9)	276 (38.9)	45 (4.0)	258 (10.9)	48 (4.1)	226 (12.8)
Lithuania [†]		6 (2.1)	487 (17.2)	71 (3.7)	489 (4.7)	23 (3.6)	487 (9.0)
Chinese Taipei		5 (2.1)	567 (14.5)	78 (3.4)	571 (5.0)	17 (2.9)	562 (9.3)
Slovak Republic		5 (2.0)	564 (9.2)	87 (3.1)	532 (3.6)	8 (2.4)	534 (8.7)
Morocco		5 (1.8)	324 (14.0)	70 (4.1)	323 (5.1)	25 (3.8)	322 (6.0)
Iran, Islamic Rep.		5 (1.9)	469 (14.1)	71 (3.9)	450 (5.0)	23 (3.6)	437 (7.4)
Tunisia		5 (1.9)	441 (12.7)	66 (4.3)	431 (3.6)	30 (3.8)	427 (5.0)
Jordan		5 (1.8)	458 (22.7)	59 (4.4)	448 (5.4)	37 (4.3)	453 (8.0)
Turkey		2 (1.4)	~ ~	53 (4.1)	434 (5.8)	44 (4.0)	430 (5.1)
Latvia (LSS)		2 (1.3)	~ ~	59 (4.5)	504 (6.3)	39 (4.3)	502 (6.7)
Macedonia, Rep. of		2 (1.2)	~ ~	59 (3.8)	462 (7.3)	39 (3.9)	450 (8.2)
Romania		2 (1.1)	~ ~	72 (3.6)	465 (6.6)	26 (3.4)	483 (9.9)
Russian Federation		1 (0.9)	~ ~	46 (4.6)	539 (8.3)	52 (4.6)	521 (7.6)
Thailand		1 (0.8)	~ ~	43 (3.9)	484 (5.1)	56 (4.0)	481 (6.2)
Bulgaria		0 (0.0)	~ ~	66 (4.3)	517 (7.5)	34 (4.3)	522 (8.2)
Moldova		0 (0.0)	~ ~	30 (3.9)	454 (7.9)	70 (3.9)	462 (5.3)
International Avg.		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.

[†] 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.

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

An "r" indicates school response data available for 70-84% of students.

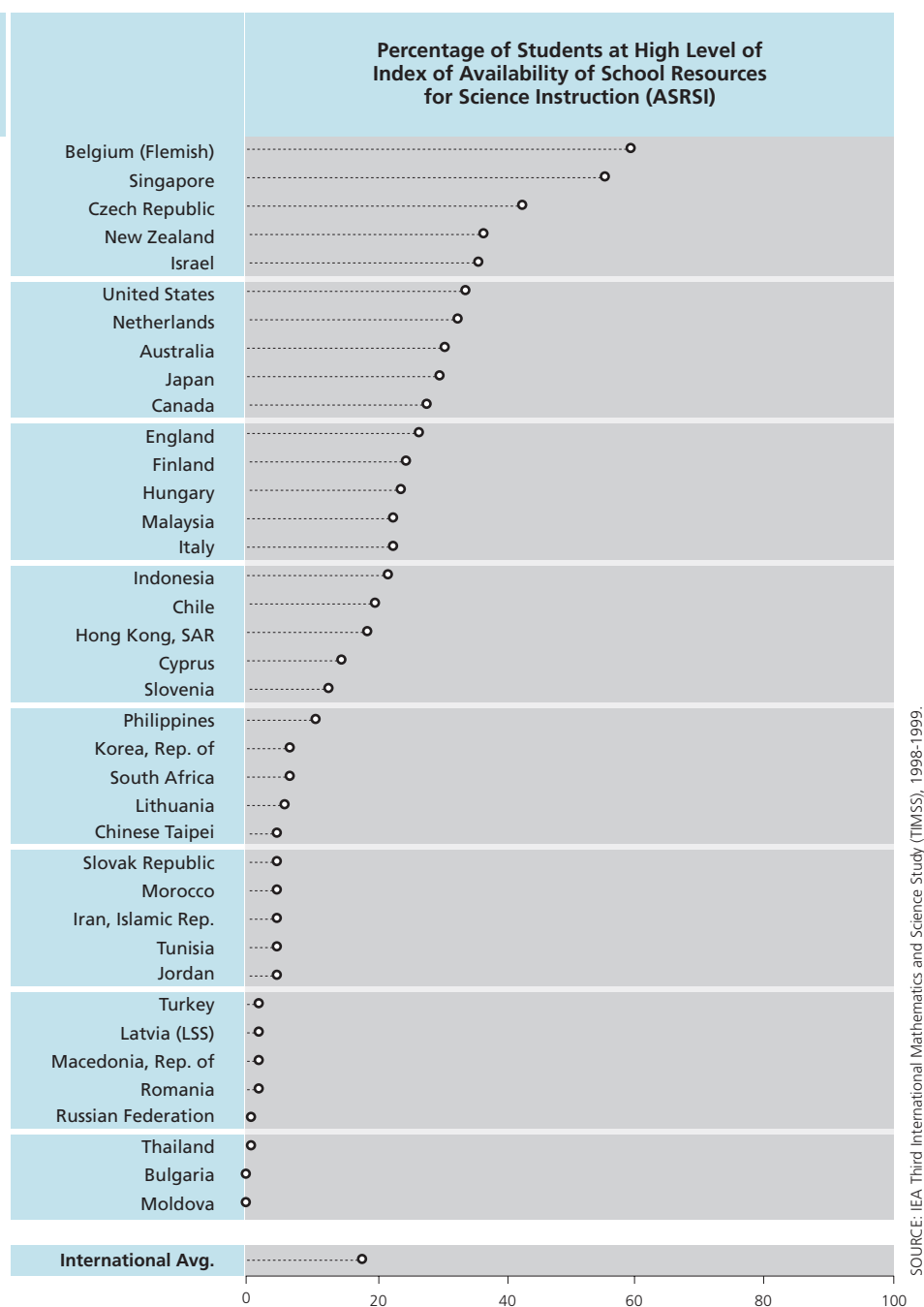


Exhibit 7.2 Trends in Index of Availability of School Resources for Science Instruction (ASRSI)

		High ASRSI			Medium ASRSI			Low ASRSI		
		Percent of Students			Percent of Students			Percent of Students		
		1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference	1995	1999	1995-1999 Difference
Australia	r	42 (5.2)	31 (3.8)	-11 (6.5) ●	52 (5.4)	60 (4.0)	8 (6.7) ●	6 (2.3)	9 (2.5)	3 (3.5) ●
Belgium (Flemish)		52 (5.8)	60 (4.5)	8 (7.3) ●	48 (5.8)	40 (4.5)	-7 (7.3) ●	1 (0.8)	0 (0.0)	-1 (0.8) ●
Canada		23 (2.9)	28 (2.0)	5 (3.5) ●	75 (2.8)	66 (2.4)	-8 (3.7) ●	2 (0.7)	6 (1.3)	4 (1.4) ●
Cyprus	r	23 (0.5)	15 (0.1)	-8 (0.5) ▼	69 (0.6)	80 (0.2)	11 (0.6) ▲	8 (0.4)	5 (0.2)	-3 (0.5) ▼
Czech Republic		30 (4.8)	43 (4.3)	13 (6.5) ●	69 (4.8)	57 (4.3)	-13 (6.5) ●	0 (0.4)	0 (0.1)	0 (0.4) ●
England	r	24 (4.5)	27 (4.2)	3 (6.2) ●	71 (4.8)	68 (4.6)	-3 (6.6) ●	4 (1.6)	5 (2.1)	1 (2.7) ●
Hong Kong, SAR		23 (5.4)	19 (3.3)	-4 (6.3) ●	72 (5.7)	73 (3.5)	1 (6.7) ●	5 (2.6)	8 (2.3)	3 (3.5) ●
Hungary		21 (3.3)	24 (3.6)	3 (4.8) ●	77 (3.4)	69 (3.9)	-8 (5.1) ●	1 (1.0)	7 (2.2)	5 (2.4) ●
Iran, Islamic Rep.		2 (1.1)	5 (1.9)	3 (2.2) ●	67 (4.9)	71 (3.9)	5 (6.2) ●	31 (4.8)	23 (3.6)	-7 (6.0) ●
Israel † s		14 (6.9)	42 (4.9)	28 (8.4) ▲	82 (7.6)	57 (4.7)	-25 (8.9) ●	4 (3.7)	1 (1.0)	-3 (3.9) ●
Italy		6 (1.9)	23 (3.7)	17 (4.1) ▲	76 (3.6)	72 (4.2)	-5 (5.5) ●	18 (3.2)	5 (2.1)	-13 (3.8) ▼
Japan		25 (3.5)	30 (3.7)	5 (5.1) ●	67 (3.8)	65 (4.1)	-2 (5.6) ●	8 (2.4)	5 (1.9)	-3 (3.1) ●
Korea, Rep. of		3 (1.5)	7 (2.2)	3 (2.7) ●	80 (3.0)	76 (3.7)	-4 (4.7) ●	17 (2.9)	17 (3.2)	0 (4.3) ●
Latvia (LSS)		2 (1.3)	2 (1.3)	0 (1.8) ●	51 (4.2)	59 (4.5)	8 (6.1) ●	47 (4.2)	39 (4.3)	-8 (6.0) ●
Lithuania		4 (1.6)	6 (2.1)	2 (2.7) ●	77 (3.7)	71 (3.7)	-6 (5.2) ●	19 (3.3)	23 (3.6)	4 (4.9) ●
Netherlands	r	52 (7.1)	33 (6.5)	-19 (9.6) ●	48 (7.1)	66 (6.5)	18 (9.6) ●	0 (0.0)	1 (0.7)	1 (0.7) ●
New Zealand		20 (3.3)	37 (4.1)	17 (5.3) ▲	73 (3.9)	62 (4.1)	-12 (5.7) ●	7 (2.3)	1 (1.0)	-6 (2.5) ●
Romania		3 (1.1)	2 (1.1)	-1 (1.6) ●	73 (3.8)	72 (3.6)	-1 (5.3) ●	24 (3.9)	26 (3.4)	3 (5.1) ●
Russian Federation		1 (0.0)	1 (0.9)	1 (0.9) ●	47 (4.2)	46 (4.6)	0 (6.2) ●	53 (4.3)	52 (4.6)	0 (6.3) ●
Singapore		61 (4.8)	56 (3.9)	-5 (6.2) ●	38 (4.7)	40 (4.1)	3 (6.2) ●	1 (0.8)	4 (1.4)	3 (1.6) ●
Slovak Republic		11 (2.5)	5 (2.0)	-6 (3.2) ●	86 (2.8)	87 (3.1)	1 (4.2) ●	3 (1.5)	8 (2.4)	5 (2.8) ●
Slovenia	r	7 (2.6)	13 (2.8)	6 (3.9) ●	73 (4.4)	64 (4.1)	-9 (6.0) ●	20 (3.8)	23 (3.2)	3 (5.0) ●
Thailand †		2 (1.9)	1 (0.8)	-1 (2.1) ●	51 (5.5)	43 (3.9)	-8 (6.8) ●	47 (5.4)	56 (4.0)	9 (6.7) ●
United States	r	16 (3.3)	34 (3.3)	18 (4.6) ▲	77 (3.5)	60 (3.2)	-17 (4.7) ▼	7 (0.9)	6 (2.4)	0 (2.5) ●
International Avg. §		21 (0.8)	23 (0.7)	2 (1.0) ●	67 (0.9)	65 (0.9)	-2 (1.3) ●	13 (0.6)	12 (0.5)	0 (0.8) ●

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

▲ 1999 significantly higher than 1995
● No significant difference between 1995 and 1999
▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by schools.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

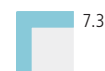
Background data for Bulgaria and South Africa are unavailable for 1995.

() 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, based on the lower response rate in either 1995 or 1999. An "s" indicates school response data available for 50-69% of students, based on the lower response rate in either 1995 or 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. More 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 asked how much time they spend per month talking with parents, counseling and disciplining students, and responding to requests from local, regional, or national education officials. They also responded to questions about how much time they spend carrying out administrative duties, including hiring teachers, representing the school in the community and at official meetings, and doing internal tasks (e.g., regulations, school budget, and timetable). Finally, they were asked how much time they spend teaching. The results presented in Exhibit 7.3 show that principals reported spending, internationally on average, 51 hours per month on administrative duties, 35 hours per month communicating with various constituents, 33 hours per month on instructional leadership activities, and 16 hours per month teaching.¹



Countries where principals reported spending an average of at least 75 hours per month on administrative duties included Australia, Chinese Taipei, Hong Kong, and New Zealand. Principals reported spending at least 50 hours per month communicating with various groups in Australia, Canada, and the United States. Principals in 10 countries reported spending at least 40 hours per month on instructional leadership activities, and in eight countries they reported that teaching duties (including preparation) occupied at least 30 hours per month.

It is noteworthy that a number of countries, such as Australia, Canada, Chinese Taipei, Hong Kong, New Zealand, Singapore, Thailand, and the United States, have similar patterns in principals' use of time. For example, unlike in most European 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.

¹ 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

	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)
Australia	r 33 (1.9)	r 50 (2.7)	r 75 (3.2)	r 3 (0.7)
Belgium (Flemish)	29 (2.3)	27 (2.1)	56 (2.5)	0 (0.1)
Bulgaria	38 (2.5)	39 (1.9)	47 (2.3)	21 (1.0)
Canada	25 (1.1)	54 (1.4)	54 (2.1)	5 (0.9)
Chile	31 (1.4)	36 (1.5)	53 (3.0)	5 (0.6)
Chinese Taipei	24 (1.4)	34 (1.7)	86 (4.1)	4 (0.6)
Cyprus	r 18 (0.1)	r 46 (0.1)	33 (0.1)	r 18 (0.0)
Czech Republic	32 (1.9)	33 (1.8)	44 (2.4)	36 (1.8)
England	—	—	—	—
Finland	27 (1.5)	29 (1.2)	66 (2.7)	24 (1.6)
Hong Kong, SAR	r 43 (3.2)	r 29 (1.8)	r 75 (4.2)	r 3 (0.6)
Hungary	47 (2.1)	28 (1.2)	46 (2.1)	35 (1.6)
Indonesia	15 (1.8)	20 (1.6)	40 (2.9)	16 (1.8)
Iran, Islamic Rep.	28 (1.6)	42 (2.4)	35 (3.0)	4 (0.6)
Israel	43 (2.4)	38 (2.1)	43 (2.5)	24 (1.8)
Italy	36 (1.4)	44 (2.1)	45 (1.7)	—
Japan	33 (2.0)	19 (1.3)	69 (3.6)	1 (0.8)
Jordan	31 (1.8)	43 (2.1)	27 (1.8)	9 (0.9)
Korea, Rep. of	30 (2.1)	22 (1.6)	46 (3.6)	3 (0.5)
Latvia (LSS)	r 33 (1.9)	r 26 (1.9)	r 58 (3.8)	r 41 (2.7)
Lithuania *	40 (1.7)	34 (1.4)	50 (2.4)	33 (1.4)
Macedonia, Rep. of	40 (2.2)	34 (1.7)	32 (1.9)	16 (1.9)
Malaysia	24 (1.5)	31 (1.7)	61 (3.1)	22 (2.1)
Moldova	r 45 (1.9)	r 32 (1.5)	r 55 (2.7)	r 41 (1.7)
Morocco	9 (0.8)	24 (1.7)	29 (4.9)	0 (0.0)
Netherlands	r 42 (4.0)	r 20 (2.0)	r 49 (5.6)	r 7 (1.7)
New Zealand	r 39 (2.0)	r 45 (1.9)	r 83 (3.6)	r 5 (0.8)
Philippines	30 (2.0)	31 (1.8)	42 (3.4)	10 (1.8)
Romania	31 (1.6)	32 (1.5)	40 (2.3)	45 (2.3)
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)
Slovak Republic	36 (1.8)	31 (1.5)	34 (2.0)	32 (1.2)
Slovenia	43 (2.2)	29 (1.2)	41 (2.2)	11 (1.0)
South Africa	19 (1.2)	34 (2.3)	43 (3.4)	r 22 (2.6)
Thailand	37 (2.2)	32 (1.7)	68 (3.8)	6 (1.0)
Tunisia	28 (2.0)	47 (2.6)	55 (2.6)	—
Turkey	25 (1.7)	43 (2.0)	46 (2.9)	17 (1.9)
United States	r 34 (1.9)	r 52 (2.4)	r 56 (3.2)	r 3 (0.6)
International Avg.	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 students. 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).

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

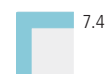
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (—) indicates data are not available.

An "r" indicates school response data available for 70–84% of students.

What Are the Schools' Expectations of Parents?

The schools' expectations for parental involvement are shown in Exhibit 7.4. Clearly schools expect help from parents. On average across 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.



At the country level, in all countries with the exception of Japan, at least 60 percent of students were in schools where parents were expected to ensure that their children complete their homework. Twenty countries had at least 90 percent of their students in such schools, and in Canada and the United States almost all students (99 percent) were in such schools. The expectation that parents would serve as classroom aides was especially high in Iran, and low in Finland, Indonesia, Japan, and New Zealand. All Malaysian and Lithuanian students were in schools where parents were expected to volunteer for school projects or field trips. Raising funds was an expectation of parents for at least 75 percent of the students in Cyprus, Morocco, the Slovak Republic, South Africa, and Turkey. At least three-quarters of students were in schools where parents were expected to serve on committees in Australia, Iran, Latvia (LSS), Macedonia, Romania, South Africa, and Turkey.

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
Australia	96 (1.7)	6 (1.9)	66 (4.5)	61 (5.4)	78 (3.9)
Belgium (Flemish)	94 (2.1)	19 (3.7)	39 (4.3)	9 (2.7)	10 (2.7)
Bulgaria	73 (5.6)	64 (5.1)	63 (5.5)	55 (5.2)	22 (3.5)
Canada	99 (0.6)	15 (1.7)	82 (2.2)	52 (3.4)	55 (2.7)
Chile	92 (2.1)	73 (3.3)	94 (1.9)	57 (3.6)	33 (3.1)
Chinese Taipei	97 (1.3)	58 (4.2)	90 (2.5)	41 (4.2)	56 (4.4)
Cyprus	78 (0.2)	15 (0.1)	44 (0.2)	87 (0.1)	18 (0.2)
Czech Republic	91 (3.1)	7 (2.7)	80 (3.8)	32 (4.7)	35 (4.9)
England	--	--	--	--	--
Finland	94 (2.0)	4 (1.5)	72 (4.3)	23 (4.2)	57 (4.8)
Hong Kong, SAR	96 (1.8)	30 (4.2)	77 (3.8)	60 (4.6)	21 (3.7)
Hungary	96 (1.6)	35 (3.8)	95 (1.9)	12 (2.5)	35 (3.9)
Indonesia	97 (1.5)	4 (1.8)	70 (4.5)	59 (4.2)	28 (4.4)
Iran, Islamic Rep.	95 (2.1)	82 (3.7)	96 (2.0)	74 (3.7)	85 (2.7)
Israel	77 (4.0)	16 (3.0)	90 (2.4)	42 (4.6)	48 (4.8)
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)
Jordan	78 (3.7)	23 (3.5)	77 (3.9)	29 (4.1)	17 (3.3)
Korea, Rep. of	64 (3.9)	33 (4.1)	71 (3.8)	31 (3.8)	44 (4.2)
Latvia (LSS)	69 (4.1)	65 (4.4)	95 (2.1)	45 (4.7)	75 (4.0)
Lithuania [‡]	88 (2.6)	11 (2.6)	100 (0.0)	62 (3.9)	73 (3.8)
Macedonia, Rep. of	72 (3.6)	27 (4.1)	48 (4.1)	53 (3.9)	95 (2.0)
Malaysia	97 (1.4)	29 (4.0)	100 (0.0)	64 (4.3)	21 (3.2)
Moldova	66 (4.5)	46 (4.4)	66 (3.4)	55 (4.5)	62 (4.3)
Morocco	62 (3.2)	37 (3.9)	90 (2.2)	80 (2.9)	14 (2.6)
Netherlands	r 81 (5.6)	r 46 (6.2)	r 61 (6.2)	r 16 (5.2)	r 46 (6.5)
New Zealand	97 (1.6)	4 (1.6)	74 (3.7)	62 (4.2)	21 (3.5)
Philippines	86 (2.9)	30 (4.1)	89 (2.8)	65 (4.1)	37 (4.0)
Romania	90 (2.6)	8 (2.4)	86 (3.2)	73 (4.1)	79 (4.3)
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)
Slovak Republic	84 (2.8)	42 (5.0)	90 (2.9)	81 (3.3)	65 (4.1)
Slovenia	98 (1.3)	16 (2.8)	94 (2.1)	35 (3.8)	42 (4.0)
South Africa	93 (1.8)	39 (4.4)	97 (1.2)	87 (2.4)	99 (0.8)
Thailand	92 (2.2)	40 (3.6)	76 (3.5)	69 (3.6)	48 (3.8)
Tunisia	73 (4.0)	15 (3.2)	71 (3.6)	55 (3.7)	21 (3.3)
Turkey	85 (2.8)	33 (3.9)	94 (2.3)	78 (3.2)	89 (2.4)
United States	r 99 (0.7)	r 15 (3.0)	r 94 (1.7)	r 55 (4.7)	r 68 (4.1)
International Avg.	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.

[‡] 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.

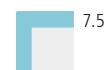
A dash (–) indicates data are not available.

An "r" indicates school response data available for 70-84% 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 schools reported that all three behaviors are not a problem. The low level indicates that two or more are a serious problem, or two are minor problems and the third a serious problem. The medium category includes all other possible combinations of responses.

The results of the index are presented in Exhibit 7.5. Sixty percent of students on average internationally 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 index level. Although countries varied considerably, there was a modest positive relationship between good attendance and science achievement on average across countries.



The information used to compute this index appears in Exhibit 7.6, together with data showing the percentages of students in schools where the behaviors occur at least weekly. Student attendance problems were common and considered to be a serious problem in many countries, and were most acute in South Africa. For most countries, however, schools reported the frequency of the attendance problems to be greater than their seriousness.

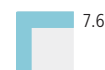


Exhibit 7.5 Index of Good School and Class Attendance (SCA)

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
Belgium (Flemish)	52 (4.4)	550 (5.2)	45 (4.5)	520 (6.6)	3 (1.0)	539 (10.1)
Slovenia	39 (4.0)	538 (5.6)	58 (4.0)	532 (3.7)	4 (1.7)	496 (17.5)
Jordan	39 (4.2)	464 (5.6)	56 (4.5)	444 (6.0)	5 (1.9)	423 (11.9)
Iran, Islamic Rep.	37 (4.9)	445 (7.9)	61 (4.9)	451 (4.2)	2 (1.3)	~ ~
Czech Republic	36 (5.8)	544 (6.7)	56 (6.0)	538 (5.6)	8 (2.3)	555 (17.7)
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)
Macedonia, Rep. of	31 (4.2)	452 (10.9)	51 (4.5)	465 (8.3)	19 (3.2)	446 (16.1)
Slovak Republic	31 (4.3)	535 (6.7)	57 (4.5)	538 (3.9)	12 (3.3)	510 (8.7)
Netherlands	30 (7.3)	531 (10.2)	46 (7.3)	560 (6.2)	24 (7.5)	519 (28.3)
Chinese Taipei	28 (3.7)	591 (8.3)	61 (3.6)	558 (4.1)	11 (2.7)	576 (9.1)
Turkey	26 (3.1)	453 (7.9)	62 (3.9)	428 (4.8)	12 (2.8)	421 (10.1)
Hong Kong, SAR	25 (3.9)	540 (7.9)	68 (4.3)	531 (5.6)	7 (2.5)	500 (10.8)
Bulgaria	23 (5.7)	516 (8.9)	61 (5.4)	525 (8.0)	17 (3.1)	502 (11.3)
Hungary	23 (3.6)	565 (8.3)	60 (4.2)	552 (4.6)	17 (3.1)	536 (10.7)
United States	19 (3.0)	553 (10.2)	68 (3.4)	512 (6.5)	13 (2.5)	480 (11.8)
Cyprus	19 (0.1)	465 (5.8)	54 (0.2)	460 (4.0)	27 (0.2)	465 (3.8)
Canada	18 (2.2)	536 (5.7)	73 (3.0)	533 (2.5)	9 (2.0)	535 (11.8)
Thailand	17 (3.3)	481 (8.8)	68 (4.3)	485 (5.3)	14 (3.3)	488 (15.8)
Australia	17 (3.5)	559 (7.0)	70 (4.0)	542 (5.4)	13 (3.3)	506 (14.2)
Chile	16 (3.1)	440 (10.8)	70 (3.8)	418 (4.7)	13 (2.7)	413 (7.4)
Finland	15 (2.9)	532 (7.0)	67 (4.4)	536 (4.8)	18 (3.8)	535 (6.0)
Tunisia	15 (3.1)	439 (6.9)	60 (3.8)	429 (4.2)	26 (3.6)	427 (4.4)
New Zealand	15 (2.9)	531 (10.4)	69 (3.7)	515 (6.0)	16 (2.5)	461 (10.2)
Romania	15 (3.2)	483 (15.0)	55 (4.2)	463 (7.5)	31 (4.1)	480 (9.8)
Lithuania [†]	12 (2.6)	494 (12.3)	56 (4.2)	493 (5.7)	32 (3.7)	480 (6.3)
Latvia (LSS)	11 (2.6)	497 (9.2)	63 (4.6)	504 (5.8)	26 (4.3)	499 (7.1)
Russian Federation	10 (1.7)	538 (16.1)	70 (3.8)	535 (7.4)	20 (3.4)	505 (8.5)
Indonesia	10 (2.6)	423 (14.7)	57 (4.5)	439 (6.7)	33 (4.1)	427 (7.4)
Philippines	8 (2.4)	350 (20.8)	72 (3.9)	352 (9.9)	20 (3.4)	322 (13.0)
Japan	7 (2.4)	560 (5.0)	47 (4.1)	551 (4.1)	46 (3.9)	546 (2.7)
Israel	7 (2.3)	466 (15.1)	57 (4.8)	480 (6.2)	36 (4.6)	451 (12.4)
Malaysia	6 (2.4)	480 (18.4)	69 (4.1)	499 (5.4)	25 (3.8)	478 (8.6)
Morocco	4 (1.4)	325 (7.1)	56 (4.3)	320 (4.8)	40 (4.4)	327 (7.1)
South Africa	3 (1.2)	386 (44.1)	44 (3.9)	270 (15.4)	53 (4.0)	212 (9.7)
Moldova	1 (1.0)	~ ~	63 (3.8)	455 (5.6)	35 (3.8)	463 (8.8)
England	--	--	--	--	--	--
International Avg.	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.

[†] 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.

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.

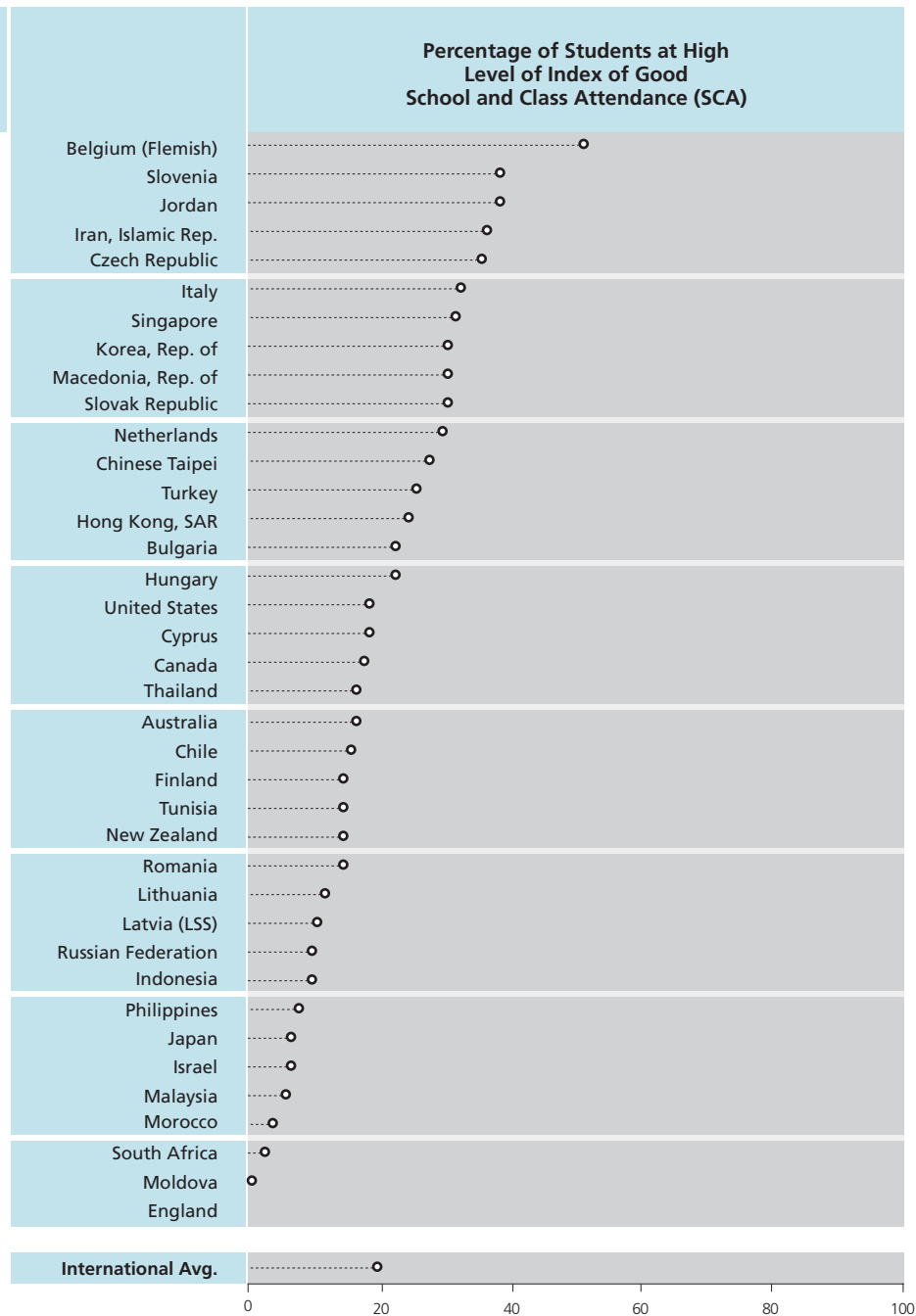


Exhibit 7.6 Frequency and Seriousness of Student Attendance Problems

	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
Australia	77 (3.5)	6 (2.5)	63 (4.1)	11 (2.7)	50 (4.0)	4 (2.0)
Belgium (Flemish)	44 (4.7)	3 (1.4)	11 (2.4)	4 (1.8)	4 (1.3)	2 (1.0)
Bulgaria	34 (4.6)	11 (2.8)	26 (3.8)	18 (3.4)	16 (3.3)	8 (2.4)
Canada	58 (2.7)	7 (1.7)	45 (3.1)	7 (1.6)	22 (2.3)	3 (1.0)
Chile	62 (3.6)	17 (2.8)	40 (3.5)	8 (2.1)	11 (2.7)	5 (1.6)
Chinese Taipei	43 (4.1)	2 (1.1)	32 (4.0)	10 (2.7)	30 (3.8)	11 (2.8)
Cyprus	52 (0.2)	r 15 (0.2)	52 (0.2)	r 25 (0.2)	26 (0.2)	r 28 (0.2)
Czech Republic	21 (3.8)	0 (0.3)	9 (2.8)	8 (2.5)	5 (2.2)	8 (2.4)
England	—	—	—	—	—	—
Finland	62 (3.8)	13 (3.4)	46 (4.0)	12 (3.0)	34 (4.3)	11 (3.1)
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)
Hungary	20 (3.4)	7 (2.2)	10 (2.5)	17 (3.0)	4 (1.7)	10 (2.3)
Indonesia	55 (4.6)	16 (3.0)	44 (4.8)	24 (3.4)	29 (4.2)	32 (4.2)
Iran, Islamic Rep.	29 (3.3)	4 (1.8)	11 (2.6)	5 (2.1)	3 (1.7)	r 3 (1.4)
Israel	74 (4.0)	r 30 (4.2)	53 (4.4)	r 24 (4.1)	48 (4.7)	r 24 (4.3)
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)
Jordan	34 (4.0)	3 (1.6)	26 (4.1)	1 (1.0)	17 (3.3)	r 6 (2.2)
Korea, Rep. of	32 (4.0)	1 (1.0)	31 (4.1)	12 (2.9)	21 (3.6)	5 (1.8)
Latvia (LSS)	46 (4.4)	r 12 (3.2)	19 (3.3)	r 16 (3.4)	31 (3.7)	r 21 (3.7)
Lithuania [†]	45 (3.8)	19 (2.7)	37 (3.8)	27 (3.6)	42 (3.5)	25 (3.2)
Macedonia, Rep. of	34 (4.0)	14 (2.9)	34 (4.0)	13 (2.5)	20 (3.3)	14 (3.2)
Malaysia	41 (4.1)	7 (2.4)	44 (4.2)	23 (3.7)	31 (3.6)	12 (2.5)
Moldova	52 (4.3)	24 (3.6)	44 (3.7)	32 (3.9)	39 (4.1)	14 (2.8)
Morocco	81 (3.4)	16 (2.7)	73 (3.4)	40 (4.4)	42 (3.9)	34 (4.3)
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)
New Zealand	73 (3.8)	7 (1.7)	66 (3.9)	15 (2.5)	60 (4.1)	8 (2.2)
Philippines	57 (4.5)	9 (2.6)	55 (4.5)	17 (3.2)	41 (4.3)	8 (2.2)
Romania	30 (4.0)	11 (2.8)	27 (3.8)	27 (4.0)	20 (3.8)	29 (4.2)
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)
Slovak Republic	20 (3.5)	1 (0.8)	10 (3.0)	11 (3.1)	8 (2.4)	4 (1.9)
Slovenia	52 (4.2)	2 (1.1)	51 (4.0)	3 (1.3)	32 (4.0)	2 (1.2)
South Africa	75 (3.6)	48 (4.5)	69 (3.6)	r 46 (3.9)	57 (4.4)	36 (3.5)
Thailand	45 (4.3)	5 (1.9)	37 (4.3)	11 (3.0)	32 (3.9)	8 (2.3)
Tunisia	49 (3.9)	6 (2.1)	33 (3.9)	20 (3.2)	32 (3.6)	21 (3.5)
Turkey	32 (3.5)	6 (1.5)	33 (3.3)	15 (3.4)	15 (2.4)	5 (2.1)
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)
International Avg.	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.

A dash (—) indicates data are not available.

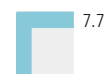
[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

An "r" indicates school response data available for 70-84% of students.

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

How Safe and Orderly Are Schools?

The frequency and seriousness of student behavior threatening an orderly school environment are presented in Exhibit 7.7. The three behaviors 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, and on average internationally only six percent of the students were in schools where it was a serious problem.



In contrast, 13 percent of the students, on average internationally, were in schools that reported classroom disturbances to be a serious problem. Most countries showed a pattern in which a larger percentage of students were in schools where classroom disturbances occurred at least weekly compared with the percentage of students in schools where it was considered a serious problem. The single exception was Japan, where just five percent of the students were in schools in which classroom disturbances occurred weekly, and yet 23 percent were in schools that considered classroom disturbances to be a serious problem.

The frequency and seriousness of student behavior threatening a safe school environment are shown in Exhibit 7.8. The five behaviors 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 these student behaviors was generally low in most countries. The exception was intimidation or verbal abuse of other students, for which several countries had relatively high percentages of students in schools where the behavior occurs at least weekly; in Australia, Israel, the Netherlands, and the United States, close to half of the students were in such schools.

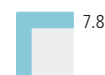


Exhibit 7.7 Frequency and Seriousness of Student Behavior Threatening an Orderly School Environment

	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
Australia	75 (4.1)	r 9 (3.0)	73 (4.2)	11 (2.8)	7 (2.6)	0 (0.0)
Belgium (Flemish)	6 (2.1)	0 (0.0)	40 (5.4)	7 (2.5)	14 (2.7)	1 (0.0)
Bulgaria	2 (1.1)	0 (0.0)	22 (3.8)	6 (1.9)	3 (1.5)	0 (0.4)
Canada	22 (1.8)	2 (0.8)	60 (2.6)	21 (2.3)	4 (1.4)	2 (0.9)
Chile	31 (3.8)	4 (1.5)	46 (3.6)	15 (2.7)	13 (2.8)	2 (1.0)
Chinese Taipei	41 (4.1)	3 (1.5)	30 (3.8)	4 (1.6)	9 (2.1)	8 (2.3)
Cyprus	26 (0.2)	r 12 (0.1)	r 55 (0.2)	r 25 (0.2)	4 (0.1)	r 15 (0.2)
Czech Republic	3 (1.7)	0 (0.0)	63 (4.7)	21 (4.4)	9 (4.3)	11 (3.5)
England	--	--	--	--	--	--
Finland	2 (1.1)	1 (0.0)	50 (3.9)	6 (2.1)	0 (0.4)	0 (0.4)
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)
Hungary	2 (1.1)	1 (0.8)	41 (4.2)	15 (2.4)	2 (1.1)	16 (2.9)
Indonesia	31 (4.6)	19 (3.5)	21 (3.4)	12 (3.0)	12 (2.7)	15 (2.9)
Iran, Islamic Rep.	3 (1.1)	2 (1.0)	21 (3.4)	5 (1.9)	0 (0.0)	4 (1.3)
Israel	46 (4.9)	r 12 (3.8)	61 (4.5)	r 35 (4.9)	6 (2.1)	r 5 (2.2)
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)
Jordan	23 (3.9)	r 15 (3.4)	28 (3.7)	r 5 (2.2)	5 (2.0)	r 6 (2.1)
Korea, Rep. of	37 (4.3)	3 (1.4)	43 (4.2)	7 (1.8)	3 (1.3)	8 (2.5)
Latvia (LSS)	s 5 (2.4)	r 2 (1.3)	37 (4.5)	17 (3.8)	53 (5.0)	r 18 (3.9)
Lithuania [†]	4 (1.7)	1 (1.0)	18 (2.8)	12 (2.4)	7 (2.1)	6 (2.0)
Macedonia, Rep. of	1 (1.0)	0 (0.0)	13 (2.3)	5 (2.0)	8 (1.9)	2 (0.7)
Malaysia	30 (3.7)	6 (1.8)	26 (3.7)	8 (2.3)	10 (2.4)	7 (1.8)
Moldova	6 (1.9)	3 (1.4)	29 (3.7)	13 (2.7)	19 (3.2)	14 (3.3)
Morocco	38 (4.9)	13 (2.8)	32 (3.8)	28 (3.2)	9 (2.0)	28 (3.1)
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)
New Zealand	75 (3.9)	7 (2.0)	68 (3.8)	9 (2.5)	6 (2.0)	0 (0.0)
Philippines	33 (4.2)	3 (1.5)	27 (3.7)	4 (1.7)	13 (3.1)	2 (1.3)
Romania	16 (3.2)	7 (2.4)	17 (3.3)	14 (3.0)	0 (0.0)	10 (2.6)
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)
Slovak Republic	3 (1.6)	2 (1.3)	60 (4.4)	21 (4.1)	51 (4.1)	4 (1.8)
Slovenia	4 (1.8)	1 (0.0)	61 (4.3)	9 (2.5)	4 (1.7)	0 (0.4)
South Africa	60 (4.2)	r 33 (3.3)	39 (4.1)	15 (3.3)	21 (3.6)	13 (2.3)
Thailand	40 (4.5)	4 (1.8)	13 (2.6)	3 (1.4)	3 (1.5)	r 2 (1.2)
Tunisia	18 (3.1)	4 (1.7)	54 (4.0)	20 (3.2)	2 (1.4)	38 (4.2)
Turkey	10 (2.2)	6 (2.2)	15 (2.5)	10 (2.8)	5 (1.6)	4 (1.8)
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)
International Avg.	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.

[†] 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.

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.



Exhibit 7.8 Overleaf

Exhibit 7.8 Frequency and Seriousness of Student Behavior Threatening a Safe School Environment

	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
Australia	27 (4.2)	2 (1.2)	23 (3.7)	1 (0.7)	14 (3.1)	3 (1.4)
Belgium (Flemish)	8 (2.4)	9 (2.6)	7 (2.2)	9 (2.5)	8 (1.9)	6 (2.1)
Bulgaria	5 (1.8)	4 (1.6)	1 (0.6)	1 (1.0)	4 (1.4)	1 (0.0)
Canada	15 (1.5)	6 (2.0)	7 (1.4)	6 (1.9)	6 (1.8)	4 (1.5)
Chile	9 (2.3)	7 (2.0)	10 (2.3)	7 (1.9)	12 (2.5)	9 (1.8)
Chinese Taipei	14 (3.1)	11 (2.5)	7 (2.2)	16 (2.9)	8 (2.3)	21 (3.2)
Cyprus	r 18 (0.1)	r 22 (0.2)	r 8 (0.1)	r 23 (0.2)	2 (0.0)	r 20 (0.2)
Czech Republic	13 (2.7)	21 (3.6)	3 (1.9)	17 (3.8)	2 (1.7)	17 (3.7)
England	—	—	—	—	—	—
Finland	6 (2.2)	3 (1.6)	3 (1.8)	1 (0.8)	7 (2.5)	2 (1.4)
Hong Kong, SAR	18 (3.7)	r 6 (2.3)	8 (2.6)	r 5 (2.2)	5 (2.1)	r 3 (1.6)
Hungary	10 (2.6)	30 (3.5)	2 (1.1)	25 (3.4)	8 (2.0)	23 (3.1)
Indonesia	4 (1.8)	29 (4.0)	1 (0.9)	30 (4.1)	0 (0.0)	26 (3.9)
Iran, Islamic Rep.	3 (1.4)	r 4 (1.6)	1 (0.6)	4 (1.6)	3 (1.4)	r 2 (1.4)
Israel	30 (4.2)	r 28 (4.1)	10 (2.9)	r 15 (3.5)	24 (4.3)	r 18 (3.7)
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)
Jordan	5 (1.8)	r 16 (3.6)	2 (1.1)	r 12 (3.1)	9 (2.5)	r 10 (2.7)
Korea, Rep. of	12 (2.8)	10 (2.5)	9 (2.5)	13 (3.0)	10 (2.6)	9 (2.6)
Latvia (LSS)	2 (1.3)	r 4 (2.0)	0 (0.0)	10 (3.0)	5 (2.3)	r 8 (2.6)
Lithuania [†]	0 (0.0)	6 (1.7)	0 (0.0)	9 (2.0)	1 (0.0)	7 (1.3)
Macedonia, Rep. of	3 (1.4)	8 (2.6)	1 (0.9)	6 (2.2)	3 (1.6)	9 (2.4)
Malaysia	12 (3.0)	17 (3.4)	7 (2.0)	12 (2.8)	2 (1.1)	11 (2.2)
Moldova	1 (1.0)	3 (1.3)	0 (0.0)	8 (2.3)	0 (0.0)	2 (1.2)
Morocco	17 (2.8)	34 (4.0)	8 (1.8)	26 (3.3)	9 (2.3)	25 (3.6)
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)
New Zealand	21 (3.5)	4 (1.8)	15 (3.0)	4 (1.5)	8 (2.0)	1 (0.9)
Philippines	16 (3.2)	11 (2.4)	6 (2.2)	2 (1.1)	6 (2.0)	1 (0.7)
Romania	0 (0.0)	11 (2.9)	2 (1.3)	19 (3.5)	9 (2.6)	22 (3.5)
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)
Slovak Republic	15 (3.4)	24 (4.1)	2 (1.4)	17 (3.4)	3 (1.7)	15 (3.8)
Slovenia	8 (2.0)	2 (1.5)	3 (1.3)	1 (0.8)	4 (1.9)	1 (0.8)
South Africa	18 (3.3)	32 (4.2)	16 (2.7)	29 (4.2)	7 (2.0)	14 (3.3)
Thailand	9 (2.3)	3 (1.6)	4 (1.6)	4 (1.7)	3 (1.5)	3 (1.5)
Tunisia	9 (2.5)	35 (4.4)	2 (1.2)	29 (4.0)	5 (1.9)	28 (3.8)
Turkey	10 (2.0)	11 (2.9)	6 (1.9)	10 (3.1)	7 (1.4)	10 (2.8)
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)
International Avg.	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.

A dash (—) indicates data are not available.

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

An "r" indicates school response data available for 70-84% of students.

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

	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
Australia	51 (4.0)	11 (3.1)	16 (3.2)	5 (1.8)
Belgium (Flemish)	23 (3.4)	15 (3.7)	5 (1.5)	3 (1.2)
Bulgaria	9 (2.3)	2 (0.9)	1 (0.6)	0 (0.4)
Canada	42 (3.0)	22 (2.5)	4 (1.2)	3 (1.1)
Chile	23 (3.3)	14 (2.4)	4 (1.5)	7 (2.0)
Chinese Taipei	11 (2.7)	18 (3.1)	1 (1.0)	17 (3.0)
Cyprus	23 (0.2)	20 (0.2)	3 (0.1)	25 (0.2)
Czech Republic	5 (1.5)	17 (3.6)	0 (0.0)	9 (2.6)
England	--	--	--	--
Finland	14 (3.2)	7 (2.2)	4 (1.4)	2 (1.1)
Hong Kong, SAR	8 (2.7)	4 (1.8)	3 (1.5)	2 (1.3)
Hungary	9 (2.5)	25 (3.6)	1 (0.6)	8 (1.9)
Indonesia	2 (1.3)	25 (3.9)	0 (0.0)	28 (3.8)
Iran, Islamic Rep.	11 (2.9)	2 (1.5)	2 (1.2)	4 (1.8)
Israel	51 (4.6)	32 (5.1)	8 (2.6)	14 (3.6)
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)
Jordan	18 (3.0)	8 (2.4)	1 (0.8)	11 (2.9)
Korea, Rep. of	12 (2.9)	12 (2.8)	8 (2.3)	9 (2.5)
Latvia (LSS)	1 (1.1)	5 (2.1)	0 (0.0)	1 (0.6)
Lithuania [†]	3 (1.4)	14 (2.2)	0 (0.0)	6 (1.4)
Macedonia, Rep. of	6 (1.8)	7 (2.0)	1 (0.0)	5 (2.0)
Malaysia	4 (1.7)	11 (2.3)	1 (0.9)	8 (2.1)
Moldova	3 (1.4)	5 (1.9)	1 (0.0)	4 (1.7)
Morocco	18 (3.0)	22 (3.1)	10 (2.4)	32 (3.7)
Netherlands	49 (7.3)	23 (6.9)	17 (6.6)	16 (6.4)
New Zealand	39 (3.9)	12 (2.7)	13 (2.8)	3 (1.5)
Philippines	10 (2.7)	0 (0.0)	3 (1.6)	1 (0.0)
Romania	10 (2.5)	21 (3.5)	2 (1.1)	14 (3.3)
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)
Slovak Republic	10 (3.0)	17 (4.0)	0 (0.0)	8 (2.7)
Slovenia	17 (3.0)	3 (1.4)	1 (0.8)	0 (0.4)
South Africa	22 (3.0)	17 (2.8)	4 (1.5)	12 (3.5)
Thailand	7 (2.1)	4 (1.7)	2 (1.2)	3 (1.3)
Tunisia	5 (1.9)	25 (3.6)	2 (1.3)	38 (4.1)
Turkey	9 (1.8)	12 (2.8)	3 (1.4)	6 (2.5)
United States	46 (4.3)	16 (3.6)	7 (2.0)	3 (1.5)
International Avg.	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

R

1



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
Australia	82 (1.1)	548 (4.2)	18 (1.1)	508 (6.3)	99 (0.2)	95 (0.4)	86 (1.0)
Belgium (Flemish)	82 (1.2)	541 (2.7)	18 (1.2)	507 (6.9)	98 (0.7)	96 (0.6)	86 (1.0)
Bulgaria	21 (2.4)	549 (9.7)	79 (2.4)	511 (4.7)	89 (0.9)	87 (1.2)	23 (2.3)
Canada	78 (0.8)	539 (2.2)	22 (0.8)	513 (3.6)	98 (0.2)	91 (0.6)	85 (0.8)
Chile	21 (1.7)	468 (7.9)	79 (1.7)	409 (2.8)	97 (0.4)	78 (0.9)	23 (1.7)
Chinese Taipei	61 (1.1)	588 (4.2)	39 (1.1)	541 (5.5)	98 (0.2)	94 (0.4)	63 (1.0)
Cyprus	56 (0.8)	475 (2.6)	44 (0.8)	444 (3.9)	97 (0.3)	97 (0.3)	58 (0.9)
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)
Finland	71 (1.2)	544 (3.8)	29 (1.2)	516 (5.1)	89 (0.7)	97 (0.4)	79 (0.9)
Hong Kong, SAR	57 (1.3)	537 (3.8)	43 (1.3)	522 (4.5)	99 (0.1)	75 (0.9)	72 (1.3)
Hungary	48 (1.4)	577 (3.9)	52 (1.4)	530 (4.7)	95 (0.8)	95 (0.5)	50 (1.4)
Indonesia	6 (0.8)	474 (15.9)	94 (0.8)	434 (4.3)	86 (0.9)	84 (1.1)	7 (0.8)
Iran, Islamic Rep.	5 (0.7)	492 (8.4)	95 (0.7)	447 (3.6)	51 (1.5)	47 (2.2)	7 (0.8)
Israel	78 (1.5)	490 (4.2)	22 (1.5)	402 (6.9)	98 (0.3)	97 (0.3)	80 (1.5)
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)
Jordan	16 (0.9)	493 (5.8)	84 (0.9)	448 (4.1)	80 (0.9)	73 (1.1)	23 (1.1)
Korea, Rep. of	65 (0.9)	563 (3.0)	35 (0.9)	523 (3.2)	99 (0.2)	96 (0.2)	67 (0.9)
Latvia (LSS)	14 (1.0)	529 (6.5)	86 (1.0)	499 (5.1)	94 (0.7)	98 (0.3)	15 (1.0)
Lithuania [‡]	15 (1.1)	530 (9.7)	85 (1.1)	481 (4.0)	86 (0.9)	95 (0.5)	16 (1.1)
Macedonia, Rep. of	18 (1.2)	498 (6.4)	82 (1.2)	452 (5.2)	83 (1.2)	87 (0.8)	21 (1.3)
Malaysia	28 (1.2)	533 (6.6)	72 (1.2)	477 (4.2)	99 (0.2)	87 (0.6)	31 (1.3)
Moldova	5 (0.6)	478 (13.0)	95 (0.6)	459 (4.3)	72 (1.3)	79 (0.9)	7 (0.7)
Morocco	6 (0.7)	340 (16.4)	94 (0.7)	326 (3.6)	71 (1.2)	52 (1.1)	9 (0.9)
Netherlands	94 (1.0)	548 (6.7)	6 (1.0)	499 (16.2)	100 (0.2)	99 (0.2)	96 (1.0)
New Zealand	67 (1.3)	532 (4.9)	33 (1.3)	468 (5.4)	97 (0.4)	90 (0.6)	72 (1.2)
Philippines	11 (0.9)	404 (16.1)	89 (0.9)	342 (7.4)	89 (0.7)	74 (1.0)	15 (0.9)
Romania	11 (0.8)	507 (9.7)	89 (0.8)	470 (5.7)	69 (1.6)	76 (1.4)	14 (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)
Slovak Republic	36 (1.3)	555 (5.0)	64 (1.3)	524 (3.4)	96 (0.5)	88 (0.8)	41 (1.3)
Slovenia	61 (1.2)	552 (3.2)	39 (1.2)	507 (4.3)	92 (0.6)	96 (0.3)	66 (1.2)
South Africa	8 (1.0)	423 (20.0)	92 (1.0)	230 (6.2)	75 (1.1)	56 (1.1)	11 (1.1)
Thailand	8 (0.6)	535 (9.4)	92 (0.6)	478 (4.0)	75 (1.2)	63 (1.5)	8 (0.7)
Tunisia	23 (1.3)	438 (4.7)	77 (1.3)	427 (3.6)	87 (1.0)	92 (0.6)	24 (1.3)
Turkey	8 (0.6)	467 (7.7)	92 (0.6)	431 (4.3)	89 (0.7)	69 (1.3)	10 (0.7)
United States	74 (1.3)	535 (3.9)	26 (1.3)	469 (5.8)	97 (0.3)	90 (0.5)	80 (1.2)
International Avg.	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.

[‡] 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 R1.2

Trends in Educational Aids in the Home

	Have All Three Educational Aids		Have Dictionary		Have Study Desk/ Table for Own Use		Have Computer	
	Percent of Students	1995 - 1999 Difference	Percent of Students	1995 - 1999 Difference	Percent of Students	1995 - 1999 Difference	Percent of Students	1995 - 1999 Difference
Australia	82 (1.1)	16 (1.6) ▲	99 (0.2)	11 (0.8) ▲	95 (0.4)	-2 (0.5) ▼	86 (1.0)	13 (1.5) ▲
Belgium (Flemish)	82 (1.2)	19 (1.8) ▲	98 (0.7)	0 (0.8) ●	96 (0.6)	-1 (0.8) ●	86 (1.0)	19 (1.6) ▲
Canada	78 (0.8)	21 (1.6) ▲	98 (0.2)	2 (0.4) ▲	91 (0.6)	2 (0.8) ●	85 (0.8)	24 (1.6) ▲
Cyprus	56 (0.8)	18 (1.2) ▲	97 (0.3)	0 (0.5) ●	97 (0.3)	1 (0.6) ●	58 (0.9)	19 (1.3) ▲
Czech Republic	43 (1.2)	11 (1.8) ▲	94 (0.8)	-1 (0.9) ●	91 (0.7)	2 (0.9) ●	47 (1.2)	11 (1.7) ▲
England	79 (0.9)	-1 (1.4) ●	98 (0.3)	0 (0.5) ●	92 (0.6)	2 (1.0) ●	85 (0.8)	-4 (1.2) ▼
Hong Kong, SAR	57 (1.3)	24 (2.2) ▲	99 (0.1)	0 (0.2) ●	75 (0.9)	-5 (1.4) ▼	72 (1.3)	33 (2.3) ▲
Hungary	--	--	--	--	95 (0.5)	3 (0.9) ▲	50 (1.4)	13 (1.8) ▲
Iran, Islamic Rep.	5 (0.7)	4 (0.8) ▲	51 (1.5)	-2 (2.1) ●	47 (2.2)	8 (3.0) ●	7 (0.8)	3 (1.0) ▲
Israel [†]	83 (1.7)	9 (2.7) ▲	99 (0.2)	-1 (0.3) ●	98 (0.2)	0 (0.5) ●	85 (1.8)	9 (2.7) ▲
Italy	58 (1.4)	-1 (2.1) ●	98 (0.4)	-1 (0.4) ●	93 (0.6)	-1 (1.0) ●	62 (1.3)	0 (2.0) ●
Japan	--	--	--	--	--	--	--	--
Korea, Rep. of	65 (0.9)	27 (1.5) ▲	99 (0.2)	0 (0.3) ●	96 (0.2)	1 (0.5) ●	67 (0.9)	27 (1.5) ▲
Latvia (LSS)	14 (1.0)	2 (1.3) ●	94 (0.7)	1 (0.9) ●	98 (0.3)	0 (0.5) ●	15 (1.0)	2 (1.3) ●
Lithuania	--	--	86 (0.9)	-2 (1.4) ●	95 (0.5)	1 (0.8) ●	--	--
Netherlands	94 (1.0)	11 (1.6) ▲	100 (0.2)	0 (0.2) ●	99 (0.2)	0 (0.3) ●	96 (1.0)	11 (1.6) ▲
New Zealand	67 (1.3)	11 (1.9) ▲	97 (0.4)	-2 (0.4) ▼	90 (0.6)	0 (0.8) ●	72 (1.2)	12 (1.8) ▲
Romania	11 (0.8)	3 (1.3) ●	69 (1.6)	9 (2.2) ▲	76 (1.4)	7 (1.9) ▲	14 (1.0)	-5 (1.5) ▼
Russian Federation	19 (1.2)	-11 (1.9) ▼	88 (1.3)	-1 (1.7) ●	92 (0.8)	-3 (1.1) ●	22 (1.2)	-13 (2.0) ▼
Singapore	75 (1.4)	28 (2.0) ▲	99 (0.2)	0 (0.2) ●	92 (0.5)	0 (0.7) ●	80 (1.3)	31 (2.0) ▲
Slovak Republic	36 (1.3)	9 (1.8) ▲	96 (0.5)	0 (0.7) ●	88 (0.8)	1 (1.1) ●	41 (1.3)	10 (1.8) ▲
Slovenia	61 (1.2)	18 (1.8) ▲	92 (0.6)	-2 (0.8) ●	96 (0.3)	3 (0.7) ▲	66 (1.2)	19 (1.8) ▲
Thailand [†]	8 (0.6)	4 (1.0) ▲	75 (1.2)	8 (2.4) ▲	63 (1.5)	-2 (2.6) ●	8 (0.7)	4 (1.1) ▲
United States	74 (1.3)	18 (2.1) ▲	97 (0.3)	0 (0.5) ●	90 (0.5)	0 (0.9) ●	80 (1.2)	21 (2.1) ▲
International Avg. [§]	53 (0.2)	10 (0.4) ▲	93 (0.1)	1 (0.2) ▲	90 (0.2)	1 (0.2) ▲	57 (0.2)	10 (0.4) ▲

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by students.

[†] Countries with unapproved sampling procedures at the classroom level in 1995.[§] International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 R1.3 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
Australia	38 (1.2)	565 (4.7)	27 (0.9)	544 (4.8)	24 (0.9)	521 (6.0)	7 (0.6)	495 (9.2)	3 (0.4)	483 (15.0)
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)
Bulgaria	37 (2.2)	548 (7.6)	19 (0.9)	529 (5.6)	24 (1.1)	509 (5.2)	12 (1.0)	477 (8.1)	9 (1.3)	450 (9.1)
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)
Chile	9 (0.6)	468 (10.4)	11 (0.6)	457 (8.1)	28 (0.9)	441 (5.3)	32 (0.9)	403 (4.0)	20 (1.1)	378 (4.7)
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)
Cyprus	17 (0.8)	479 (4.5)	23 (0.9)	476 (3.7)	36 (1.0)	465 (4.0)	19 (0.9)	437 (4.9)	5 (0.5)	402 (10.0)
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)
Finland	22 (1.1)	552 (5.7)	22 (0.9)	544 (4.7)	39 (1.1)	536 (4.4)	14 (0.8)	506 (5.3)	4 (0.4)	495 (11.6)
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)
Hungary	38 (1.4)	581 (3.7)	21 (0.8)	561 (5.6)	25 (1.0)	539 (4.4)	12 (0.8)	502 (8.6)	3 (0.5)	460 (14.4)
Indonesia	5 (0.5)	437 (17.8)	5 (0.4)	451 (14.1)	26 (0.9)	446 (4.6)	39 (1.0)	429 (5.5)	26 (1.3)	438 (5.5)
Iran, Islamic Rep.	9 (0.7)	482 (8.3)	8 (0.7)	479 (8.8)	22 (0.6)	465 (6.1)	32 (0.8)	443 (4.7)	29 (1.4)	425 (4.9)
Israel	22 (1.3)	498 (5.3)	21 (0.8)	504 (5.7)	33 (1.0)	471 (6.1)	18 (0.9)	434 (7.0)	6 (0.5)	388 (15.8)
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)
Jordan	10 (0.6)	485 (6.7)	10 (0.6)	493 (6.5)	28 (0.8)	471 (4.8)	31 (1.1)	447 (4.3)	21 (1.2)	416 (5.8)
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)
Latvia (LSS)	47 (1.4)	522 (6.2)	25 (0.9)	499 (4.5)	21 (0.9)	480 (4.6)	6 (0.7)	465 (10.6)	1 (0.2)	~ ~
Lithuania [‡]	17 (1.0)	528 (7.1)	21 (1.0)	517 (6.2)	36 (1.2)	482 (5.2)	20 (1.1)	454 (6.1)	7 (0.8)	433 (10.1)
Macedonia, Rep. of	7 (0.7)	492 (8.0)	9 (0.6)	498 (5.9)	30 (1.2)	487 (5.4)	38 (1.3)	449 (6.6)	15 (1.3)	408 (9.8)
Malaysia	9 (0.7)	538 (8.1)	12 (0.6)	521 (8.3)	32 (0.9)	505 (6.3)	34 (0.9)	472 (4.7)	13 (0.8)	460 (6.6)
Moldova	9 (0.7)	486 (7.8)	11 (0.8)	489 (7.5)	28 (1.0)	470 (4.9)	33 (1.2)	456 (5.1)	20 (1.1)	427 (7.4)
Morocco	3 (0.3)	343 (13.9)	5 (0.4)	372 (20.0)	20 (1.0)	335 (11.4)	35 (0.9)	323 (5.9)	37 (1.7)	320 (5.7)
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)
New Zealand	33 (1.1)	541 (5.7)	24 (0.8)	529 (5.3)	27 (0.8)	499 (5.3)	10 (0.7)	460 (8.2)	6 (0.5)	407 (12.1)
Philippines	5 (0.4)	355 (16.5)	5 (0.4)	388 (17.3)	15 (0.8)	393 (11.9)	33 (0.9)	350 (8.0)	41 (1.4)	323 (7.0)
Romania	15 (1.3)	515 (8.1)	15 (0.9)	510 (8.3)	32 (1.1)	474 (6.0)	24 (1.6)	447 (6.8)	14 (1.1)	434 (9.3)
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)
Slovak Republic	17 (0.9)	566 (6.6)	24 (1.0)	550 (5.6)	43 (1.1)	531 (3.9)	14 (1.0)	494 (6.4)	2 (0.4)	~ ~
Slovenia	14 (0.9)	564 (5.6)	20 (0.8)	556 (5.6)	46 (1.0)	532 (3.3)	16 (0.8)	498 (6.4)	4 (0.4)	483 (11.1)
South Africa	7 (0.5)	293 (25.6)	6 (0.5)	337 (18.9)	14 (0.8)	308 (15.3)	31 (0.8)	245 (8.7)	43 (1.6)	208 (5.9)
Thailand	6 (0.5)	509 (7.0)	8 (0.5)	502 (6.6)	27 (0.9)	493 (4.5)	37 (1.1)	477 (4.1)	22 (1.0)	465 (5.4)
Tunisia	9 (0.6)	438 (7.2)	9 (0.6)	444 (6.4)	25 (0.7)	438 (4.7)	36 (0.9)	424 (5.2)	21 (1.1)	422 (3.4)
Turkey	6 (0.4)	441 (11.1)	8 (0.5)	459 (7.4)	28 (0.8)	449 (5.3)	37 (0.8)	426 (5.0)	22 (1.1)	415 (5.2)
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)
International Avg.	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.

[‡] 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.

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

Exhibit R1.4 Trends in Number of Books in the Home

	Two or More Bookcases (More Than 100 Books)		About One Bookcase (26-100 Books)		About One Shelf or Fewer (0-25 Books)	
	Percent of Students 1999	1995 - 1999 Difference	Percent of Students 1999	1995 - 1999 Difference	Percent of Students 1999	1995 - 1999 Difference
Australia	65 (1.3)	-2 (1.9) ●	24 (0.9)	1 (1.3) ●	11 (0.8)	1 (1.1) ●
Belgium (Flemish)	28 (1.0)	-11 (1.7) ▼	31 (1.3)	-2 (1.7) ●	41 (1.6)	13 (2.3) ▲
Canada	56 (1.1)	-2 (1.7) ●	28 (0.7)	0 (1.3) ●	16 (0.6)	2 (1.0) ●
Cyprus	40 (1.0)	-2 (1.5) ●	36 (1.0)	2 (1.3) ●	24 (1.0)	0 (1.5) ●
Czech Republic	58 (1.5)	-8 (2.4) ▼	34 (1.1)	4 (1.9) ●	8 (0.8)	4 (1.0) ▲
England	49 (1.6)	-5 (2.3) ●	32 (1.1)	5 (1.7) ●	19 (1.1)	0 (1.5) ●
Hong Kong, SAR	17 (0.8)	-3 (1.6) ●	27 (0.7)	-2 (1.2) ●	55 (1.2)	4 (1.9) ●
Hungary	60 (1.5)	-4 (2.1) ●	25 (1.0)	1 (1.4) ●	15 (1.1)	3 (1.4) ●
Iran, Islamic Rep.	16 (1.3)	3 (1.6) ●	22 (0.6)	5 (1.1) ▲	62 (1.6)	-8 (2.2) ▼
Israel †	44 (1.9)	-7 (3.3) ●	34 (1.1)	2 (2.3) ●	23 (1.3)	5 (1.9) ●
Italy	34 (1.5)	-8 (2.2) ▼	28 (1.2)	-4 (1.8) ●	38 (1.5)	12 (1.9) ▲
Japan	--	--	--	--	--	--
Korea, Rep. of	44 (1.0)	-1 (1.6) ●	36 (0.7)	3 (1.2) ●	20 (0.7)	-2 (1.2) ●
Latvia (LSS)	72 (1.3)	-6 (1.8) ▼	21 (0.9)	4 (1.3) ▲	8 (0.8)	2 (1.0) ●
Lithuania	38 (1.6)	-6 (2.1) ▼	36 (1.2)	0 (1.7) ●	26 (1.6)	6 (1.9) ▲
Netherlands	47 (2.6)	5 (3.3) ●	31 (1.1)	-3 (1.7) ●	23 (2.3)	-2 (2.8) ●
New Zealand	56 (1.3)	-9 (1.8) ▼	27 (0.8)	3 (1.2) ●	16 (1.0)	6 (1.3) ▲
Romania	30 (1.8)	-5 (2.7) ●	32 (1.1)	12 (1.4) ▲	38 (2.0)	-8 (2.8) ●
Russian Federation	53 (2.0)	2 (2.7) ●	31 (1.3)	-5 (1.8) ●	17 (1.3)	3 (1.6) ●
Singapore	26 (1.2)	0 (1.8) ●	40 (1.1)	-1 (1.4) ●	34 (1.5)	1 (2.0) ●
Slovak Republic	41 (1.5)	-1 (2.1) ●	43 (1.1)	-2 (1.5) ●	16 (1.2)	3 (1.4) ●
Slovenia	34 (1.3)	-10 (1.9) ▼	46 (1.0)	7 (1.6) ▲	20 (1.1)	2 (1.4) ●
Thailand †	15 (0.7)	-3 (1.6) ●	27 (0.9)	-7 (1.5) ▼	59 (1.3)	10 (2.4) ▲
United States	50 (1.4)	-2 (2.2) ●	29 (0.8)	0 (1.2) ●	22 (1.1)	1 (1.8) ●
International Avg. §	43 (0.3)	-4 (0.4) ▼	31 (0.2)	1 (0.3) ▲	26 (0.3)	2 (0.4) ▲

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

- ▲ 1999 significantly higher than 1995
- No significant difference between 1995 and 1999
- ▼ 1999 significantly lower than 1995
- Significance tests adjusted for multiple comparisons

Background data provided by students.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 R1.5 Highest Level of Education of Either Parent*

	Finished University ¹		Finished Upper Secondary School But Not University ²		Finished Primary School But Not Upper Secondary School ³		Did Not Finish Primary School ⁴		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
Australia	28 (1.8)	581 (5.4)	30 (1.1)	545 (5.4)	21 (1.1)	526 (5.0)	0 (0.1)	~ ~	21 (1.0)	508 (6.7)
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)
Bulgaria	34 (2.9)	547 (8.5)	51 (2.4)	511 (4.2)	7 (0.8)	465 (8.8)	1 (0.2)	~ ~	7 (0.7)	496 (12.9)
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)
Chile ^r	14 (1.4)	491 (9.0)	30 (1.2)	444 (5.0)	34 (1.4)	392 (5.0)	13 (0.8)	380 (5.9)	10 (0.6)	407 (7.0)
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)
Cyprus	22 (0.7)	495 (3.6)	48 (0.9)	469 (2.8)	26 (0.9)	425 (4.5)	1 (0.2)	~ ~	3 (0.3)	442 (11.4)
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	--	--	--	--	--	--	--	--	--	--
Finland	7 (0.8)	575 (6.7)	28 (1.1)	559 (5.4)	11 (0.7)	522 (5.6)	3 (0.4)	520 (14.1)	51 (1.5)	526 (3.8)
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)
Hungary	27 (1.4)	598 (4.2)	59 (1.3)	546 (3.9)	7 (0.7)	489 (8.0)	0 (0.0)	~ ~	7 (0.7)	514 (10.2)
Indonesia	9 (0.9)	466 (14.1)	30 (1.2)	454 (4.9)	44 (1.4)	428 (5.6)	10 (0.6)	413 (6.9)	7 (0.6)	422 (9.7)
Iran, Islamic Rep.	8 (1.1)	504 (8.8)	17 (1.4)	479 (5.1)	48 (1.5)	444 (3.9)	25 (1.5)	432 (4.3)	2 (0.2)	~ ~
Israel	34 (1.6)	511 (5.4)	42 (1.3)	472 (4.4)	10 (0.6)	425 (7.7)	3 (0.7)	345 (33.1)	11 (1.0)	439 (11.5)
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	--	--	--	--	--	--	--	--	--	--
Jordan	29 (1.1)	485 (5.3)	34 (1.0)	458 (5.3)	23 (0.9)	425 (5.3)	5 (0.5)	406 (11.5)	8 (0.7)	435 (11.4)
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)
Latvia (LSS)	29 (1.5)	534 (6.1)	42 (1.3)	505 (4.9)	7 (0.7)	468 (11.3)	0 (0.1)	~ ~	21 (1.3)	478 (8.1)
Lithuania [†]	29 (1.6)	529 (7.0)	54 (1.5)	482 (4.4)	4 (0.6)	438 (15.3)	0 (0.1)	~ ~	13 (0.9)	460 (7.4)
Macedonia, Rep. of	18 (1.2)	519 (6.5)	51 (1.2)	478 (4.8)	24 (1.5)	411 (7.8)	3 (0.6)	354 (15.8)	3 (0.4)	418 (11.9)
Malaysia	12 (0.9)	546 (8.3)	44 (0.9)	499 (4.8)	29 (1.0)	478 (4.3)	3 (0.3)	470 (10.5)	12 (0.9)	460 (7.8)
Moldova	28 (1.5)	482 (5.9)	49 (1.6)	461 (5.3)	8 (0.8)	447 (11.5)	1 (0.1)	~ ~	14 (1.2)	436 (10.0)
Morocco ^r	7 (0.7)	350 (14.6)	14 (0.8)	349 (7.7)	27 (0.9)	330 (6.1)	42 (1.9)	317 (4.8)	9 (0.7)	329 (12.1)
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)
New Zealand	28 (1.4)	549 (5.6)	34 (0.7)	508 (4.8)	12 (0.7)	493 (6.6)	0 (0.1)	~ ~	25 (1.1)	482 (6.9)
Philippines	30 (1.5)	397 (11.2)	37 (0.9)	339 (7.4)	25 (1.1)	321 (9.4)	5 (0.4)	286 (15.3)	4 (0.4)	333 (16.1)
Romania	20 (1.7)	507 (10.2)	49 (1.6)	483 (5.6)	17 (1.6)	451 (8.4)	3 (0.5)	420 (17.5)	11 (0.9)	434 (8.7)
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)
Slovak Republic	22 (1.5)	574 (5.9)	64 (1.3)	531 (2.8)	6 (0.7)	498 (9.9)	0 (0.1)	~ ~	8 (0.7)	492 (5.8)
Slovenia	19 (0.9)	572 (6.8)	65 (1.0)	532 (3.2)	10 (0.7)	502 (6.9)	1 (0.2)	~ ~	5 (0.5)	495 (13.5)
South Africa	15 (1.1)	306 (14.6)	30 (1.3)	269 (10.0)	32 (1.1)	215 (6.4)	11 (1.2)	183 (9.4)	12 (0.9)	230 (10.1)
Thailand	9 (0.9)	538 (8.4)	13 (0.8)	503 (6.1)	40 (1.3)	481 (4.3)	30 (1.5)	467 (5.7)	9 (0.7)	471 (7.7)
Tunisia	10 (0.8)	451 (6.8)	28 (1.1)	438 (4.4)	41 (1.3)	426 (2.2)	14 (0.9)	412 (6.4)	6 (0.9)	417 (6.4)
Turkey	9 (0.8)	487 (6.7)	20 (1.0)	447 (6.0)	60 (1.3)	425 (4.2)	10 (0.7)	418 (10.5)	2 (0.2)	~ ~
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)
International Avg.	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 R1.6 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.[†] 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.

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

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



Exhibit R1.6 Overleaf

Exhibit R1.6

Country Modifications to the Definitions of Educational Levels for Parents' Education or Students' Expectations for Finishing School*

	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
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 or Dottorato di Ricerca; 4-6 Year Diploma)	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) [‡]	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, hbo, 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, VITEB) [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)		
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

■ National educational level is the same as the internationally-defined level

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

* 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 4.4 and R1.5. National modifications pertain to both the parents' education and students' 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.

	Finished Primary School But Not Upper Secondary School		Did Not Finish Primary School ²	
	Lower-Secondary Level	Primary Level ²		
	Finished Some Secondary School	Finished Primary School	Some Primary School or Did Not Go to School	Internationally Defined Level
			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
Some High School		Finish Elementary School	Finish elementary school or did not go to school	United States (P)
Some High School				United States (S)

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

 National educational level is the same as the internationally-defined level

Exhibit R1.7 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
Australia	92 (0.6)	97 (0.3)	97 (0.4)	99 (0.2)	83 (0.8)
Belgium (Flemish)	91 (0.8)	98 (0.3)	96 (0.4)	98 (0.4)	77 (0.9)
Bulgaria	91 (0.8)	96 (0.6)	96 (0.5)	96 (0.5)	83 (1.0)
Canada	95 (0.4)	98 (0.2)	97 (0.5)	99 (0.2)	82 (0.6)
Chile	98 (0.2)	99 (0.2)	98 (0.2)	98 (0.3)	95 (0.4)
Chinese Taipei	89 (0.5)	89 (0.5)	89 (0.5)	99 (0.1)	94 (0.3)
Cyprus	91 (0.5)	96 (0.3)	96 (0.3)	97 (0.3)	90 (0.5)
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)
Finland	84 (0.9)	93 (0.6)	91 (0.6)	96 (0.4)	82 (1.0)
Hong Kong, SAR	86 (0.7)	95 (0.4)	96 (0.4)	97 (0.3)	84 (0.6)
Hungary	87 (0.6)	97 (0.3)	97 (0.4)	96 (0.4)	68 (0.9)
Indonesia	98 (0.2)	97 (0.3)	98 (0.2)	71 (1.0)	96 (0.3)
Iran, Islamic Rep.	96 (0.3)	96 (0.4)	94 (0.5)	89 (0.6)	93 (0.5)
Israel	90 (0.7)	98 (0.3)	92 (0.6)	96 (0.4)	86 (0.7)
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)
Jordan	97 (0.3)	96 (0.4)	95 (0.4)	87 (0.7)	89 (0.5)
Korea, Rep. of	87 (0.5)	90 (0.4)	89 (0.4)	92 (0.3)	88 (0.5)
Latvia (LSS)	86 (0.9)	98 (0.3)	98 (0.3)	97 (0.3)	88 (0.7)
Lithuania [†]	84 (1.0)	97 (0.4)	98 (0.3)	96 (0.4)	92 (0.6)
Macedonia, Rep. of	96 (0.4)	95 (0.4)	97 (0.3)	94 (0.5)	95 (0.4)
Malaysia	99 (0.1)	99 (0.1)	99 (0.2)	78 (1.0)	93 (0.5)
Moldova	95 (0.6)	93 (0.7)	95 (0.4)	92 (0.7)	91 (0.5)
Morocco	r 92 (0.6)	r 91 (0.5)	r 90 (0.5)	r 65 (1.1)	r 91 (0.5)
Netherlands	94 (0.9)	98 (0.3)	99 (0.3)	98 (0.3)	76 (1.5)
New Zealand	93 (0.5)	97 (0.3)	97 (0.3)	98 (0.2)	86 (0.8)
Philippines	93 (0.5)	91 (0.6)	90 (0.8)	78 (1.0)	87 (0.7)
Romania	94 (0.6)	97 (0.4)	98 (0.3)	91 (0.8)	83 (1.0)
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)
Slovak Republic	96 (0.5)	99 (0.2)	99 (0.2)	99 (0.2)	91 (0.7)
Slovenia	80 (0.9)	91 (0.6)	92 (0.5)	97 (0.3)	87 (0.7)
South Africa	89 (1.3)	90 (0.5)	91 (0.6)	72 (1.1)	83 (0.7)
Thailand	96 (0.3)	95 (0.3)	97 (0.3)	92 (0.5)	95 (0.3)
Tunisia	97 (0.3)	96 (0.5)	96 (0.3)	83 (0.7)	91 (0.5)
Turkey	97 (0.3)	96 (0.3)	97 (0.2)	75 (1.0)	86 (0.6)
United States	96 (0.3)	97 (0.3)	96 (0.3)	99 (0.2)	84 (0.6)
International Avg.	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.

[†] 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.

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

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
Australia	96 (0.4)	98 (0.2)	98 (0.3)	95 (0.5)	78 (0.7)
Belgium (Flemish)	92 (0.6)	97 (0.4)	97 (0.5)	96 (0.5)	66 (1.6)
Bulgaria	92 (0.6)	97 (0.3)	96 (0.6)	90 (0.7)	79 (1.3)
Canada	98 (0.3)	99 (0.1)	99 (0.2)	96 (0.4)	76 (0.8)
Chile	98 (0.2)	99 (0.2)	99 (0.2)	93 (0.5)	95 (0.4)
Chinese Taipei	95 (0.4)	95 (0.5)	93 (0.4)	95 (0.3)	91 (0.4)
Cyprus	92 (0.5)	96 (0.4)	97 (0.3)	95 (0.4)	85 (0.8)
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)
Finland	90 (0.7)	96 (0.4)	95 (0.4)	88 (0.7)	74 (1.1)
Hong Kong, SAR	87 (0.7)	96 (0.3)	97 (0.3)	82 (0.7)	73 (0.9)
Hungary	86 (0.7)	97 (0.4)	97 (0.3)	83 (0.8)	46 (1.1)
Indonesia	98 (0.3)	97 (0.3)	98 (0.2)	65 (1.0)	95 (0.4)
Iran, Islamic Rep.	94 (0.5)	94 (0.4)	93 (0.5)	82 (0.8)	89 (0.6)
Israel	94 (0.5)	98 (0.2)	96 (0.3)	94 (0.4)	83 (0.8)
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)
Jordan	96 (0.3)	95 (0.4)	95 (0.5)	82 (0.8)	86 (0.7)
Korea, Rep. of	90 (0.4)	95 (0.3)	92 (0.4)	66 (0.7)	78 (0.6)
Latvia (LSS)	90 (0.7)	98 (0.4)	98 (0.3)	90 (0.7)	82 (0.7)
Lithuania [†]	80 (1.0)	95 (0.5)	97 (0.4)	85 (0.8)	86 (0.8)
Macedonia, Rep. of	97 (0.3)	96 (0.3)	97 (0.3)	91 (0.7)	91 (0.6)
Malaysia	98 (0.2)	99 (0.1)	98 (0.2)	66 (1.2)	90 (0.5)
Moldova	91 (0.6)	91 (0.6)	93 (0.6)	85 (0.9)	86 (0.7)
Morocco	r 86 (0.7)	r 88 (0.7)	r 88 (0.6)	r 53 (1.2)	r 86 (0.7)
Netherlands	94 (0.8)	98 (0.3)	98 (0.3)	97 (0.5)	59 (1.9)
New Zealand	96 (0.3)	98 (0.2)	98 (0.2)	95 (0.4)	84 (0.9)
Philippines	93 (0.5)	90 (0.7)	89 (0.8)	75 (0.8)	85 (0.6)
Romania	96 (0.7)	97 (0.5)	98 (0.4)	79 (1.0)	75 (1.5)
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)
Slovak Republic	98 (0.3)	99 (0.2)	99 (0.2)	96 (0.4)	89 (0.8)
Slovenia	83 (0.8)	91 (0.5)	94 (0.5)	89 (0.6)	82 (0.9)
South Africa	89 (1.2)	89 (0.6)	91 (0.6)	70 (1.0)	81 (0.8)
Thailand	96 (0.3)	94 (0.4)	97 (0.3)	80 (0.7)	93 (0.4)
Tunisia	96 (0.3)	92 (0.7)	94 (0.4)	72 (0.7)	87 (0.5)
Turkey	95 (0.4)	94 (0.5)	95 (0.4)	67 (1.0)	79 (0.9)
United States	98 (0.2)	98 (0.2)	98 (0.2)	93 (0.4)	76 (0.6)
International Avg.	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.

[†] 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.

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

Students' Perception of Their Friends' View of the Importance of Various Activities

	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
Australia	65 (1.4)	79 (1.0)	78 (1.0)	98 (0.2)	81 (0.8)
Belgium (Flemish)	66 (1.2)	81 (1.1)	77 (1.4)	98 (0.5)	76 (1.1)
Bulgaria	70 (1.7)	84 (0.8)	85 (0.9)	96 (0.4)	82 (1.2)
Canada	72 (0.9)	84 (0.6)	82 (0.7)	99 (0.1)	84 (0.9)
Chile	89 (0.6)	94 (0.3)	94 (0.4)	98 (0.3)	95 (0.4)
Chinese Taipei	82 (0.7)	84 (0.7)	84 (0.6)	98 (0.2)	94 (0.4)
Cyprus	75 (0.9)	87 (0.6)	88 (0.6)	94 (0.4)	89 (0.5)
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)
Finland	53 (1.2)	70 (1.2)	65 (1.2)	97 (0.4)	74 (1.2)
Hong Kong, SAR	66 (1.0)	84 (0.7)	87 (0.8)	96 (0.3)	83 (0.8)
Hungary	62 (0.9)	80 (0.9)	79 (1.0)	94 (0.5)	62 (1.0)
Indonesia	96 (0.3)	96 (0.2)	97 (0.3)	69 (1.0)	95 (0.4)
Iran, Islamic Rep.	90 (0.5)	92 (0.5)	89 (0.8)	87 (0.6)	92 (0.5)
Israel	68 (1.2)	92 (0.5)	79 (0.9)	96 (0.4)	81 (0.9)
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)
Jordan	95 (0.4)	93 (0.5)	93 (0.4)	85 (0.7)	88 (0.6)
Korea, Rep. of	72 (0.8)	77 (0.7)	73 (0.8)	93 (0.3)	80 (0.8)
Latvia (LSS)	53 (1.6)	87 (0.9)	87 (0.8)	96 (0.4)	85 (0.7)
Lithuania †	54 (1.4)	87 (1.0)	88 (0.8)	96 (0.4)	90 (0.7)
Macedonia, Rep. of	86 (0.7)	89 (0.6)	92 (0.5)	93 (0.6)	93 (0.5)
Malaysia	98 (0.2)	99 (0.2)	97 (0.3)	77 (1.0)	91 (0.5)
Moldova	90 (0.7)	91 (0.7)	93 (0.6)	93 (0.5)	90 (0.6)
Morocco	r 86 (0.6)	r 88 (0.7)	r 86 (0.6)	r 63 (1.0)	r 89 (0.5)
Netherlands	79 (1.2)	88 (1.0)	90 (0.9)	98 (0.4)	70 (1.9)
New Zealand	67 (1.1)	76 (0.9)	75 (0.8)	97 (0.4)	86 (0.7)
Philippines	91 (0.6)	88 (0.7)	87 (0.7)	79 (0.9)	86 (0.7)
Romania	84 (1.2)	90 (0.9)	92 (0.6)	92 (0.9)	83 (1.0)
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)
Slovak Republic	78 (1.2)	88 (0.9)	89 (0.7)	99 (0.2)	93 (0.6)
Slovenia	44 (1.4)	69 (1.2)	70 (1.1)	96 (0.3)	85 (0.9)
South Africa	85 (1.1)	88 (0.6)	90 (0.6)	72 (1.1)	81 (0.7)
Thailand	95 (0.4)	94 (0.4)	96 (0.3)	93 (0.4)	95 (0.4)
Tunisia	88 (0.6)	91 (0.7)	91 (0.6)	81 (0.7)	88 (0.5)
Turkey	93 (0.4)	93 (0.3)	94 (0.3)	77 (0.8)	85 (0.7)
United States	72 (0.8)	79 (0.8)	76 (1.0)	98 (0.2)	86 (0.5)
International Avg.	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.

† 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.

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



Exhibit R1.10 Overleaf

Exhibit R1.10 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
General/Integrated Science									
 Australia	24 (0.9)	30 (0.7)	46 (1.0)	20 (0.9)	49 (0.9)	32 (1.2)	26 (1.0)	36 (0.8)	38 (1.1)
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)
Chile	33 (0.8)	31 (0.7)	36 (1.0)	32 (0.8)	37 (0.6)	31 (0.8)	48 (0.8)	32 (0.7)	20 (0.6)
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)
Cyprus	26 (0.7)	33 (0.9)	41 (0.9)	25 (0.8)	37 (0.8)	38 (0.8)	34 (0.9)	35 (1.0)	31 (0.7)
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)
Indonesia ^b	44 (0.9)	52 (0.9)	4 (0.3)	43 (1.0)	52 (0.9)	5 (0.4)	45 (0.9)	50 (0.8)	5 (0.4)
Iran, Islamic Rep.	42 (1.2)	38 (0.8)	20 (1.0)	52 (1.1)	40 (1.0)	8 (0.5)	50 (1.3)	37 (0.9)	13 (0.7)
Israel	30 (0.9)	26 (0.8)	44 (1.1)	29 (1.0)	35 (0.9)	36 (1.0)	46 (1.2)	35 (0.8)	18 (0.8)
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)
Jordan	60 (1.0)	31 (0.9)	9 (0.6)	57 (1.1)	33 (0.9)	10 (0.6)	64 (0.9)	26 (0.6)	10 (0.6)
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)
Malaysia	55 (1.0)	36 (0.8)	9 (0.5)	56 (1.3)	37 (1.0)	7 (0.6)	60 (1.1)	34 (0.9)	6 (0.4)
New Zealand	25 (0.7)	33 (0.9)	43 (1.0)	21 (0.8)	44 (0.8)	35 (0.9)	27 (0.8)	41 (0.9)	32 (1.0)
Philippines	43 (1.0)	44 (0.8)	12 (0.7)	34 (0.8)	47 (0.7)	19 (0.7)	48 (1.0)	39 (0.8)	13 (0.7)
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)
South Africa	53 (1.2)	29 (0.7)	19 (1.0)	41 (1.2)	34 (1.0)	25 (1.1)	51 (1.2)	28 (0.9)	21 (1.1)
Thailand	43 (1.0)	49 (1.0)	8 (0.5)	53 (1.0)	45 (1.0)	2 (0.2)	53 (1.1)	42 (1.0)	5 (0.4)
Tunisia	44 (0.8)	34 (0.9)	22 (0.8)	34 (0.9)	43 (0.6)	22 (0.9)	44 (0.9)	35 (0.8)	21 (0.7)
Turkey	41 (1.0)	42 (0.9)	17 (0.6)	34 (0.8)	43 (0.8)	23 (0.9)	52 (0.9)	40 (0.8)	8 (0.5)
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)
International Avg.	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)
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)
Bulgaria	27 (1.6)	33 (1.8)	40 (2.9)	20 (1.0)	36 (1.2)	44 (1.3)	29 (1.5)	35 (1.8)	35 (2.7)
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)
Finland	9 (0.6)	28 (1.0)	63 (1.0)	8 (0.6)	33 (0.8)	58 (1.0)	11 (0.6)	40 (1.2)	49 (1.2)
Hungary	9 (0.5)	32 (1.1)	60 (1.2)	6 (0.5)	37 (1.0)	57 (1.0)	20 (0.8)	48 (1.2)	32 (1.1)
Latvia (LSS)	--	--	--	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--	--	--	--
Macedonia, Rep. of	38 (1.2)	32 (1.0)	30 (1.0)	32 (1.0)	33 (0.9)	35 (1.2)	44 (1.1)	37 (0.9)	19 (0.8)
Moldova	30 (1.3)	43 (1.1)	27 (1.1)	26 (1.2)	44 (1.1)	30 (1.4)	31 (1.3)	48 (1.2)	21 (0.9)
Morocco	x x	x x	x x	x x	x x	x x	x x	x x	x x
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)
Romania	31 (1.3)	42 (1.3)	28 (1.3)	28 (1.2)	48 (1.3)	24 (1.5)	30 (1.2)	45 (1.1)	25 (1.1)
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)
Slovak Republic	12 (0.8)	34 (1.1)	54 (1.4)	10 (0.7)	44 (1.3)	46 (1.6)	18 (0.9)	46 (1.1)	36 (1.3)
Slovenia	--	--	--	--	--	--	--	--	--
International Avg.	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)

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.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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

		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
	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)
	Bulgaria	28 (1.7)	34 (1.4)	38 (2.5)	19 (0.9)	36 (1.1)	45 (1.4)	32 (1.7)	36 (1.3)	32 (2.1)
	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)
	Finland	8 (0.6)	27 (0.9)	64 (1.1)	6 (0.6)	35 (1.0)	59 (1.0)	11 (0.7)	41 (1.1)	47 (1.1)
	Hungary	10 (0.6)	31 (1.0)	59 (1.0)	5 (0.4)	35 (1.0)	60 (1.0)	22 (0.9)	49 (1.1)	29 (1.0)
	Latvia (LSS)	12 (0.9)	36 (1.2)	53 (1.3)	12 (0.9)	53 (1.1)	34 (1.3)	19 (1.0)	50 (1.0)	31 (1.1)
	Lithuania *	17 (0.8)	36 (1.1)	46 (1.2)	6 (0.5)	27 (1.1)	67 (1.2)	22 (0.9)	44 (1.0)	34 (1.1)
	Macedonia, Rep. of	37 (1.2)	34 (0.9)	29 (1.2)	31 (1.1)	34 (0.8)	35 (1.2)	48 (1.1)	36 (1.0)	15 (0.7)
	Moldova	29 (1.2)	45 (1.2)	26 (1.2)	25 (1.2)	45 (1.1)	30 (1.4)	32 (1.1)	49 (1.1)	20 (1.0)
	Morocco s	49 (1.0)	34 (0.9)	18 (1.0)	s 52 (1.4)	32 (1.5)	16 (1.1)	s 50 (1.0)	35 (1.0)	16 (0.8)
	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)
	Romania	24 (1.1)	43 (1.2)	33 (1.3)	23 (1.1)	47 (1.2)	30 (1.6)	28 (1.2)	44 (1.0)	28 (1.1)
	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)
	Slovak Republic	13 (0.7)	35 (1.2)	52 (1.4)	8 (0.6)	43 (1.5)	48 (1.6)	22 (1.0)	48 (1.3)	30 (1.3)
	Slovenia	9 (0.5)	28 (1.0)	63 (1.1)	3 (0.4)	23 (0.9)	74 (1.1)	14 (0.7)	45 (0.9)	41 (1.1)
	International Avg.	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)
	Bulgaria	30 (1.4)	31 (1.9)	38 (2.5)	23 (1.4)	34 (1.3)	43 (1.5)	33 (1.6)	35 (1.4)	33 (2.1)
	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)
	Finland	9 (0.7)	25 (1.1)	66 (1.3)	8 (0.6)	32 (1.0)	60 (1.0)	11 (0.7)	37 (1.1)	53 (1.3)
	Hungary	12 (0.6)	34 (1.1)	54 (1.3)	7 (0.5)	37 (1.0)	56 (1.0)	21 (0.9)	48 (1.2)	31 (1.2)
	Latvia (LSS)	17 (0.8)	44 (1.0)	40 (1.2)	20 (1.0)	53 (1.0)	27 (1.1)	24 (1.0)	52 (1.0)	24 (1.0)
	Lithuania *	22 (1.1)	42 (1.2)	36 (1.4)	8 (0.6)	28 (1.2)	63 (1.3)	25 (1.0)	45 (1.2)	31 (1.4)
	Macedonia, Rep. of	38 (1.1)	33 (0.9)	30 (1.1)	31 (1.1)	34 (1.0)	35 (1.3)	43 (1.1)	37 (0.9)	19 (0.9)
	Moldova	28 (1.2)	42 (1.2)	30 (1.2)	24 (1.1)	45 (1.2)	31 (1.6)	28 (1.2)	49 (1.1)	23 (1.0)
	Morocco s	61 (1.3)	28 (1.0)	11 (0.8)	s 56 (1.4)	33 (1.2)	11 (0.8)	s 56 (1.8)	32 (1.2)	12 (0.9)
	Netherlands c	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)
	Romania	23 (1.1)	40 (1.2)	37 (1.3)	23 (1.0)	47 (1.4)	30 (1.5)	23 (1.0)	42 (1.0)	35 (1.2)
	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)
	Slovak Republic	14 (0.8)	35 (1.0)	50 (1.3)	10 (0.8)	44 (1.2)	45 (1.4)	21 (0.9)	48 (1.0)	31 (1.2)
	Slovenia	12 (0.6)	31 (1.0)	57 (1.1)	5 (0.5)	25 (0.9)	70 (1.0)	14 (0.8)	45 (1.1)	41 (1.3)
	International Avg.	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)	--	--	--	--	--	--	--	--	--
	Bulgaria	25 (1.3)	31 (1.7)	44 (2.6)	19 (1.2)	34 (1.1)	47 (1.5)	28 (1.4)	35 (1.7)	37 (2.5)
	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)
	Finland	9 (0.7)	26 (1.0)	66 (1.3)	7 (0.6)	31 (1.0)	62 (1.0)	11 (0.7)	38 (1.3)	51 (1.4)
	Hungary	9 (0.5)	30 (1.0)	61 (1.1)	5 (0.4)	36 (1.0)	59 (1.0)	20 (0.9)	47 (1.1)	33 (1.1)
	Latvia (LSS)	17 (1.0)	39 (1.1)	44 (1.1)	18 (1.0)	54 (1.0)	29 (1.2)	23 (0.9)	52 (1.1)	25 (0.8)
	Lithuania *	17 (1.0)	40 (1.3)	43 (1.3)	7 (0.6)	29 (1.2)	64 (1.2)	21 (0.9)	46 (1.1)	33 (1.2)
	Macedonia, Rep. of	34 (1.3)	34 (1.1)	33 (1.2)	29 (1.1)	34 (0.9)	37 (1.3)	42 (1.2)	39 (1.1)	19 (0.9)
	Moldova	26 (1.1)	41 (1.1)	32 (1.3)	24 (1.2)	44 (1.1)	32 (1.5)	27 (1.0)	50 (1.1)	23 (1.0)
	Morocco s	54 (1.3)	32 (1.1)	13 (1.2)	s 54 (1.5)	32 (1.3)	13 (0.9)	s 52 (1.2)	34 (1.1)	14 (0.9)
	Netherlands	--	--	--	--	--	--	--	--	--
	Romania	22 (1.1)	39 (1.2)	39 (1.4)	22 (1.2)	46 (1.3)	32 (1.6)	25 (1.2)	42 (1.1)	33 (1.2)
	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)
	Slovak Republic	13 (0.8)	33 (1.1)	54 (1.4)	10 (0.7)	43 (1.1)	47 (1.3)	21 (0.9)	47 (1.1)	33 (1.2)
	Slovenia	10 (0.6)	28 (1.0)	62 (1.1)	3 (0.3)	24 (0.9)	73 (0.9)	14 (0.7)	45 (1.0)	41 (1.0)
	International Avg.	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 R1.11 Students' Daily Out-of-School Study Time

	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	
Australia	0.6 (0.02)	0.7 (0.02)	0.8 (0.02)	2.0 (0.04)	74 (1.6)
Belgium (Flemish)	0.8 (0.03)	1.1 (0.03)	1.4 (0.04)	2.9 (0.05)	86 (1.2)
Bulgaria	1.1 (0.03)	1.1 (0.04)	1.3 (0.04)	3.0 (0.06)	74 (1.9)
Canada	0.6 (0.01)	0.8 (0.02)	1.0 (0.02)	2.2 (0.04)	78 (1.0)
Chile	0.9 (0.02)	0.9 (0.02)	1.2 (0.03)	2.4 (0.04)	75 (1.0)
Chinese Taipei	0.6 (0.02)	0.7 (0.02)	1.0 (0.02)	2.0 (0.05)	55 (1.3)
Cyprus	0.7 (0.02)	1.1 (0.03)	1.5 (0.03)	2.8 (0.04)	79 (0.8)
Czech Republic	0.6 (0.02)	0.7 (0.02)	0.7 (0.02)	1.9 (0.04)	74 (1.4)
England	--	--	--	--	--
Finland	0.5 (0.01)	0.6 (0.01)	0.7 (0.01)	1.8 (0.02)	90 (0.8)
Hong Kong, SAR	0.5 (0.01)	0.7 (0.02)	0.7 (0.02)	1.6 (0.04)	53 (1.3)
Hungary	1.1 (0.02)	0.8 (0.02)	1.2 (0.03)	2.8 (0.04)	90 (0.8)
Indonesia	1.1 (0.02)	1.2 (0.03)	1.3 (0.02)	3.0 (0.05)	83 (1.0)
Iran, Islamic Rep.	1.6 (0.03)	1.9 (0.03)	2.0 (0.04)	r 4.0 (0.05)	92 (0.5)
Israel	0.8 (0.02)	1.1 (0.03)	1.4 (0.04)	2.7 (0.05)	79 (0.9)
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)
Jordan	1.5 (0.03)	1.7 (0.03)	2.4 (0.05)	r 3.7 (0.06)	r 87 (0.9)
Korea, Rep. of	0.4 (0.01)	0.6 (0.02)	0.7 (0.02)	1.6 (0.03)	50 (0.9)
Latvia (LSS)	0.8 (0.02)	1.0 (0.02)	1.5 (0.03)	3.0 (0.04)	89 (0.7)
Lithuania [‡]	0.8 (0.02)	0.9 (0.03)	1.5 (0.04)	2.8 (0.04)	89 (1.0)
Macedonia, Rep. of	2.0 (0.05)	1.2 (0.03)	1.5 (0.04)	r 3.4 (0.05)	90 (0.5)
Malaysia	1.3 (0.02)	1.6 (0.02)	1.8 (0.03)	3.8 (0.04)	94 (0.4)
Moldova	1.7 (0.04)	1.1 (0.03)	1.4 (0.04)	r 3.3 (0.05)	83 (0.8)
Morocco	r 1.5 (0.06)	r 1.7 (0.07)	r 1.8 (0.06)	s 3.1 (0.05)	s 77 (1.3)
Netherlands	0.6 (0.02)	0.6 (0.02)	1.0 (0.02)	2.2 (0.04)	89 (1.1)
New Zealand	0.6 (0.02)	0.7 (0.02)	0.9 (0.02)	2.0 (0.04)	76 (1.3)
Philippines	1.7 (0.04)	1.7 (0.04)	2.1 (0.04)	r 3.3 (0.04)	88 (0.7)
Romania	1.2 (0.03)	1.6 (0.05)	1.4 (0.04)	3.4 (0.06)	77 (1.2)
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)
Slovak Republic	0.8 (0.02)	0.8 (0.02)	0.9 (0.02)	2.3 (0.03)	88 (0.8)
Slovenia	0.9 (0.02)	0.8 (0.02)	0.9 (0.02)	2.5 (0.03)	85 (1.0)
South Africa	1.5 (0.05)	1.8 (0.04)	2.0 (0.06)	r 3.1 (0.06)	71 (1.9)
Thailand	1.0 (0.02)	1.1 (0.02)	1.2 (0.02)	2.9 (0.04)	88 (0.6)
Tunisia	1.2 (0.03)	1.8 (0.03)	2.1 (0.03)	r 3.6 (0.04)	82 (0.8)
Turkey	1.2 (0.02)	1.2 (0.02)	1.9 (0.03)	3.5 (0.05)	90 (0.7)
United States	0.6 (0.01)	0.8 (0.02)	0.9 (0.02)	2.1 (0.04)	72 (1.6)
International Avg.	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.[‡] 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.

A dash (–) indicates data are not available.

An "r" indicates a 70-84% student response rate. An "s" indicates a 50-69% student response rate.

	Spend Any Time Studying All Three Science, Mathematics, and Other Subjects		Spend At Least 3 Hours Studying Across Subjects		Spend 1 Hour or More Studying Science	
	Percent of Students 1999	1995 - 1999 Difference	Percent of Students 1999	1995 - 1999 Difference	Percent of Students 1999	1995 - 1999 Difference
Australia	74 (1.6)	4 (2.1) ●	17 (0.9)	1 (1.1) ●	14 (0.8)	2 (1.0) ●
Belgium (Flemish)	85 (1.2)	-3 (1.5) ●	41 (1.3)	-1 (2.0) ●	31 (1.4)	0 (2.0) ●
Canada	78 (1.0)	7 (2.0) ▲	24 (0.8)	4 (1.3) ▲	18 (0.7)	2 (1.2) ●
Cyprus	79 (0.8)	4 (1.2) ●	35 (1.1)	-5 (1.4) ▼	25 (1.0)	-5 (1.5) ▼
Czech Republic	74 (1.4)	5 (2.2) ●	16 (1.1)	3 (1.3) ●	20 (1.1)	3 (1.4) ●
England	--	--	--	--	--	--
Hong Kong, SAR	53 (1.3)	-17 (2.1) ▼	16 (0.8)	-12 (1.4) ▼	13 (0.6)	-2 (1.0) ●
Hungary	90 (0.8)	2 (1.1) ●	40 (1.3)	2 (1.9) ●	45 (1.3)	0 (1.8) ●
Iran, Islamic Rep.	92 (0.5)	r -3 (0.7) ▼	69 (1.1)	s -4 (1.9) ●	68 (1.1)	-8 (1.9) ▼
Israel †	80 (0.9)	4 (1.7) ●	33 (1.7)	2 (2.5) ●	20 (1.2)	3 (2.0) ●
Italy	92 (0.8)	0 (1.2) ●	60 (1.6)	0 (2.2) ●	46 (1.7)	1 (2.4) ●
Japan	59 (1.4)	-13 (1.9) ▼	17 (0.9)	-10 (1.3) ▼	12 (0.7)	-7 (1.1) ▼
Korea, Rep. of	50 (0.9)	-15 (1.6) ▼	16 (0.7)	-11 (1.4) ▼	13 (0.6)	-5 (1.1) ▼
Latvia (LSS)	89 (0.7)	9 (1.6) ▲	40 (1.2)	13 (1.6) ▲	25 (1.0)	8 (1.5) ▲
Lithuania	89 (1.0)	7 (1.5) ▲	35 (1.2)	10 (1.8) ▲	25 (1.2)	4 (1.8) ●
Netherlands	89 (1.1)	-1 (1.6) ●	19 (1.4)	3 (1.6) ●	15 (1.3)	2 (1.6) ●
New Zealand	76 (1.3)	0 (1.8) ●	17 (1.0)	1 (1.3) ●	15 (1.0)	2 (1.2) ●
Romania	76 (1.2)	1 (1.8) ●	55 (1.6)	r 4 (2.2) ●	48 (1.3)	-7 (2.1) ▼
Russian Federation	89 (0.7)	4 (1.1) ▲	48 (1.3)	13 (1.9) ▲	61 (1.3)	18 (1.9) ▲
Singapore	90 (0.8)	-2 (1.0) ●	59 (1.2)	-18 (1.5) ▼	55 (1.2)	-18 (1.6) ▼
Slovak Republic	88 (0.8)	4 (1.3) ▲	24 (0.9)	2 (1.3) ●	25 (1.2)	-1 (1.7) ●
Slovenia	85 (1.0)	-1 (1.3) ●	32 (1.0)	-3 (1.4) ●	38 (1.1)	-4 (1.6) ●
Thailand †	88 (0.6)	-3 (1.0) ●	45 (1.2)	-6 (2.0) ▼	42 (1.2)	-3 (1.9) ●
United States	72 (1.6)	1 (2.1) ●	22 (0.8)	0 (1.1) ●	16 (0.8)	-2 (1.0) ●
International Avg. §	79 (0.2)	0 (0.4) ●	33 (0.2)	0 (0.4) ●	30 (0.2)	-1 (0.3) ●

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by students.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 a 70-84% student response rate, based on the lower response rate in either 1995 or 1999. An "s" indicates a 50-69% student response rate, based on the lower response rate in either 1995 or 1999.

Exhibit R1.13 Students' Daily Leisure Time*

	Average Hours Spent Each Day ¹					
	Watching Television or Videos	Playing Computer Games	Playing or Talking With	Doing Jobs at Home	Playing Sports	Reading a Book for Enjoyment
Australia	2.3 (0.05)	0.8 (0.03)	1.5 (0.03)	0.9 (0.03)	1.6 (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)
Bulgaria	2.8 (0.05)	0.8 (0.04)	2.6 (0.06)	1.9 (0.04)	1.5 (0.05)	1.0 (0.03)
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)
Chile	2.7 (0.05)	0.6 (0.02)	1.9 (0.04)	1.5 (0.03)	2.0 (0.03)	0.7 (0.02)
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)
Cyprus	2.2 (0.04)	1.0 (0.03)	1.8 (0.04)	0.9 (0.03)	1.4 (0.04)	0.7 (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)
Finland	2.5 (0.04)	1.1 (0.03)	3.2 (0.07)	0.9 (0.02)	1.6 (0.04)	0.8 (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)
Hungary	2.7 (0.05)	1.0 (0.03)	2.0 (0.05)	1.6 (0.04)	1.5 (0.04)	0.8 (0.02)
Indonesia	1.7 (0.05)	0.2 (0.02)	1.1 (0.02)	1.9 (0.03)	1.0 (0.02)	0.9 (0.02)
Iran, Islamic Rep.	1.8 (0.04)	0.3 (0.03)	1.3 (0.04)	1.7 (0.04)	1.3 (0.06)	0.9 (0.02)
Israel	3.1 (0.05)	1.5 (0.04)	2.4 (0.04)	1.3 (0.05)	1.8 (0.05)	1.0 (0.03)
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)
Jordan	1.7 (0.04)	0.8 (0.04)	1.1 (0.04)	1.3 (0.05)	1.4 (0.05)	r 1.4 (0.04)
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)
Latvia (LSS)	2.8 (0.05)	0.7 (0.03)	2.6 (0.06)	1.7 (0.03)	1.3 (0.03)	0.9 (0.03)
Lithuania [†]	2.4 (0.05)	0.6 (0.03)	2.4 (0.06)	1.6 (0.05)	1.0 (0.03)	0.7 (0.02)
Macedonia, Rep. of	2.2 (0.05)	0.7 (0.04)	1.8 (0.05)	1.9 (0.04)	1.8 (0.05)	1.2 (0.04)
Malaysia	1.9 (0.05)	0.5 (0.02)	1.2 (0.03)	1.8 (0.03)	1.1 (0.02)	1.1 (0.02)
Moldova	2.6 (0.07)	1.0 (0.05)	1.9 (0.06)	3.2 (0.09)	1.4 (0.04)	1.5 (0.04)
Morocco	r 1.1 (0.03)	r 0.7 (0.02)	r 0.9 (0.03)	r 1.5 (0.03)	r 1.5 (0.04)	r 1.4 (0.05)
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)
New Zealand	2.5 (0.05)	0.9 (0.04)	1.6 (0.04)	1.0 (0.03)	1.5 (0.04)	0.7 (0.02)
Philippines	1.7 (0.04)	0.7 (0.03)	1.2 (0.03)	2.4 (0.05)	1.6 (0.04)	1.6 (0.04)
Romania	2.2 (0.06)	0.6 (0.04)	1.6 (0.05)	2.0 (0.06)	1.2 (0.04)	1.0 (0.03)
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)
Slovak Republic	2.5 (0.06)	0.6 (0.03)	2.7 (0.06)	1.6 (0.05)	1.9 (0.04)	0.7 (0.02)
Slovenia	2.3 (0.05)	0.9 (0.03)	1.8 (0.04)	1.2 (0.03)	1.6 (0.04)	0.7 (0.02)
South Africa	2.0 (0.07)	0.8 (0.04)	1.5 (0.04)	2.0 (0.04)	2.0 (0.05)	1.8 (0.05)
Thailand	2.1 (0.05)	0.4 (0.02)	1.6 (0.04)	1.6 (0.02)	1.5 (0.03)	1.0 (0.02)
Tunisia	2.0 (0.04)	0.9 (0.03)	1.3 (0.03)	1.7 (0.04)	1.9 (0.04)	1.4 (0.03)
Turkey	1.6 (0.04)	r 0.4 (0.02)	1.5 (0.03)	1.1 (0.04)	1.4 (0.03)	1.2 (0.03)
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)
International Avg.	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.[†] 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.

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

Percentage of Students Reporting Agree or Strongly Agree						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	45 (1.4)	Belgium (Flemish)	50 (1.1)	44 (1.5)	49 (2.3)	—
Canada	43 (0.8)	Bulgaria	41 (1.5)	35 (2.3)	45 (2.0)	52 (1.3)
Chile	46 (1.1)	Czech Republic	33 (1.3)	29 (1.2)	45 (1.5)	45 (1.8)
Chinese Taipei ^a	50 (1.1)	Finland	41 (1.3)	38 (1.4)	58 (1.3)	48 (1.4)
Cyprus	42 (1.0)	Hungary	36 (1.2)	30 (1.3)	48 (1.3)	55 (1.4)
England	36 (1.1)	Latvia (LSS)	—	33 (1.3)	59 (1.4)	57 (1.6)
Hong Kong, SAR	55 (1.1)	Lithuania [†]	—	33 (1.4)	55 (1.5)	63 (1.2)
Indonesia ^b	55 (1.0)	Macedonia, Rep. of	37 (1.4)	38 (1.1)	48 (1.2)	52 (1.2)
Iran, Islamic Rep.	30 (0.9)	Moldova	23 (1.3)	25 (1.2)	31 (1.3)	32 (1.2)
Israel	38 (1.1)	Morocco	r 54 (0.9)	r 52 (0.9)	r 45 (1.5)	r 51 (1.0)
Italy	36 (1.1)	Netherlands ^c	38 (1.4)	34 (1.2)	44 (2.1)	—
Japan	53 (0.9)	Romania	54 (1.4)	56 (1.5)	70 (1.2)	67 (1.3)
Jordan	37 (1.0)	Russian Federation	24 (1.0)	15 (1.0)	29 (1.1)	38 (1.7)
Korea, Rep. of	55 (1.1)	Slovak Republic	36 (1.4)	40 (1.4)	53 (1.3)	44 (1.4)
Malaysia	33 (1.1)	Slovenia	—	12 (0.7)	28 (1.1)	32 (1.0)
New Zealand	48 (1.1)	International Avg.	39 (0.4)	34 (0.3)	47 (0.4)	49 (0.4)
Philippines	47 (1.2)					
Singapore	41 (1.2)					
South Africa	55 (1.4)					
Thailand	53 (1.1)					
Tunisia	28 (0.8)					
Turkey	42 (1.1)					
United States	35 (0.9)					
International Avg.	44 (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 form, students were asked about each subject area separately.

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

^a Chinese Taipei: Students were asked about 'natural science'; data pertain to grade 8 physics/chemistry course.^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.^c 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.

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

Exhibit R1.15 Students' Liking the Sciences*

Percentage of Students Reporting Like or Like A Lot								
Countries with General/ Integrated Science			Countries with Separate Science Subjects					
				Earth Science	Biology	Physics	Chemistry	
Australia	66 (1.5)		Belgium (Flemish)	51 (1.6)	67 (1.1)	57 (2.3)	--	
Canada	70 (1.0)		Bulgaria	76 (2.1)	87 (1.0)	74 (1.9)	63 (1.7)	
Chile	89 (0.7)		Czech Republic	72 (1.6)	78 (1.6)	54 (2.1)	58 (2.1)	
Chinese Taipei ^a	69 (0.9)		Finland	71 (1.3)	74 (1.3)	50 (1.5)	68 (1.3)	
Cyprus	75 (0.9)		Hungary	66 (1.4)	77 (1.2)	52 (1.5)	48 (1.6)	
England	83 (0.9)		Latvia (LSS)	--	80 (1.3)	55 (1.7)	63 (1.7)	
Hong Kong, SAR	76 (1.1)		Lithuania [†]	--	81 (1.3)	55 (1.8)	50 (1.7)	
Indonesia ^b	96 (0.4)		Macedonia, Rep. of	94 (0.6)	96 (0.4)	84 (1.2)	84 (1.0)	
Iran, Islamic Rep.	92 (0.6)		Moldova	22 (1.1)	23 (1.1)	38 (1.3)	40 (1.4)	
Israel	67 (1.4)		Morocco	r 62 (1.1)	r 67 (1.2)	r 90 (0.6)	r 77 (0.9)	
Italy	72 (1.2)		Netherlands	--	--	--	--	
Japan	55 (1.1)		Romania	83 (1.1)	82 (1.3)	58 (1.8)	58 (1.6)	
Jordan	87 (0.9)		Russian Federation	81 (1.2)	92 (0.6)	78 (1.1)	75 (1.3)	
Korea, Rep. of	52 (1.2)		Slovak Republic	79 (1.7)	77 (1.2)	57 (1.6)	70 (1.9)	
Malaysia	96 (0.5)		Slovenia	--	77 (1.3)	55 (1.4)	53 (1.3)	
New Zealand	70 (1.1)		International Avg.	69 (0.4)	76 (0.3)	61 (0.4)	62 (0.4)	
Philippines	92 (0.6)							
Singapore	86 (1.1)							
South Africa	86 (1.4)							
Thailand	90 (0.6)							
Tunisia	90 (0.6)							
Turkey	87 (0.7)							
United States	73 (0.8)							
International Avg.	79 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

() 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 a 70-84% student response rate.

REFERENCE 2

The Science Curriculum



Exhibit R2.1 Achievement Standards in Science

	Achievement Standards
Australia	Achievement standards are stated as learning outcomes.
Belgium (Flemish)	Achievement standards are stated in terms of final learning objectives for A Stream and developmental objectives for B Stream. Students not meeting the standards may need to repeat the grade, receive reduced hours of instruction, or be moved to an easier class.
Bulgaria	The curriculum does not incorporate achievement standards.
Canada	Achievement standards are prescribed learning outcomes with the stem "It's expected that students will..." or contained in supplementary resource books.
Chile	There are no performance standards but there are objectives describing what students should learn. The revised curriculum will include performance standards stated as expected learning outcomes.
Chinese Taipei	The curriculum does not incorporate achievement standards.
Cyprus	The curriculum does not incorporate achievement standards.
Czech Republic	The curriculum provides a description of the skills and knowledge students must have. Teachers decide if the student has met the curriculum standards and considers this in promotion. If a student fails a single subject, the student must repeat the grade.
England	Achievement standards are established as a system of levels, each level with its own description of performance. On average, at age 7 students are expected to be at level 2; at age 11 level 4; and at age 13 level 5/6. One level is regarded as two years progress.
Finland	The curriculum does not incorporate achievement standards.
Hong Kong, SAR	The curriculum does not incorporate achievement standards.
Hungary	Standards are stated as learning objectives.
Indonesia	There are instructional objectives in the curriculum but no performance standards.
Iran, Islamic Rep.	The curriculum does not incorporate achievement standards.
Israel	The curriculum does not incorporate achievement standards.
Italy	The curriculum does not incorporate achievement standards.
Japan	Achievement standards are stated in the national curriculum as learning objectives, such as "To help students..." or "To enable students to..."
Jordan	Objectives are defined in the curriculum and the minimum percent of attainment for each objective is specified.
Korea, Rep. of	Achievement standards will be included in the revised curriculum (to be implemented at the 8th grade in 2001).
Latvia (LSS)	The curriculum incorporates achievement standards.
Lithuania	Achievement standards are not a part of curricula, but are prepared as separate documents. The draft of the National Educational Standards was released in 1997. As of 1999, the document had not been officially approved.
Macedonia, Rep. of	In physics and geography achievement standards are stated as the compulsory knowledge and skills which should be attained by all students. In biology and chemistry achievement standards are stated as learning objectives.
Malaysia	Achievement standards are stated as scientific skills in the curriculum content specification document.
Moldova	The curriculum incorporates achievement standards.
Morocco	The curriculum does not incorporate achievement standards.
Netherlands	Achievement standards are stated as learning objectives, such as "Students develop a competence...." or "Students learn to research..."
New Zealand	Achievement standards are stated as learning outcomes expressed at eight levels of learning independent of age and grade.
Philippines	Achievement standards are stated as learning competencies.
Romania	The achievement standards are stated as learning objectives, such as "The student should be able to arrive at a conclusion based on experimental work."
Russian Federation	Achievement standards are stated as knowledge and skills which should be attained by students by the end of basic school.
Singapore	Achievement standards are stated in terms of learning objectives, assessment guidelines (table of specifications), and science process skills (practicals).
Slovak Republic	Learning objectives are included in the curriculum. Performance standards are in development.
Slovenia	The curriculum states standards for student performance by grade level and subject area. If a student's achievement in a subject is under minimal standard, the student receives an unsatisfactory mark and must take a correcting exam in that subject. Students receiving three or more unsatisfactory marks must repeat the grade.
South Africa	The standards are not specific. A list of content to be covered is provided.
Thailand	Achievement standards are stated as learning objectives.
Tunisia	Achievement standards are stated as learning objectives.
Turkey	Achievement standards are stated as objectives, such as "Ability to understand/know..."
United States	For states that have science standards, indicators or benchmarks are included.

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

Background data provided by National Research Coordinators.

Exhibit R2.2 Organization of Science Instruction

	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
Australia	45 (4.5)	34 (3.6)	50 (4.5)	42 (4.3)	18 (3.0)
Belgium (Flemish)	57 (4.4)	11 (2.1)	19 (3.1)	37 (4.4)	58 (3.9)
Bulgaria	56 (5.1)	58 (5.6)	22 (3.8)	15 (2.9)	11 (2.6)
Canada	x x	x x	x x	x x	x x
Chile	73 (3.5)	29 (3.2)	25 (3.2)	47 (4.0)	15 (3.0)
Chinese Taipei	49 (4.0)	23 (3.6)	83 (3.2)	78 (3.7)	16 (3.2)
Cyprus	53 (0.2)	37 (0.2)	6 (0.2)	28 (0.2)	4 (0.1)
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)
Finland	96 (2.0)	1 (0.8)	35 (3.4)	77 (4.0)	5 (2.1)
Hong Kong, SAR	47 (4.9)	10 (2.9)	49 (4.2)	21 (3.2)	r 2 (1.2)
Hungary	88 (2.6)	23 (3.5)	56 (4.1)	37 (4.3)	4 (1.7)
Indonesia	49 (5.0)	16 (3.4)	97 (1.3)	93 (2.3)	14 (3.0)
Iran, Islamic Rep.	0 (0.0)	s 41 (4.8)	s 26 (4.5)	s 62 (5.4)	0 (0.0)
Israel	s 32 (5.4)	s 34 (5.3)	s 83 (4.9)	s 33 (4.9)	s 23 (4.7)
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)
Jordan	68 (4.2)	34 (4.7)	73 (4.0)	85 (3.2)	1 (0.0)
Korea, Rep. of	24 (3.7)	39 (4.3)	21 (3.3)	17 (3.0)	16 (2.8)
Latvia (LSS)	r 61 (4.8)	r 27 (4.2)	r 11 (3.1)	r 85 (3.2)	r 2 (1.3)
Lithuania [†]	--	--	--	--	--
Macedonia, Rep. of	62 (4.4)	21 (3.4)	90 (2.4)	94 (2.0)	5 (2.0)
Malaysia	57 (4.4)	53 (3.8)	92 (2.7)	82 (3.3)	34 (4.1)
Moldova	76 (3.1)	68 (3.7)	72 (3.9)	r 60 (4.6)	17 (3.2)
Morocco	51 (4.0)	2 (1.2)	5 (1.9)	30 (3.4)	8 (2.4)
Netherlands	r 62 (6.2)	r 32 (6.8)	r 77 (6.3)	r 38 (6.4)	r 61 (6.6)
New Zealand	72 (3.8)	35 (4.4)	68 (4.2)	45 (4.0)	r 4 (1.7)
Philippines	86 (3.2)	43 (4.4)	71 (4.3)	66 (4.2)	18 (3.5)
Romania	81 (3.3)	51 (4.5)	82 (3.5)	80 (3.5)	4 (1.6)
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)
Slovak Republic	64 (4.6)	7 (2.6)	25 (3.9)	59 (5.2)	2 (1.5)
Slovenia	0 (0.0)	22 (4.1)	94 (2.1)	74 (3.5)	0 (0.0)
South Africa	--	--	--	--	--
Thailand	91 (2.7)	48 (4.0)	43 (3.9)	40 (3.7)	4 (1.3)
Tunisia	89 (2.8)	9 (2.6)	22 (3.6)	28 (3.7)	4 (1.6)
Turkey	69 (4.3)	16 (2.7)	22 (3.1)	47 (4.0)	12 (2.3)
United States	r 52 (4.6)	r 17 (3.4)	r 34 (4.0)	r 17 (3.4)	r 12 (2.7)
International Avg.	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.

[†] 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.

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 R2.3

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)
Australia	●	●	●	●
Belgium (Flemish)	●	●	●	●
Bulgaria	●	●	●	●
Canada	●	●	●	●
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	●	●	●	●
United States	●	●	●	●

● 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)

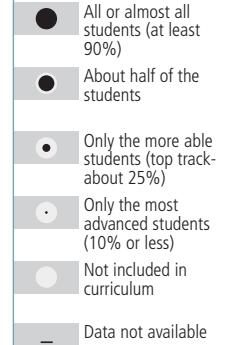
● Not included in curriculum

— Data not available

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

Background data provided by National Research Coordinators.

	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
Australia	●	●	●	●	●	●	●
Belgium (Flemish)	●	●	●	●	●	●	●
Bulgaria	●	●	●	●	●	●	●
Canada	●	●	●	●	●	●	●
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	●	●	●	●	●	●	●
United States	●	●	●	●	●	●	●

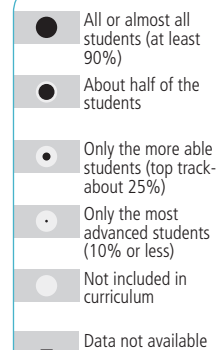


SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit R2.5

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
Australia	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	●	●	●	●	●	●	●	●	●	●
Bulgaria	●	●	●	●	●	●	●	●	●	●
Canada	●	●	●	●	●	●	●	●	●	●
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	●	●	●	●	●	●	●	●	●	●
United States	●	●	●	●	●	●	●	●	●	●



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

Exhibit R2.6

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
Australia	●	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	●	●	●	●	●	●	●	●	●	●	●	●
Bulgaria	●	●	●	●	●	●	●	●	●	●	●	●
Canada	●	●	●	●	●	●	●	●	●	●	●	●
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	●	●	●	●	●	●	●	●	●	●	●	●
United States	●	●	●	●	●	●	●	●	●	●	●	●

- 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.

	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
Australia	●	●	●
Belgium (Flemish)	●	●	●
Bulgaria	●	●	●
Canada	●	●	●
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	●	●	●
United States	●	●	●

● 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

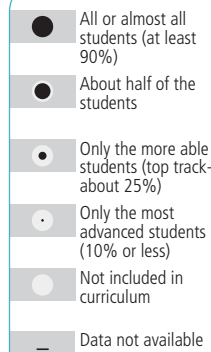
— Data not available

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

Background data provided by National Research Coordinators.

Detailed Information About Topics in the Intended Curriculum, Up to and Including Eighth Grade - 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
Australia	●	●	●	●	●	●
Belgium (Flemish)	●	●	●	●	●	●
Bulgaria	●	●	●	●	●	●
Canada	●	●	●	●	●	●
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	●	●	●	●	●	●
United States	●	●	●	●	●	●



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

Exhibit R2.9 When Earth Science 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	
Australia	r	6 (1.7)	11 (2.2)	10 (1.8)	18 (2.5)	21 (3.1)	34 (2.9)
Belgium (Flemish)	r	4 (1.8)	12 (2.4)	2 (1.3)	10 (2.7)	12 (2.8)	60 (4.1)
Bulgaria	r	1 (0.6)	1 (0.0)	45 (5.6)	52 (5.9)	1 (0.1)	1 (0.6)
Canada	s	17 (2.6)	12 (2.5)	21 (2.8)	22 (2.8)	14 (2.8)	16 (2.6)
Chile		29 (3.4)	22 (3.5)	15 (2.9)	17 (2.9)	11 (2.4)	7 (2.0)
Chinese Taipei ²		--	--	--	--	--	--
Cyprus	s	10 (2.8)	12 (3.9)	1 (0.1)	6 (3.3)	8 (3.1)	62 (5.6)
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)
Finland	r	3 (1.5)	3 (1.8)	6 (2.0)	27 (3.7)	5 (1.7)	56 (4.1)
Hong Kong, SAR	s	1 (0.1)	0 (0.0)	2 (1.6)	7 (2.9)	1 (0.1)	88 (3.6)
Hungary		1 (1.0)	25 (3.4)	17 (3.3)	19 (3.4)	15 (3.0)	23 (3.7)
Indonesia		4 (1.9)	4 (1.6)	12 (3.3)	67 (4.6)	10 (2.7)	2 (1.2)
Iran, Islamic Rep.		26 (4.2)	25 (3.7)	0 (0.5)	14 (2.9)	6 (1.8)	29 (4.0)
Israel		x x	x x	x x	x x	x x	x x
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)
Jordan		9 (2.4)	29 (4.1)	4 (1.8)	18 (3.8)	28 (4.2)	13 (3.0)
Korea, Rep. of		4 (1.6)	13 (3.0)	12 (2.8)	22 (3.4)	41 (4.0)	8 (2.1)
Latvia (LSS)	s	23 (4.6)	16 (3.8)	3 (1.7)	26 (4.7)	14 (3.0)	17 (4.1)
Lithuania ³		--	--	--	--	--	--
Macedonia, Rep. of		53 (4.9)	14 (3.5)	4 (1.8)	9 (2.7)	6 (2.1)	15 (2.4)
Malaysia		3 (1.5)	5 (2.0)	2 (1.2)	3 (1.4)	4 (1.6)	84 (3.3)
Moldova		--	--	--	--	--	--
Morocco		--	--	--	--	--	--
Netherlands		0 (0.0)	1 (0.8)	10 (3.5)	59 (6.0)	14 (3.8)	17 (4.7)
New Zealand	r	3 (1.4)	4 (2.0)	7 (2.1)	21 (3.5)	4 (1.5)	61 (3.6)
Philippines		4 (1.7)	9 (2.3)	29 (4.1)	47 (4.5)	8 (2.3)	3 (1.5)
Romania		60 (4.1)	12 (2.9)	7 (3.2)	15 (3.3)	5 (1.6)	0 (0.0)
Russian Federation		--	--	--	--	--	--
Singapore		x x	x x	x x	x x	x x	x x
South Africa		x x	x x	x x	x x	x x	x x
Thailand		5 (1.8)	2 (1.2)	19 (3.0)	62 (4.3)	4 (1.8)	9 (2.3)
Tunisia	r	2 (1.2)	2 (1.1)	2 (1.2)	1 (1.0)	2 (1.4)	92 (2.6)
Turkey		15 (2.6)	13 (2.5)	3 (1.2)	10 (2.3)	4 (1.5)	55 (4.3)
United States	r	20 (3.1)	12 (2.6)	26 (3.4)	20 (2.1)	11 (2.3)	11 (2.4)
International Avg.		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 5.12.

¹ For each topic in exhibit 5.12, 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, regardless if taught before this year, are included in this category.² Data for grade 9 earth science teachers not available.[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 Biology 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	
Australia r	1 (0.8)	0 (0.2)	26 (3.2)	27 (3.0)	17 (3.2)	28 (3.2)
Belgium (Flemish)	0 (0.0)	7 (2.0)	27 (4.3)	39 (4.4)	25 (4.2)	2 (1.3)
Bulgaria r	0 (0.0)	0 (0.0)	11 (2.9)	26 (4.5)	56 (5.6)	8 (3.9)
Canada s	1 (0.5)	6 (1.8)	10 (2.1)	26 (4.1)	10 (3.4)	47 (3.3)
Chile	12 (2.7)	20 (3.1)	28 (3.6)	19 (3.2)	16 (2.6)	6 (2.0)
Chinese Taipei ²	--	--	--	--	--	--
Cyprus r	0 (0.0)	1 (0.7)	8 (2.6)	30 (3.8)	47 (4.5)	14 (3.2)
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)
Finland	1 (0.5)	6 (1.6)	4 (1.8)	4 (1.7)	13 (3.0)	72 (3.5)
Hong Kong, SAR r	3 (1.3)	6 (2.4)	4 (1.7)	17 (3.8)	25 (4.3)	45 (4.5)
Hungary	7 (2.3)	24 (3.4)	17 (3.3)	23 (3.8)	23 (3.5)	6 (2.1)
Indonesia	5 (1.7)	8 (2.9)	12 (2.9)	34 (4.4)	39 (4.8)	2 (1.3)
Iran, Islamic Rep.	5 (1.9)	13 (2.8)	7 (2.2)	43 (4.3)	30 (4.0)	2 (1.0)
Israel r	5 (1.4)	5 (1.7)	12 (3.3)	18 (3.8)	11 (2.5)	51 (4.1)
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)
Jordan	12 (2.9)	23 (3.8)	13 (2.9)	23 (3.5)	17 (3.2)	12 (3.2)
Korea, Rep. of	4 (1.7)	1 (1.0)	13 (3.1)	39 (3.8)	21 (3.6)	20 (3.3)
Latvia (LSS)	2 (1.1)	7 (2.2)	5 (1.8)	14 (3.1)	32 (4.5)	40 (4.6)
Lithuania [†]	--	--	--	--	--	--
Macedonia, Rep. of	0 (0.0)	2 (1.2)	15 (2.9)	44 (4.4)	37 (4.4)	2 (1.2)
Malaysia	1 (0.0)	0 (0.0)	44 (4.4)	41 (3.8)	3 (1.6)	11 (2.8)
Moldova	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
Netherlands r	0 (0.0)	1 (0.7)	2 (1.2)	96 (1.7)	1 (0.9)	0 (0.0)
New Zealand	0 (0.0)	1 (0.4)	20 (3.3)	29 (4.0)	3 (1.8)	48 (4.0)
Philippines	7 (2.3)	4 (1.9)	6 (2.0)	29 (3.7)	8 (2.4)	46 (4.2)
Romania	1 (0.7)	51 (4.7)	11 (2.4)	11 (3.1)	25 (3.7)	2 (1.3)
Russian Federation	--	--	--	--	--	--
Singapore	0 (0.0)	2 (1.5)	34 (4.3)	45 (4.6)	14 (3.3)	4 (2.0)
South Africa r	2 (1.0)	2 (1.4)	26 (5.0)	15 (3.7)	1 (1.0)	54 (5.4)
Thailand	14 (3.2)	5 (1.8)	19 (3.4)	45 (4.1)	9 (2.4)	9 (2.3)
Tunisia	1 (1.0)	7 (2.3)	9 (2.5)	8 (2.4)	19 (3.6)	55 (4.1)
Turkey	43 (4.6)	22 (2.6)	6 (1.6)	13 (3.1)	10 (2.7)	7 (2.5)
United States r	45 (3.7)	10 (2.1)	9 (2.0)	17 (2.6)	9 (2.2)	10 (2.0)
International Avg.	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 5.13.

¹ For each topic in exhibit 5.13, 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, regardless if taught before this year, are included in this category.² Data for grade 7 biology teachers not available.[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit R2.11 When Physics 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	
Australia	r	0 (0.0)	3 (0.8)	10 (1.8)	27 (3.6)	25 (2.8)	36 (2.8)
Belgium (Flemish)	s	0 (0.0)	0 (0.0)	1 (0.9)	13 (3.4)	2 (1.3)	84 (3.3)
Bulgaria	r	1 (0.7)	4 (1.4)	20 (6.7)	63 (6.2)	8 (2.3)	4 (1.7)
Canada	s	0 (0.2)	6 (2.0)	7 (1.7)	25 (3.0)	16 (2.8)	45 (3.2)
Chile	r	18 (3.3)	27 (3.8)	7 (2.2)	13 (2.9)	10 (2.5)	26 (3.8)
Chinese Taipei		5 (1.6)	5 (1.9)	12 (2.7)	34 (4.2)	26 (3.8)	19 (2.9)
Cyprus	s	0 (0.0)	0 (0.0)	9 (2.9)	32 (4.8)	2 (1.6)	56 (5.8)
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)
Finland		0 (0.4)	0 (0.0)	4 (2.0)	22 (3.2)	3 (1.3)	71 (3.8)
Hong Kong, SAR	r	1 (0.9)	2 (1.3)	12 (3.3)	21 (4.0)	37 (4.9)	28 (4.3)
Hungary		0 (0.0)	16 (3.3)	10 (2.4)	24 (3.6)	48 (4.3)	2 (1.3)
Indonesia		6 (2.2)	9 (2.6)	15 (3.4)	41 (5.1)	19 (3.0)	10 (2.3)
Iran, Islamic Rep.		1 (0.8)	8 (2.2)	2 (1.1)	69 (3.5)	18 (3.0)	2 (1.0)
Israel	r	0 (0.0)	2 (1.2)	6 (2.3)	10 (3.0)	7 (2.4)	76 (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)
Jordan		1 (0.9)	3 (1.5)	30 (4.1)	48 (4.2)	16 (3.0)	2 (1.1)
Korea, Rep. of		4 (1.6)	13 (2.6)	2 (1.2)	24 (3.7)	30 (3.9)	28 (3.8)
Latvia (LSS)		0 (0.0)	1 (0.7)	28 (4.6)	55 (4.6)	0 (0.0)	17 (3.3)
Lithuania ‡		--	--	--	--	--	--
Macedonia, Rep. of		0 (0.0)	4 (1.7)	21 (4.0)	47 (4.5)	27 (3.6)	1 (0.0)
Malaysia		2 (1.1)	2 (1.2)	10 (2.7)	30 (4.0)	35 (4.3)	21 (3.2)
Moldova		--	--	--	--	--	--
Morocco		--	--	--	--	--	--
Netherlands		0 (0.0)	1 (0.7)	0 (0.0)	98 (0.9)	1 (0.6)	0 (0.0)
New Zealand		0 (0.1)	4 (1.3)	7 (2.2)	48 (3.5)	1 (0.7)	40 (4.0)
Philippines		9 (2.5)	7 (2.1)	9 (2.3)	53 (4.6)	5 (1.9)	18 (3.5)
Romania		2 (1.3)	23 (3.6)	8 (2.3)	18 (3.7)	48 (4.8)	1 (0.0)
Russian Federation		--	--	--	--	--	--
Singapore		0 (0.1)	2 (1.1)	20 (3.5)	59 (4.3)	17 (3.6)	2 (1.4)
South Africa	r	3 (1.7)	1 (1.0)	18 (4.1)	19 (4.0)	5 (1.7)	54 (5.1)
Thailand	r	2 (1.2)	3 (1.5)	4 (1.7)	23 (3.8)	10 (2.9)	59 (4.8)
Tunisia	s	1 (0.6)	0 (0.0)	0 (0.0)	2 (1.5)	0 (0.0)	97 (1.6)
Turkey		1 (0.8)	20 (3.4)	13 (2.6)	25 (3.8)	39 (3.2)	2 (1.3)
United States	r	5 (1.5)	7 (1.9)	21 (3.6)	37 (2.9)	12 (2.4)	18 (3.1)
International Avg.		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 5.14.

¹ For each topic in exhibit 5.14, 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, regardless if taught before this year, are included in this category.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit R2.12 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	
Australia	r	2 (0.7)	2 (1.2)	29 (3.3)	25 (3.0)	9 (2.0)	34 (4.1)
Belgium (Flemish)	s	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.9)	0 (0.0)	97 (1.9)
Bulgaria		6 (2.0)	11 (2.6)	31 (5.8)	31 (4.8)	20 (3.4)	1 (0.7)
Canada	s	6 (2.0)	2 (0.9)	15 (2.7)	25 (3.2)	2 (0.9)	51 (3.9)
Chile		51 (4.0)	9 (2.4)	9 (2.5)	13 (2.7)	3 (1.4)	14 (2.8)
Chinese Taipei		7 (1.9)	1 (0.7)	41 (4.5)	46 (3.9)	5 (1.9)	1 (0.7)
Cyprus	r	0 (0.0)	0 (0.0)	3 (1.9)	59 (4.4)	1 (0.0)	38 (4.8)
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)
Finland		2 (1.1)	2 (1.2)	21 (3.5)	52 (3.8)	2 (1.1)	20 (2.7)
Hong Kong, SAR	r	8 (2.6)	19 (3.8)	6 (1.9)	15 (3.5)	18 (3.8)	35 (4.8)
Hungary		22 (3.7)	17 (2.9)	15 (3.0)	25 (3.3)	19 (3.2)	1 (1.0)
Indonesia		x x	x x	x x	x x	x x	x x
Iran, Islamic Rep.		3 (1.2)	5 (1.6)	6 (1.8)	64 (4.0)	19 (3.4)	4 (1.5)
Israel		1 (0.8)	2 (1.5)	26 (3.7)	23 (3.3)	12 (2.8)	36 (4.1)
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)
Jordan		3 (1.6)	5 (1.7)	35 (4.1)	33 (4.0)	22 (3.8)	2 (1.1)
Korea, Rep. of		2 (1.3)	3 (1.3)	27 (3.4)	45 (3.8)	13 (2.8)	10 (2.3)
Latvia (LSS)		0 (0.0)	0 (0.0)	32 (4.3)	59 (4.5)	0 (0.3)	9 (2.4)
Lithuania ‡		--	--	--	--	--	--
Macedonia, Rep. of		56 (4.0)	14 (3.1)	7 (2.4)	15 (3.1)	7 (2.0)	2 (1.1)
Malaysia		10 (2.8)	10 (2.7)	11 (3.1)	13 (2.8)	11 (2.9)	45 (4.4)
Moldova		--	--	--	--	--	--
Morocco		--	--	--	--	--	--
Netherlands	r	0 (0.0)	0 (0.0)	0 (0.0)	98 (1.0)	0 (0.0)	1 (0.9)
New Zealand		0 (0.0)	0 (0.0)	25 (3.5)	35 (3.7)	0 (0.0)	40 (3.9)
Philippines		9 (2.6)	10 (2.6)	13 (2.8)	48 (4.4)	3 (1.5)	17 (2.9)
Romania		5 (1.7)	9 (2.3)	16 (3.5)	23 (4.1)	33 (3.9)	15 (3.9)
Russian Federation		--	--	--	--	--	--
Singapore	r	1 (0.6)	11 (2.9)	20 (3.8)	48 (4.9)	9 (2.3)	13 (3.3)
South Africa	r	2 (1.1)	0 (0.0)	32 (4.6)	23 (3.7)	3 (1.6)	39 (3.8)
Thailand	r	5 (1.9)	5 (1.9)	6 (1.8)	33 (4.7)	9 (2.5)	42 (4.7)
Tunisia	s	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)	99 (1.1)
Turkey		1 (0.0)	0 (0.0)	48 (4.1)	45 (4.2)	1 (0.7)	5 (2.1)
United States	r	8 (1.9)	2 (0.9)	31 (3.5)	32 (3.4)	4 (1.0)	23 (3.3)
International Avg.		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 5.15.

¹ For each topic in exhibit 5.15, 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, regardless if taught before this year, are included in this category.[‡] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit R2.13 When Environmental and Resource Issues 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	
Australia	r	6 (1.6)	6 (2.0)	7 (1.8)	24 (3.1)	2 (0.9)	55 (3.9)
Belgium (Flemish)	r	4 (1.9)	6 (3.3)	6 (2.0)	64 (4.9)	3 (1.5)	17 (3.6)
Bulgaria	s	4 (2.1)	1 (0.9)	11 (2.6)	73 (4.1)	0 (0.0)	11 (3.3)
Canada	s	9 (2.1)	10 (2.0)	19 (3.6)	51 (4.5)	3 (1.2)	8 (1.7)
Chile		4 (1.6)	4 (1.4)	65 (3.5)	24 (3.1)	0 (0.0)	4 (1.6)
Chinese Taipei	r	16 (3.8)	5 (2.2)	4 (1.8)	22 (3.4)	3 (1.5)	51 (4.4)
Cyprus	s	2 (1.4)	1 (1.3)	2 (0.1)	72 (5.2)	1 (1.2)	22 (4.6)
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)
Finland		2 (1.2)	2 (1.3)	2 (0.9)	67 (4.3)	0 (0.0)	27 (4.2)
Hong Kong, SAR	r	4 (1.9)	10 (3.1)	4 (2.0)	29 (5.0)	6 (2.4)	46 (5.3)
Hungary		6 (1.9)	6 (2.1)	24 (3.5)	59 (4.1)	3 (1.6)	1 (1.0)
Indonesia		17 (4.0)	6 (1.9)	12 (3.2)	45 (5.3)	3 (1.5)	17 (3.6)
Iran, Islamic Rep.		18 (3.4)	23 (4.6)	1 (0.8)	21 (3.2)	3 (1.2)	34 (3.9)
Israel	r	7 (3.3)	4 (1.7)	3 (1.5)	23 (4.0)	2 (1.5)	61 (4.4)
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)
Jordan		7 (2.4)	19 (3.8)	12 (2.8)	32 (4.0)	7 (1.8)	22 (3.8)
Korea, Rep. of		13 (2.7)	7 (2.2)	4 (1.7)	31 (3.7)	3 (1.4)	42 (4.5)
Latvia (LSS)	r	3 (1.4)	13 (3.6)	9 (2.7)	58 (5.1)	3 (1.8)	14 (3.5)
Lithuania [‡]		--	--	--	--	--	--
Macedonia, Rep. of	r	17 (3.2)	12 (3.0)	10 (2.9)	43 (4.8)	4 (2.1)	14 (3.0)
Malaysia		1 (0.0)	2 (1.3)	19 (3.4)	56 (4.1)	1 (0.8)	21 (3.5)
Moldova		--	--	--	--	--	--
Morocco		--	--	--	--	--	--
Netherlands		1 (0.5)	2 (1.1)	5 (1.9)	92 (2.5)	0 (0.0)	1 (1.0)
New Zealand		2 (1.1)	1 (0.7)	5 (1.7)	46 (3.9)	2 (1.2)	43 (3.6)
Philippines		9 (2.5)	6 (2.1)	32 (4.3)	47 (4.3)	2 (1.2)	4 (1.7)
Romania		7 (2.1)	1 (0.9)	19 (4.4)	67 (4.9)	1 (0.9)	6 (2.3)
Russian Federation		--	--	--	--	--	--
Singapore	r	13 (2.6)	12 (3.1)	10 (2.9)	41 (4.5)	12(2.9)	13 (3.4)
South Africa	s	3 (1.4)	0 (0.1)	34 (5.1)	26 (4.6)	1 (1.0)	36 (4.8)
Thailand		9 (2.6)	4 (1.7)	25 (3.9)	48 (4.8)	4 (1.8)	8 (2.4)
Tunisia	r	7 (1.9)	10 (2.6)	12 (3.2)	6 (2.2)	6 (2.1)	58 (4.5)
Turkey		36 (3.9)	17 (3.1)	5 (1.5)	23 (3.5)	3 (1.7)	16 (3.2)
United States	r	21 (2.8)	8 (2.1)	15 (2.3)	34 (3.3)	3 (0.7)	19 (2.5)
International Avg.		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 5.16.

¹ For each topic in exhibit 5.16, 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, regardless if taught before this year, are included in this category.[‡] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

Exhibit R2.14

When Scientific Inquiry Skills and the Nature of Science Topics Are Taught*

TIMSS 1999
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	
Australia	4 (0.9)	3 (1.1)	48 (3.9)	35 (3.6)	8 (2.0)	2 (0.7)
Belgium (Flemish) r	3 (2.6)	2 (1.1)	30 (4.4)	37 (4.7)	2 (1.3)	26 (4.8)
Bulgaria	x x	x x	x x	x x	x x	x x
Canada r	2 (0.9)	0 (0.3)	47 (3.1)	47 (3.0)	2 (0.9)	1 (0.7)
Chile	11 (2.6)	4 (1.6)	24 (3.2)	39 (4.5)	13 (2.5)	9 (2.3)
Chinese Taipei	31 (4.1)	6 (2.3)	10 (2.5)	26 (3.8)	4 (1.7)	23 (3.9)
Cyprus r	0 (0.0)	4 (0.2)	11 (1.2)	80 (2.7)	0 (0.0)	5 (2.4)
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)
Finland	0 (0.0)	0 (0.4)	14 (2.6)	75 (3.4)	0 (0.3)	10 (2.3)
Hong Kong, SAR	18 (3.5)	10 (2.6)	12 (3.1)	27 (3.9)	9 (2.7)	24 (3.8)
Hungary	6 (2.2)	6 (2.1)	16 (3.4)	54 (4.3)	10 (2.5)	8 (2.0)
Indonesia	6 (2.2)	4 (1.6)	12 (3.1)	45 (4.7)	7 (2.2)	27 (4.1)
Iran, Islamic Rep. r	3 (1.6)	2 (1.0)	12 (4.5)	36 (4.8)	4 (1.9)	43 (4.4)
Israel	6 (2.4)	0 (0.0)	21 (3.9)	50 (4.3)	11 (2.8)	12 (2.7)
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)
Jordan r	2 (1.4)	3 (1.5)	9 (2.9)	44 (5.1)	10 (2.7)	32 (4.8)
Korea, Rep. of	8 (1.9)	4 (1.7)	14 (2.9)	59 (4.0)	6 (2.0)	9 (2.3)
Latvia (LSS) r	1 (0.8)	0 (0.0)	20 (3.5)	63 (4.2)	5 (2.3)	11 (3.3)
Lithuania [†]	--	--	--	--	--	--
Macedonia, Rep. of s	13 (4.4)	6 (2.8)	18 (4.3)	39 (6.1)	8 (3.1)	16 (5.1)
Malaysia	13 (2.8)	6 (2.2)	16 (3.0)	41 (4.0)	6 (2.1)	18 (3.7)
Moldova	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
Netherlands	3 (2.8)	0 (0.0)	1 (0.7)	96 (3.0)	1 (0.7)	0 (0.0)
New Zealand	0 (0.0)	0 (0.0)	56 (3.9)	40 (3.9)	1 (1.5)	2 (1.1)
Philippines	21 (3.4)	3 (1.4)	18 (3.2)	51 (4.3)	3 (1.5)	4 (1.6)
Romania r	18 (3.4)	7 (2.7)	20 (4.4)	40 (5.0)	9 (3.1)	6 (2.4)
Russian Federation	--	--	--	--	--	--
Singapore	13 (3.2)	8 (2.5)	18 (3.5)	46 (4.5)	9 (2.5)	6 (2.4)
South Africa r	1 (0.7)	2 (1.3)	21 (3.9)	37 (4.5)	2 (1.6)	36 (4.4)
Thailand	30 (4.2)	5 (1.5)	15 (3.3)	32 (4.1)	4 (1.6)	14 (2.9)
Tunisia r	6 (2.0)	4 (1.8)	53 (4.4)	3 (1.4)	8 (1.7)	27 (4.2)
Turkey r	17 (3.4)	7 (2.4)	6 (2.3)	17 (3.2)	9 (2.5)	44 (4.2)
United States r	2 (0.8)	1 (0.4)	49 (4.0)	43 (4.1)	2 (1.3)	2 (1.1)
International Avg.	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 5.17.

¹ For each topic in exhibit 5.17, 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, regardless if taught before this year, are included in this category.[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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

R

3



Exhibit R3.1 Teachers' Major Area of Study in Their BA, MA, or Teacher Training Certification*

	Percentage of Students Whose Teachers Report Having the Major Area of Study						
	Biology	Physics	Chemistry	Science Education	Mathematics or Mathematics Education	Education	Other
General/Integrated Science							
 Australia	58 (4.2)	23 (2.9)	40 (3.2)	52 (3.2)	25 (3.0)	44 (3.6)	r 38 (3.6)
Canada	36 (2.8)	8 (1.9)	17 (2.3)	28 (2.9)	11 (1.8)	51 (3.0)	67 (2.8)
Chile	57 (3.5)	30 (3.8)	45 (3.6)	52 (4.0)	36 (3.6)	67 (3.6)	r 45 (3.9)
Cyprus	52 (2.5)	64 (2.5)	49 (2.7)	21 (2.0)	x x	20 (2.1)	r 15 (1.4)
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)
Iran, Islamic Rep.	4 (1.4)	3 (1.2)	3 (1.2)	66 (3.8)	3 (1.3)	1 (0.9)	6 (1.7)
Israel	78 (4.5)	30 (5.0)	51 (5.4)	69 (4.5)	9 (2.8)	45 (5.2)	r 29 (5.8)
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)
Jordan	24 (3.9)	31 (3.8)	27 (3.8)	41 (4.7)	14 (3.2)	13 (3.2)	16 (3.6)
Korea, Rep. of	27 (3.5)	24 (3.5)	28 (3.6)	38 (3.9)	1 (0.8)	10 (2.3)	10 (2.2)
Malaysia	22 (3.2)	12 (2.8)	21 (3.7)	59 (4.4)	52 (4.4)	42 (4.2)	33 (3.8)
New Zealand	48 (4.0)	15 (2.9)	31 (3.9)	7 (2.0)	16 (3.0)	14 (3.0)	37 (3.8)
Philippines	38 (4.3)	12 (2.6)	14 (3.2)	44 (3.9)	18 (3.2)	24 (3.5)	34 (4.0)
Singapore	48 (4.7)	20 (3.4)	53 (4.5)	46 (4.3)	49 (4.4)	40 (4.3)	r 29 (4.5)
South Africa	52 (4.4)	41 (4.0)	36 (3.5)	29 (3.5)	62 (3.5)	66 (4.8)	45 (4.6)
Thailand	23 (3.7)	5 (1.9)	12 (2.8)	49 (3.7)	6 (2.0)	11 (2.5)	26 (3.7)
Tunisia	73 (3.8)	15 (2.6)	26 (3.5)	47 (4.0)	76 (3.8)	15 (3.1)	24 (4.1)
Turkey	37 (4.0)	36 (3.9)	34 (4.1)	52 (3.8)	13 (2.8)	22 (3.4)	9 (2.3)
United States	47 (3.5)	13 (2.2)	21 (3.0)	43 (3.7)	14 (2.5)	56 (3.6)	r 45 (3.7)
International Avg.	42 (0.8)	23 (0.7)	30 (0.8)	44 (0.9)	25 (0.7)	30 (0.7)	29 (0.8)
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)
Bulgaria	8 (2.2)	1 (0.6)	6 (2.0)	--	1 (1.2)	29 (6.3)	85 (6.5)
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)
Finland ^b	--	--	--	--	--	--	--
Hungary	50 (4.3)	1 (0.7)	1 (0.7)	22 (3.6)	2 (1.2)	11 (2.7)	91 (2.6)
Indonesia	--	--	--	--	--	--	--
Latvia (LSS)	--	--	--	--	--	--	--
Lithuania [†]	--	--	--	--	--	--	--
Macedonia, Rep. of	12 (3.1)	9 (2.8)	8 (2.6)	75 (3.8)	9 (2.7)	52 (4.7)	49 (4.0)
Moldova	37 (4.6)	6 (1.8)	21 (3.3)	x x	17 (3.3)	58 (4.7)	60 (4.7)
Morocco	--	--	--	--	--	--	--
Netherlands	3 (1.6)	2 (1.2)	1 (0.1)	1 (0.7)	1 (0.1)	4 (1.8)	85 (4.5)
Romania	6 (2.3)	1 (0.7)	3 (1.6)	25 (4.3)	1 (0.3)	32 (4.5)	77 (4.1)
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.	28 (1.3)	7 (0.7)	13 (0.9)	39 (1.5)	8 (0.8)	37 (1.5)	79 (1.4)

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.

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

^b Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

		Percentage of Students Whose Teachers Report Having the Major Area of Study						
		Biology	Physics	Chemistry	Science Education	Mathematics or Mathematics Education	Education	Other
	Biology							
	Belgium (Flemish)	78 (4.3)	44 (4.9)	56 (4.7)	45 (4.6)	18 (3.7)	41 (4.9)	74 (4.6)
	Bulgaria	93 (2.0)	3 (1.4)	30 (4.5)	--	0 (0.0)	16 (3.4)	7 (2.0)
	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)
	Finland ^b	68 (4.1)	0 (0.0)	2 (1.4)	5 (1.9)	0 (0.0)	8 (2.0)	42 (4.0)
	Hungary	94 (1.8)	0 (0.4)	16 (2.6)	14 (2.8)	0 (0.0)	9 (2.3)	76 (3.8)
	Indonesia	68 (4.8)	17 (3.4)	15 (3.4)	43 (4.6)	10 (2.6)	26 (4.4)	21 (3.5)
	Latvia (LSS)	96 (2.2)	41 (5.7)	91 (3.0)	78 (4.0)	22 (4.7)	88 (2.9)	r 71 (5.1)
	Lithuania [†]	93 (2.2)	--	--	--	--	--	--
	Macedonia, Rep. of	92 (2.4)	8 (2.6)	68 (4.2)	53 (4.4)	9 (2.5)	49 (4.2)	26 (4.2)
	Moldova	70 (2.7)	21 (3.1)	59 (4.2)	--	33 (3.0)	34 (3.8)	30 (3.6)
	Morocco ^c	r 80 (3.1)	r 21 (2.7)	r 30 (3.2)	r 76 (2.6)	r 12 (1.9)	r 72 (3.1)	r 64 (3.1)
	Netherlands	84 (4.1)	3 (1.3)	7 (3.0)	9 (3.6)	4 (2.2)	3 (2.1)	20 (5.9)
	Romania	89 (3.4)	5 (1.9)	8 (2.5)	27 (4.0)	4 (1.9)	40 (4.5)	32 (4.7)
	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.	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)
	Bulgaria	1 (0.9)	74 (6.4)	24 (6.6)	--	27 (4.3)	9 (2.4)	8 (2.5)
	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)
	Finland ^b	0 (0.0)	49 (3.7)	36 (4.2)	6 (1.6)	69 (3.6)	22 (3.3)	16 (1.5)
	Hungary	3 (1.5)	92 (2.3)	9 (2.1)	12 (2.7)	80 (3.0)	7 (2.3)	35 (4.4)
	Indonesia	21 (4.1)	56 (4.9)	15 (3.4)	52 (5.1)	16 (3.3)	18 (3.5)	15 (3.2)
	Latvia (LSS)	6 (2.1)	87 (2.7)	16 (3.1)	50 (4.5)	85 (3.1)	85 (3.1)	r 65 (4.5)
	Lithuania [†]	--	90 (2.5)	--	--	--	--	--
	Macedonia, Rep. of	9 (2.5)	96 (1.1)	51 (4.1)	54 (4.0)	54 (4.0)	59 (4.5)	25 (3.9)
	Moldova	28 (3.0)	71 (2.9)	17 (3.3)	x x	50 (3.7)	50 (4.5)	34 (4.1)
	Morocco ^c	11 (2.7)	88 (2.6)	87 (3.0)	82 (3.2)	21 (3.3)	71 (2.9)	47 (3.9)
	Netherlands ^d	14 (4.7)	39 (5.4)	28 (6.7)	15 (4.7)	32 (5.7)	13 (4.5)	23 (5.4)
	Romania	1 (1.0)	76 (4.0)	43 (4.3)	18 (3.0)	10 (2.6)	37 (3.8)	16 (3.3)
	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.	11 (0.8)	75 (1.0)	34 (1.2)	41 (1.2)	44 (1.1)	41 (1.0)	33 (1.1)	
	Chemistry							
	Belgium (Flemish)	--	--	--	--	--	--	--
	Bulgaria	30 (4.4)	15 (6.4)	89 (2.7)	--	10 (6.4)	21 (6.3)	13 (2.5)
	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)
	Finland ^b	--	--	--	--	--	--	--
	Hungary	27 (3.5)	12 (2.8)	90 (2.2)	18 (3.5)	56 (4.1)	13 (2.9)	32 (3.6)
	Indonesia	--	--	--	--	--	--	--
	Latvia (LSS)	78 (3.7)	40 (4.9)	93 (2.7)	73 (4.8)	30 (4.4)	87 (3.0)	r 79 (4.4)
	Lithuania [†]	--	--	92 (2.5)	--	--	--	--
	Macedonia, Rep. of	58 (4.5)	35 (3.8)	96 (1.7)	52 (3.9)	10 (2.6)	52 (4.0)	22 (3.4)
	Moldova	62 (3.4)	40 (3.5)	69 (3.6)	--	20 (3.1)	38 (4.1)	29 (3.6)
	Morocco	--	--	--	--	--	--	--
	Netherlands	--	--	--	--	--	--	--
	Romania	7 (2.3)	34 (4.5)	82 (3.1)	23 (3.5)	8 (2.4)	37 (4.4)	16 (3.4)
	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.	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.

^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 Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.^c Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.^d Netherlands: Data for physics/chemistry teachers are reported in physics panel.

Exhibit R3.2 Teachers' Confidence in Their Preparation to Teach Science Topics

	Percentage of Students Whose Teachers Report Feeling Very Well Prepared to Teach Topic ¹						
	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	
Australia	38 (3.2)	44 (3.5)	76 (2.8)	68 (3.5)	62 (3.2)	54 (3.6)	
Belgium (Flemish)	r 64 (4.5)	r 30 (4.9)	r 79 (2.9)	s 65 (3.9)	s 58 (5.7)	s 37 (5.9)	
Bulgaria	s 44 (3.4)	s 40 (5.7)	s 64 (4.1)	s 60 (4.2)	s 53 (3.8)	s 52 (3.8)	
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)	
Chile	13 (2.1)	19 (3.0)	46 (3.5)	44 (3.8)	24 (3.5)	20 (2.9)	
Chinese Taipei	17 (3.9)	16 (3.6)	10 (3.6)	12 (4.0)	64 (4.3)	66 (4.4)	
Cyprus	r 38 (4.0)	39 (3.2)	56 (2.6)	57 (2.5)	59 (2.9)	56 (2.6)	
Czech Republic	70 (3.4)	68 (3.6)	77 (3.1)	74 (3.8)	69 (3.7)	68 (3.5)	
England	--	--	--	--	--	--	
Finland	55 (3.8)	22 (3.0)	78 (3.5)	64 (3.8)	57 (3.5)	54 (3.5)	
Hong Kong, SAR	8 (2.7)	9 (2.6)	44 (4.2)	38 (4.5)	35 (4.8)	36 (4.1)	
Hungary	16 (2.3)	17 (2.6)	49 (3.3)	45 (3.1)	40 (2.9)	40 (3.1)	
Indonesia	50 (4.4)	56 (4.3)	74 (3.5)	72 (3.5)	40 (5.7)	39 (6.4)	
Iran, Islamic Rep.	37 (4.5)	11 (3.2)	66 (4.1)	44 (4.6)	45 (4.5)	44 (4.7)	
Israel	r 16 (3.7)	r 15 (3.3)	85 (3.0)	85 (2.7)	79 (3.3)	64 (3.9)	
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)	
Jordan	41 (4.9)	42 (4.8)	72 (4.0)	57 (4.6)	65 (4.1)	59 (4.2)	
Korea, Rep. of	26 (3.7)	22 (3.3)	42 (3.6)	34 (3.7)	40 (4.0)	45 (3.6)	
Latvia (LSS)	r 14 (2.4)	r 16 (2.9)	62 (3.3)	58 (3.7)	46 (3.6)	60 (3.5)	
Lithuania [†]	--	--	--	--	--	--	
Macedonia, Rep. of	r 65 (3.0)	s 65 (2.7)	r 73 (2.5)	r 74 (2.4)	r 74 (2.4)	r 74 (2.4)	
Malaysia	16 (4.4)	16 (4.5)	33 (4.3)	34 (4.2)	22 (3.9)	14 (3.7)	
Moldova	r 33 (2.8)	r 37 (2.6)	r 49 (3.4)	r 51 (3.1)	r 46 (3.0)	r 49 (2.9)	
Morocco	53 (2.9)	32 (3.4)	r 82 (1.9)	r 78 (2.0)	r 66 (3.2)	r 66 (3.1)	
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)	
New Zealand	44 (4.4)	43 (3.5)	74 (3.6)	70 (3.7)	74 (3.4)	62 (4.2)	
Philippines	46 (4.2)	51 (4.4)	36 (4.3)	44 (4.2)	37 (4.5)	15 (3.5)	
Romania	r 52 (2.9)	r 49 (3.2)	r 57 (3.6)	r 58 (3.5)	r 65 (2.9)	r 62 (3.0)	
Russian Federation	--	--	--	--	--	--	
Singapore	13 (3.3)	11 (3.2)	56 (4.6)	52 (4.6)	63 (3.5)	57 (4.1)	
South Africa	r 33 (5.9)	r 25 (5.1)	67 (4.1)	60 (3.7)	70 (4.3)	54 (4.6)	
Thailand	26 (3.6)	33 (4.0)	45 (4.6)	30 (3.9)	19 (3.6)	15 (3.6)	
Tunisia	22 (3.5)	11 (2.6)	81 (3.7)	64 (4.1)	8 (2.7)	8 (3.0)	
Turkey	44 (4.1)	50 (3.5)	73 (3.9)	68 (4.2)	83 (2.6)	77 (3.1)	
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)	
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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.

		Percentage of Students Whose Teachers Report Feeling Very Well Prepared to Teach Topic ¹				
		Physics-types of energy, sources of energy, conversion between energy types	Physics-light	Environmental and resources issues	Scientific methods and inquiry skills	Average ²
	Australia	49 (3.2)	48 (3.3)	49 (3.4)	64 (3.1)	55 (1.8)
	Belgium (Flemish)	r 33 (4.1)	r 63 (5.6)	28 (2.6)	30 (3.2)	47 (2.1)
	Bulgaria	s 48 (4.9)	s 46 (4.1)	r 28 (2.3)	30 (2.8)	46 (1.9)
	Canada	r 48 (3.8)	s 34 (3.4)	r 45 (3.7)	58 (3.0)	44 (1.7)
	Chile	19 (3.0)	7 (2.0)	62 (3.3)	32 (3.7)	29 (1.9)
	Chinese Taipei	70 (3.8)	58 (4.1)	20 (3.6)	21 (3.6)	42 (2.6)
	Cyprus	76 (2.2)	68 (2.1)	59 (2.1)	46 (2.6)	57 (1.4)
	Czech Republic	64 (3.2)	r 60 (3.7)	66 (2.8)	12 (2.0)	64 (2.0)
	England	--	--	--	--	--
	Finland	56 (3.3)	57 (3.3)	31 (2.3)	25 (2.1)	47 (1.7)
	Hong Kong, SAR	47 (4.7)	33 (4.5)	30 (4.1)	36 (4.3)	34 (2.4)
	Hungary	37 (3.0)	30 (3.3)	21 (2.2)	15 (1.7)	29 (1.4)
	Indonesia	68 (3.6)	70 (3.6)	40 (4.0)	35 (4.4)	58 (2.7)
	Iran, Islamic Rep.	65 (4.2)	55 (4.9)	43 (4.9)	18 (3.3)	42 (2.8)
	Israel	43 (4.1)	r 23 (4.3)	39 (3.6)	55 (4.4)	55 (1.7)
	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)
	Jordan	72 (4.0)	69 (4.1)	49 (4.4)	46 (4.7)	57 (2.6)
	Korea, Rep. of	35 (3.6)	17 (3.1)	22 (3.3)	21 (3.0)	31 (1.9)
	Latvia (LSS)	39 (3.1)	r 41 (3.7)	21 (2.8)	15 (1.9)	37 (1.5)
	Lithuania *	--	--	--	--	--
	Macedonia, Rep. of	r 70 (2.5)	s 74 (2.5)	r 60 (2.8)	38 (3.6)	72 (1.3)
	Malaysia	22 (3.4)	27 (3.8)	25 (3.3)	14 (2.5)	22 (2.3)
	Moldova	s 45 (3.5)	s 46 (3.4)	r 30 (2.7)	17 (2.1)	39 (1.6)
	Morocco	r 65 (3.4)	r 67 (3.5)	38 (3.1)	35 (3.2)	57 (1.4)
	Netherlands	r 54 (3.0)	r 57 (3.5)	49 (3.6)	41 (4.5)	50 (1.7)
	New Zealand	62 (3.9)	56 (3.6)	47 (4.0)	61 (4.1)	59 (2.1)
	Philippines	52 (4.5)	23 (3.5)	51 (4.2)	52 (4.0)	41 (2.3)
	Romania	r 63 (2.9)	r 67 (3.2)	41 (2.7)	26 (2.6)	57 (1.5)
	Russian Federation	--	--	--	--	--
	Singapore	58 (4.0)	57 (3.9)	30 (4.0)	35 (4.5)	46 (2.4)
	South Africa	66 (4.4)	61 (4.6)	34 (3.7)	38 (4.5)	53 (2.8)
	Thailand	18 (3.7)	16 (4.7)	35 (4.1)	33 (4.8)	30 (2.4)
	Tunisia	6 (2.0)	9 (2.6)	31 (4.0)	18 (3.3)	32 (1.9)
	Turkey	75 (3.6)	72 (3.1)	51 (4.6)	32 (3.6)	63 (2.2)
	United States	r 55 (4.2)	r 40 (3.6)	r 56 (3.8)	86 (2.2)	58 (1.5)
	International Avg.	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 R3.3

Shortages of Teachers Qualified to Teach the Sciences Affecting Capacity to Provide Instruction*

TIMSS¹⁹⁹⁹
8th grade
Science

Percentage of Students Whose Schools Report That Shortages Affect Instructional Capacity Some or A Lot						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	5 (2.1)	Belgium (Flemish)	4 (1.5)	7 (3.3)	4 (1.6)	— —
Canada	19 (2.1)	Bulgaria	72 (4.3)	70 (4.3)	70 (4.6)	69 (4.5)
Chile	26 (3.5)	Czech Republic	12 (3.8)	9 (3.1)	9 (2.7)	6 (2.6)
Chinese Taipei ^a	21 (3.4)	Finland	5 (1.6)	7 (2.0)	3 (1.1)	4 (1.3)
Cyprus	15 (0.2)	Hungary	10 (2.4)	9 (2.3)	15 (2.8)	11 (2.3)
England ^r	5 (2.1)	Latvia (LSS)	— —	31 (4.8)	39 (4.4)	30 (4.4)
Hong Kong, SAR	13 (2.7)	Lithuania [†]	— —	4 (1.7)	7 (2.1)	7 (1.9)
Indonesia ^b	39 (5.0)	Macedonia, Rep. of	13 (2.7)	14 (2.6)	12 (2.6)	13 (2.5)
Iran, Islamic Rep.	43 (4.0)	Moldova	66 (3.6)	65 (3.6)	72 (3.5)	69 (3.5)
Israel	42 (4.7)	Morocco ^c	— —	45 (4.6)	45 (4.6)	— —
Italy	26 (3.6)	Netherlands ^r	5 (1.6)	12 (5.8)	24 (6.5)	22 (6.6)
Japan	17 (3.3)	Romania	19 (3.3)	11 (2.6)	9 (2.4)	12 (2.7)
Jordan	88 (2.7)	Russian Federation	42 (3.5)	40 (3.6)	39 (3.7)	40 (4.0)
Korea, Rep. of	32 (3.9)	Slovak Republic	24 (4.1)	8 (2.9)	13 (2.9)	11 (3.2)
Malaysia	51 (3.9)	Slovenia	— —	54 (4.4)	55 (4.2)	56 (4.3)
New Zealand	13 (3.0)	International Avg.	25 (0.9)	26 (0.9)	28 (0.9)	27 (1.0)
Philippines	41 (4.2)					
Singapore	17 (3.2)					
South Africa	45 (3.4)					
Thailand	70 (4.1)					
Tunisia	85 (3.0)					
Turkey	81 (2.8)					
United States ^r	16 (2.5)					
International Avg.	35 (0.7)					

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

Background data provided by schools.

* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

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

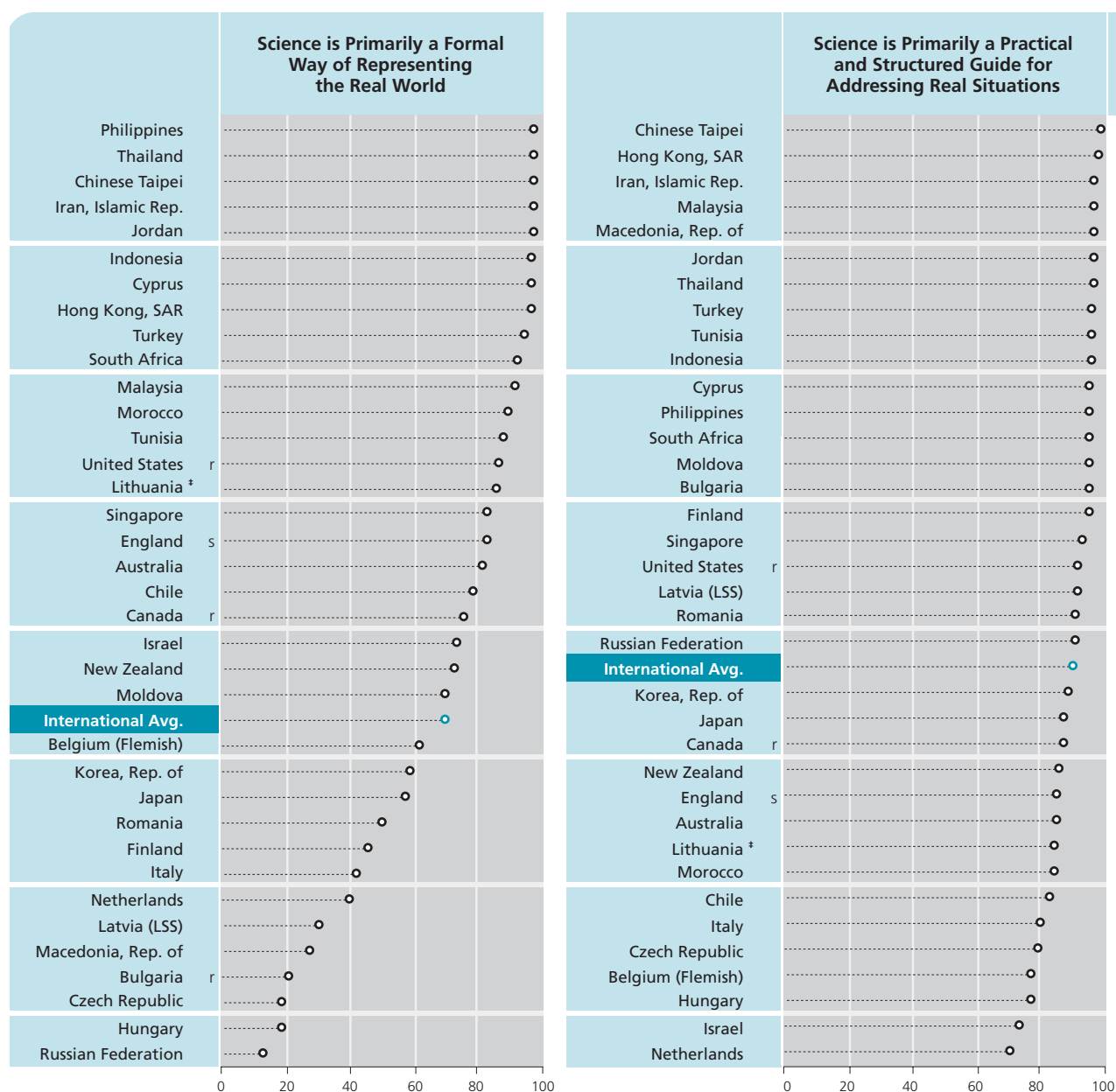
^a Chinese Taipei: Data pertain to teachers of grade 8 physics/chemistry course.^b Indonesia: Data pertain to teachers of 'IPA science', a composite course taught by biology and physics teachers.^c Morocco: Data pertaining to teachers of Natural Science course (biology/geology) are reported in biology column; data pertaining to teachers of physics/chemistry course are reported in physics column.

() 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.

Exhibit R3.4 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.

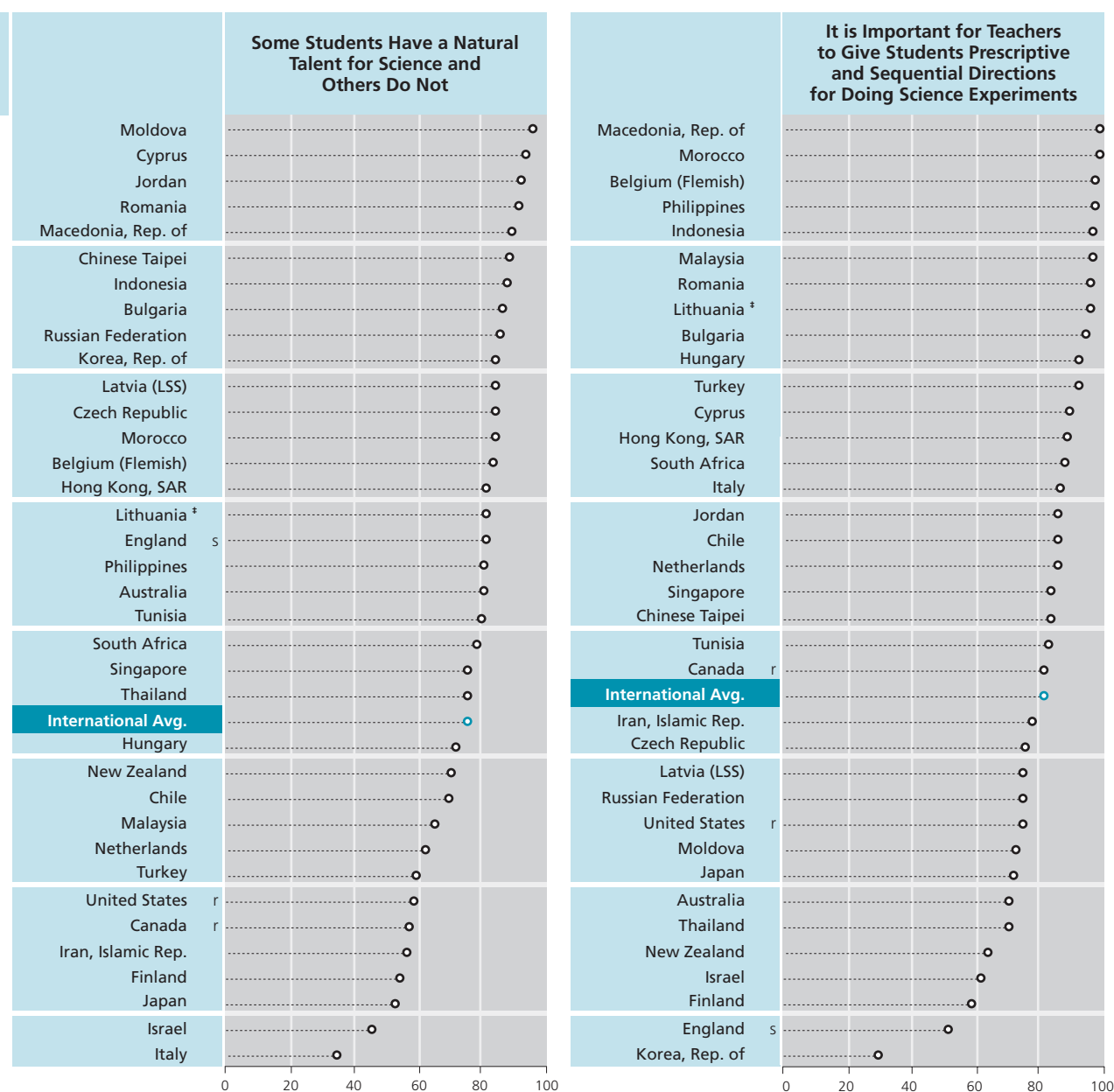
Background data provided by teachers.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

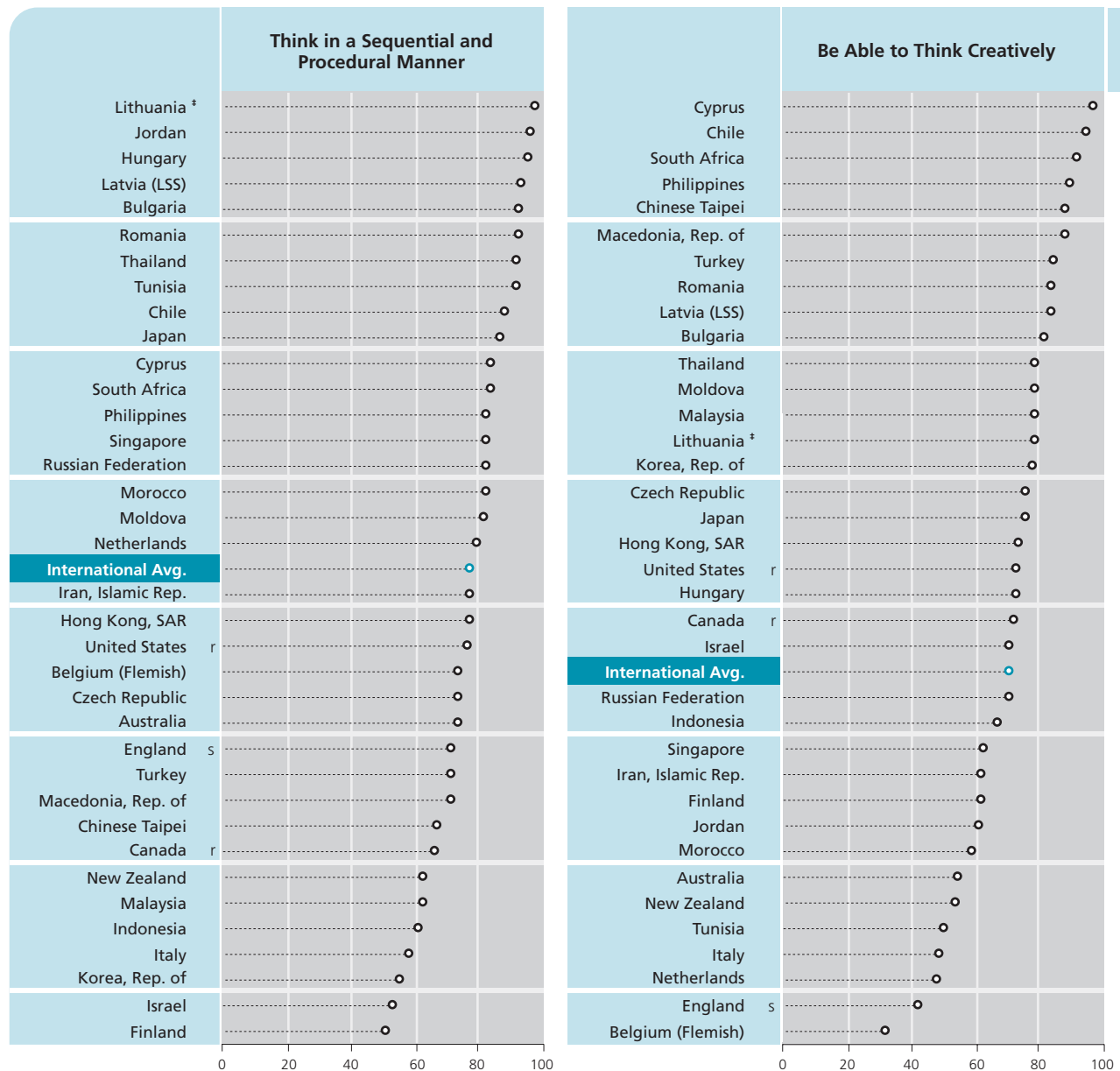
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit R3.4: Percentage of Students Whose Science Teachers Agree or Strongly Agree with Statements About the Nature of Science and Science Teaching (Continued)



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

Exhibit R3.5 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.

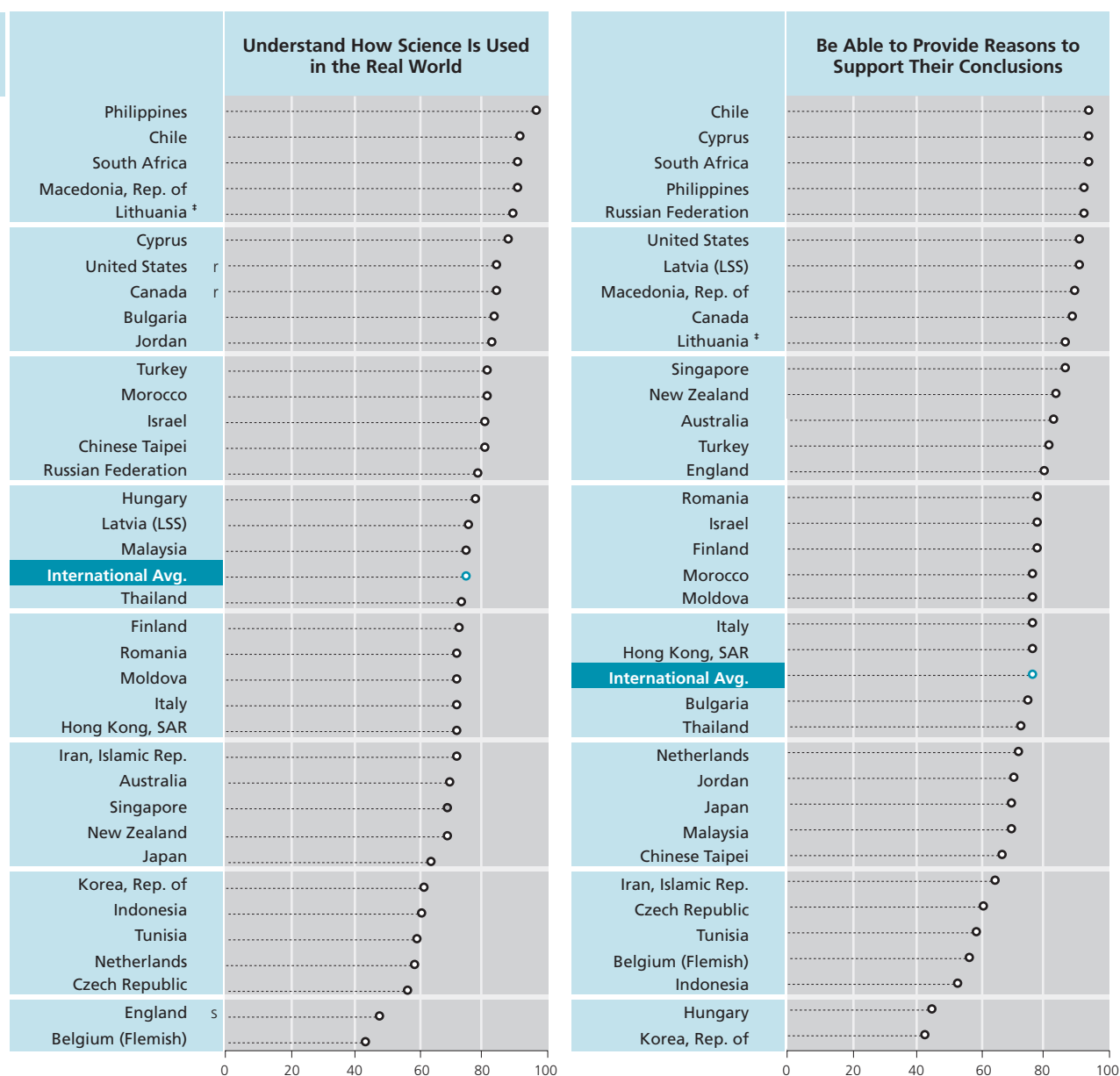
Background data provided by teachers.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

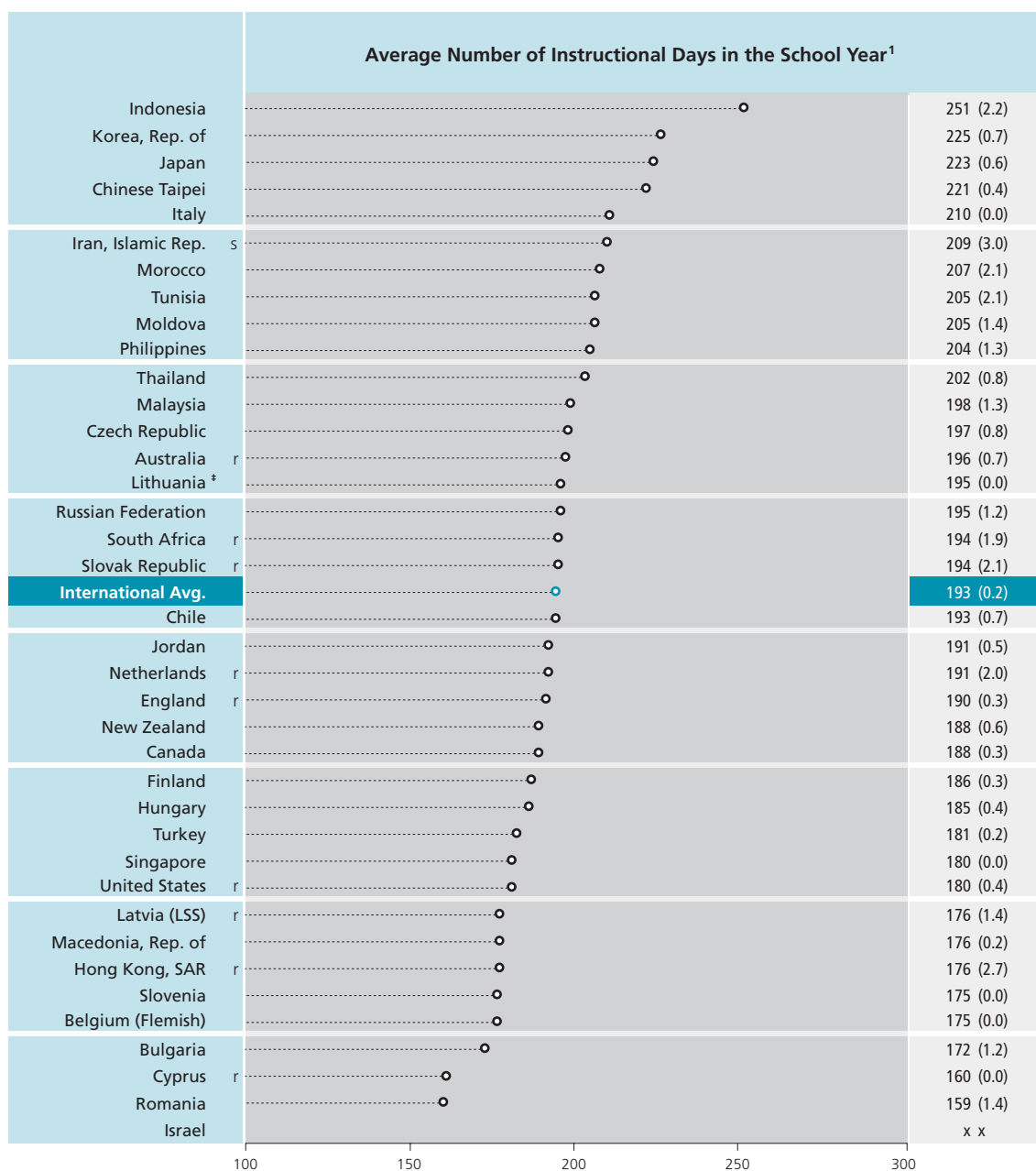
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

Exhibit R3.5: Percentage of Students Whose Science Teachers Think Particular Abilities Are Very Important for Students' Success in Science in School (Continued)



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

Exhibit R3.6 Average Number of Instructional Days in the School Year



Background data provided by schools.

¹ Days reported averaged across students.

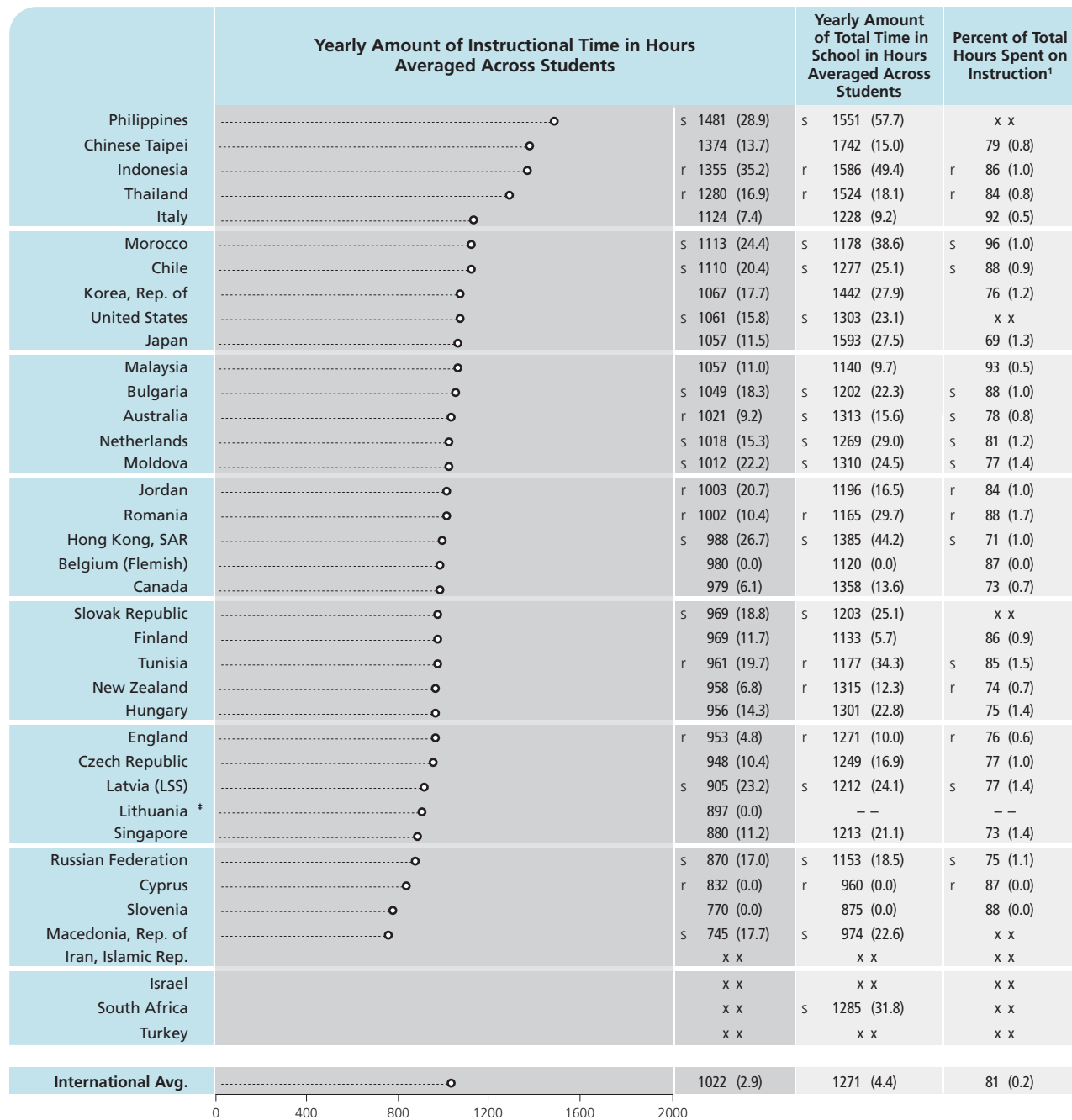
[†] Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

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

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

Instructional Time in School



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

Background data provided by schools.

¹ Computed as the ratio of instructional hours to total hours averaged across students.[‡] 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.

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 R3.8 How Teachers Spend Their Formally Scheduled School Time

	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
Australia	80 (0.7)	r 63 (1.9)	r 5 (0.7)	r 5 (0.6)	11 (0.7)
Belgium (Flemish)	86 (1.1)	64 (2.2)	3 (0.4)	1 (0.3)	10 (0.7)
Bulgaria	r 71 (1.4)	r 60 (1.9)	r 9 (0.8)	r 5 (0.5)	r 16 (0.9)
Canada	79 (1.0)	41 (1.6)	8 (0.5)	1 (0.3)	12 (0.7)
Chile	72 (1.3)	45 (1.7)	9 (0.6)	5 (0.7)	14 (1.0)
Chinese Taipei	59 (2.3)	58 (2.4)	10 (1.0)	5 (1.0)	26 (1.7)
Cyprus	r 83 (1.3)	r 83 (1.3)	r 5 (0.5)	r 3 (0.6)	r 10 (0.8)
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)
Finland	85 (0.7)	60 (1.2)	2 (0.3)	1 (0.2)	12 (0.5)
Hong Kong, SAR	x x	x x	x x	x x	x x
Hungary	62 (0.9)	39 (0.9)	11 (0.5)	7 (0.3)	20 (0.7)
Indonesia	66 (1.8)	64 (1.9)	12 (0.9)	7 (0.6)	15 (0.9)
Iran, Islamic Rep.	62 (3.4)	60 (3.4)	11 (1.2)	2 (0.5)	25 (3.2)
Israel	r 78 (1.7)	r 75 (1.8)	r 10 (1.2)	s 2 (0.3)	r 10 (1.1)
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)
Jordan	67 (1.2)	52 (1.9)	11 (0.5)	4 (0.3)	18 (0.8)
Korea, Rep. of	48 (1.3)	47 (1.3)	15 (0.6)	13 (0.6)	24 (1.0)
Latvia (LSS)	r 70 (1.6)	r 55 (1.7)	r 4 (0.4)	r 4 (1.1)	r 23 (1.2)
Lithuania †	65 (1.0)	59 (1.1)	11 (0.5)	5 (0.8)	20 (0.7)
Macedonia, Rep. of	52 (0.8)	47 (0.9)	21 (0.7)	5 (0.2)	22 (0.6)
Malaysia	65 (1.0)	54 (1.4)	10 (0.5)	6 (0.4)	19 (0.7)
Moldova	60 (1.2)	r 53 (1.2)	r 13 (0.9)	r 5 (0.7)	22 (0.8)
Morocco	76 (1.7)	74 (1.8)	10 (0.9)	1 (0.3)	13 (0.9)
Netherlands ⁴	r 87 (0.7)	r 75 (2.1)	--	--	r 13 (0.7)
New Zealand	83 (1.0)	71 (1.7)	2 (0.4)	5 (0.7)	10 (0.7)
Philippines	71 (1.7)	57 (2.2)	8 (0.9)	3 (0.4)	18 (1.3)
Romania	55 (1.4)	47 (1.3)	12 (0.7)	6 (0.5)	28 (1.0)
Russian Federation ⁵	--	--	--	--	--
Singapore	75 (0.9)	65 (1.2)	--	3 (0.4)	22 (0.8)
South Africa	77 (1.5)	r 58 (2.5)	r 6 (0.8)	r 5 (0.8)	13 (0.9)
Thailand	59 (1.4)	51 (1.6)	17 (0.9)	3 (0.4)	21 (1.1)
Tunisia	60 (1.4)	60 (1.5)	22 (1.1)	2 (0.6)	15 (1.1)
Turkey	63 (1.3)	51 (1.3)	14 (0.9)	4 (0.8)	19 (1.0)
United States	r 74 (1.0)	r 62 (1.7)	r 13 (0.7)	r 2 (0.3)	r 12 (0.9)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 R3.9 Overleaf

Exhibit R3.9 Asking Students to Do Problem-Solving Activities During Science Lessons

	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
Australia	65 (3.1)	22 (2.8)	9 (1.8)	68 (3.5)	26 (3.0)
Belgium (Flemish)	53 (3.4)	37 (2.6)	r 6 (1.5)	12 (2.0)	9 (1.7)
Bulgaria	r 81 (2.5)	r 55 (2.3)	r 9 (1.6)	r 14 (1.9)	r 61 (2.2)
Canada	r 85 (2.5)	r 35 (3.3)	r 17 (3.1)	r 78 (2.4)	r 36 (3.7)
Chile	67 (3.2)	33 (3.7)	18 (2.9)	68 (3.4)	45 (3.6)
Chinese Taipei	42 (3.6)	35 (3.7)	14 (2.9)	57 (4.4)	34 (3.7)
Cyprus	s 88 (2.5)	s 40 (4.2)	s 4 (1.9)	s 57 (4.1)	s 53 (4.9)
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)
Finland	59 (3.0)	30 (2.3)	20 (2.5)	42 (2.4)	40 (2.8)
Hong Kong, SAR	50 (4.6)	22 (4.0)	10 (2.6)	34 (4.2)	23 (3.5)
Hungary	81 (1.7)	49 (1.9)	16 (1.8)	30 (2.2)	46 (2.3)
Indonesia	47 (4.0)	39 (3.8)	39 (3.4)	52 (3.4)	64 (3.5)
Iran, Islamic Rep.	49 (4.3)	15 (2.9)	22 (3.2)	55 (4.0)	41 (4.4)
Israel	71 (3.7)	28 (3.8)	r 9 (2.0)	71 (3.3)	47 (3.6)
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)
Jordan	73 (3.7)	28 (4.1)	7 (2.3)	61 (4.1)	67 (3.6)
Korea, Rep. of	58 (4.0)	47 (4.0)	16 (2.9)	50 (3.6)	17 (3.0)
Latvia (LSS)	r 60 (2.6)	r 46 (3.0)	r 12 (1.8)	r 13 (1.7)	r 31 (2.8)
Lithuania [†]	61 (2.5)	40 (2.6)	13 (1.6)	73 (2.2)	33 (2.3)
Macedonia, Rep. of	73 (2.1)	58 (2.8)	14 (2.0)	48 (2.4)	35 (2.5)
Malaysia	68 (3.8)	32 (3.6)	25 (3.5)	71 (4.2)	56 (4.5)
Moldova	87 (1.5)	22 (2.1)	15 (1.9)	32 (2.4)	48 (2.5)
Morocco	47 (3.1)	31 (2.8)	6 (1.1)	78 (1.8)	59 (3.0)
Netherlands	57 (3.7)	15 (2.5)	18 (2.8)	34 (4.7)	20 (2.5)
New Zealand	63 (3.9)	12 (2.3)	5 (1.9)	71 (3.6)	20 (3.1)
Philippines	81 (3.5)	40 (3.8)	16 (3.2)	77 (3.3)	61 (4.0)
Romania	91 (1.6)	40 (2.3)	11 (1.5)	52 (2.5)	40 (2.4)
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)
South Africa	62 (4.2)	35 (4.0)	22 (3.9)	53 (3.9)	40 (4.5)
Thailand	61 (4.1)	18 (3.2)	28 (3.7)	38 (4.3)	47 (4.5)
Tunisia	79 (3.6)	62 (4.5)	8 (2.2)	89 (2.8)	55 (4.2)
Turkey	70 (3.6)	60 (3.7)	17 (3.1)	56 (4.4)	61 (3.8)
United States	r 80 (3.2)	r 40 (3.1)	r 18 (2.3)	r 59 (3.3)	r 40 (3.3)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 R3.10

Trends in Asking Students to Do Problem-Solving Activities During Most or Every Science Lesson

TIMSS 1999
8th grade
Science

	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	
	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Belgium (Flemish)	53 (3.4) r	5 (5.9) ●	37 (2.6) r	3 (5.5) ●	6 (1.5) r	0 (2.6) ●	12 (2.0) r	-4 (4.3) ●	9 (1.7) r	-3 (3.4) ●
Canada	85 (2.5) r	7 (4.7) ●	35 (3.3) r	11 (5.6) ●	17 (3.1) r	12 (4.7) ●	78 (2.4) r	24 (6.5) ▲	36 (3.7) r	19 (4.9) ▲
Cyprus	88 (2.5) s	14 (5.9) ●	40 (4.2) s	4 (7.0) ●	4 (1.9) s	-3 (3.8) ●	57 (4.1) s	10 (7.7) ●	53 (4.9) s	-8 (7.9) ●
Czech Republic	89 (2.0)	-3 (2.5) ●	17 (1.9)	0 (3.0) ●	10 (1.9)	3 (2.5) ●	32 (2.9)	-15 (4.7) ▼	32 (2.8) r	5 (4.0) ●
England	64 (4.8) s	-8 (5.6) ●	24 (3.7) s	-2 (4.5) ●	x x	x x	67 (4.6) s	-5 (5.5) ●	21 (3.7) s	-1 (4.7) ●
Hong Kong, SAR	50 (4.6)	10 (7.9) ●	22 (4.0)	3 (6.1) ●	10 (2.6)	7 (3.4) ●	34 (4.2)	-23 (7.5) ▼	23 (3.5)	-5 (6.3) ●
Hungary	81 (1.7)	3 (2.8) ●	49 (1.9)	3 (3.4) ●	16 (1.8)	3 (2.6) ●	30 (2.2)	-9 (3.2) ●	46 (2.3)	-4 (2.9) ●
Iran, Islamic Rep.	49 (4.3)	-1 (7.6) ●	15 (2.9)	4 (4.0) ●	22 (3.2)	-3 (7.3) ●	55 (4.0)	29 (7.6) ▲	41 (4.4)	20 (7.8) ●
Israel †	71 (4.0) r	-14 (6.7) ●	26 (4.1) r	9 (7.3) ●	8 (2.1) s	4 (4.0) ●	71 (3.8) r	5 (10.5) ●	40 (4.3) s	2 (9.0) ●
Italy	87 (3.0)	11 (5.2) ●	42 (4.0)	15 (5.6) ●	23 (3.8)	8 (5.2) ●	43 (4.8)	13 (6.5) ●	43 (5.2)	-2 (6.9) ●
Japan	69 (4.1)	12 (6.3) ●	60 (4.0)	13 (5.8) ●	32 (4.0)	20 (4.9) ▲	57 (4.0)	-3 (5.9) ●	48 (4.2)	8 (6.1) ●
Korea, Rep. of	58 (4.0)	-5 (5.5) ●	47 (4.0)	-7 (5.9) ●	16 (2.9)	-7 (4.5) ●	50 (3.6)	0 (5.1) ●	17 (3.0)	-17 (4.8) ▼
Latvia (LSS)	60 (2.6) s	4 (3.7) ●	46 (3.0) s	-3 (4.1) ●	12 (1.8) s	-3 (2.6) ●	13 (1.7) s	-40 (3.5) ▼	31 (2.8) s	-4 (3.9) ●
Lithuania	61 (2.5) r	4 (3.2) ●	40 (2.6) r	9 (3.4) ●	13 (1.6) r	8 (1.9) ▲	73 (2.2) r	47 (3.1) ▲	33 (2.3) r	-12 (3.5) ▼
Netherlands	57 (3.7) r	-1 (6.2) ●	15 (2.5) r	3 (3.3) ●	18 (2.8) r	7 (3.6) ●	34 (4.7) r	6 (5.6) ●	20 (2.5) r	8 (3.3) ●
New Zealand	63 (3.9)	7 (5.7) ●	12 (2.3)	1 (3.5) ●	5 (1.9)	2 (2.4) ●	71 (3.6)	2 (5.3) ●	20 (3.1)	9 (4.1) ●
Romania	91 (1.6)	1 (2.1) ●	40 (2.3)	1 (3.3) ●	11 (1.5) r	-4 (2.4) ●	52 (2.5)	7 (3.3) ●	40 (2.4)	19 (3.1) ▲
Russian Federation	55 (2.2)	-5 (3.8) ●	35 (1.8)	7 (3.6) ●	10 (1.6)	2 (2.1) ●	36 (1.9)	19 (2.9) ▲	71 (2.2)	11 (4.8) ●
Singapore	63 (4.3)	13 (6.8) ●	13 (2.8)	4 (4.0) ●	8 (1.9)	5 (2.7) ●	44 (4.7)	-6 (6.6) ●	30 (4.1)	5 (5.9) ●
Thailand †	61 (4.1) r	-1 (7.5) ●	18 (3.2) r	-4 (6.3) ●	28 (3.7) s	10 (5.4) ●	38 (4.3) s	-12 (7.5) ●	47 (4.5) r	-5 (7.4) ●
United States	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
International Avg. §	68 (0.7)	4 (1.2) ▲	33 (0.7)	4 (1.1) ▲	13 (0.5)	3 (0.9) ▲	48 (0.8)	5 (1.3) ▲	34 (0.8)	2 (1.2) ●

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

Background data provided by teachers.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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, based on the lower response rate in either 1995 or 1999. An "s" indicates teacher response data available for 50-69% of students, based on the lower response rate in either 1995 or 1999. An "x" indicates teacher response data available for <50% of students, based on the lower response rate in either 1995 or 1999.

Exhibit R3.11 Teachers Demonstrating an Experiment in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	79 (1.1)	Belgium (Flemish)	13 (1.0)	71 (1.5)	81 (2.3)	—
Canada	77 (1.2)	Bulgaria	22 (1.4)	34 (1.8)	48 (1.5)	57 (2.2)
Chile	58 (1.4)	Czech Republic	6 (0.8)	24 (1.8)	53 (2.3)	76 (1.9)
Chinese Taipei ^a	70 (1.3)	Finland	23 (1.1)	27 (1.2)	57 (1.6)	61 (1.4)
Cyprus	92 (0.6)	Hungary	12 (0.8)	26 (1.3)	70 (1.7)	82 (1.7)
England	91 (0.9)	Latvia (LSS)	—	29 (1.8)	49 (2.0)	61 (2.1)
Hong Kong, SAR	88 (0.9)	Lithuania [†]	—	—	—	—
Indonesia ^b	34 (1.4)	Macedonia, Rep. of	30 (1.2)	59 (1.4)	66 (1.5)	73 (1.5)
Iran, Islamic Rep.	59 (1.9)	Moldova	39 (1.7)	57 (1.6)	68 (1.5)	72 (1.4)
Israel	79 (1.5)	Morocco	x x	s 78 (1.2)	x x	x x
Italy	29 (1.6)	Netherlands ^c	7 (0.9)	32 (2.8)	56 (2.7)	—
Japan	75 (1.5)	Romania	27 (1.5)	47 (1.5)	59 (1.7)	65 (1.8)
Jordan	70 (1.4)	Russian Federation	17 (1.1)	37 (1.7)	69 (1.7)	75 (1.6)
Korea, Rep. of	53 (1.7)	Slovak Republic	13 (0.8)	31 (1.8)	54 (1.9)	58 (2.0)
Malaysia	78 (1.7)	Slovenia	—	41 (1.5)	57 (1.6)	73 (1.3)
New Zealand	84 (0.9)	International Avg.	19 (0.3)	42 (0.4)	61 (0.5)	68 (0.5)
Philippines	77 (0.9)					
Singapore	88 (1.0)					
South Africa	69 (1.6)					
Thailand	80 (1.2)					
Tunisia	84 (0.6)					
Turkey	54 (1.7)					
United States	71 (1.1)					
International Avg.	71 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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

Percentage of Students Reporting Almost Always or Pretty Often

Countries with General/Integrated Science		Countries with Separate Science Subjects							
		Earth Science		Biology		Physics		Chemistry	
	Percent of Students 1999	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	79 (1.1)	13 (1.0)	-5 (1.8) ▼	71 (1.5)	-8 (2.3) ▼	81 (2.3)	-4 (3.5) ●	—	—
Canada	77 (1.2)	6 (0.8)	2 (0.9) ▲	24 (1.8)	4 (2.7) ●	53 (2.3)	-6 (3.3) ●	76 (1.9)	6 (3.1) ●
Cyprus	92 (0.6)	12 (0.8)	3 (1.1) ●	26 (1.3)	8 (2.0) ▲	70 (1.7)	2 (2.3) ●	82 (1.7)	1 (2.4) ●
England	91 (0.9)	—	—	29 (1.8)	-19 (2.6) ▼	49 (2.0)	-24 (2.6) ▼	61 (2.1)	-17 (2.7) ▼
Hong Kong, SAR	88 (0.9)	—	—	—	—	—	—	—	—
Iran, Islamic Rep.	59 (1.9)	7 (0.9)	1 (1.1) ●	32 (2.8)	4 (3.5) ●	56 (2.7)	2 (3.6) ●	—	—
Israel [†]	81 (1.7)	27 (1.5)	-8 (2.1) ▼	47 (1.5)	-2 (2.0) ●	59 (1.7)	-1 (2.4) ●	65 (1.8)	2 (2.5) ●
Italy	29 (1.8)	17 (1.1)	1 (1.8) ●	37 (1.7)	7 (2.3) ▲	69 (1.7)	-1 (2.3) ●	75 (1.6)	5 (2.5) ●
Japan	75 (1.5)	13 (0.8)	1 (1.1) ●	31 (1.8)	2 (2.3) ●	54 (1.9)	-4 (2.7) ●	58 (2.0)	-6 (2.6) ●
Korea, Rep. of	53 (1.7)	—	—	41 (1.5)	5 (2.5) ●	57 (1.6)	-4 (2.4) ●	73 (1.3)	1 (2.2) ●
New Zealand	84 (0.9)	13 (0.4)	0 (0.5) ●	38 (0.6)	1 (0.8) ●	61 (0.7)	-4 (0.9) ▼	70 (0.7)	1 (0.9) ●
Singapore	88 (1.0)	—	—	—	—	—	—	—	—
Thailand [†]	80 (1.2)	—	—	—	—	—	—	—	—
United States	71 (1.1)	—	—	—	—	—	—	—	—
International Avg. [§]	74 (0.4)	—	—	—	—	—	—	—	—

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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.

† Countries with unapproved sampling procedures at the classroom level in 1995.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

c Netherlands: Data in physics panel pertain to physics/chemistry course.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated L55 for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 R3.13 Students Doing an Experiment or Practical Investigation in Science Classes*

Percentage of Students Reporting Almost Always or Pretty Often						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	81 (1.3)	Belgium (Flemish)	8 (0.7)	36 (1.6)	61 (3.1)	--
Canada	69 (1.4)	Bulgaria	18 (1.3)	19 (1.4)	30 (1.5)	32 (1.5)
Chile	48 (1.3)	Czech Republic	5 (0.5)	25 (2.0)	31 (2.2)	39 (2.4)
Chinese Taipei ^a	57 (1.6)	Finland	21 (1.1)	24 (1.4)	70 (1.3)	80 (1.0)
Cyprus	48 (1.7)	Hungary	8 (0.6)	11 (0.9)	21 (1.2)	20 (1.6)
England	89 (1.1)	Latvia (LSS)	--	22 (1.3)	30 (1.8)	34 (1.6)
Hong Kong, SAR	77 (1.2)	Lithuania [†]	--	--	--	--
Indonesia ^b	29 (1.2)	Macedonia, Rep. of	30 (1.3)	41 (1.3)	48 (1.5)	46 (1.6)
Iran, Islamic Rep.	34 (1.3)	Moldova	30 (1.3)	34 (1.4)	38 (1.2)	33 (1.2)
Israel	56 (1.6)	Morocco	x x	s 60 (1.6)	x x	x x
Italy	18 (1.1)	Netherlands ^c	5 (0.8)	20 (2.2)	41 (2.9)	--
Japan	79 (1.7)	Romania	23 (1.3)	25 (1.4)	33 (1.5)	37 (1.7)
Jordan	49 (1.2)	Russian Federation	13 (0.9)	20 (1.0)	41 (1.6)	41 (1.8)
Korea, Rep. of	46 (1.5)	Slovak Republic	8 (0.8)	19 (1.3)	33 (1.7)	33 (1.7)
Malaysia	43 (1.7)	Slovenia	--	17 (1.1)	33 (1.4)	32 (1.8)
New Zealand	82 (1.0)	International Avg.	15 (0.3)	27 (0.4)	39 (0.5)	39 (0.5)
Philippines	66 (1.1)					
Singapore	65 (1.4)					
South Africa	58 (1.2)					
Thailand	50 (1.3)					
Tunisia	68 (1.0)					
Turkey	30 (1.0)					
United States	65 (1.5)					
International Avg.	57 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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

Exhibit R3.14

Trends in Students Doing an Experiment or Practical Investigation in Science Classes*

TIMSS 1999
8th grade
Science

Percentage of Students Reporting Almost Always or Pretty Often

Countries with General/Integrated Science		Countries with Separate Science Subjects							
		Earth Science		Biology		Physics		Chemistry	
	Percent of Students 1999	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference
Australia	81 (1.3)	8 (0.7)	-3 (1.3)	36 (1.6)	-7 (2.4)	61 (3.1)	-11 (4.2)	--	--
Canada	69 (1.4)	5 (0.5)	2 (0.7)	25 (2.0)	5 (2.5)	31 (2.2)	2 (3.0)	39 (2.4)	4 (3.3)
Cyprus	48 (1.7)	8 (0.6)	2 (0.9)	11 (0.9)	4 (1.0)	21 (1.2)	1 (1.6)	20 (1.6)	0 (2.3)
England	89 (1.1)	--	--	22 (1.3)	-14 (2.1)	30 (1.8)	-16 (2.6)	34 (1.6)	-16 (2.8)
Hong Kong, SAR	77 (1.2)	--	--	--	--	--	--	--	--
Iran, Islamic Rep.	34 (1.3)	5 (0.8)	-1 (1.1)	20 (2.2)	0 (3.4)	41 (2.9)	-8 (4.0)	--	--
Israel [†]	56 (1.8)	23 (1.3)	-9 (1.9)	25 (1.4)	-9 (1.8)	33 (1.5)	-16 (2.2)	37 (1.7)	-13 (2.4)
Italy	17 (1.3)	13 (0.9)	0 (1.4)	20 (1.0)	3 (1.4)	41 (1.6)	-3 (2.3)	41 (1.8)	-5 (3.0)
Japan	79 (1.7)	8 (0.8)	-4 (1.1)	19 (1.3)	1 (1.7)	33 (1.7)	3 (2.3)	33 (1.7)	8 (2.2)
Korea, Rep. of	46 (1.5)	--	--	17 (1.1)	2 (1.7)	33 (1.4)	2 (2.1)	32 (1.8)	7 (2.6)
New Zealand	82 (1.0)	10 (0.3)	-1 (0.4)	22 (0.5)	-1 (0.7)	36 (0.7)	-4 (0.9)	34 (0.7)	-1 (1.0)
Singapore	65 (1.4)								
Thailand [†]	50 (1.3)								
United States	65 (1.5)								
International Avg. [§]	63 (0.4)								

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

▲ 1999 significantly higher than 1995

● No significant difference between 1995 and 1999

▼ 1999 significantly lower than 1995

Significance tests adjusted for multiple comparisons

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.

† Countries with unapproved sampling procedures at the classroom level in 1995.

c Netherlands: Data in physics panel pertain to physics/chemistry course.

§ International average is for countries that participated and met sampling guidelines in both 1995 and 1999.

Trend notes: Because coverage fell below 65% in 1995 and 1999, Latvia is annotated LSS for Latvian-Speaking Schools only. Lithuania tested later in 1999 than in 1995, at the beginning of the next school year. In 1995, Italy and Israel were unable to cover their International Desired Population; 1999 data are based on their comparable populations.

Background data for Bulgaria and South Africa are unavailable for 1995.

() 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 R3.15 Students Using Things from Everyday Life in Solving Science Problems*

Percentage of Students Reporting Almost Always or Pretty Often						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	46 (1.1)	Belgium (Flemish)	29 (0.9)	35 (1.1)	40 (1.8)	—
Canada	51 (0.9)	Bulgaria	31 (1.7)	30 (1.1)	34 (1.3)	30 (1.2)
Chile	53 (0.9)	Czech Republic	31 (1.4)	37 (1.5)	39 (1.7)	31 (1.4)
Chinese Taipei ^a	66 (1.2)	Finland	25 (1.2)	22 (1.2)	33 (1.7)	33 (1.4)
Cyprus	64 (1.0)	Hungary	30 (1.1)	35 (1.1)	41 (1.3)	33 (1.1)
England	51 (1.2)	Latvia (LSS)	—	55 (1.2)	54 (1.1)	52 (1.1)
Hong Kong, SAR	63 (1.0)	Lithuania [†]	—	—	—	—
Indonesia ^b	23 (1.0)	Macedonia, Rep. of	55 (1.2)	65 (1.0)	61 (1.2)	57 (1.2)
Iran, Islamic Rep.	35 (1.0)	Moldova	42 (1.4)	45 (1.4)	50 (1.3)	43 (1.3)
Israel	45 (1.2)	Morocco	x x	s 49 (1.6)	x x	x x
Italy	31 (1.1)	Netherlands ^c	33 (1.7)	42 (2.0)	31 (1.6)	—
Japan	21 (1.1)	Romania	31 (1.3)	40 (1.3)	36 (1.1)	32 (1.4)
Jordan	59 (1.1)	Russian Federation	39 (1.7)	43 (1.3)	41 (1.1)	37 (1.4)
Korea, Rep. of	39 (1.1)	Slovak Republic	31 (1.2)	29 (1.3)	44 (1.3)	34 (1.2)
Malaysia	49 (1.1)	Slovenia	—	45 (1.3)	37 (1.3)	33 (1.3)
New Zealand	52 (1.0)	International Avg.	34 (0.4)	41 (0.4)	42 (0.4)	38 (0.4)
Philippines	65 (1.0)					
Singapore	64 (1.2)					
South Africa	65 (1.3)					
Thailand	41 (1.2)					
Tunisia	50 (1.1)					
Turkey	34 (1.1)					
United States	50 (1.0)					
International Avg.	49 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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

	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	
Australia	21 (2.5)	1 (0.6)	47 (3.5)	7 (1.8)	20 (3.1)	4 (1.3)	0 (0.1)
Belgium (Flemish)	0 (0.0)	0 (0.0)	7 (2.0)	1 (0.6)	68 (3.5)	10 (2.1)	14 (2.4)
Bulgaria	3 (0.6)	0 (0.3)	32 (3.7)	3 (1.0)	50 (3.0)	7 (1.5)	5 (1.2)
Canada	19 (2.7)	6 (2.1)	50 (3.5)	8 (1.8)	14 (2.6)	3 (1.4)	0 (0.3)
Chile ^s	2 (1.1)	1 (0.7)	30 (3.6)	26 (3.6)	27 (3.8)	12 (2.3)	3 (1.3)
Chinese Taipei	8 (2.4)	7 (2.2)	42 (4.3)	19 (3.2)	20 (3.3)	4 (1.6)	0 (0.0)
Cyprus	37 (3.8)	11 (2.4)	35 (4.4)	10 (2.2)	6 (2.5)	1 (0.8)	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)
Finland	25 (3.1)	2 (1.1)	55 (3.0)	3 (1.0)	11 (1.6)	2 (0.9)	0 (0.4)
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)
Hungary	17 (1.7)	1 (0.6)	49 (2.0)	3 (0.8)	26 (2.0)	1 (0.3)	3 (0.7)
Indonesia ^s	2 (0.8)	5 (1.7)	34 (3.4)	49 (3.8)	5 (1.4)	5 (1.5)	0 (0.0)
Iran, Islamic Rep. ^s	2 (1.0)	10 (2.1)	15 (2.9)	51 (4.4)	7 (2.1)	14 (4.1)	1 (0.8)
Israel	14 (3.1)	6 (1.7)	50 (3.9)	10 (2.4)	16 (2.8)	1 (0.5)	3 (1.7)
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)
Jordan	46 (4.5)	9 (2.4)	35 (4.5)	3 (1.5)	3 (1.5)	2 (1.4)	0 (0.0)
Korea, Rep. of	9 (2.5)	1 (1.0)	27 (3.6)	6 (2.0)	37 (3.8)	16 (2.7)	3 (0.8)
Latvia (LSS)	13 (2.0)	2 (0.8)	62 (3.0)	5 (1.3)	17 (2.3)	1 (0.7)	1 (0.4)
Lithuania [†]	47 (2.7)	7 (1.3)	33 (2.1)	2 (0.7)	10 (1.7)	1 (0.4)	1 (0.4)
Macedonia, Rep. of	6 (1.4)	2 (0.6)	45 (3.0)	9 (1.4)	32 (2.8)	3 (0.9)	2 (0.9)
Malaysia	9 (2.4)	17 (3.4)	36 (4.1)	29 (3.8)	3 (1.5)	6 (2.0)	0 (0.0)
Moldova	27 (2.3)	21 (2.2)	30 (2.3)	21 (2.0)	1 (0.5)	0 (0.3)	0 (0.0)
Morocco	3 (0.8)	2 (0.8)	26 (2.2)	16 (2.2)	34 (3.2)	16 (2.1)	4 (1.2)
Netherlands	6 (1.8)	2 (1.1)	72 (3.2)	4 (1.1)	15 (3.4)	1 (0.4)	1 (0.7)
New Zealand	26 (3.2)	1 (0.7)	43 (3.9)	7 (2.0)	15 (3.0)	5 (1.7)	3 (1.6)
Philippines	72 (3.9)	10 (2.7)	11 (2.6)	6 (1.8)	0 (0.0)	1 (1.0)	0 (0.0)
Romania	6 (1.1)	2 (0.8)	39 (2.1)	5 (1.1)	36 (2.3)	2 (1.0)	8 (1.0)
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)
South Africa	29 (3.7)	10 (2.8)	38 (4.1)	13 (3.0)	9 (2.7)	1 (0.0)	1 (0.7)
Thailand	11 (2.4)	12 (3.1)	29 (3.8)	45 (4.3)	1 (1.0)	1 (1.0)	0 (0.0)
Tunisia ^s	2 (1.0)	2 (1.1)	23 (3.6)	7 (2.3)	38 (3.9)	20 (3.6)	9 (2.1)
Turkey	11 (2.7)	8 (2.1)	49 (3.7)	16 (3.2)	11 (2.4)	0 (0.4)	4 (1.8)
United States	35 (3.8)	8 (1.4)	32 (3.5)	11 (2.0)	10 (2.1)	2 (0.7)	3 (1.6)
International Avg.	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.

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

Science teacher background data for Slovak Republic and Slovenia are unavailable.

() 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 R3.17 Assigning Science Homework Based on Projects and Investigations*

		Sometimes or Always		Never or Rarely	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia		46 (3.4)	540 (5.1)	54 (3.4)	539 (6.7)
Belgium (Flemish)	r	11 (2.5)	534 (10.5)	89 (2.5)	537 (4.4)
Bulgaria	r	15 (2.0)	520 (10.6)	85 (2.0)	510 (4.9)
Canada	r	56 (3.4)	532 (3.5)	44 (3.4)	538 (4.6)
Chile		62 (3.8)	427 (5.6)	38 (3.8)	411 (5.1)
Chinese Taipei		6 (2.1)	566 (14.4)	94 (2.1)	569 (4.5)
Cyprus	s	43 (4.0)	466 (3.4)	57 (4.0)	461 (4.1)
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)
Finland		17 (2.1)	532 (5.2)	83 (2.1)	536 (3.7)
Hong Kong, SAR		10 (2.6)	551 (8.1)	90 (2.6)	527 (4.2)
Hungary		12 (1.5)	554 (7.3)	88 (1.5)	551 (3.9)
Indonesia		--	--	--	--
Iran, Islamic Rep.		24 (3.7)	445 (7.4)	76 (3.7)	450 (4.6)
Israel	r	47 (4.0)	465 (8.9)	53 (4.0)	468 (7.0)
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)
Jordan		36 (4.6)	458 (6.1)	64 (4.6)	445 (4.9)
Korea, Rep. of		35 (4.0)	552 (3.7)	65 (4.0)	547 (3.4)
Latvia (LSS)	r	21 (2.6)	508 (6.4)	79 (2.6)	506 (5.3)
Lithuania *		27 (2.5)	504 (6.1)	73 (2.5)	482 (4.5)
Macedonia, Rep. of		32 (2.7)	461 (7.3)	68 (2.7)	457 (5.8)
Malaysia		27 (3.7)	492 (8.4)	73 (3.7)	492 (5.5)
Moldova		32 (2.3)	463 (4.9)	68 (2.3)	458 (4.4)
Morocco		36 (3.2)	320 (4.7)	64 (3.2)	325 (5.6)
Netherlands		27 (2.9)	549 (7.2)	73 (2.9)	544 (8.9)
New Zealand		41 (4.3)	520 (7.9)	59 (4.3)	506 (6.7)
Philippines		72 (4.0)	344 (8.5)	28 (4.0)	344 (14.2)
Romania		31 (2.4)	482 (7.9)	69 (2.4)	465 (6.5)
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)
South Africa		43 (4.2)	248 (16.0)	57 (4.2)	244 (8.6)
Thailand		70 (4.0)	488 (4.8)	30 (4.0)	470 (6.9)
Tunisia		52 (3.9)	427 (4.3)	48 (3.9)	430 (4.2)
Turkey		34 (3.7)	424 (6.4)	66 (3.7)	436 (5.3)
United States	r	58 (3.4)	521 (6.6)	42 (3.4)	519 (5.3)
International Avg.		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.

† 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.

Science teacher background data for Slovak Republic and Slovenia are unavailable.

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.

Percentage of Students Reporting Almost Always or Pretty Often						
Countries with General/ Integrated Science		Countries with Separate Science Subjects				
			Earth Science	Biology	Physics	Chemistry
Australia	52 (1.3)	Belgium (Flemish)	45 (1.9)	55 (1.5)	58 (2.4)	--
Canada	62 (1.8)	Bulgaria	35 (1.9)	36 (2.2)	42 (1.9)	44 (2.2)
Chile	83 (0.9)	Czech Republic	37 (2.2)	40 (2.1)	38 (1.7)	45 (2.2)
Chinese Taipei ^a	74 (1.3)	Finland	33 (1.4)	34 (1.5)	29 (1.4)	31 (1.6)
Cyprus	83 (0.9)	Hungary	26 (1.2)	26 (1.2)	31 (1.5)	31 (1.3)
England	63 (1.7)	Latvia (LSS)	--	27 (1.5)	23 (1.3)	25 (1.5)
Hong Kong, SAR	36 (1.8)	Lithuania [†]	--	--	--	--
Indonesia ^b	59 (1.3)	Macedonia, Rep. of	38 (1.6)	40 (1.5)	45 (1.5)	43 (1.3)
Iran, Islamic Rep.	66 (1.6)	Moldova	66 (1.3)	69 (1.4)	70 (1.2)	73 (1.2)
Israel	56 (1.6)	Morocco	x x	s 68 (1.7)	s 70 (1.1)	x x
Italy	35 (1.4)	Netherlands ^c	49 (2.7)	56 (3.1)	51 (2.7)	--
Japan	29 (1.8)	Romania	77 (1.4)	78 (1.2)	73 (1.1)	76 (1.2)
Jordan	65 (1.3)	Russian Federation	65 (1.2)	66 (1.5)	75 (1.1)	77 (1.2)
Korea, Rep. of	27 (1.7)	Slovak Republic	38 (2.3)	41 (2.1)	47 (2.0)	62 (2.3)
Malaysia	41 (1.3)	Slovenia	--	57 (1.6)	59 (1.3)	61 (1.3)
New Zealand	57 (1.5)	International Avg.	46 (0.5)	49 (0.5)	51 (0.4)	52 (0.5)
Philippines	74 (1.0)					
Singapore	64 (1.3)					
South Africa	73 (1.1)					
Thailand	65 (1.1)					
Tunisia	63 (1.3)					
Turkey	26 (0.9)					
United States	77 (1.2)					
International Avg.	58 (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. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

^b Indonesia: Students were asked about 'IPA science'; data pertain to the composite course taught by biology and physics teachers.

^c 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.

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



REFERENCE 4

School Contexts for
Learning and
Instruction

R

4



Exhibit R4.1

Shortages or Inadequacies in General Facilities and Materials That Affect Schools' Capacity to Provide Science Instruction Some or A Lot

	Percentage of Students Affected by Shortage or Inadequacy				
	Instructional Materials	Budget for Supplies	School Buildings/ Grounds	Heating/Cooling and Lighting	Instructional Space
Australia	26 (3.7)	22 (4.1)	32 (4.1)	21 (3.5)	27 (4.0)
Belgium (Flemish)	6 (2.2)	5 (2.1)	20 (3.3)	4 (1.8)	20 (4.2)
Bulgaria	92 (2.2)	80 (5.8)	71 (4.3)	72 (4.1)	63 (5.0)
Canada	45 (2.8)	43 (2.8)	29 (2.8)	11 (1.9)	25 (2.4)
Chile	23 (3.1)	34 (3.0)	38 (3.6)	22 (2.9)	31 (3.8)
Chinese Taipei	45 (4.4)	45 (4.0)	59 (4.1)	41 (3.9)	51 (4.0)
Cyprus	7 (0.1)	7 (0.1)	61 (0.2)	30 (0.3)	45 (0.3)
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)
Finland	31 (4.0)	10 (2.8)	49 (4.1)	16 (3.6)	41 (3.7)
Hong Kong, SAR	35 (3.9)	21 (3.9)	57 (4.8)	24 (3.4)	57 (4.6)
Hungary	27 (3.9)	25 (3.7)	32 (3.8)	17 (3.4)	39 (4.2)
Indonesia	45 (4.4)	36 (4.3)	39 (4.1)	36 (4.6)	44 (3.9)
Iran, Islamic Rep.	26 (4.0)	61 (3.7)	68 (4.0)	50 (4.7)	54 (3.9)
Israel	15 (3.1)	18 (3.3)	42 (4.5)	28 (3.8)	33 (4.4)
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)
Jordan	74 (4.1)	64 (4.3)	75 (3.9)	74 (3.7)	69 (3.7)
Korea, Rep. of	37 (3.9)	29 (4.0)	51 (4.5)	52 (4.2)	55 (4.2)
Latvia (LSS)	80 (3.8)	87 (3.3)	72 (4.0)	65 (4.9)	65 (4.2)
Lithuania [†]	82 (3.3)	65 (3.9)	31 (4.0)	45 (4.1)	56 (3.8)
Macedonia, Rep. of	38 (4.3)	75 (3.8)	74 (3.7)	52 (4.2)	63 (4.4)
Malaysia	38 (4.3)	44 (4.2)	40 (4.6)	26 (3.4)	40 (4.2)
Moldova	97 (0.9)	95 (1.8)	77 (3.9)	91 (2.4)	69 (4.0)
Morocco	59 (4.0)	77 (3.4)	58 (4.3)	45 (4.1)	45 (4.0)
Netherlands	r 10 (4.0)	r 19 (6.4)	r 45 (7.0)	r 9 (2.8)	r 26 (5.3)
New Zealand	24 (3.6)	27 (3.5)	37 (4.2)	6 (2.1)	29 (3.9)
Philippines	67 (4.0)	52 (4.4)	56 (3.9)	49 (3.9)	52 (4.3)
Romania	54 (4.6)	74 (3.8)	50 (4.8)	36 (4.1)	46 (4.3)
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)
Slovak Republic	44 (4.4)	67 (4.0)	31 (4.6)	12 (2.9)	42 (5.0)
Slovenia	55 (4.2)	68 (4.0)	60 (4.5)	49 (4.3)	62 (4.2)
South Africa	67 (4.1)	66 (4.1)	61 (4.3)	59 (4.1)	57 (3.7)
Thailand	86 (3.0)	84 (2.9)	81 (3.2)	63 (4.1)	78 (3.1)
Tunisia	83 (3.2)	77 (3.5)	87 (2.8)	48 (4.5)	76 (3.7)
Turkey	80 (3.6)	60 (4.0)	78 (3.6)	74 (3.5)	75 (4.0)
United States	r 22 (2.9)	r 27 (4.1)	r 33 (3.4)	r 17 (3.5)	r 33 (3.4)
International Avg.	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.

[†] 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.

An "r" indicates school response data available for 70-80% of students.

Exhibit R4.2

Shortages or Inadequacies in Equipment and Materials for Science Instruction That Affect Schools' Capacity to Provide Instruction in Science Some or A Lot

	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
Australia	27 (4.0)	48 (4.6)	45 (4.7)	11 (2.5)	23 (3.4)	23 (3.5)
Belgium (Flemish)	14 (3.5)	29 (4.5)	30 (4.6)	4 (1.4)	9 (2.4)	11 (3.8)
Bulgaria	88 (3.1)	78 (4.0)	77 (3.9)	45 (5.5)	85 (3.2)	86 (4.0)
Canada	37 (3.2)	49 (2.8)	54 (2.9)	27 (2.5)	39 (2.9)	33 (3.4)
Chile	67 (3.6)	55 (3.4)	58 (4.0)	42 (3.4)	44 (3.8)	48 (4.1)
Chinese Taipei	56 (4.1)	62 (4.1)	68 (4.2)	50 (4.4)	56 (4.5)	58 (4.5)
Cyprus	22 (0.3)	61 (0.2)	r 47 (0.2)	20 (0.3)	28 (0.3)	37 (0.2)
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)
Finland	45 (4.0)	49 (4.1)	50 (4.3)	10 (2.7)	19 (3.4)	15 (3.1)
Hong Kong, SAR	36 (4.5)	65 (4.3)	71 (4.1)	20 (3.6)	32 (4.3)	43 (4.7)
Hungary	61 (4.1)	47 (4.2)	53 (4.3)	20 (3.6)	26 (3.7)	39 (4.1)
Indonesia	61 (4.7)	37 (4.5)	37 (4.5)	34 (4.6)	55 (4.7)	47 (4.6)
Iran, Islamic Rep.	58 (3.6)	75 (4.1)	74 (4.1)	65 (4.2)	71 (3.6)	66 (4.5)
Israel	38 (4.6)	44 (4.3)	44 (4.5)	29 (4.0)	39 (4.1)	32 (4.3)
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)
Jordan	87 (2.9)	56 (4.2)	55 (4.2)	45 (4.4)	72 (3.8)	75 (3.8)
Korea, Rep. of	60 (4.1)	65 (4.1)	77 (3.7)	43 (4.2)	62 (4.1)	68 (3.9)
Latvia (LSS)	78 (4.0)	71 (4.4)	69 (4.6)	40 (4.6)	66 (4.2)	70 (4.6)
Lithuania [†]	81 (3.0)	77 (3.6)	76 (3.7)	37 (4.0)	63 (4.4)	80 (3.5)
Macedonia, Rep. of	90 (2.1)	89 (2.8)	90 (2.6)	89 (2.6)	85 (3.1)	88 (2.1)
Malaysia	49 (4.3)	44 (4.5)	44 (4.5)	30 (3.8)	54 (4.3)	52 (4.0)
Moldova	96 (1.7)	88 (2.6)	87 (3.0)	78 (3.7)	88 (2.3)	91 (2.2)
Morocco	62 (4.0)	62 (4.8)	61 (4.7)	54 (4.7)	65 (4.1)	64 (4.8)
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)
New Zealand	31 (3.9)	45 (4.3)	45 (4.3)	15 (3.0)	22 (3.9)	23 (3.7)
Philippines	64 (3.8)	63 (3.9)	64 (4.0)	56 (3.8)	69 (3.7)	68 (3.8)
Romania	81 (3.3)	88 (3.1)	89 (2.9)	67 (4.2)	69 (4.2)	83 (3.4)
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)
Slovak Republic	81 (3.4)	88 (2.8)	87 (3.1)	32 (4.4)	51 (5.0)	68 (3.5)
Slovenia	72 (4.2)	54 (4.6)	56 (4.0)	18 (3.5)	42 (4.3)	61 (4.1)
South Africa	74 (3.6)	78 (3.5)	79 (3.5)	70 (4.0)	79 (3.3)	79 (3.4)
Thailand	85 (3.1)	80 (3.3)	81 (3.3)	61 (3.9)	88 (3.1)	88 (2.5)
Tunisia	80 (3.4)	42 (4.3)	44 (4.4)	27 (3.8)	56 (4.1)	77 (3.8)
Turkey	91 (2.7)	76 (3.3)	73 (3.1)	43 (3.9)	80 (3.0)	80 (3.6)
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)
International Avg.	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.

[†] 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.

An "r" indicates school response data available for 70-80% of students.

Exhibit R4.3 Availability of Computers for Instructional Purposes

		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	
Australia	r	100 (0.0)	0 (0.0)	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)
Bulgaria		48 (5.9)	9 (2.3)	4 (1.5)	2 (1.1)	37 (5.3)
Canada		100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Chile		70 (2.8)	6 (1.9)	2 (1.1)	4 (1.0)	18 (3.0)
Chinese Taipei		90 (2.5)	9 (2.6)	1 (0.8)	0 (0.0)	0 (0.0)
Cyprus		6 (0.1)	9 (0.1)	16 (0.1)	48 (0.2)	22 (0.2)
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)
Finland		98 (1.2)	1 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)
Hong Kong, SAR	r	86 (3.3)	3 (1.5)	4 (1.8)	3 (1.3)	5 (2.2)
Hungary		98 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)
Indonesia		6 (1.4)	12 (3.6)	3 (1.0)	22 (4.4)	57 (4.5)
Iran, Islamic Rep.		1 (1.1)	1 (0.6)	1 (0.7)	5 (1.7)	92 (2.1)
Israel	s	92 (2.8)	4 (2.4)	1 (0.0)	0 (0.0)	3 (1.7)
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)
Jordan		44 (3.4)	9 (2.5)	1 (0.0)	1 (0.8)	45 (3.7)
Korea, Rep. of		75 (3.6)	14 (3.2)	6 (1.8)	5 (1.8)	1 (0.0)
Latvia (LSS)	r	88 (3.0)	2 (1.7)	1 (1.1)	1 (0.1)	7 (2.3)
Lithuania [‡]		81 (3.2)	8 (2.4)	1 (0.9)	1 (1.0)	8 (2.2)
Macedonia, Rep. of		20 (2.8)	26 (3.6)	5 (2.1)	3 (1.6)	45 (3.8)
Malaysia		6 (2.2)	10 (2.2)	7 (2.0)	26 (3.6)	50 (4.0)
Moldova		81 (3.6)	6 (2.0)	0 (0.0)	0 (0.0)	13 (3.0)
Morocco		3 (1.4)	4 (1.5)	8 (2.2)	16 (2.8)	68 (3.6)
Netherlands	s	99 (1.0)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)
New Zealand		99 (0.6)	0 (0.0)	0 (0.0)	1 (0.0)	0 (0.0)
Philippines		14 (2.2)	8 (2.2)	6 (2.0)	31 (3.9)	42 (4.2)
Romania		14 (3.2)	13 (2.9)	2 (1.2)	5 (1.8)	65 (4.3)
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)
Slovak Republic		21 (3.9)	10 (3.0)	4 (2.0)	4 (1.9)	61 (4.7)
Slovenia		95 (1.9)	3 (1.6)	0 (0.0)	1 (0.9)	1 (0.0)
South Africa		18 (2.9)	4 (1.6)	2 (0.9)	5 (1.5)	72 (3.0)
Thailand		58 (4.3)	16 (2.9)	5 (1.8)	10 (2.7)	11 (2.7)
Tunisia		0 (0.0)	0 (0.0)	1 (0.7)	6 (2.2)	93 (2.3)
Turkey	s	21 (4.1)	2 (1.1)	2 (1.1)	2 (1.3)	73 (4.1)
United States	s	97 (1.8)	3 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
International Avg.		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 Ratio of grade 8 enrollment to total computers for instructional use by grade 8 teachers and students.[‡] 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.

An "r" indicates school response data available for 70-84% of students. An "s" indicates school response data available for 50-69% of students.

	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 to the Internet and No Immediate Plans to Obtain Access
Australia r	94 (1.9)	0 (0.0)	6 (1.9)	0 (0.0)
Belgium (Flemish)	73 (4.0)	1 (0.7)	24 (3.9)	2 (1.2)
Bulgaria	18 (6.5)	0 (0.0)	39 (5.0)	43 (5.2)
Canada	96 (1.2)	1 (0.5)	3 (1.0)	0 (0.3)
Chile	23 (3.5)	3 (1.3)	59 (4.3)	16 (2.8)
Chinese Taipei	89 (2.8)	5 (1.9)	6 (2.0)	0 (0.0)
Cyprus r	23 (0.1)	0 (0.0)	49 (0.2)	28 (0.2)
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)
Finland	100 (0.5)	0 (0.0)	0 (0.5)	0 (0.0)
Hong Kong, SAR r	85 (3.7)	0 (0.0)	15 (3.7)	0 (0.0)
Hungary	46 (4.2)	3 (1.6)	42 (4.2)	9 (2.5)
Indonesia	0 (0.4)	0 (0.0)	15 (3.4)	85 (3.4)
Iran, Islamic Rep.	0 (0.0)	0 (0.0)	39 (4.4)	61 (4.4)
Israel r	68 (4.0)	0 (0.0)	26 (4.0)	6 (2.3)
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)
Jordan	2 (1.4)	1 (0.0)	28 (3.8)	70 (3.7)
Korea, Rep. of	48 (4.4)	0 (0.0)	46 (4.3)	6 (1.9)
Latvia (LSS) r	48 (4.2)	9 (2.9)	20 (3.7)	23 (4.2)
Lithuania †	64 (3.7)	0 (0.0)	24 (3.4)	12 (2.7)
Macedonia, Rep. of	1 (0.9)	0 (0.0)	51 (4.5)	48 (4.4)
Malaysia	16 (3.3)	2 (1.0)	60 (4.4)	22 (3.5)
Moldova	2 (1.2)	0 (0.0)	14 (2.6)	84 (2.9)
Morocco	0 (0.0)	0 (0.0)	8 (2.2)	92 (2.2)
Netherlands r	81 (7.1)	3 (1.9)	15 (7.0)	1 (0.7)
New Zealand	87 (3.0)	1 (0.6)	12 (2.9)	1 (0.0)
Philippines	9 (2.6)	1 (1.0)	48 (4.2)	41 (3.9)
Romania	3 (1.6)	1 (0.7)	41 (4.2)	55 (4.1)
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)
Slovak Republic	6 (2.1)	0 (0.0)	26 (4.1)	68 (4.4)
Slovenia	85 (3.6)	4 (1.9)	11 (3.1)	0 (0.0)
South Africa	7 (1.9)	0 (0.5)	33 (4.0)	60 (4.2)
Thailand	17 (2.5)	0 (0.0)	31 (3.6)	52 (3.5)
Tunisia	1 (0.0)	0 (0.0)	86 (3.2)	13 (3.1)
Turkey	3 (1.3)	1 (0.7)	46 (3.9)	50 (4.1)
United States r	91 (3.1)	0 (0.0)	9 (2.8)	0 (0.0)
International Avg.	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.

† 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.

An "r" indicates school response data available for 70-84% of students.



APPENDIX A

Overview of TIMSS
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. IEA conducted its First International Science Study (FISS) in 1970-71, and the Second International Science Study (SISS) in 1983-84. The First and Second International Mathematics Studies (FIMS and SIMS) were conducted in 1964 and 1980-82, respectively. The Third International Mathematics and Science Study (TIMSS), conducted in 1994-1995, was the largest and most complex IEA study to date, 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.

Participants in TIMSS

Of the 42 countries that participated in TIMSS¹ at the eighth grade in 1995, 26 availed themselves of the opportunity to measure changes in the achievement of their students by also taking part in 1999 (see Exhibit A.1). Twelve additional countries participated in 1999, for a total of 38 countries. Of those taking part in 1999, 19 had also participated in 1995 at the fourth grade.² Since fourth-grade students in 1995 were in eighth grade in 1999, these countries can compare the eighth-grade performance of this cohort of students with their performance at the fourth grade, as well as with the eighth-grade performance of students in other countries.



¹ Results for 41 countries are reported in the 1995 international reports. Italy also completed the 1995 testing, but too late to be included in the international reports. It is counted as a 1995 country in this report and included in all trend exhibits in the 1999 international reports. Unweighted data for the Philippines were reported in an appendix to the international reports in 1995. These data were not included in trend exhibits in the 1999 international reports.



Exhibit A.1

Countries Participating in TIMSS 1999 and 1995

	TIMSS 1999	TIMSS 1995 (Grade 8)	TIMSS 1995 (Grade 4)
Australia	●	●	●
Austria		●	●
Belgium (Flemish)	●	●	
Belgium (French)		●	
Bulgaria	●	●	
Canada	●	●	●
Chile	●		
Chinese Taipei	●		
Colombia		●	
Cyprus	●	●	●
Czech Republic	●	●	●
Denmark		●	
England	●	●	●
Finland	●		
France		●	
Germany		●	
Greece		●	●
Hong Kong, SAR	●	●	●
Hungary	●	●	●
Iceland		●	●
Indonesia	●		
Iran, Islamic Republic	●	●	●
Ireland		●	●
Israel	●	●	●
Italy	●	●	●
Japan	●	●	●
Jordan	●		
Korea, Republic of	●	●	●
Kuwait		●	●
Latvia	●	●	●
Lithuania	●	●	
Macedonia, Republic of	●		
Malaysia	●		
Moldova	●		
Morocco	●		
Netherlands	●	●	●
New Zealand	●	●	●
Norway		●	●
Philippines	●		
Portugal		●	●
Romania	●	●	
Russian Federation	●	●	
Scotland		●	●
Singapore	●	●	●
Slovak Republic	●	●	
Slovenia	●	●	●
South Africa	●	●	
Spain		●	
Sweden		●	
Switzerland		●	
Thailand	●	●	●
Tunisia	●		
Turkey	●		
United States	●	●	●

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

Developing the TIMSS 1999 Science Test

A.2



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.2, 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.³ 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.

A.3



Exhibit A.3 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.

A.4



Exhibit A.4 shows how the trend and replacement items were distributed across these content areas and performance categories.⁴ About one-fourth of the items were in the free-response format, requiring students to gener-

² Two of the 19 countries with fourth-grade data from 1995 (Israel and Thailand) did not satisfy guidelines for sampling procedures at the classroom level and were not included in the comparisons for fourth and eighth grade.

³ 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.

⁴ The 1995 reporting category "Environmental Issues and the Nature of Science" was replaced in 1999 by two separate reporting categories: "Environmental and Resource Issues," and "Scientific Inquiry and the Nature of Science." Extra replacement items were added to each of the new reporting categories.



ate 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 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 test were endorsed by the NRCs of the participating countries.⁵ In addition, countries had an opportunity to match the content of the test to their curriculum. They identified items measuring topics not covered in their intended curriculum. The information from this Test-Curriculum Matching Analysis, provided in Appendix C, indicates that omitting such items has little effect on the overall pattern of results.

⁵ 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 and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

Exhibit A.2 The Three Aspects and Major Categories of the Science Frameworks

Content	Performance Expectations	Perspectives
▶ Earth Sciences ▶ Life Sciences ▶ Physical Sciences ▶ Science, Technology, and Mathematics ▶ History of Science and Technology ▶ Environmental and Resource Issues ▶ Nature of Science ▶ Science and Other Disciplines	▶ Understanding ▶ Theorizing, Analyzing, and Solving Problems ▶ Using Tools, Routine Procedures and Science Processes ▶ Investigating the Natural World ▶ Communicating	▶ Attitudes ▶ Careers ▶ Participation ▶ Increasing Interest ▶ Safety ▶ Habits of Mind

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

Exhibit A.3

Distribution of Science Items by Content Reporting Category and Performance Category

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.

Exhibit A.4 Distribution of Science Trend and Replacement Items by Content Reporting Category and Performance Category

Content Category	Trend Items		Replacement Items		Total Items	
	Number of Items	Number of Points	Number of Items	Number of Points	Number of Items	Number of Points
Earth Science	11	11	11	12	22	23
Life Science	13	13	27	29	40	42
Physics	15	15	24	24	39	39
Chemistry	5	5	15	17	20	22
Environmental and Resource Issues	4	4	9	10	13	14
Scientific Inquiry and the Nature of Science	–	–	12	13	12	13
Total	48	48	98	105	146	153

Performance Category	Trend Items		Replacement Items		Total Items	
	Number of Items	Number of Points	Number of Items	Number of Points	Number of Items	Number of Points
Understanding Simple Information	27	27	30	30	57	57
Understanding Complex Information	14	14	31	33	45	47
Theorizing, Analyzing and Solving Problems	3	3	25	29	28	32
Using Tools, Routine Procedures and Science Processes	4	4	6	6	10	10
Investigating the Natural World	–	–	6	7	6	7
Total	48	48	98	105	146	153

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

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.⁶

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.

⁶ 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.⁷

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.⁸

The selection of valid and efficient samples is crucial to the quality and success of an international comparative study such as TIMSS. The accuracy of the survey results depends on the quality of sampling information and that of the sampling activities themselves. For TIMSS, NRCS worked on all phases of sampling with staff from Statistics Canada. NRCS received training in how to select the school and student samples and in the use of the sampling software. In consultation with the TIMSS sampling referee (Keith Rust, Westat, Inc.), staff from Statistics Canada reviewed the national sampling plans, sampling data, sampling frames, and sample execution. The sampling documentation was used by the International Study Center, in consultation with Statistics Canada and the sampling referee, to evaluate the quality of the samples.

⁷ 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 and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

⁸ 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.

In a few situations where it was not possible to test the entire internationally desired population (all students in the upper of the two adjacent grades with the greatest proportion of 13-year-olds), countries were permitted to define a national desired population that excluded part of the internationally desired population. Exhibit A.5 shows any differences in coverage between the international and national desired populations. Almost all participants achieved 100 percent coverage (36 out of 38), with Lithuania and Latvia the exceptions. Consequently, the results for Lithuania are annotated in exhibits in this report, and because coverage fell below 65 percent for Latvia, the Latvian results have been labeled “Latvia (LSS),” for Latvian-Speaking Schools. Although achieving 100 percent coverage of their populations in 1999, both Italy and Israel had less than complete coverage in 1995 – Italy because four of its provinces did not take part, and Israel because it did not test the Arabic-speaking population. Comparisons between 1995 and 1999 for these countries are based on the subsets of the 1999 populations that were comparable to the populations tested in 1995.



Within the desired population, countries could define a population 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.5 also shows that the degree of such exclusions was small. Only Israel exceeded the 10 percent limit, and this is annotated in the exhibits in 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.



Exhibits A.6 and A.7 present achieved sample sizes for schools and students, respectively, for participating countries. Exhibit A.8 shows the participation rates for schools, students, and overall, both with and without the use of replacement schools. All countries achieved the minimum acceptable participation rates – 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.

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 accordingly in exhibits in this report.

Whereas all countries achieved a high degree of compliance with sampling guidelines in 1999, three of them (Israel, South Africa, and Thailand) had experienced difficulties with sampling at the classroom level in 1995. Accordingly, results for these three countries are reported in a separate panel of the exhibits in these reports that deal with trends from 1995.

Exhibit A.5

Coverage of TIMSS 1999 Target Population

	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
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%
United States	100%		0%	4%	4%

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

Exhibit A.6 School Sample Sizes

	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
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
United States	250	246	202	19	221

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

Exhibit A.7 Student Sample Sizes

	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
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
United States	94%	9981	115	142	9724	652	9072

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

Exhibit A.8 Overall Participation Rates

	School Participation		Student Participation	Overall Participation	
	Before Replacement	After Replacement		Before Replacement	After Replacement
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%
United States	83%	90%	94%	78%	85%

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.

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. 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 quality control monitors participated in this training.

The 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.⁹ Quality control monitors interviewed school coordinators in all 38 countries, and observed a total of 550 testing sessions.

The results of the interviews indicate 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.

⁹ Steps taken to ensure high-quality data collection in TIMSS 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.

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. Because of the burden of maintaining scoring consistency across time, no free-response items were used to measure trends from 1995 to 1999. However, samples of student responses from each country to selected items in 1999 have been scanned using advanced imaging technology in preparation for studying trends to 2003 and beyond.

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.

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.9 shows the average and range of the within-country exact percent of agreement between scorers on the 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.

A.9



Exhibit A.9

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
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
United States	94	74	100	89	64	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

A.10



Exhibit A.10 displays the science test reliability coefficient for each country. This coefficient is the median KR-20 reliability across the eight test booklets. 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.

Data Processing

To ensure the availability of comparable, high-quality data for analysis, TIMSS took rigorous quality control steps to create the international database.¹⁰ 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.

Throughout the process, the data were checked and double-checked by the IEA Data Processing Center, the International Study Center, and the national centers. The national centers were contacted regularly and given multiple opportunities to review the data for their countries. In conjunction with the IEA Data Processing Center, the International Study Center reviewed item statistics for each cognitive item in each country to identify poorly performing items. On the science test, 18 countries had one or more items deleted (in most cases, one). Usually the poor statistics (negative point-biserials for the key, large item-by-country interactions, and statistics indicating lack of fit with the model) were a result of translation, adaptation, or printing deviations.

¹⁰ These steps are detailed in Hastedt, D., and Gonzalez, E. (2000), "Data Management and Database Construction" in M.O. Martin, K.D. Gregory and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

	Reliability Coefficient ¹
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
United States	0.85
International Median	0.80

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

¹ The reliability coefficient for each country is the median KR-20 reliability across the eight test booklets.

IRT Scaling and Data Analysis

The general approach to reporting the TIMSS achievement data was based primarily on item response theory (IRT) scaling methods.¹¹ 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 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. However, insufficient items were used both in 1995 and in 1999 to establish reliable IRT content area scales for trend purposes. The trend exhibits presented in Chapter 3 were based on the average percentage of students responding correctly to the common items in each content area.

¹¹ 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 and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.



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 national performance based on samples of students, rather than the values that could be calculated if every student in every country 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.¹² 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.

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 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 country to be different from that for another country. In the

¹² 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 and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

multiple comparison charts (Exhibit 1.2 and those in Appendix B), the Bonferroni procedure adjusts for the number of countries in the chart, minus one. In exhibits where a country statistic is compared to the international average, the adjustment is for the number of countries.¹³

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 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 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.¹⁴

¹³ 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 and S.E. Stemler (eds.), *TIMSS 1999 Technical Report*, Chestnut Hill, MA: Boston College.

¹⁴ 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 and S.E. Stemler (eds.), *TIMSS 1999 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.

Science Curriculum Questionnaire

In an effort to collect information about the content of the intended curriculum in science, TIMSS asked National Research Coordinators to complete a questionnaire about the structure, organization, and content coverage of their national curricula. NRCS 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 NRCS found it necessary to expand on or qualify the topic description to describe their situation accurately. These country-specific adaptations to the science curriculum questionnaire are presented in Exhibit A.11.



Exhibit A.11 Country-Specific Variations in Science Topics in the Curriculum Questionnaire

	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.
Chile	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.
	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.
Chinese Taipei	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.
	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
	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, measurements (reliability, replication, experimental error,	All or almost all of the students (at least 90%)	Formulating hypotheses, drawing conclusions, and generalizing not included in curriculum through grade 8.
Cyprus	Scientific Inquiry and the Nature of Science: Scientific measurements (reliability, replication, experimental error,	All or almost all of the students (at least 90%)	Reliability not included in curriculum through grade 8.
	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.

	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.
	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.
New Zealand	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.

	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.

APPENDIX B

B

Multiple Comparisons
of Average Achievement
in Science Content Areas



Exhibit B.1 Multiple Comparisons of Average Achievement in Earth Science

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

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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

Significance tests adjusted for multiple comparisons

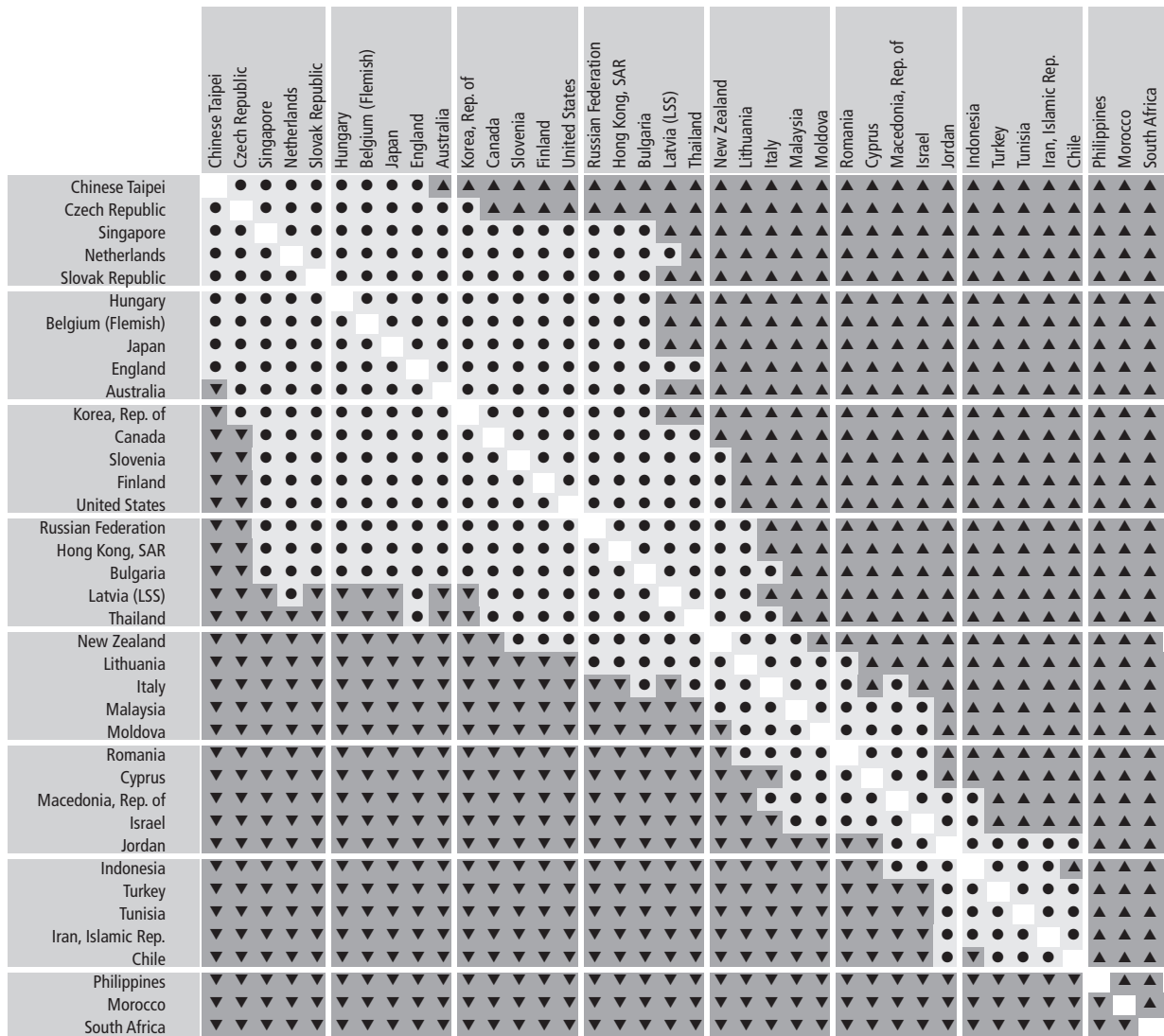
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

Exhibit B.2

Multiple Comparisons of Average Achievement in Life Science

TIMSS 1999
8th grade
 Science

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



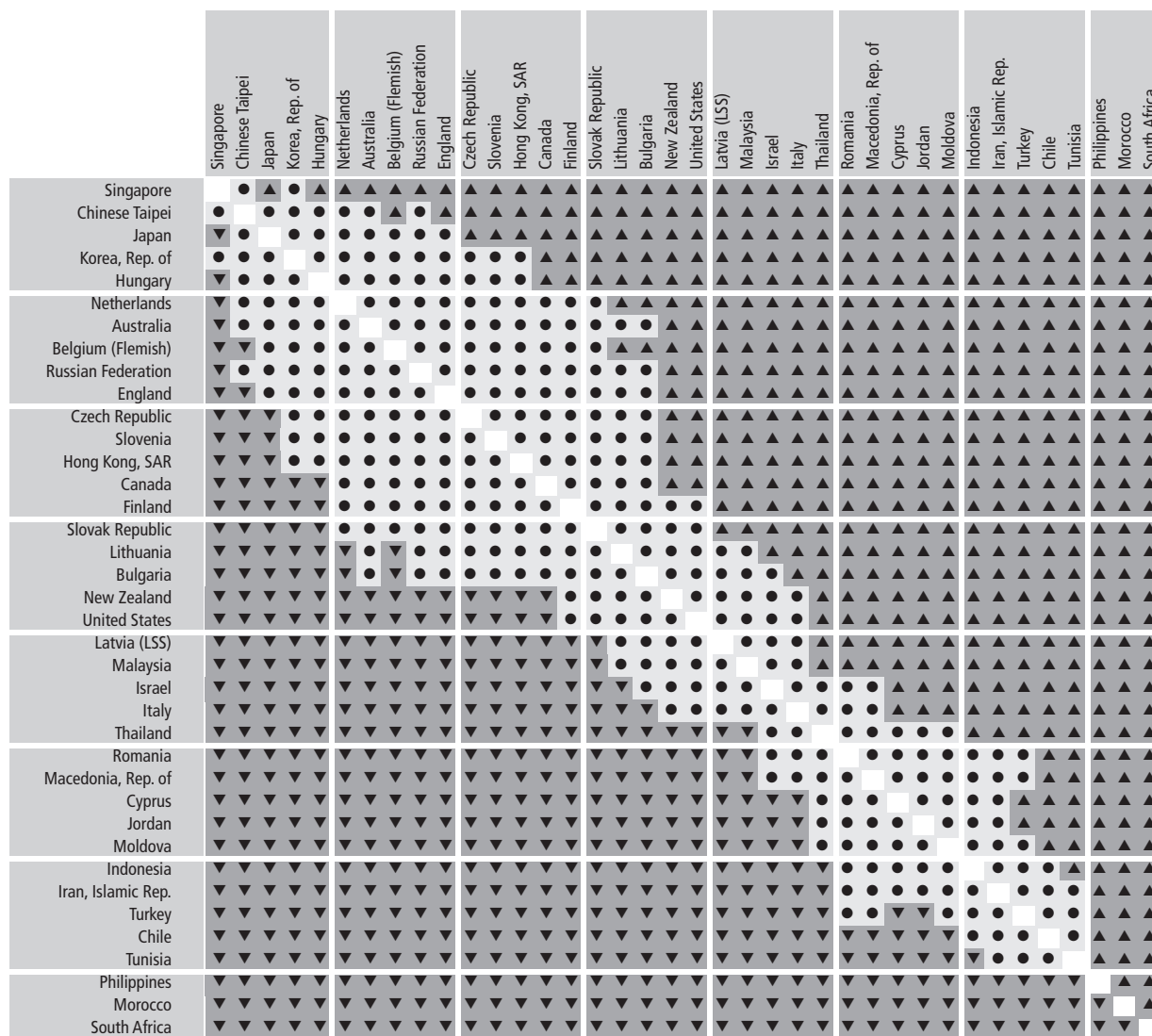
- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

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 country to compare performance with the countries listed along the top of the chart. The symbols indicate whether the average achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the average achievement of the two countries.



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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

Significance tests adjusted for multiple comparisons

Exhibit B.4 Multiple Comparisons of Average Achievement in Chemistry

TIMSS 1999
8th grade
 Science

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

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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

Significance tests adjusted for multiple comparisons

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

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

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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

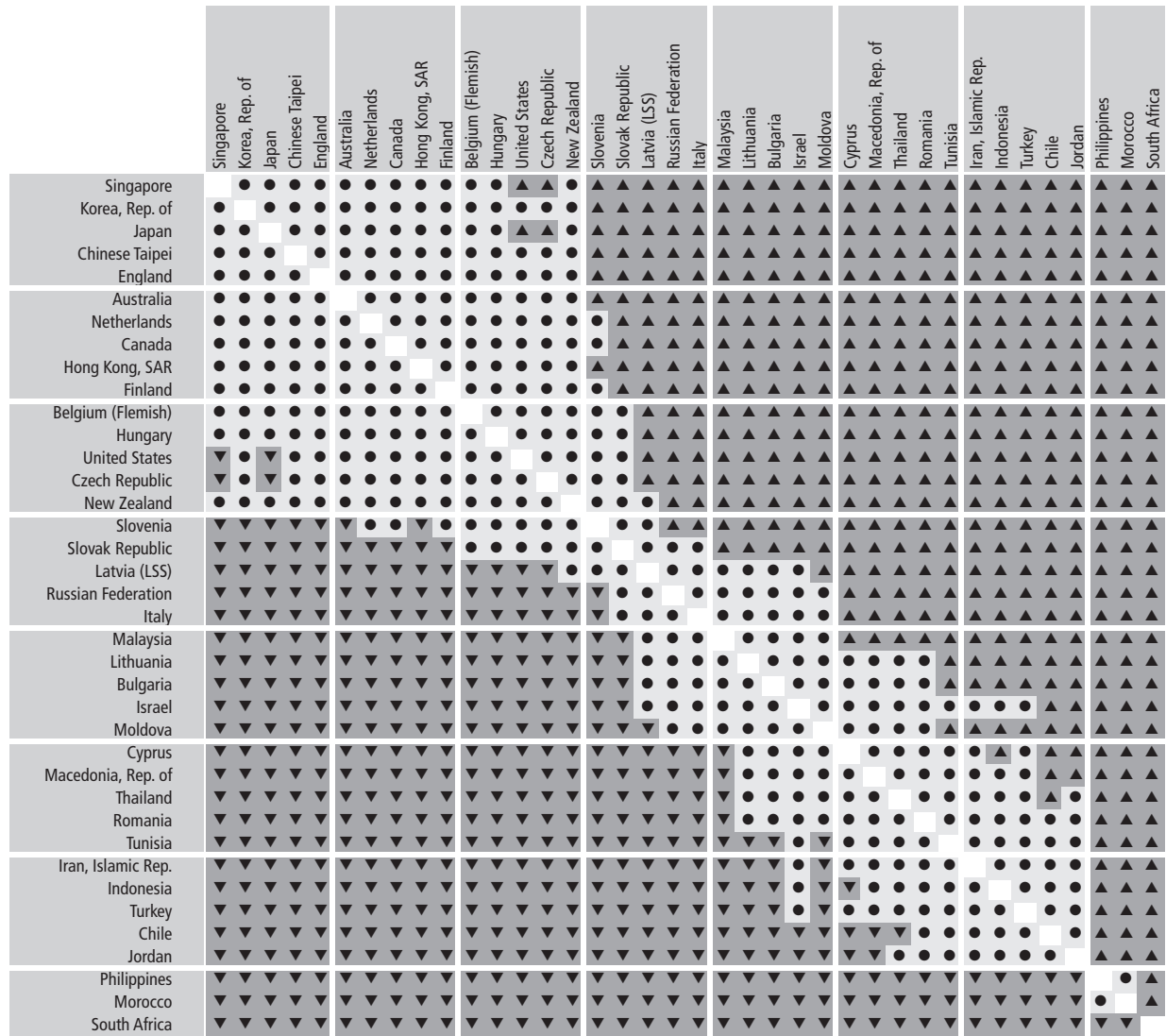
Significance tests adjusted for multiple comparisons

Exhibit B.6

Multiple Comparisons of Average Achievement in Scientific Inquiry and the Nature of Science

TIMSS 1999
8th grade
Science

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



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

- ▲ Average achievement significantly higher than comparison country
- No statistically significant difference from comparison country
- ▼ Average achievement significantly lower than comparison country

Significance tests adjusted for multiple comparisons



APPENDIX C

The Test-Curriculum Matching Analysis: Science





When comparing student achievement across countries, it is important that the comparisons be as fair as possible. TIMSS has worked toward this goal in a number of ways, including providing detailed procedures for standardizing the population definitions, sampling, test translations, test administration, scoring, and database formation. Similar to the procedures used for developing the original TIMSS instruments, developing the TIMSS 1999 tests involved a series of reviews by representatives of the participating countries, experts in the sciences, and testing specialists.¹ The National Research Coordinators (NRCs) from each country formally approved the TIMSS 1999 tests, thus accepting them as being sufficiently fair to compare their students' science achievement with that of students from other countries.

Although the tests were developed to represent a set of agreed-upon science content, differences among the curricula of participating countries result in various topics being taught at different grades. To restrict test items to topics included in the curricula of all participating countries and covered in the same sequence would severely limit test coverage and restrict the research questions that the study is designed to address. The tests, therefore, inevitably have some items measuring topics unfamiliar to some students in some countries.

The Test-Curriculum Matching Analysis (TCMA) was conducted to investigate the appropriateness of the TIMSS 1999 science test for the eighth-grade students in the participating countries. TCMA also shows how student performance for individual countries varies when based only on the test questions that are judged to be relevant to their own curricula.²

To gather data about the extent to which the TIMSS 1999 tests were relevant to the curricula of the participating countries, each NRC reported whether each item was in that country's intended curriculum at the grade tested. The NRC was asked to choose a person or persons who were very familiar with the curriculum at the grade tested to make this determination. Since an item might be in the curriculum for some but not all students in a country, an item was determined appropriate if it was in the intended curriculum for more than 50 percent of the students. The NRCs had considerable flexibility in selecting items and may have considered items inappropriate for other reasons. All participating countries returned the information for analysis.

¹ See Appendix A for more information on test development.

² Because there may also be curriculum areas covered in some countries that are not covered by the TIMSS 1999 tests, the TCMA does not provide complete information about how well the tests cover the curricula of the countries.



Exhibits C.1 and C.2 present the TCMA results for the TIMSS 1999 tests. Exhibit C.1 shows the average percent correct for each country on items selected as appropriate and on the test as a whole. Exhibit C.2 shows the standard errors corresponding to the percentages presented in Exhibit C.1.

In Exhibit C.1, the last row of the exhibit indicates that the countries varied substantially in the number of items (score points) identified as appropriate.³ The percentages ranged from 100 percent (153 score points) in Slovenia, the United States, Latvia (LSS), Lithuania, and Moldova to 31 percent (47 score points) in South Africa. Nineteen of the 38 countries indicated that the items representing three-quarters or more of the score points (115 out of a possible 153) were appropriate.

Since most countries indicated that some items were not included in their intended curriculum at the grade tested, the data were analyzed to determine whether the inclusion of these items had any effect on the international performance comparisons.⁴

The first column in Exhibit C.1 shows the average percent correct on all test items for each country. The countries are presented in order of their overall performance based on overall percent correct, from highest to lowest. To interpret this exhibit, reading across a row provides the average percent correct for the students in that country on the items selected by each of the countries listed across the top of the exhibit. For example, Chinese Taipei, where the average percent correct was 69 percent on its own set of items, also had 67 percent correct for the items selected by Singapore, 67 percent for the items selected by Korea, and so forth. The column for a country listed across the top shows how each of the other countries performed on the subset of items selected as appropriate for its own students. Using the set of items selected by Canada as an example, on average 66 percent of these items were answered correctly by students in Chinese Taipei, 67 percent by students in Singapore, 65 percent by those in Korea, and so forth. The shaded diagonal element in the exhibit shows how each country performed on the subset of items that it selected based on its own curriculum. Thus, Canadian students averaged 61 percent correct on the set of items identified by Canada for the analysis.

The international averages of each country's selected items are presented across the second to the last row of the exhibit. They show that the selection of items for the participating countries varied somewhat in average difficulty, ranging from 51 to 54 percent. Despite these differences, the overall picture presented by Exhibit C.1 reveals that different item selections do not make a major difference in how well countries perform rela-

³ Of the 146 items in the test, some items were assigned more score points than others. In particular, some items had two parts, and some extended-response items were scored on a two-point scale. The total number of score points available for analysis was 153. The TCMA uses score points in order to give the same weight to items given them in test scoring.

⁴ It should be noted that the performance levels presented in Exhibit C.1 are based on average percents, which are different from the average scale scores that are presented in Chapter 1.

tive to one another. The items selected by some countries were more difficult than those selected by others. The relative performance of countries on various item selections did vary somewhat, but generally not in a statistically significant manner.⁵

Comparing the diagonal element for a country with the overall average percent correct shows the difference between performance on the subset of items chosen as appropriate and performance on the test as a whole. In general, there were only small increases in each country's performance on its own subset of items. To illustrate, the average percent correct for Chinese Taipei was 66 percent. The diagonal element shows that Chinese Taipei students had about the same percent correct (69 percent) based on the smaller set of items selected as they did overall. Most countries had a difference of less than five percentage points between the two performance measures, with the largest difference six percent for Tunisia (45 percent compared with 39 percent) and Iran (48 percent compared with 42 percent).

It is clear that the selection of items does not have a major effect on the general relationship among countries. Countries that had substantially higher or lower relative performance on all items also had higher or lower relative performance on the different sets of items selected for the TCMA. For example, Chinese Taipei had the highest average percent correct on the test as a whole and on all but one of the different item selections, with Singapore, Korea, Japan and Hungary among the five highest-performing countries in all cases. Although there are some changes in the ordering of countries based on the items selected for the TCMA, most of these differences are within the boundaries of sampling error. As an example, consider the 73 score points selected by Tunisia. The Tunisian students did better on these items than on the test as a whole, with 45 percent correct on these items, on average, compared with 39 percent correct on all items. However, most other countries also did better on these particular items, with an international average of 54 percent correct on the items selected by Tunisia. Thirty-one of the 33 countries that performed better than Tunisia on the overall test also performed better on the items selected by Tunisia.

The TCMA results provide evidence that the TIMSS 1999 science test provides a reasonable basis for comparing achievement of the participating countries. This result is not unexpected, since making the test as fair as possible was a major consideration in test development. The fact that the majority of countries indicated that most items were appropriate for their students means that the different average percent correct estimates were based on essentially the same items. Insofar as countries

⁵ Small differences in performance shown in this exhibit are not statistically significant. The standard errors for the estimated average percent correct statistics are in Exhibit C.2. It can be said with 95 percent confidence that the value for the entire population falls between the sample estimate plus or minus two standard errors.



rejected items that would be difficult for their students, these items tended to be difficult for students in other countries as well. The analysis shows that omitting such items tends to improve the results for that country, but also tends to improve the results for all other countries, so that the overall pattern of results is largely unaffected.

Instructions: Read **across** the row to compare that country's performance based on the test items included by each of the countries across the top. Read **down** the column under a country name to compare the performance of the country down the left on the items included by the country listed on the top. Read along the **diagonal** to compare performance for each different country based on its own decisions about the test items to include.

Countries	Average Percent Correct on All Items	Chinese Taipei	Singapore	Korea, Rep. of	Japan	Hungary	Australia	Netherlands	Finland	England	Canada	Slovak Republic	Czech Republic	Hong Kong, SAR	Belgium (Flemish)	Slovenia	Russian Federation	Bulgaria	United States	Latvia (LSS)	Malaysia	Lithuania	Italy	Thailand	Israel	Romania	Moldova	Cyprus	Jordan	Macedonia, Rep. of	Iran, Islamic Rep.	Turkey	Tunisia	Chile	Philippines	Morocco	South Africa		
	66 (0.6)	69	67	67	66	68	68	68	67	96	96	66	66	67	66	66	99	66	66	68	66	66	66	66	67	68	67	68	67	68	67	69	96	67	99	68	70	69	
	66 (1.4)	68	68	67	66	66	68	68	67	96	96	66	66	67	66	66	99	66	66	68	66	66	66	66	67	68	67	68	67	68	67	69	96	67	99	68	70	69	
	63 (0.4)	64	63	64	64	63	63	65	64	63	65	63	62	65	65	63	63	63	64	63	64	63	64	63	65	62	63	64	63	65	62	63	65	62	66	65	65	65	
	62 (0.4)	65	63	64	62	63	63	64	62	62	63	62	62	65	62	62	62	62	63	62	62	63	62	62	62	63	62	64	64	63	64	62	62	65	61	66	64	66	
	62 (0.7)	63	61	62	64	63	62	65	63	62	61	62	62	65	62	62	62	62	63	62	62	63	62	62	62	63	62	64	64	65	64	62	62	65	61	66	64	66	
	60 (0.9)	61	60	61	60	61	61	63	62	60	62	60	60	63	61	60	59	61	60	63	60	60	60	62	60	61	60	61	62	61	61	61	60	63	61	63	63	62	
	60 (1.4)	61	60	62	60	61	64	62	60	63	60	60	62	62	60	60	59	61	60	62	60	60	62	59	61	60	62	62	61	60	60	60	63	60	63	63	63		
	60 (0.5)	59	59	60	61	60	60	63	60	61	60	60	60	62	60	60	61	60	60	62	60	60	60	61	60	60	62	61	60	60	60	60	63	60	63	63	63		
	60 (1.0)	60	61	61	60	61	62	61	61	62	60	60	60	63	62	60	58	61	60	62	60	61	60	61	60	62	61	60	60	60	60	60	62	60	63	62	63		
	59 (0.4)	59	59	60	60	60	62	61	60	61	61	59	59	60	61	59	60	59	62	59	59	59	59	59	60	59	61	61	60	60	60	60	60	60	61	62	61		
	59 (0.7)	60	58	59	59	59	62	58	58	59	59	59	59	58	59	58	60	61	59	60	59	58	59	61	59	60	59	61	61	60	59	59	59	61	61	61	61	57	
	59 (0.8)	60	58	59	60	59	59	62	61	58	59	59	59	61	60	59	59	61	59	60	59	58	59	61	60	59	60	61	61	58	59	62	59	62	63	58	62	58	
	59 (0.5)	59	59	60	58	59	63	61	60	60	59	59	59	63	61	59	58	60	59	61	59	59	59	60	58	59	61	60	61	59	59	59	61	59	62	63	58	60	62
	58 (0.6)	59	58	59	59	58	59	62	61	58	59	58	58	60	59	58	60	58	59	58	57	58	61	60	57	59	58	60	60	60	60	58	58	62	58	61	62	60	
	58 (1.1)	59	56	59	59	58	58	61	60	56	59	58	57	61	57	58	60	58	58	58	57	58	59	58	57	59	58	59	59	61	62	57	57	60	57	61	60	61	
	56 (1.1)	58	55	56	57	56	56	59	59	54	56	56	55	58	56	56	57	56	56	56	55	56	57	55	57	56	57	56	58	58	59	55	56	58	55	58	58	56	
	55 (0.8)	57	55	56	56	56	56	58	57	55	57	55	54	56	55	57	55	54	56	55	55	55	57	55	56	56	57	57	56	57	55	55	55	58	55	58	58	56	
	55 (1.0)	55	55	56	55	56	55	54	57	56	55	56	55	54	57	56	55	55	55	58	55	55	56	54	55	55	56	56	55	57	55	55	55	55	57	55	57	57	
	53 (0.6)	53	52	53	54	53	53	56	55	52	54	53	53	55	53	53	54	54	53	53	52	53	53	52	53	52	53	54	54	55	55	53	53	56	53	56	56	51	
	52 (0.8)	54	53	54	52	53	56	53	53	55	52	51	57	53	52	54	53	52	53	52	53	52	53	52	53	52	53	54	54	55	55	52	52	56	52	56	56	57	
	51 (0.7)	52	50	52	52	52	54	53	50	51	51	51	53	50	51	50	51	51	51	51	50	51	53	51	50	51	52	51	53	53	54	54	51	51	54	55	54	51	
	50 (0.7)	50	49	50	50	50	51	53	52	51	51	50	50	51	52	50	51	50	50	51	50	50	50	50	50	51	50	51	52	51	51	50	54	50	51	54	49		
	47 (0.7)	48	47	48	48	48	47	49	49	48	47	47	47	49	48	47	47	48	47	48	47	47	48	48	47	48	48	49	49	49	47	47	47	46	49	49	49		
	47 (0.9)	48	46	48	47	47	49	49	46	47	47	47	49	47	47	47	48	47	47	46	47	46	47	48	47	48	48	49	49	50	46	47	50	45	50	49	48		
	46 (0.7)	47	46	46	47	46	47	49	50	45	46	46	46	48	47	46	48	46	46	46	45	46	48	48	46	47	46	48	48	49	46	47	49	46	48	50	47		
	46 (0.3)	47	47	46	47	45	47	48	46	46	46	46	46	49	48	46	47	47	46	47	46	46	47	46	45	46	46	48	47	48	49	45	46	51	46	49	48		
	46 (0.5)	47	47	47	47	46	47	47	48	46	47	46	46	49	46	46	47	46	47	46	47	46	46	46	46	47	46	48	48	51	45	46	47	45	49	50	51		
	44 (0.7)	47	44	46	46	45	46	47	48	44	44	45	45	48	45	44	45	46	44	47	45	44	46	45	46	44	46	48	49	44	45	48	44	48	46	47	48		
	42 (0.6)	44	42	43	43	42	43	44	45	43	43	42	43	45	42	44	44	42	43	42	42	42	43	41	43	42	45	44	45	48	42	43	45	41	45	44	44		
	41 (0.6)	42	41	41	40	40	42	43	43	41	43	41	41	44	43	41	41	41	41	43	41	40	41	42	41	39	41	42	43	44	41	41	44	41	43	44	40	40	
	41 (0.6)	42	41	41	40	41	43	44	41	41	41	41	41	43	42	41	42	41	42	41	40	41	42	41	42	41	42	41	42	43	44	41	44	41	43	44	40	40	
	39 (0.3)	39	40	41	39	39	41	41	41	41	41	39	39	42	41	39	40	39	40	39	39	39	40	40	39	40	39	40	41	41	42	39	39	45	39	44	44	44	
	38 (0.6)	39	38	39	39	38	39	42	40	38	38	38	38	40	39	38	38	39	40	38	38	38	38	38	38	39	38	39	40	39	38	38	41	38	41	42	39	39	
	32 (0.8)	34	32	34	32	33	33	33	33	32	34	32	32	35	34	32	32	32	32	32	32	32	32	32	32	32	33	34	36	32	32	32	34	31	36	34	32		
	28 (0.3)	29	28	28	28	29	29	29	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	29	29	31	27	28	29	27	31	30	31		
	24 (0.7)	25	24	25	25	24	25	24	25	24	25	24	24	26	25	24	25	24	24	24	24	23	24	24	25	24	25	25	26	23	24	25	24	23	26	27	27		
	51 (0.1)	53	51	52	52	52	54	53	51	52	51	51	51	54	52	51	52	52	51	53	51	51	53	52	51	52	51	53	53	53	54	51	51	51	54	51	54	54	
International Avg.																																							

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

Of the 146 items in the Science test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 153 total score points.

APPENDIX D

Percentiles and Standard Deviations of Science Achievement

D



Exhibit D.1 Percentiles of Achievement in Science

	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
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)
United States	349 (5.5)	450 (5.4)	520 (5.3)	583 (4.6)	667 (3.4)

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

() Standard errors appear in parentheses.

Exhibit D.2 Standard Deviations of Achievement in Science

TIMSS 1999
8th grade
 Science

	Overall		Girls		Boys	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
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)
United States	515 (4.6)	97 (2.0)	505 (4.6)	92 (2.0)	524 (5.5)	102 (2.6)

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

() Standard errors appear in parentheses.



APPENDIX E

Acknowledgments

E





TIMSS 1999 was truly a collaborative effort among hundreds of individuals around the world. Staff from the national research centers in each participating country, the International Association for the Evaluation of Educational Achievement (IEA), the International Study Center (ISC) at Boston College, advisors, and funding agencies worked closely to develop and implement TIMSS 1999. The project would not have been possible without the tireless efforts of all involved. Inside, the individuals and organizations are acknowledged for their contributions. Given that implementing TIMSS 1999 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 also acknowledges the students, teachers, and school principals who contributed their time and effort to the study. This report would not be possible without them.

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Management and Operations

TIMSS 1999 was conducted under the auspices of the IEA. The study was co-directed by Michael O. Martin and Ina V.S. Mullis, and managed centrally by the staff of the International Study Center at Boston College, Lynch School of Education. 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, Hans Wagemaker, Executive Director, was responsible for overseeing fundraising and country participation. The IEA Secretariat also coordinated translation verification and recruiting of quality control monitors. The data were processed centrally by the IEA Data Processing Center in Hamburg. Statistics Canada was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. Educational Testing Service in Princeton, New Jersey conducted the scaling of the achievement data.

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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.

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