Science achievement in the primary school years: IEA's third international Mathematics and science study (TIMSS)

Chestnut Hill, MA: TIMSS International Study Center, 1997

International Association for the Evaluation of
Educational Achievement

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Contents

Executive Summary

SCIENCE

Since its inception in 1959, the International Association for the Evaluation of Educational Achievement (IEA) has conducted a series of international comparative studies designed to provide policy makers, educators, researchers, and practitioners with information about educational achievement and learning contexts. The Third International Mathematics and Science Study (TIMSS) is the largest and most ambitious of these studies ever undertaken.

The scope and complexity of TIMSS is enormous. Forty-five countries collected data in more than 30 different languages. Five grade levels were tested in the two subject areas, totaling more than half a million students tested around the world. The success of TIMSS depended on a collaborative effort between the research centers in each country responsible for implementing the steps of the project and the network of centers responsible for managing the across-country tasks such as training country representatives in standardized procedures, selecting comparable samples of schools and students, and conducting the various steps required for data processing and analysis. Including the administrators in the approximately 15,000 schools involved, many thousands of individuals around the world were involved in the data collection effort. Most countries collected their data in May and June of 1995, although those countries on a southern hemisphere schedule tested in late 1994, which was the end of their school year.

Four content dimensions were covered in the TIMSS science tests given to the primary-school students: earth science, life science, physical science, and environmental issues and the nature of science. About one-fourth of the questions were in free-response format requiring students to generate and write their answers. These types of questions, some of which required extended responses, were allotted approximately one-third of the testing time. Chapter 3 of this report contains 20 example items illustrating the range of science concepts and processes addressed by the TIMSS test.

Because the home, school, and national contexts within which education takes place can play important roles in how students learn science, TIMSS collected extensive information about such background factors. The students who participated in TIMSS completed questionnaires about their home and school experiences related to learning science. Also, teachers and school administrators completed questionnaires about instructional practices. System-level information was provided by each participating country.

TIMSS was conducted with attention to quality at every step of the way. Rigorous procedures were designed specifically to translate the tests, and numerous regional training sessions were held in data collection and scoring procedures. Quality control monitors observed testing sessions and sent reports back to the TIMSS International Study Center at Boston College. The samples of students selected for testing were scrutinized according to rigorous standards designed to prevent bias and ensure

comparability. In this publication, the countries are grouped for reporting of achievement according to their compliance with the sampling guidelines and the level of their participation rates. Prior to analysis, the data from each country were subjected to exhaustive checks for adherence to the international formats as well as for within-country consistency and comparability across countries.

Of the five grade levels tested, the results provided in this report describe students' science achievement at both the third and fourth grades. For most, but not all TIMSS countries, the two grades tested at the primary-school level represented the third and fourth years of formal schooling. Special emphasis is placed on the fourth-grade results, including selected information about students' background experiences and teachers' classroom practices in science. Results are reported for the 26 countries that completed all of the steps on the schedule necessary to appear in this report.

The science achievement results for students in the seventh and eighth grades were published in *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*.[1] This report describes science achievement in 41 countries, including results for selected background and attitudinal factors. Achievement results for students in their final year of secondary school will appear in a subsequent report.

The following sections summarize the major findings described in this report.

Students' Science Achievement

- Korea was the top-performing country at both the fourth and third grades. Japan, the United States, Austria, and Australia also performed very well at both grades. Lower-performing countries included Iran and Kuwait (see Tables 1.1 and 1.2; Figures 1.1 and 1.2).

- Perhaps the most striking finding was the large difference in average science achievement between the top-performing and bottom-performing countries. Despite this large difference, when countries were ordered by average achievement there were only small or negligible differences in achievement between each country and the one with the next-lowest average achievement. In some sense, at both grades, the results provide a chain of overlapping performances, where most countries had average achievement similar to a cluster of other countries, but from the beginning to the end of the chain there were substantial

[1] Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: The IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College. The mathematics achievement results for seventh- and eighth-grade students are presented in a companion volume, 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.

differences. For example, at both grades, average achievement in top-performing Korea was comparable to or even exceeded performance for 95% of the students in the lowest-performing countries.

- Many countries (9 of 13) that performed above the international average at the fourth grade also did so at the eighth grade. However, Ireland, the United States, Canada, and Scotland were above the international average at the fourth grade, but just at the average at the eighth grade (see Figure 1.3).

- In about half the countries and internationally, boys had significantly higher mean science achievement than girls at both the third and fourth grades. This is attributable mainly to significantly higher performance by boys in earth science and physical science. In few countries were significant gender differences found in life science or environmental issues and the nature of science, although in life science one such difference favored girls in New Zealand at both grades. Gender differences at the third and fourth grades were much less pervasive than at the seventh and eighth grades.

- Compared with their overall performance in science, many countries did relatively better or worse in some content areas than they did in others. Consistent with the idea of countries having different emphases in curriculum, some countries performed better in life science, some performed better in physics, and others performed better in chemistry.

- Internationally, students found many of the physical science items quite challenging. For example, an item that required students to understand what happens to the level of water in a watering can as the can is tilted was answered correctly by less than a fifth of both third- and fourth-grade students on average. Fourth-grade students, in general, performed better than third-grade students on this item, but in only one country (Singapore) did 30% or more of fourth-grade students correctly draw a line showing the level of water in the tilted can.

- In general, students had slightly less difficulty with the life science items, although there were some difficult items in this content area. A free-response item requiring the students to write down one thing that the heart does to help other parts of the body was answered correctly by 28% of third-grade students and 40% of fourth graders. Only in Australia, England, and the United States did more than 60% of students correctly mention the heart's role in pumping blood around the body.

- One of the relatively easier earth science items was a multiple-choice item that asked students to indicate why the moon shines at night even though it produces no light. About two-thirds of both third- and fourth-grade students correctly recognized from a list of four options that the moon reflects the light of the sun. More than 80% of the fourth-grade students in Hong Kong, the Netherlands, Norway, and Singapore answered this item correctly.

Students' Attitudes Towards Science

- Four-fifths of the fourth graders in every country except the Netherlands indicated that they liked science to some degree. In the Netherlands, a third of the students reported that they disliked science.

- In most countries, fourth-grade students of both genders were equally positive about liking science. However, a greater percentage of boys reported liking science in Austria, Japan, and Korea, and a greater percentage of girls in Iceland and Ireland.

- In all except three countries, the majority of students, male and female, agreed or strongly agreed that they did well in science – a perception that did not always coincide with the comparisons of achievement across countries on the TIMSS test.

Home Environment

Home factors were strongly related to science achievement in every country that participated in TIMSS.

- In most countries, fourth-grade students who reported having more educational resources in the home had higher science achievement than those who reported little access to such resources. Positive relationships were found between science achievement and having study aids in the home, including a dictionary, a computer, and a study desk/table for the student's own use.

- The number of books in the home can be an indicator of a home environment that values and provides general academic support. In most TIMSS countries, the more books students reported in the home, the higher their science achievement.

- In all but a few countries, 80% or more of the students responded that they always or almost always spoke the language they were tested in at home. Most certainly, these relatively high percentages reflect the effort expended by the participating countries to test in more than one language when necessary.

- Students having both parents born in the country had higher average science achievement than those with one or both parents born abroad in about a quarter of the countries (e.g., Austria, Canada, Cyprus, England, Greece, and the United States).

- For about half of the TIMSS countries, students born abroad had lower average science achievement than students born in the country.

- For a normal school day, fourth-grade students in most countries reported spending between half an hour and an hour studying or doing homework in science.

- Beyond the one to two hours of daily television viewing reported by close to the majority of fourth graders in all participating countries, the amount of television students watched was negatively associated with science achievement.

- Besides watching television, students reported spending from one to two hours each day playing or talking with friends and one to two hours playing sports. (It should be noted, however, that the time spent in these activities is not additive because students can talk with their friends at sporting events or while watching TV, for example.)

Instructional Contexts and Practices

In comparison with the positive relationships observed between science achievement and home factors, the relationships were less clear between achievement and various instructional variables, both within and across countries. Obviously, educational practices such as tracking and streaming can serve to systematically confound these relationships. Also, the interaction among instructional variables can be extremely complex and merits further study.

- The qualifications required for teaching certification were relatively uniform across countries. Most countries reported that three or four years of post-secondary education were required, in either a university, a teacher training institution, or both. Almost all countries reported that teaching practice was a requirement, as was an examination or evaluation.

- In every country except Greece and the Netherlands, the majority of fourth-grade students were taught science by female teachers. For seven countries, the percentage of students taught by female teachers was 90% or more (the Czech Republic, Hungary, Israel, Latvia (LSS), Portugal, Scotland, and Slovenia).

- Teachers in about half the countries reported that science is taught in their class for less than two hours a week. In Austria, Japan, Korea, Kuwait, and Singapore, the norm for science teaching was between two and three hours per week, while in Canada, England, Portugal, Thailand, and the United States, more than 20% of students have three hours or more of science weekly. The data, however, revealed no clear pattern across countries between the number of in-class instructional hours and science achievement.

- Science is taught as a separate subject in all fourth-grade classrooms in Israel, Japan, Korea, Kuwait, and Singapore, whereas for large percentages of students in Iceland, Ireland, New Zealand, Norway, Portugal, Scotland, and Thailand, science instruction is integrated with the teaching of other subjects.

- In most countries, almost all fourth-grade students were taught science by teachers who teach both mathematics and science. The exceptions were Hong Kong, Israel, and Kuwait, where most students had different teachers for mathematics and science.

- In most countries, the challenge of catering to students of differing academic abilities was the factor teachers mentioned most often as limiting how they teach their science classes. Other limiting factors were a high student/teacher ratio, a shortage of equipment for use in instruction, and the burden of dealing with disruptive students.

- There was considerable variation in class size across the TIMSS countries. Science classes were relatively small in a number of countries, with an average class size of 25 or fewer in 13 countries. Norway had the smallest fourth-grade science classes, with 57% of students in classes of 20 or fewer students. At the other end of the spectrum, the average size of science classes in Korea was 43, and 69% of the students in that country were in classes with more than 40 students. The TIMSS data showed different patterns of science achievement in relation to class size for different countries.

- Across countries, science teachers reported that working together as a class with the teacher teaching the whole class, and having students work individually with assistance from the teacher were the most frequently used instructional approaches. Working without teacher assistance was less common in most countries. Working together as a class with students responding to one another was a common approach in Japan, Korea, and the Netherlands.

Introduction

SCIENCE

The fact that skills in mathematics and science are so critical to economic progress in a technologically-based society has led countries to seek information about what their school-age populations know and can do in mathematics and science. There is interest in what concepts students understand, how well they can apply their knowledge to problem-solving situations, and whether they can communicate their understandings. Even more vital, countries desire to further their knowledge about what can be done to improve students' understanding of mathematical and scientific concepts, their ability to solve problems, and their attitudes towards learning.

The Third International Mathematics and Science Study (TIMSS) provided countries with a vehicle for investigating these issues while expanding their perspectives of what is possible beyond the confines of their national borders. It is the most ambitious and complex comparative education study in a series of such undertakings conducted during the past 37 years by the International Association for the Evaluation of Educational Achievement (IEA).[1] The main purpose of TIMSS was to focus on educational policies, practices, and outcomes in order to enhance mathematics and science learning within and across systems of education.

With its wealth of information covering more than half a million students at five grade levels in 15,000 schools and more than 40 countries around the world, TIMSS offers an unprecedented opportunity to examine similarities and differences in how mathematics and science education works and how well it works. The study used innovative testing approaches and collected extensive information about the contexts within which students learn mathematics and science.

The present report focuses on the science achievement of primary school students in 26 countries. Participants were to test students in the two grades with the largest proportion of 9-year-olds – the third and fourth grades in most countries. Special emphasis is placed on the fourth-grade results, including selected information about students' background and about classroom practices in teaching science.

The countries that participated in TIMSS tested students in both mathematics and science. A companion report, *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS)*,[2] presents corresponding results about students' mathematics achievement in the lower grades.

[1] The previous IEA mathematics studies were conducted in 1964 and 1980-82, and the science studies in 1970-71 and 1983-84. For information about TIMSS procedures, see Appendix A.

[2] Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1997). *Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).* Chestnut Hill, MA: Boston College

Forty-one countries, including those in this report, also tested the mathematics and science achievement of students in the two grades with the largest proportion of 13-year-olds (seventh and eighth grades in most countries). The initial achievement results for the seventh- and eighth-grade students already have been published in two companion volumes:[3]

- *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*
- *Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study*

Approximately 25 of the TIMSS participants also assessed the mathematics and science literacy of students in their final year of secondary education. Additionally, separate samples of students who had taken the relevant coursework were assessed in advanced mathematics and physics. In yet another effort, subsets of students, except the final-year students, also had the opportunity to participate in a "hands-on" performance assessment where they designed experiments and tested hypotheses. The achievement results for the final-year students and for the TIMSS performance assessment will be presented in forthcoming reports.

Together with the achievement tests, TIMSS administered a broad array of background questionnaires. The data collected from students, teachers, and school principals, as well as the system-level information collected from the participating countries, provide an abundance of information for further study and research. TIMSS data make it possible to examine differences in current levels of performance in relation to a wide variety of variables associated with the classroom, school, and national contexts within which education takes place.

Which Countries Participated?

TIMSS was very much a collaborative process among countries. Table 1 shows the countries participating in TIMSS testing at the primary grades. Each participant designated a national center to conduct the activities of the study and a National Research Coordinator (NRC) to assume responsibility for the successful completion of these tasks.[4] For the sake of comparability, all testing was conducted towards the end of the school year. The four countries on a Southern Hemisphere school schedule (Australia, Korea, New Zealand, and Singapore) tested in September through November of 1994, which was the end of their school year. The remaining countries tested the mathematics and science achievement of their students towards the end of the 1994-95 school year, most often in May and June of 1995. Because Italy and Indonesia were

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

[4] Appendix D lists the National Research Coordinators as well as the members of the TIMSS advisory committees.

Table 1

TIMSS Countries Testing in the Primary Grades[1]

- Australia
- Austria
- Canada
- Cyprus
- Czech Republic
- England
- Greece
- Hong Kong
- Hungary
- Iceland
- Indonesia
- Iran, Islamic Republic
- Ireland
- Israel
- Italy
- Japan
- Korea
- Kuwait
- Latvia
- Mexico
- Netherlands
- New Zealand
- Norway
- Portugal
- Scotland
- Singapore
- Slovenia
- Thailand
- United States

[1] Indonesia and Italy were unable to complete the steps necessary for their data to appear in this report. Please see Appendix A, Figure A.1, for countries participating in other components of the TIMSS achievement testing. Mexico participated in the testing portion of TIMSS, but chose not to release its results at grades 3 and 4 in the international report.

unable to complete the steps necessary for their inclusion in this report, the tables throughout the report do not include data for these countries. Results also are not presented for Mexico, which chose not to release its third- and fourth-grade results in the international reports.

Table 2 shows information about the lower and upper grades tested in each country, including the country names for those two grades and the years of formal schooling students in those grades had completed when they were tested for TIMSS. Table 2 reveals that for most, but not all, countries, the two grades tested represented the third and fourth years of formal schooling. Thus, solely for convenience, the report often refers to the upper grade tested as the fourth grade and the lower grade tested as the third grade. Two countries, Israel and Kuwait, tested only at the upper grade.

Having valid and efficient samples in each country is crucial to the quality and success of any international comparative 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 for coverage of the target population, participation rates, and the age of students were established, as were clearly documented procedures on how to obtain the national samples. For the most part, the national samples were drawn in accordance with the TIMSS standards, and achievement results can be compared with confidence. However, despite efforts to meet the TIMSS specifications, some countries did not do so. These countries are specially annotated and/or shown in separate sections of the tables in this report.[5]

[5] The TIMSS sampling requirements and the outcomes of the sampling procedures are described in Appendix A.

Table 2

Information About the Grades Tested

Country	Lower Grade		Upper Grade	
	Country's Name for Lower Grade	Years of Formal Schooling Including Lower Grade[1]	Country's Name for Upper Grade	Years of Formal Schooling Including Upper Grade[1]
[2] Australia	3 or 4	3 or 4	4 or 5	4 or 5
Austria	3	3	4	4
Canada	3	3	4	4
Cyprus	3	3	4	4
Czech Republic	3	3	4	4
England	Year 4	4	Year 5	5
Greece	3	3	4	4
Hong Kong	Primary 3	3	Primary 4	4
Hungary	3	3	4	4
Iceland	3	3	4	4
Iran, Islamic Rep.	3	3	4	4
Ireland	3rd Class	3	4th Class	4
Israel	–	–	4	4
[3] Japan	3rd Grade	3	4th Grade	4
Korea	3rd Grade	3	4th Grade	4
Kuwait	–	–	5	5
Latvia	3	3	4	4
[4] Netherlands	5	3	6	4
[5] New Zealand	Standard 2	3.5–4.5	Standard 3	4.5–5.5
Norway	2	2	3	3
Portugal	3	3	4	4
Scotland	Year 4	4	Year 5	5
Singapore	Primary 3	3	Primary 4	4
Slovenia	3	3	4	4
Thailand	Primary 3	3	Primary 4	4
United States	3	3	4	4

[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 Classification of Education Level 1). Does not include preprimary education.

[2] Australia: Each state/territory has its own policy regarding age of entry to primary school. In 4 of the 8 states/territories students were sampled from grades 3 and 4; in the other four states/territories students were sampled from grades 4 and 5.

[3] Japan: 3rd Grade Elementary and 4th Grade Elementary.

[4] In the Netherlands kindergarten is integrated with primary education. Grade-counting starts at age 4 (formerly kindergarten 1). Formal schooling in reading, writing, and arithmetic starts in grade 3, age 6.

[5] New Zealand: The majority of students begin primary school on or near their 5th birthday so the "years of formal schooling" vary.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

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. All participants wish to ensure that the achievement items are appropriate for their students and reflect their current curriculum. Developing the 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 piloted, the results reviewed, and new items were written and piloted. The resulting TIMSS science test contained 97 items representing a range of science topics and skills.

The TIMSS curriculum frameworks described the content dimensions for the TIMSS tests as well as performance expectations (behaviors that might be expected of students in school science).[6] Four content areas are covered in the science test taken by third- and fourth-grade students. These areas and the percentage of the test items devoted to each are earth science (18%), life science (42%), physical science (31%), and environmental issues and the nature of science (9%). The performance expectations include understanding simple information (45%); understanding complex information (31%); theorizing, analyzing, and solving problems (14%); using tools, routine procedures, and science processes (6%); and investigating the natural world (3%).

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 approximately 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.[7] Chapter 3 of this report contains 20 example items illustrating the range of science concepts and processes addressed by the TIMSS test.

The TIMSS tests were prepared in English and translated into the additional necessary languages using explicit guidelines and procedures. A series of verification checks were conducted to ensure the comparability of the translations.[8]

The tests were given so that no one student took all of the items, which would have required about four hours for both mathematics and science. Instead, the tests were assembled in eight booklets, containing about one hour of material. Each student took only one booklet,[9] and the items were rotated through the booklets so that each one was answered by a representative sample of students.

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

[7] TIMSS scoring reliability studies within and across countries indicate that the percent of exact agreement for correctness scores averaged over 85%. For more details, see Appendix A.

[8] See Appendix A for more information about the translation procedures.

[9] Primary students were given a break during the testing sessions. Four clusters of items (37 minutes total) were administered prior to the break and three clusters (27 minutes total) after the break.

TIMSS conducted a Test-Curriculum Matching Analysis whereby countries examined the TIMSS test to identify items measuring topics not addressed 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.[10]

How Do Country Characteristics Differ?

International studies of student achievement provide valuable comparative information about student performance and instructional practices. Along with the benefits of international studies, though, are challenges associated with comparing achievement across countries, cultures, and languages. In TIMSS, 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.[11]

Beyond the integrity of the study procedures, the results of comparative studies such as TIMSS also need to be considered in light of the larger contexts in which students are educated and the kinds of system-wide factors that might influence students' opportunity to learn. A number of these factors are more fully described in *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS*;[12] however, some selected demographic characteristics of the TIMSS countries are presented in Table 3. Table 4 contains information about public expenditure on education. The information in these two tables show that some of the TIMSS countries are densely populated and others are more rural, some are large and some small, and some expend considerably more resources on education than others. Although these factors do not necessarily determine high or low performance in science, they do provide a context for considering the difficulty of the educational task from country to country.

Describing students' educational opportunities also includes understanding the knowledge and skills that students are supposed to master. To help complete the picture of educational practices in the TIMSS countries, science and curriculum specialists within each country provided detailed categorizations of their curriculum guides, textbooks, and curricular materials. The initial results from this effort can

[10] Results of the Test-Curriculum Matching Analysis are presented in Appendix B.

[11] Appendix A contains an overview of the procedures used and cites a number of references providing details about TIMSS methodology.

[12] Robitaille D.F. (Ed.). (1997). *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS*. Vancouver, B.C.: Pacific Educational Press.

Table 3

Selected Demographic Characteristics of TIMSS Countries

Country	Population Size (1,000) [1]	Area of Country (1000 Square Kilometers) [2]	Density (Population per Square Kilometer) [3]	Percentage of Population Living in Urban Areas	Life Expectancy [4]	Percent in Secondary School [5]
Australia	17843	7713	2.29	84.8	77	84
Austria	8028	84	95.28	55.5	77	107
Canada	29248	9976	2.90	76.7	78	88
Cyprus	726	9	77.62	53.6	77	95
Czech Republic	10333	79	130.99	65.3	73	86
[6] England	48533	130	373.33	–	77	–
Greece	10426	132	78.63	64.7	78	99
[7] Hong Kong	6061	1	5691.35	94.8	78	98
Hungary	10261	93	110.03	64.2	70	81
Iceland	266	103	2.56	91.4	79	103
Iran	62550	1648	36.98	58.5	68	66
Ireland	3571	70	50.70	57.4	76	105
Israel	5383	21	252.14	90.5	77	87
Japan	124961	378	329.63	77.5	79	96
Korea	44453	99	444.92	79.8	71	93
Kuwait	1620	18	80.42	96.8	76	60
Latvia	2547	65	40.09	72.6	68	87
Netherlands	15381	37	409.30	88.9	78	93
New Zealand	3493	271	12.78	85.8	76	104
Norway	4337	324	13.31	73.0	78	116
Portugal	9902	92	106.95	35.2	75	81
[8] Scotland	5132	79	65.15	–	75	–
Singapore	2930	1	4635.48	100.0	75	84
Slovenia	1989	20	97.14	62.7	74	85
Thailand	58024	513	111.76	31.9	69	37
United States	260650	9809	27.56	76.0	77	97

[1] Estimates for 1994 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.
[2] Area is the total surface area in square kilometers, comprising all land area and inland waters.
[3] Density is population per square kilometer of total surface area.
[4] Number of years a newborn infant would live if prevailing patterns of mortality at its birth were to stay the same throughout its life.
[5] Gross enrollment of all ages at the secondary level as a percentage of school-age children as defined by each country. This may be reported in excess of 100% if some pupils are younger or older than the country's standard range of secondary school age.
[6] Annual Abstract of Statistics, Office of National Statistics.
[7] Number for Secondary Enrollment is from Education Department (1995) Education Indicators for the Hong Kong Education System (unpublished document).
[8] Registrar General for Scotland Annual Report 1995 and Scottish Abstract of Statistics 1993.
(–) A dash indicates the data were unavailable.
SOURCE: The World Bank, Social Indicators of Development, 1996.

Table 4

Public Expenditure on Education at Primary and Secondary Levels[1] in TIMSS Countries

Country	Gross National Product per Capita (US Dollars)[2]	Gross National Product per Capita (Intl. Dollars)[3]	Public Expenditure on Education (Levels 1 & 2) as % of Gross National Product[4]	Public Expenditure on Education (Intl. Dollars per Capita)[5]
Australia	17980	19000	3.69	701
Austria	24950	20230	4.24	858
Canada	19570	21230	4.62	981
[6] Cyprus	10380	–	3.60	–
Czech Republic	3210	7910	3.75	297
[7] England	18410	18170	3.57	649
Greece	7710	11400	2.27	259
[8] Hong Kong	21650	23080	1.34	309
Hungary	3840	6310	4.31	272
Iceland	24590	18900	4.77	902
Iran	–	4650	3.93	183
Ireland	13630	14550	4.21	613
Israel	14410	15690	3.72	584
Japan	34360	21350	2.82	602
Korea	8220	10540	3.43	362
Kuwait	19040	24500	3.46	848
Latvia	2290	5170	2.85	147
Netherlands	21970	18080	3.30	597
New Zealand	13190	16780	3.15	529
Norway	26480	21120	5.26	1111
Portugal	9370	12400	2.98	370
[7] Scotland	18410	18170	3.57	649
Singapore	23360	21430	3.38	724
Slovenia	7140	–	4.20	–
Thailand	2210	6870	3.00	206
United States	25860	25860	4.02	1040

[1] The levels of education are based on the International Standard Classification of Education. The duration of Primary (level 1) and Secondary (level 2) vary depending on the country.
[2] (SOURCE: The World Bank Atlas, 1996). Estimates for 1994 at current market prices in U.S. dollars, calculated by the conversion method used for the World Bank Atlas.
[3] (SOURCE: The World Bank Atlas, 1996). Converted at purchasing power parity (PPP). PPP is defined as number of units of a country's currency required to buy same amounts of goods and services in domestic market as one dollar would buy in the United States.
[4] (SOURCE: UNESCO Statistical Yearbook, 1995). Calculated by multiplying the Public Expenditure on Education as a % of GNP by the percentage of public education expenditure on the first and second levels of education. Figures represent the most recent figures released.
[5] Calculated by multiplying the GNP per Capita (Intl. Dollars) column by Public Expenditure on Education.
[6] GNP per capita figure for Cyprus is for 1993.
[7] The figures for England and Scotland are for the United Kingdom.
[8] Calculated using Education Department (1995) Education Indicators for the Hong Kong Education System (unpublished document).
(–) A dash indicates the data was unavailable.

be found in two reports, entitled *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics* and *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*.[13]

Depending on the educational system, students' learning goals are commonly set at one of three main levels: the national or regional level, the school level, or the classroom level. Some countries are highly centralized, with the ministry of education (or highest authority in the system) having exclusive responsibility for making 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 in curriculum coverage, but may constrain a school or teacher's flexibility in tailoring instruction to the different needs of students.

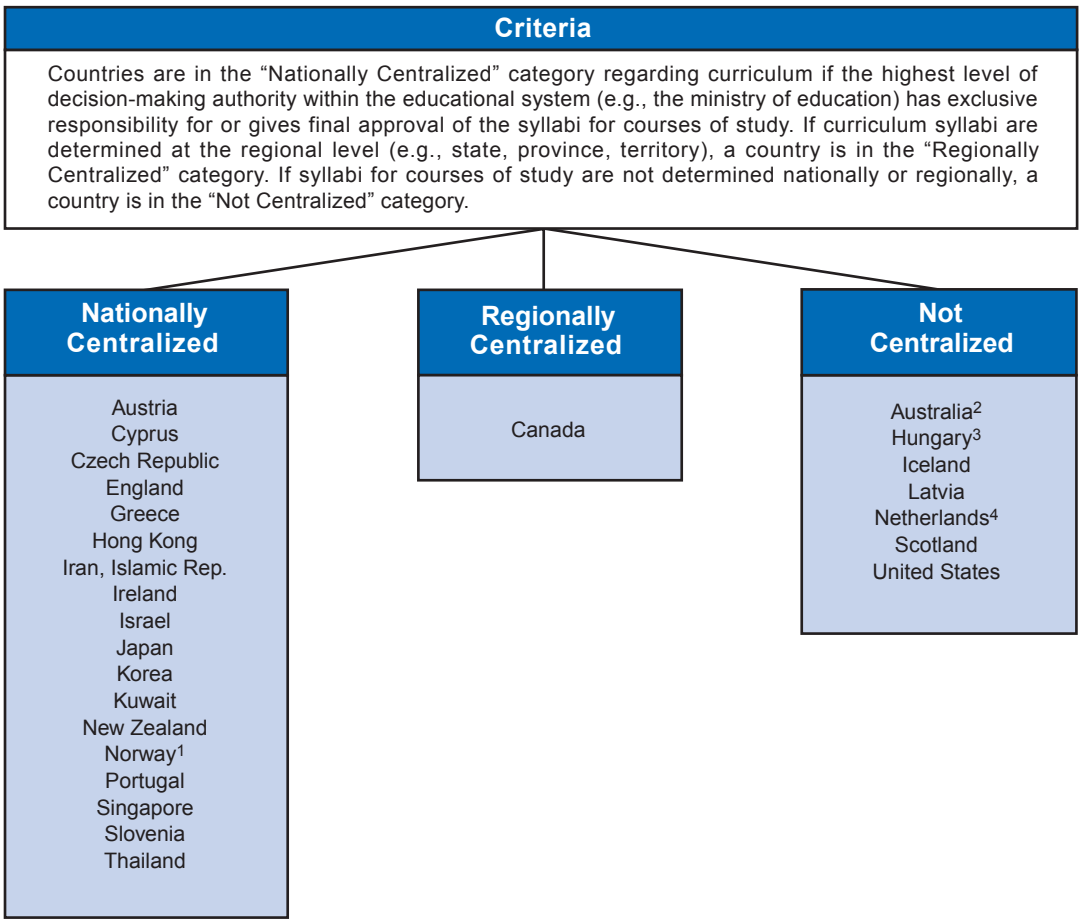
Figures 1, 2, and 3 show the degree of centralization in the TIMSS countries regarding decision-making about curriculum syllabi, textbooks, and examinations. Of the TIMSS participants at the primary school level, 18 reported nationally centralized decision-making about curriculum. Fewer countries reported nationally centralized decision-making about textbooks, although 11 participants were in this category. Five countries reported nationally centralized decision-making about examinations. Regional decision-making about these three aspects of education does not appear to be very common among the TIMSS countries, with only one or two countries reporting this level of decision-making for curriculum syllabi and textbooks, and none reporting it for examinations.

Most countries reported having centralized decision-making for one or two of the areas and "not centralized" decision-making for one or two of the areas. However, only two countries – Hong Kong and Singapore – reported nationally centralized decision-making for all three areas: curriculum syllabi, textbooks, and examinations. Six countries – Australia, Hungary, Iceland, Latvia, Scotland, and the United States – reported that decision-making is not centralized for any of these areas.

[13] Schmidt, W.H., McKnight, C.C., Valverde, G. A., Houang, R.T., and Wiley, D. E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Dordrecht, the Netherlands: Kluwer Academic Publishers. Schmidt, W.H. Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G. (in press). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

Figure 1

Centralization of Decision-Making Regarding Curriculum Syllabi



[1] Norway: The National Agency of Education provides goals which schools are required to work towards. Schools have the freedom to implement the goals based on local concerns.

[2] Australia: Students tested in TIMSS were educated under a decentralized system. Reforms beginning in 1994 are introducing regionally centralized (state-determined) curriculum guidelines.

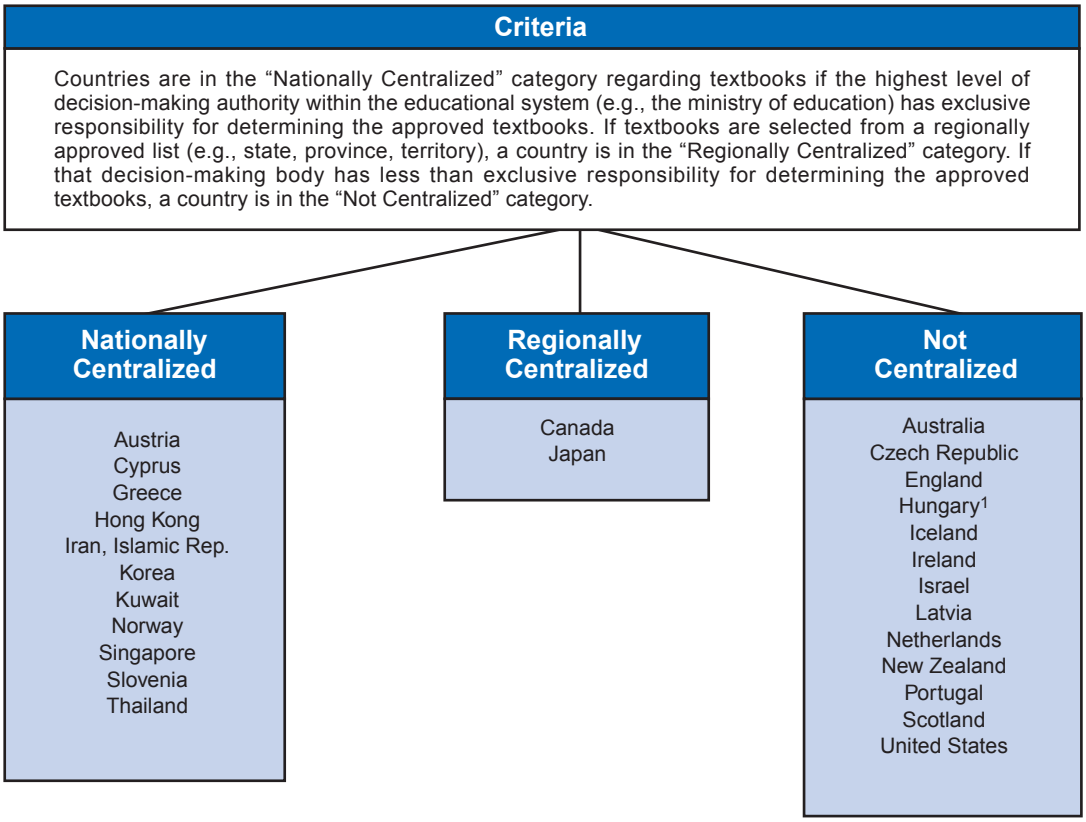
[3] Hungary: Hungary is in the midst of changing from a highly centralized system to one in which local authorities and schools have more autonomy.

[4] Netherlands: The Ministry of Education sets core objectives (for subjects in primary education and in 'basic education' at lower secondary level) and goals/objectives (for subjects in the four student ability tracks in secondary education) which schools are required to work towards. Schools have the freedom, though, to decide how to reach these objectives.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Figure 2

Centralization of Decision-Making Regarding Textbooks



[1] Hungary: Hungary is in the midst of changing from a highly centralized system to one in which local authorities and schools have more autonomy.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Figure 3

Centralization of Decision-Making Regarding Examinations

Criteria

Countries are in the "Nationally Centralized" category regarding examinations if the highest level of decision-making authority within the educational system (e.g., the ministry of education) has exclusive responsibility for or gives final approval of the content of examinations. The notes explain during which school years the examinations are administered. If that decision-making body has less than exclusive responsibility for or final approval of the examination content, the country is in the "Not Centralized" category.

Nationally Centralized	Not Centralized
England[1]	Australia[5]
Hong Kong[2]	Austria
Ireland[3]	Canada
New Zealand[4]	Cyprus
Singapore	Czech Republic
	Greece
	Hungary
	Iceland
	Iran, Islamic Rep.
	Israel
	Japan
	Korea
	Kuwait
	Latvia[6]
	Netherlands[7]
	Norway
	Portugal
	Scotland
	Slovenia
	Thailand
	United States

[1] England: Centralized national curriculum assessments taken at Years 2, 6 and 9. Regionally centralized examinations are taken at Years 11 and 13.

[2] Hong Kong: Centralized examination taken at Year 11.

[3] Ireland: Centralized examinations taken at Grades 9 and 12.

[4] New Zealand: Centralized examinations are taken at Years 11, 12 and 13. Centralized national monitoring at Years 4 and 8.

[5] Australia: Not centralized as a country, but low-stakes statewide population assessments are undertaken in most states at one or more of Grades 3, 5, 6,7 and 10. In most states centralized examinations are taken at Grade 12.

[6] Latvia: Centralized examinations taken at Grades 9 and 12.

[7] Netherlands: The majority of schools (71% in 1996) participate in a non-compulsory standardized test which is administered at the end of primary education (Cito eindtoets).School-leaving examinations consisting of a centralized part and a school-bound part are taken in the final grades of the four student ability tracks in secondary education.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Chapter 1

International Student Achievement in Science

What Are the Overall Differences in Science Achievement?

Chapter 1 summarizes achievement on the TIMSS science test for each of the participating countries. Comparisons are provided overall and by gender for the upper grade tested (often the fourth grade) and the lower grade tested (often the third grade), as well as for 9-year-olds.

Table 1.1 presents the mean (or average) achievement for 26 countries at the fourth grade.[1] The 17 countries shown in decreasing order of mean achievement in the upper part of the table were judged to have met the TIMSS requirements for testing a representative sample of students. Although all countries tried very hard to meet the TIMSS sampling requirements, several encountered resistance from schools and teachers and did not have participation rates of 85% or higher as specified in the TIMSS guidelines (i.e., Australia, Austria, Latvia, and the Netherlands). To provide a better curricular match, Slovenia elected to test its third- and fourth-grade students, even though that meant not testing the two grades with the most 9-year-olds and led to their students being somewhat older than those in the other countries. The countries in the remaining two categories encountered various degrees of difficulty in implementing the prescribed methods for sampling classrooms within schools. A full discussion of the sampling procedures and outcomes for each country can be found in Appendix A.

To aid in interpretation, the table also contains the years of formal schooling and average age of the students. 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. Notably, students in Norway had fewer years of formal schooling than their counterparts in other countries, and those in England, Scotland, New Zealand, and Kuwait had more. Countries with a high percentage of older students may have policies that include retaining students in lower grades.

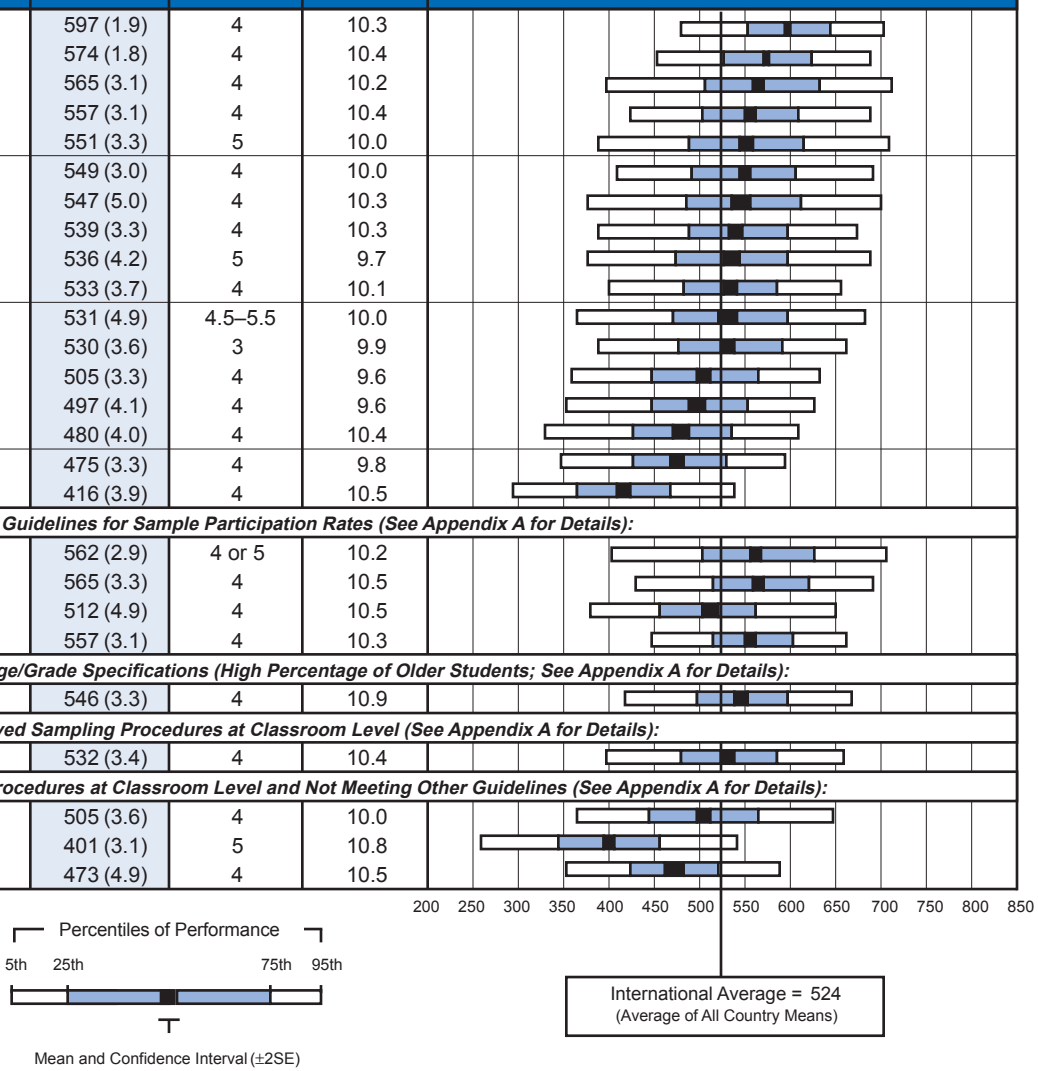
The results reveal substantial differences in science achievement between the top- and bottom-performing countries, although the average achievement of most countries was somewhere in the middle ranges. The broad range of achievement both across and within countries is illustrated in Table 1.1 by a graphical 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

[1] TIMSS used item response theory (IRT) methods to summarize the achievement results for both grades on a scale with a mean of 500 and a standard deviation of 100. Scaling averages students' responses to the subsets of items they took in a way that accounts for differences in the difficulty of those 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.

Table 1.1

Distributions of Achievement in the Sciences - Upper Grade (Fourth Grade*)

Country	Mean	Years of Formal Schooling	Average Age
Korea	597 (1.9)	4	10.3
Japan	574 (1.8)	4	10.4
United States	565 (3.1)	4	10.2
Czech Republic	557 (3.1)	4	10.4
†[2] England	551 (3.3)	5	10.0
Canada	549 (3.0)	4	10.0
Singapore	547 (5.0)	4	10.3
Ireland	539 (3.3)	4	10.3
† Scotland	536 (4.2)	5	9.7
Hong Kong	533 (3.7)	4	10.1
New Zealand	531 (4.9)	4.5–5.5	10.0
Norway	530 (3.6)	3	9.9
Iceland	505 (3.3)	4	9.6
Greece	497 (4.1)	4	9.6
Portugal	480 (4.0)	4	10.4
Cyprus	475 (3.3)	4	9.8
Iran, Islamic Rep.	416 (3.9)	4	10.5
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	562 (2.9)	4 or 5	10.2
Austria	565 (3.3)	4	10.5
[1] Latvia (LSS)	512 (4.9)	4	10.5
Netherlands	557 (3.1)	4	10.3
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	546 (3.3)	4	10.9
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	532 (3.4)	4	10.4
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
[1] Israel	505 (3.6)	4	10.0
Kuwait	401 (3.1)	5	10.8
Thailand	473 (4.9)	4	10.5



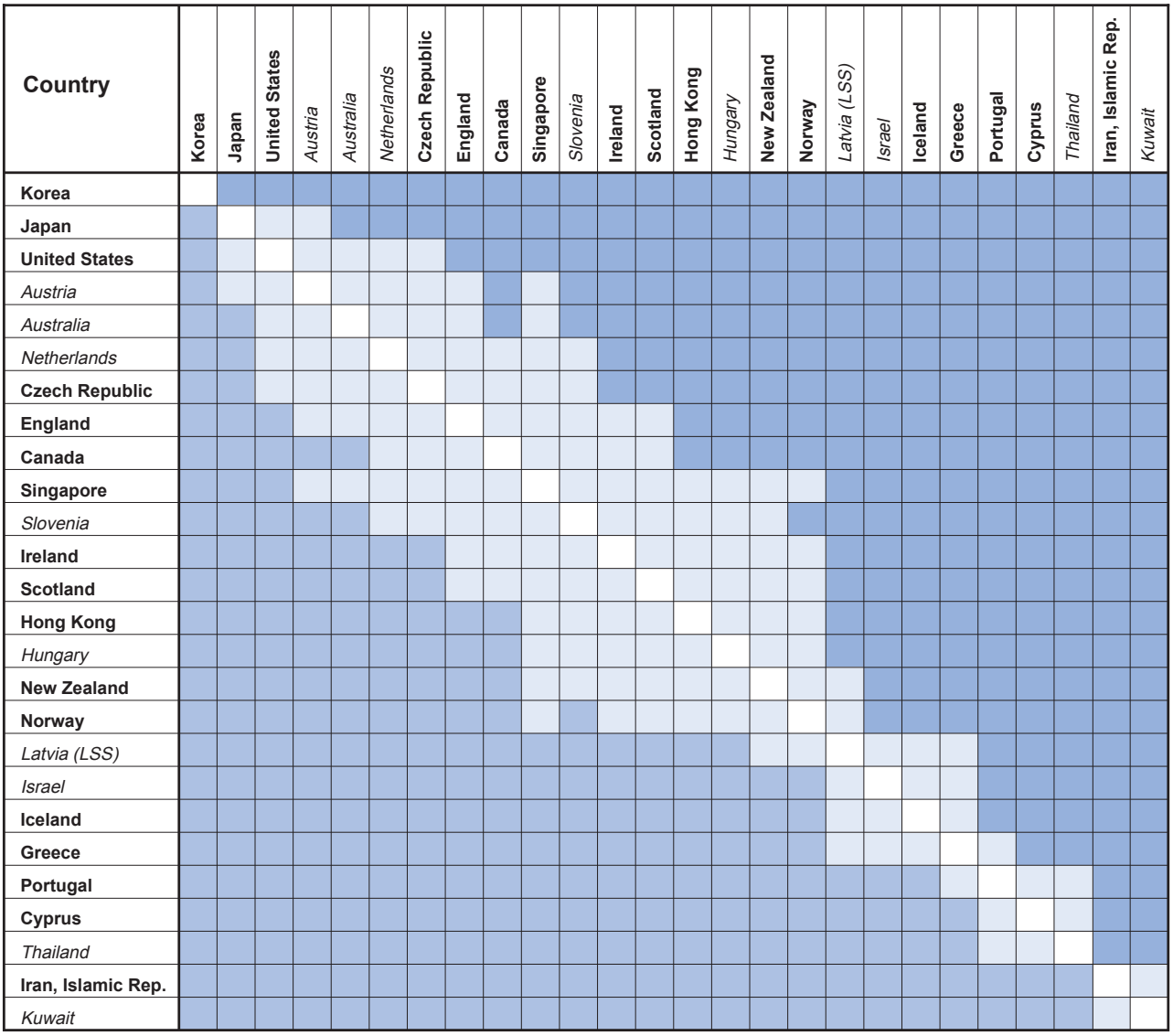
*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Figure 1.1

Multiple Comparisons of Achievement in the Sciences
Upper Grade (Fourth Grade*)

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean 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 two countries.†



Countries are ordered by mean achievement across the heading and down the rows.

Mean achievement significantly higher than comparison country

No statistically significant difference from comparison country

Mean achievement significantly lower than comparison country

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

†Statistically significant at .05 level, adjusted for multiple comparisons.

Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

percentiles.[2] Each percentile point indicates the percentages of students performing below and above that point on the scale. For example, 25% of the fourth-grade students in each country performed below the 25th percentile for that country, and 75% performed above the 25th percentile.

The range between the 25th and 75th percentiles represents performance by the middle half of the students. In contrast, performance at the 5th and 95th percentiles represents the extremes in both lower and higher achievement. The dark boxes at the midpoints of the distributions show the 95% confidence intervals around the average achievement in each country.[3] These intervals can be compared with the international average of 526, which was derived by averaging across the means for each of the 26 participants shown in the table. A number of countries had mean achievement well above or well below that level.

Considerable variation in student performance is observed between countries. For example, average performance in Korea was comparable to or even exceeded performance at the 95th percentile in the lower-performing countries such as Iran and Kuwait. The differences between the extremes in performance were also very large within most countries.

Figure 1.1 provides a method for making appropriate comparisons in overall mean achievement between countries.[4] This figure shows whether or not the differences in mean achievement between pairs of countries are statistically significant. For a given country of interest, read across the figure. A triangle pointing up indicates significantly higher performance than the country listed across the top, a dot indicates no significant difference in performance, and a triangle pointing down indicates significantly lower performance.

At the fourth grade, Korea, with all triangles pointing up, had a significantly higher mean achievement than other participating countries. Other countries that performed very well included Japan, the United States, and Austria. These countries had performance levels similar to each other. Interestingly, from the top-performing countries on down through the list of participants, the differences in performance from one country to the next was often negligible. For example, in addition to performing at about the same level as the other countries mentioned above, Austria did not differ significantly from Australia, the Netherlands, the Czech Republic, England, and Singapore. In turn, Australia, while performing less well than Korea and Japan, performed at about the same level as the United States, Austria, the Netherlands, the Czech Republic, England, and Singapore, and higher than all other countries.

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

[3] See the "Estimating Sampling Error" section of Appendix A for more details about calculating standard errors and confidence intervals for the TIMSS statistics.

[4] The significance tests in Figures 1.1 and 1.2 are based on a Bonferroni procedure for multiple comparisons that holds to 5% the probability of erroneously declaring the mean of one country to be different from another country.

Despite the small differences between adjacent countries when participants are ordered by performance, the differences between the top-performing and bottom-performing countries was very large. Because of this large 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. Kuwait and Iran performed less well than all other countries.

Table 1.2 and Figure 1.2 present corresponding data for the third grade.[5] For most countries, performance rankings tended to be similar, but not identical, to those found at the fourth grade. Korea again had significantly higher mean performance than other participating countries. Japan, the United States, and Australia also performed very well at the third grade, with performance levels similar to each other, and higher than many other countries. The United States and Australia also performed at about the same level as Austria, England, and the Netherlands, and in the case of Australia, at about the same level as the Czech Republic. Iran had the lowest average student performance.

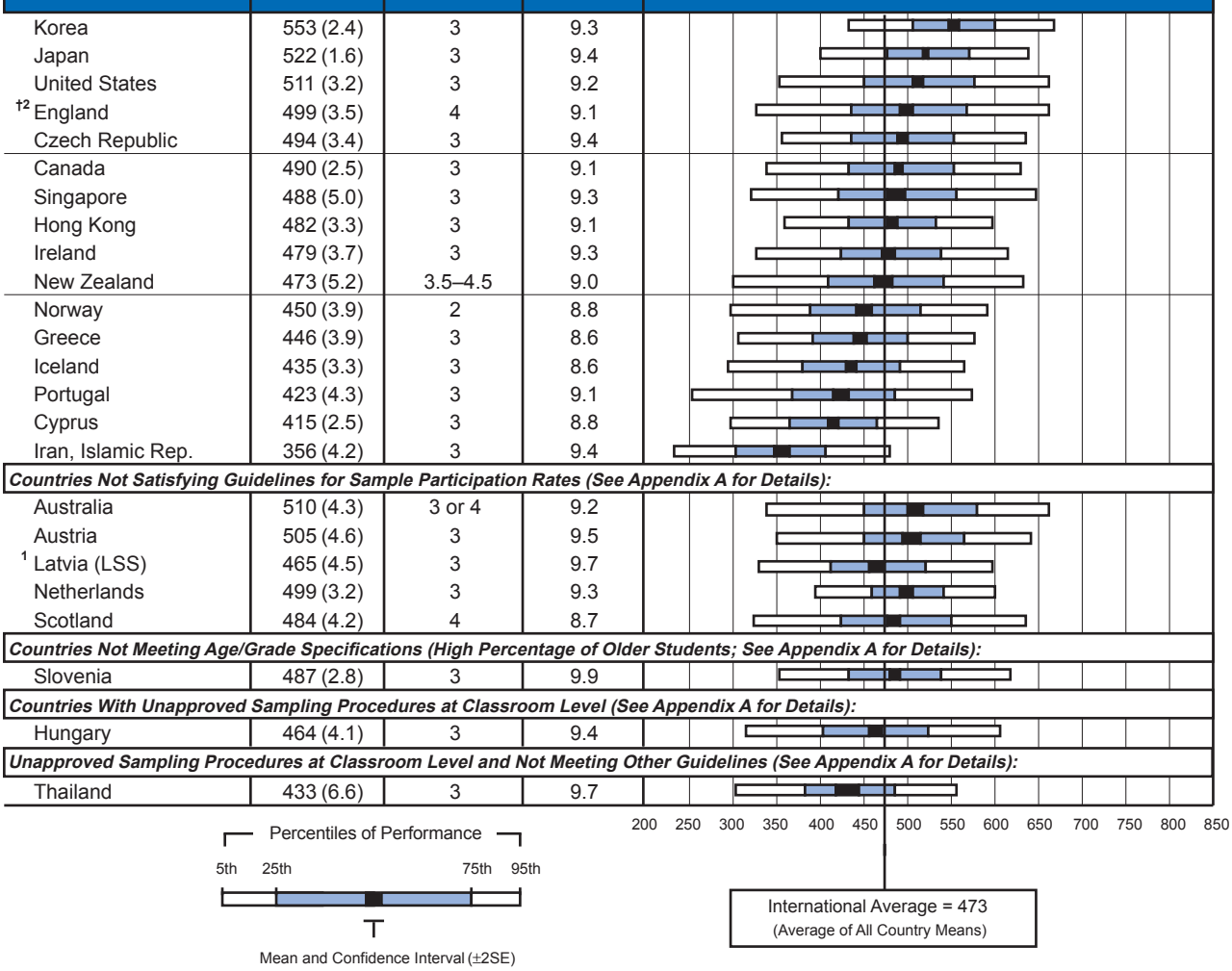
Performance in fourth grade was naturally somewhat higher than in third grade, since fourth-grade students have had one year more of schooling. The international average at the fourth grade (526) was 51 points higher than the international average of 475 at the third grade. Even though equivalent achievement increases cannot be assumed from grade to grade throughout schooling, this 51-point difference does provide a rough indication of grade-by-grade increases in science achievement during the primary school years. By this gauge, the achievement differences across countries at both grades reflect several grade levels in learning between the higher- and lower-performing countries. A similarly large range in performance can be noted within most countries. Caution is required, however, in using growth from grade to grade as an indicator of achievement. The TIMSS scale measures achievement in science judged to be appropriate for third- and fourth-grade students around the world. Thus, higher performance does not mean that students can do advanced high-school science, but only that they are more proficient at primary-school science.

[5] Results are presented for 16 countries in the top portion of Table 1.2 because Scotland did not meet the sampling requirements at this grade. Twenty-four countries are presented in total because Kuwait and Israel tested only the fourth grade.

Table 1.2

Distributions of Achievement in the Sciences - Lower Grade (Third Grade*)

Country	Mean	Years of Formal Schooling	Average Age	Science Achievement Scale Score
Korea	553 (2.4)	3	9.3	
Japan	522 (1.6)	3	9.4	
United States	511 (3.2)	3	9.2	
†[2] England	499 (3.5)	4	9.1	
Czech Republic	494 (3.4)	3	9.4	
Canada	490 (2.5)	3	9.1	
Singapore	488 (5.0)	3	9.3	
Hong Kong	482 (3.3)	3	9.1	
Ireland	479 (3.7)	3	9.3	
New Zealand	473 (5.2)	3.5–4.5	9.0	
Norway	450 (3.9)	2	8.8	
Greece	446 (3.9)	3	8.6	
Iceland	435 (3.3)	3	8.6	
Portugal	423 (4.3)	3	9.1	
Cyprus	415 (2.5)	3	8.8	
Iran, Islamic Rep.	356 (4.2)	3	9.4	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	510 (4.3)	3 or 4	9.2	
Austria	505 (4.6)	3	9.5	
[1] Latvia (LSS)	465 (4.5)	3	9.7	
Netherlands	499 (3.2)	3	9.3	
Scotland	484 (4.2)	4	8.7	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	487 (2.8)	3	9.9	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	464 (4.1)	3	9.4	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
Thailand	433 (6.6)	3	9.7	



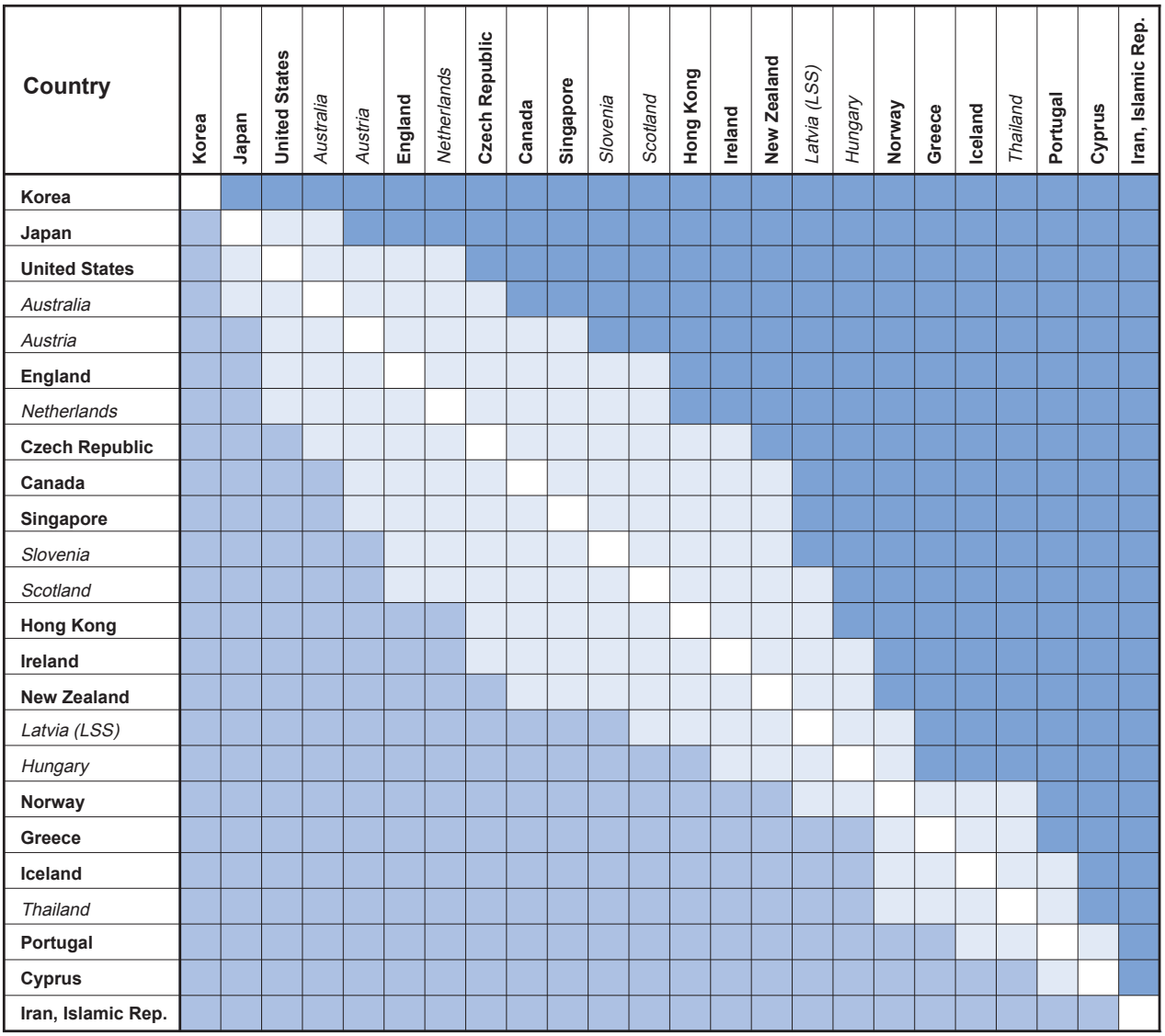
*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Figure 1.2

Multiple Comparisons of Achievement in the Sciences Lower Grade (Third Grade*)

Instructions: Read ***across*** the row for a country to compare performance with the countries listed in the heading of the chart. The symbols indicate whether the mean 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 two countries.†



Countries are ordered by mean achievement across the heading and down the rows.

Mean achievement significantly higher than comparison country

No statistically significant difference from comparison country

Mean achievement significantly lower than comparison country

*Third grade in most countries; see Table 2 for information about the grades tested in each country.

†Statistically significant at .05 level, adjusted for multiple comparisons.

Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Appendix A for details).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Increases in Achievement Between the Lower and Upper Grades?

Table 1.3 presents the increases in mean achievement between the two grades tested in each TIMSS country. Countries in the upper portion of the table are shown in decreasing order by the amount of this between-grade difference. Increases in mean performance between the two grades ranged from a high of 80 points in Norway to a low of 40 points in Thailand. This degree of increase can be compared with the difference of 51 points between the international average of 524 at fourth grade and 473 at third grade. Although the two countries with the largest increase, Norway and Iceland, were among the lower-performing countries at third grade, there is no obvious relationship between mean third-grade performance and the between-grade increase. That is, countries showing the highest performance at the third grade did not necessarily show either the largest or the smallest increases in achievement at the fourth grade. Still, in general, countries with high mean performance in the third grade also had high mean performance in the fourth grade.

Interestingly, the magnitude of the average increase in performance between the third and fourth grades is considerably larger than that found between the seventh and eighth grades. Recomputing the international averages found at the seventh and eighth grades[6] for the 26 countries that participated in the testing at the lower grades reveals an average increase of 35 points (from 492 at the seventh grade to 527 at the eighth grade).[7] This finding is not unexpected given the challenge during TIMSS test development[8] of using an accessible vocabulary to address topics in science. Although every effort was made to keep the language simple, students in the third grade who had not yet mastered the basics of reading may have found some items problematic. Fourth-grade students were less likely to have reading difficulties. It is noteworthy in this regard that Norway,[9] where students begin school at a later age than in many other countries, had the largest increase between the lower and upper grades.

[6] 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 (TIMSS).* Chestnut Hill, MA: Boston College.

[7] Please see Table A.11 in Appendix A.

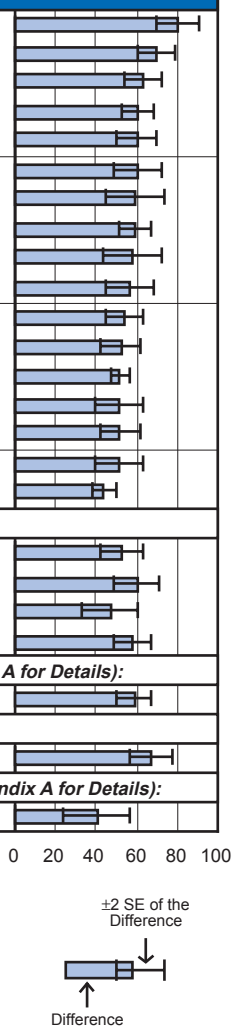
[8] Garden, R.A. (1996). "Development of the TIMSS Achievement Items" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design.* Vancouver, B.C.: Pacific Educational Press.

[9] In Norway, Grade 2 was chosen as the appropriate lower grade for TIMSS on the basis of the age distribution of the students.

Table 1.3

Achievement Differences in the Sciences Between Lower and Upper Grades (Third and Fourth Grades*)

Country	Lower Grade Mean	Upper Grade Mean	Difference
Norway	450 (3.9)	530 (3.6)	80 (5.3)
Iceland	435 (3.3)	505 (3.3)	69 (4.6)
Czech Republic	494 (3.4)	557 (3.1)	63 (4.6)
Cyprus	415 (2.5)	475 (3.3)	61 (4.2)
Ireland	479 (3.7)	539 (3.3)	60 (4.9)
Iran, Islamic Rep.	356 (4.2)	416 (3.9)	60 (5.7)
Singapore	488 (5.0)	547 (5.0)	59 (7.1)
Canada	490 (2.5)	549 (3.0)	59 (3.9)
New Zealand	473 (5.2)	531 (4.9)	58 (7.1)
Portugal	423 (4.3)	480 (4.0)	57 (5.9)
United States	511 (3.2)	565 (3.1)	54 (4.4)
†[2] England	499 (3.5)	551 (3.3)	52 (4.8)
Japan	522 (1.6)	574 (1.8)	52 (2.4)
† Scotland	484 (4.2)	536 (4.2)	52 (5.9)
Hong Kong	482 (3.3)	533 (3.7)	51 (4.9)
Greece	446 (3.9)	497 (4.1)	51 (5.6)
Korea	553 (2.4)	597 (1.9)	44 (3.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	510 (4.3)	562 (2.9)	53 (5.2)
Austria	505 (4.6)	565 (3.3)	60 (5.7)
[1] Latvia (LSS)	465 (4.5)	512 (4.9)	47 (6.7)
Netherlands	499 (3.2)	557 (3.1)	58 (4.4)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	487 (2.8)	546 (3.3)	59 (4.4)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	464 (4.1)	532 (3.4)	67 (5.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
Thailand	433 (6.6)	473 (4.9)	40 (8.2)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Differences in Performance Compared to Three Marker Levels of International Science Achievement?

Tables 1.4 and 1.5 portray the performance of students in each TIMSS country in terms of international levels of achievement for the fourth and third grades, respectively. This method provides another useful comparison of student performance across countries by determining the percentage of students in each country reaching specific levels of performance. Since the TIMSS achievement tests do not have pre-specified performance standards, three marker levels were chosen on the basis of the combined performance of all students at a grade level in the study – the Top 10%, the Top Quarter (25%), and the Top Half (50%). For example, Table 1.4 shows that 10% of all fourth graders in countries participating in the TIMSS study achieved at the level of 660 or higher. This score point, then, was designated as the marker level for the Top 10%. Similarly, the Top Quarter marker level was determined as 607 and the Top Half marker level as 541. At the third grade, these marker levels are 610, 554, and 488, respectively.

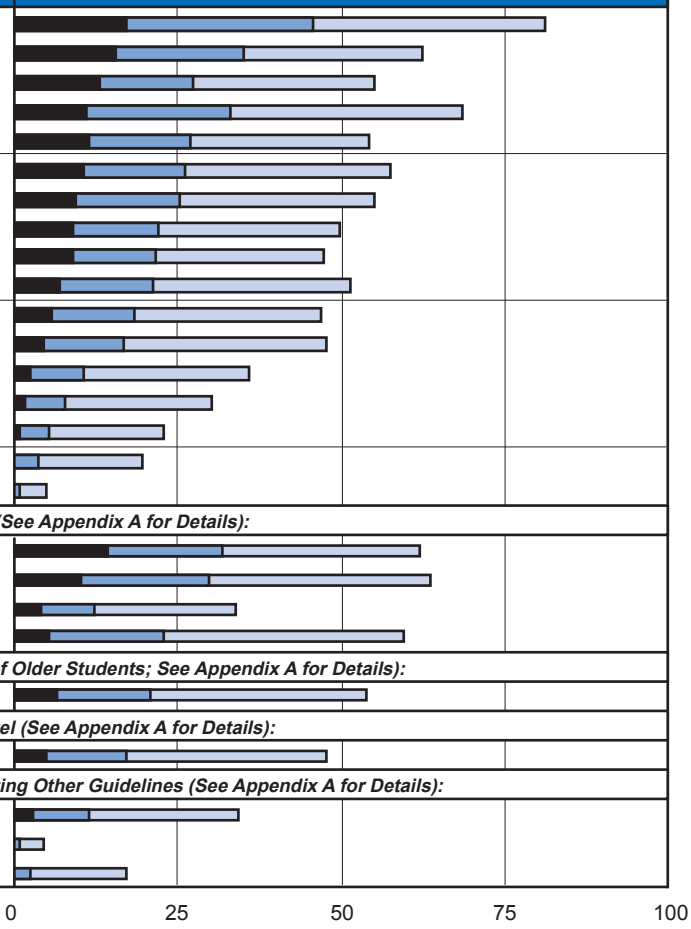
If every country had the same distribution of high-, medium-, and low-performing students, then each country would be expected to have approximately 10% of its students reaching the Top 10% level, 25% reaching the Top Quarter level, and 50% reaching the Top Half level. Although no country achieved exactly this pattern, the distributions of fourth- and/or third-grade students in several countries were quite close. For example, percentages close to the international norm were noted at both grades for Canada, Scotland, and New Zealand. In contrast, in Korea 17% of the fourth-grade students and 20% of third-grade students reached the Top 10% level, approximately half reached the Top Quarter level (46% at the fourth grade and 51% at the third grade), and almost all reached the Top Half level (81% at the fourth grade and 83% at the third grade).

It can be informative to look at performance at each marker level. For example, at the fourth grade, Japan had a slightly lower percentage of its students at the Top 10% level than the United States, England, or Australia, but a higher percentage (68%) reaching the top half level than any of these countries (63%, 55%, and 62%, respectively). A similar pattern may be found at third grade.

Table 1.4

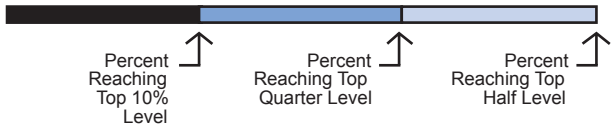
Percentages of Students Achieving International Marker Levels in the Sciences Upper Grade (Fourth Grade*)

Country	Top 10% Level	Top Quarter Level	Top Half Level	Percent Reaching International Levels
Korea	17 (0.9)	46 (1.3)	81 (0.9)	
United States	16 (0.9)	35 (1.3)	63 (1.4)	
†2 England	13 (1.0)	28 (1.4)	55 (1.5)	
Japan	11 (0.6)	33 (1.0)	68 (1.0)	
Singapore	11 (1.5)	27 (2.1)	54 (2.2)	
Czech Republic	11 (1.0)	26 (1.4)	58 (1.5)	
Canada	9 (0.7)	25 (1.5)	55 (1.4)	
† Scotland	9 (0.8)	22 (1.4)	50 (1.9)	
New Zealand	9 (0.9)	22 (1.4)	47 (2.0)	
Ireland	7 (0.6)	21 (1.3)	52 (1.7)	
Norway	6 (0.6)	19 (1.2)	47 (1.6)	
Hong Kong	4 (0.7)	17 (1.4)	48 (1.8)	
Iceland	3 (0.4)	11 (0.8)	36 (1.5)	
Greece	1 (0.2)	8 (0.8)	30 (1.5)	
Portugal	1 (0.2)	5 (0.7)	23 (1.4)	
Cyprus	1 (0.1)	4 (0.5)	20 (1.4)	
Iran, Islamic Rep.	0 (0.1)	1 (0.2)	5 (0.9)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	14 (0.7)	32 (1.1)	62 (1.3)	
Austria	10 (0.9)	30 (1.6)	64 (1.6)	
1 Latvia (LSS)	4 (1.2)	12 (1.7)	34 (2.3)	
Netherlands	5 (0.6)	23 (1.4)	60 (1.7)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	6 (0.7)	21 (1.4)	54 (1.7)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	5 (0.6)	17 (1.3)	48 (1.7)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
1 Israel	3 (0.5)	12 (1.0)	34 (1.7)	
Kuwait	0 (0.1)	1 (0.1)	5 (0.3)	
Thailand	0 (0.1)	3 (0.4)	17 (1.9)	



The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 660
Top Quarter Level (75th Percentile) = 607
Top Half Level (50th Percentile) = 541



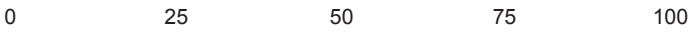
*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1 National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 1.5

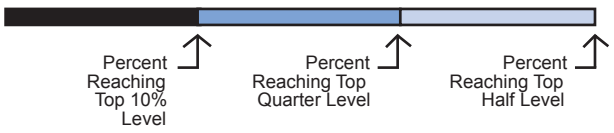
Percentages of Students Achieving International Marker Levels in the Sciences Lower Grade (Third Grade*)

Country	Top 10% Level	Top Quarter Level	Top Half Level	Percent Reaching International Levels
Korea	20 (1.1)	51 (1.4)	83 (1.0)	
United States	15 (1.1)	33 (1.6)	61 (1.3)	
†[2] England	13 (0.8)	29 (1.4)	54 (1.5)	
Japan	11 (0.6)	34 (1.0)	69 (0.9)	
Singapore	11 (1.4)	26 (2.0)	50 (2.2)	
Czech Republic	9 (0.8)	25 (1.4)	52 (1.8)	
Canada	8 (0.6)	24 (1.2)	53 (1.4)	
New Zealand	8 (1.0)	21 (1.5)	46 (2.0)	
Ireland	6 (0.7)	19 (1.3)	47 (2.0)	
Hong Kong	3 (0.4)	17 (1.5)	47 (2.1)	
Norway	3 (0.6)	12 (1.2)	34 (1.7)	
Portugal	2 (0.3)	8 (0.9)	24 (1.6)	
Greece	2 (0.7)	9 (1.3)	32 (1.9)	
Iceland	1 (0.2)	7 (0.6)	27 (1.4)	
Cyprus	0 (0.2)	3 (0.5)	16 (1.1)	
Iran, Islamic Rep.	0 (0.1)	0 (0.2)	4 (0.8)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	16 (1.2)	34 (1.8)	60 (2.0)	
Austria	10 (1.4)	29 (2.2)	61 (1.8)	
[1] Latvia (LSS)	4 (1.1)	14 (1.6)	38 (2.3)	
Netherlands	3 (0.4)	19 (1.3)	58 (1.9)	
Scotland	8 (0.9)	24 (1.5)	49 (1.9)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	6 (0.6)	19 (1.2)	49 (1.5)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	5 (0.5)	16 (1.3)	41 (2.0)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
Thailand	1 (0.6)	5 (1.9)	24 (3.4)	



The international levels correspond to the percentiles computed from the combined data from all of the participating countries.

Top 10% Level (90th Percentile) = 610
Top Quarter Level (75th Percentile) = 554
Top Half Level (50th Percentile) = 488



*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Gender Differences in Science Achievement?

Tables 1.6 and 1.7 reveal that boys had significantly higher mean science achievement than girls at both the third and fourth grades internationally and in about half of the TIMSS countries. Each table presents mean science achievement separately for boys and girls for each country, as well as the differences between the means. Countries in the upper part of the tables are shown in increasing order of this gender difference. The visual representation of the gender difference for each country, shown by a bar, indicates the amount of the difference, whether the direction of the difference favored girls or boys, and whether or not the difference is statistically significant (indicated by a darkened bar). [10]

In the fourth grade, statistically significant differences favoring boys were found in eleven countries, and ranged from 12 points in the United States to 26 points in the Netherlands. For most of these countries, and many others, the third-grade gender differences were somewhat smaller. In only nine countries – Cyprus, England, Iran, Ireland, Latvia (LSS), New Zealand, Scotland, Singapore and Thailand – were there no statistically significant differences in science achievement between boys and girls in both grades. This finding of differences favoring boys in science is substantially more pronounced than in the TIMSS mathematics results for third and fourth grades, which indicate an international pattern of gender differences favoring males but show few significant differences for individual countries.[11] However, the gender difference is much less pervasive at third and fourth grades than at seventh and eighth grades.[12] This is consistent with the results from the second IEA science study conducted in 1983-84, which found greater gender differences in science achievement among 14-year-olds than among 10-year-olds.[13]

[10] The tests for statistical significance assumed independent samples of boys and girls in each country and have not been adjusted for multiple comparisons.

[11] 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.

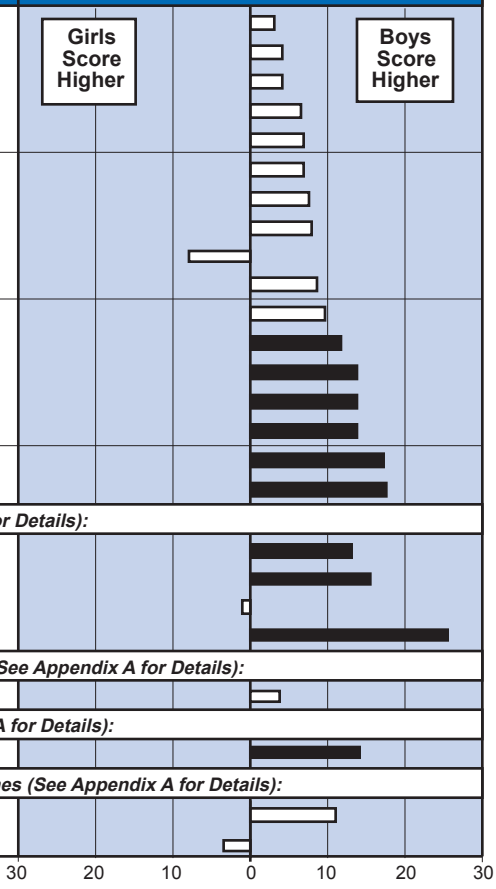
[12] Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. (1996). *Science Achievement in the Middle School Years: The IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

[13] 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.

Table 1.6

Gender Differences in Achievement in the Sciences - Upper Grade (Fourth Grade*)

Country	Boys' Mean	Girls' Mean	Difference Absolute Value	Gender Difference
Portugal	481 (4.5)	478 (4.2)	3 (6.2)	
Singapore	549 (5.4)	545 (6.3)	4 (8.3)	
†Scotland	538 (4.5)	533 (4.3)	4 (6.2)	
Ireland	543 (3.5)	536 (4.5)	7 (5.7)	
Greece	501 (4.5)	494 (4.3)	7 (6.2)	
†[2] England	555 (4.0)	548 (3.4)	7 (5.3)	
Canada	553 (3.7)	545 (3.2)	8 (4.9)	
Norway	534 (4.7)	526 (3.7)	8 (5.9)	
New Zealand	527 (6.1)	535 (4.8)	8 (7.7)	
Iran, Islamic Rep.	421 (5.9)	412 (4.7)	9 (7.6)	
Cyprus	480 (4.0)	471 (3.1)	10 (5.1)	
United States	571 (3.3)	560 (3.3)	12 (4.6)	
Japan	580 (2.0)	567 (2.0)	14 (2.9)	
Korea	604 (2.2)	590 (2.5)	14 (3.3)	
Hong Kong	540 (4.1)	526 (3.8)	14 (5.6)	
Czech Republic	565 (3.4)	548 (3.6)	17 (5.0)	
Iceland	514 (4.3)	496 (3.3)	18 (5.4)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	569 (3.3)	556 (3.2)	13 (4.6)	
Austria	572 (3.9)	556 (3.7)	15 (5.3)	
[1] Latvia (LSS)	512 (5.4)	513 (5.5)	1 (7.7)	
Netherlands	570 (3.6)	544 (3.5)	26 (5.0)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	548 (3.3)	544 (4.0)	4 (5.2)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	539 (3.8)	525 (3.9)	14 (5.4)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
[1] Israel	512 (4.5)	501 (3.8)	11 (5.9)	
Thailand	471 (5.9)	474 (4.3)	3 (7.3)	



International Averages		
Boys	Girls	Difference
537	527	9
(Averages of all country means)		

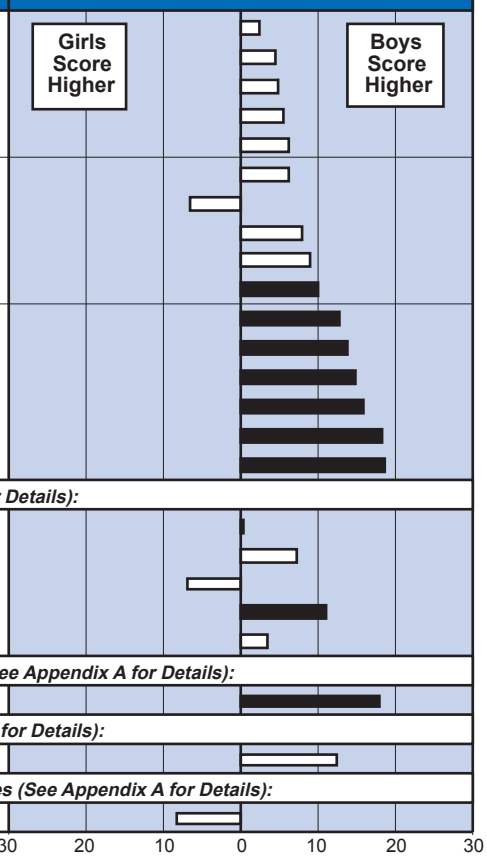
*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 1.7

Gender Differences in Achievement in the Sciences - Lower Grade (Third Grade*)

Country	Boys' Mean	Girls' Mean	Difference Absolute Value	Gender Difference
Japan	523 (2.1)	521 (2.0)	2 (2.8)	
Ireland	481 (4.6)	477 (4.4)	4 (6.4)	
Iran, Islamic Rep.	359 (5.7)	354 (5.7)	5 (8.1)	
Cyprus	418 (2.7)	412 (3.0)	6 (4.0)	
United States	514 (4.2)	508 (3.2)	6 (5.2)	
Singapore	491 (5.8)	484 (5.2)	6 (7.7)	
New Zealand	470 (5.9)	476 (5.7)	7 (8.2)	
†2 England	503 (4.8)	495 (3.4)	8 (5.9)	
Iceland	440 (4.0)	431 (3.9)	9 (5.6)	
Canada	496 (3.2)	486 (2.9)	10 (4.3)	
Norway	457 (4.6)	444 (4.5)	13 (6.4)	
Greece	453 (4.6)	439 (3.9)	14 (6.0)	
Hong Kong	488 (3.4)	473 (3.8)	15 (5.1)	
Portugal	431 (4.3)	415 (5.4)	16 (6.9)	
Czech Republic	503 (4.1)	485 (3.9)	18 (5.6)	
Korea	562 (2.8)	543 (2.7)	19 (3.9)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	510 (5.6)	510 (4.3)	0 (7.1)	
Austria	508 (6.9)	501 (4.0)	7 (7.9)	
[1] Latvia (LSS)	462 (5.2)	469 (4.8)	7 (7.1)	
Netherlands	504 (3.8)	493 (3.1)	11 (4.9)	
Scotland	485 (4.4)	482 (4.7)	3 (6.5)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	496 (3.4)	478 (3.4)	18 (4.8)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	472 (4.2)	460 (4.7)	12 (6.3)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
Thailand	428 (6.5)	437 (7.1)	8 (9.6)	



International Averages		
Boys	Girls	Difference
479	471	8
(Averages of all country means)		

*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1] National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some differences may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Differences in Median Performance at Age 9?

Testing the two adjacent grades with the most 9-year-olds provides the opportunity to compare achievement on the basis of age. For the 22 countries where the two grades tested contained at least 75% of the 9-year-olds, TIMSS estimated the median performance for this age group. Table 1.8 provides the estimated medians as well as the estimated distributions of 9-year-olds across grades.[14] For many countries, the two grades tested included practically all of their 9-year-olds (7 countries have at least 98%, and a further 11 countries at least 90%), whereas, for some others, there were substantial percentages outside these grades, mostly in the grade below.[15] Of the countries included in Table 1.8, Austria, Hungary, Latvia(LSS), and Iran, had 10% or more of their 9-year-olds below the two grades tested.

The median is the point on the science scale that divides the higher-performing 50% of the students from the lower-performing 50%. Like the mean, the median provides a useful summary statistic on which to compare performance across countries. It is used instead of the mean in this table because it can be reliably estimated even when scores from some members of the population are not available[16] (that is, those 9-year-olds outside the tested grades).

Notwithstanding the additional difficulties in obtaining the achievement estimates for the age-based samples, the results for 9-year-olds appear to be quite consistent with those obtained for the two grade levels. The relative performance of countries in science achievement on the basis of median performance of 9-year-olds was quite similar to that based on average fourth-grade and/or third-grade performance, although there are exceptions. For example, 9-year-olds in the Czech Republic, Ireland, and Latvia(LSS) did relatively less well than the fourth-grade students, whereas those in Scotland, New Zealand, and Norway did relatively better. In general, however, the higher-performing countries in the fourth and third grades generally were those with higher-performing 9-year-olds.

[14] For information about the distribution of 9-year-olds in all countries, not just those with 75% coverage, see Table A.3 in Appendix A.

[15] The number of 9-year-olds below the lower grade and above the upper grade tested were extrapolated from the distribution of 9-year-olds in the tested grades.

[16] Because TIMSS sampled students in the two adjacent grades with the most 9-year-olds within a country, it was possible to estimate the median for the 9-year-old students when the two tested grades included at least an estimated 75% of the 9-year-olds in that country. To compute the median, TIMSS assumed that those 9-year-old students in the grades below the tested grades would score below the median and those in the grades above the tested grades would score above the median. The percentages assumed to be above and below the median were added to the tails of the distribution before calculating the median using the modified distribution.

Table 1.8

Median Science Achievement of 9-Year-Old Students

Includes Only Countries Where the Grades Tested Contained at Least 75% of the 9-Year-Olds

Country	Median	Country's Name For Lower Grade	Country's Name For Upper Grade	Estimated Distribution of 9-Year-Olds			
				Percent Below Lower Grade*	Percentage of 9-Year-Old Students Tested		Percent Above Upper Grade*
					Percent in Lower Grade	Percent in Upper Grade	
Korea	561 (1.9)	3rd Grade	4th Grade	7.9%	67.2%	24.3%	0.7%
United States	535 (3.3)	3	4	4.5%	61.1%	34.2%	0.2%
Japan	529 (2.0)	3rd Grade	4th Grade	0.5%	90.8%	8.7%	0.0%
† Scotland	523 (4.2)	Year 4	Year 5	0.3%	22.9%	75.7%	1.1%
Canada	522 (4.1)	3	4	4.8%	46.3%	47.5%	1.3%
†2 England	521 (3.6)	Year 4	Year 5	0.9%	57.8%	41.2%	0.1%
New Zealand	513 (4.8)	Standard 2	Standard 3	0.3%	50.2%	49.1%	0.3%
Hong Kong	511 (3.0)	Primary 3	Primary 4	6.2%	43.2%	50.0%	0.7%
Norway	505 (3.5)	2	3	0.1%	38.1%	61.7%	0.1%
Singapore	500 (5.8)	Primary 3	Primary 4	2.1%	80.5%	17.4%	0.1%
Greece	498 (3.4)	3	4	0.8%	10.9%	87.6%	0.7%
Czech Republic	497 (3.8)	3	4	9.2%	75.5%	15.4%	0.0%
Iceland	495 (4.5)	3	4	0.4%	14.8%	84.4%	0.4%
Ireland	491 (3.9)	3rd Class	4th Class	8.4%	68.4%	23.2%	0.0%
Portugal	458 (3.2)	3	4	6.7%	45.0%	47.9%	0.4%
Cyprus	455 (2.5)	3	4	1.4%	35.1%	62.5%	0.9%
Iran, Islamic Rep.	370 (4.2)	3	4	16.9%	50.7%	32.0%	0.4%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):							
Australia	524 (4.6)	3 or 4	4 or 5	5.8%	64.9%	28.9%	0.4%
Austria	511 (3.3)	3	4	13.2%	71.5%	15.2%	0.0%
1 Latvia (LSS)	449 (3.6)	3	4	23.8%	54.7%	21.2%	0.3%
Netherlands	515 (2.8)	5	6	6.9%	63.0%	30.1%	0.0%
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):							
Hungary	477 (4.8)	3	4	10.5%	70.2%	19.0%	0.3%

*Data are extrapolated; students below the lower grade and above the upper grade were not included in the sample.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2).
[2]National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) Standard errors appear in parentheses. Because results are rounded, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

How Does Fourth-Grade Performance Compare with Eighth-Grade Performance?

Achievement at the third and fourth grades was estimated separately from achievement at the seventh and eighth grades. That is, different tests and content areas were used. Therefore, the scale scores are not comparable, and direct comparisons cannot be made between the third and fourth grades on one hand and the seventh and eighth grades on the other. One way, however, to compare relative performance between the fourth grade and the eighth grade is to compare a country's performance with the international mean at each of the two grades. For example, the means for the countries participating at both grades are portrayed in Figure 1.3, with those for the eighth grade taken directly from *Science in the Middle School Years: IEA's Third International Mathematics and Science Study*.[17]

As shown in Figure 1.3, Singapore, the Czech Republic, Japan, Korea, the Netherlands, Slovenia, Austria, England, and Australia were above the international mean at both grades, and Greece, Iceland, Portugal, Iran, Cyprus, and Kuwait were below the mean at both grades. Ireland, the United States, Canada, and Scotland were above the international mean at the fourth grade, but at the eighth grade were just about at the international mean. In contrast, Hungary, Israel, and Thailand improved their standings relative to the international mean, with Hungary moving from about the mean at fourth grade to above the mean at eighth grade, and Israel and Thailand from below the mean at fourth grade to about the mean at eighth grade.

In reading Figure 1.3 it is important to remember that the fourth- and eighth-grade scales are not directly comparable. For example, it is not the case that the eighth graders in Singapore outperformed the fourth graders in Korea by 10 points, nor is it true that fourth graders in Japan had the same level of performance as eighth graders in the Czech Republic.

[17] 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: The IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Figure 1.3

Science Performance at Fourth and Eighth Grades* Compared with the International Averages

Fourth Grade	
Country	**Mean Scale Score**
Korea	597 (1.9)
Japan	574 (1.8)
United States	565 (3.1)
Austria	565 (3.3)
Australia	562 (2.9)
Netherlands	557 (3.1)
Czech Republic	557 (3.1)
England	551 (3.3)
Canada	549 (3.0)
Singapore	547 (5.0)
Slovenia	546 (3.3)
Ireland	539 (3.3)
Scotland	536 (4.2)
Hong Kong	533 (3.7)
Hungary	532 (3.4)
New Zealand	531 (4.9)
Norway	530 (3.6)
Latvia (LSS)	512 (4.9)
Israel	505 (3.6)
Iceland	505 (3.3)
Greece	497 (4.1)
Portugal	480 (4.0)
Cyprus	475 (3.3)
Thailand	473 (4.9)
Iran, Islamic Rep.	416 (3.9)
Kuwait	401 (3.1)
International Average = 524 (0.7) (Average of All Country Means)	

Eighth Grade	
Country	**Mean Scale Score**
Singapore	607 (5.5)
Czech Republic	574 (4.3)
Japan	571 (1.6)
Korea	565 (1.9)
Netherlands	560 (5.0)
Slovenia	560 (2.5)
Austria	558 (3.7)
Hungary	554 (2.8)
England	552 (3.3)
Australia	545 (3.9)
Ireland	538 (4.5)
United States	534 (4.7)
Canada	531 (2.6)
Norway	527 (1.9)
New Zealand	525 (4.4)
Thailand	525 (3.7)
Israel	524 (5.7)
Hong Kong	522 (4.7)
Scotland	517 (5.1)
Greece	497 (2.2)
Iceland	494 (4.0)
Latvia (LSS)	485 (2.7)
Portugal	480 (2.3)
Iran, Islamic Rep.	470 (2.4)
Cyprus	463 (1.9)
Kuwait	430 (3.7)
International Average = 527 (0.7) (Average of All Country Means)	

Significantly Higher than International Average

Not Significantly Different from International Average

Significantly Lower than International Average

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Includes countries that participated in TIMSS achievement testing at both fourth and eighth grades. The eighth-grade means are the same as those reported in *Science Achievement in the Middle School Years: IEA's Third Mathematics and Science Study*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

In order to provide a more direct basis for comparison, TIMSS established a link between the results for third- and fourth-grade students and the scale used to report seventh- and eighth-grade performance. Because 17 of the 97 science items in the third- and fourth-grade assessment also were included in the seventh- and eighth-grade assessment, it was possible to use the average increase in performance on these items to estimate where on the seventh- and eighth-grade scale the younger students should be placed.[18]

Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. The mean for fourth-grade students in this table is based on all items administered to fourth-grade students, although only the common items were used to establish the link. Since there were relatively few items in common in the science tests given at the two grades, the size of the link is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. (The eighth-grade means are the same as those reported in *Science Achievement in the Middle School Years: IEA's Third Mathematics and Science Study*.)

Table 1.9 also provides information about the difference in performance between the two grades. The estimated difference between grade 4 and grade 8 varies quite a lot between countries, from a low of 105 for Korea to a high of 234 for Iran. That the increase in performance from the lower to the upper grade was not the same for each country helps to explain why the standing of some countries relative to the international mean changed from grade 4 to grade 8. For example, the United States, Canada, and Scotland, which were above the international mean at the fourth grade but just about at the international mean at the eighth grade (see Figure 3.1), were among those countries with the smallest performance increases between the grades. Hungary, Israel, and Thailand, among the countries with the largest increases, each improved their standings relative to the international mean, with Hungary moving from about the mean at fourth grade to above the mean at eighth grade, and Israel and Thailand from below the mean at fourth grade to about the mean at eighth grade.

[18] See the section "Estimating the Link Between Fourth- and Eighth-Grade Performance" in Appendix A.

Table 1.9

Increases in Science Performance Between the Fourth and Eighth Grades*

Based on Fourth-Grade Performance Estimated on the Eighth-Grade Scale

Country	Estimated Fourth-Grade Mean on Eighth-Grade Scale	Eighth-Grade Mean	Difference
Iran, Islamic Rep.	235 (14.7)	470 (2.4)	234 (14.9)
Thailand	306 (15.2)	525 (3.7)	220 (15.6)
Kuwait	217 (14.4)	430 (3.7)	213 (14.9)
Singapore	398 (15.2)	607 (5.5)	210 (16.2)
Israel	345 (14.6)	524 (5.7)	179 (15.7)
Hungary	379 (14.5)	554 (2.8)	175 (14.8)
Portugal	314 (14.8)	480 (2.3)	165 (14.9)
Czech Republic	410 (14.4)	574 (4.3)	164 (15.0)
Slovenia	396 (14.5)	560 (2.5)	164 (14.7)
Greece	336 (14.8)	497 (2.2)	161 (15.0)
Cyprus	309 (14.5)	463 (1.9)	154 (14.6)
Netherlands	410 (14.4)	560 (5.0)	150 (15.2)
Norway	377 (14.6)	527 (1.9)	150 (14.7)
Ireland	389 (14.5)	538 (4.5)	149 (15.2)
England	404 (14.5)	552 (3.3)	149 (14.9)
Iceland	345 (14.5)	494 (4.0)	148 (15.0)
New Zealand	378 (15.2)	525 (4.4)	147 (15.8)
Hong Kong	381 (14.6)	522 (4.7)	142 (15.4)
Japan	431 (14.1)	571 (1.6)	140 (14.2)
Austria	420 (14.5)	558 (3.7)	138 (14.9)
Scotland	384 (14.8)	517 (5.1)	133 (15.7)
Latvia (LSS)	355 (15.2)	485 (2.7)	130 (15.4)
Canada	401 (14.4)	531 (2.6)	130 (14.6)
Australia	417 (14.4)	545 (3.9)	127 (14.9)
United States	421 (14.4)	534 (4.7)	113 (15.2)
Korea	460 (14.1)	565 (1.9)	105 (14.2)

*Fourth and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures at the fourth grade (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Includes countries that participated in TIMSS testing at both fourth and eighth grades.
Note: Table 1.9 provides an estimate of how the fourth-grade students would have performed on the eighth-grade scale. Since there are only 18 science items in common in the tests given to the two grades, the estimate of the relationship is approximate. The standard error for the fourth-grade estimate incorporates an added component to account for the uncertainty of this approximation. The eighth-grade means are the same as those reported in *Science Achievement in the Middle School Years: IEA's Third Mathematics and Science Study.*
Table C.5 contains the means for the third and fourth grades, as well as for the seventh and eighth grades.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Chapter 2

Average Achievement in the Science Content Areas

Recognizing that curricular differences exist between and within countries is an important aspect of IEA studies, TIMSS attempted to measure achievement in different areas within the sciences that would be useful in relating achievement to curriculum. After much deliberation, the science test for the third and fourth grades was designed to enable reporting by four content areas in accordance with the TIMSS science framework.[1] These four content areas consist of:

- earth science
- life science
- physical science
- environmental issues and the nature of science

Following the discussion in this chapter about differences in average achievement for the TIMSS countries across these content areas, Chapter 3 contains further information about the types of science items, including five or six example items within each content area and the percentage of correct responses on those items for each of the TIMSS countries.

How Does Achievement Differ Across Science Content Areas?

The results reported in Chapter 1 revealed substantial achievement differences among the participating countries on the TIMSS science test. This chapter examines whether the participating countries achieved at the same level in each of the content areas as they did on the science test as a whole.

Results in this chapter are based on the average percentage of correct responses to items within each content area. Because of the additional resources and time that would have been required to use the more complex IRT scaling methodology that served as the basis for the overall achievement estimates in Chapter 1, TIMSS could not generate scale scores for the four content areas for this report.[2]

Tables 2.1 and 2.2 provide the average percentage of correct responses to items in the different content areas for the fourth- and third-grade students, respectively. The countries are listed in order of their average percent correct across all items in the test. As indicated by the numbers of items overall and in each content area, the overall test contains the most items in life science (42%) and physical science (31%) and the

[1] Please see the test development section of Appendix A for more information about the process used to develop the TIMSS tests. Appendix B 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] TIMSS plans to generate IRT scale scores for the science content areas for future reports.

fewest items in the category of environmental issues and the nature of science (9%). Thus, countries who performed very well in life science and physical science were more likely to have higher scores overall.[3]

The results for the average percent correct across all science items are presented for each country primarily to provide a basis for comparison of performance in each of the content areas. For the purpose of comparing overall achievement among countries, it is preferable to use the results presented in Chapter 1.[4] It is interesting to note, however, that even though the relative standings of countries differ somewhat from Tables 1.1 and 1.2, the slight differences are well within the limits of sampling error and can be attributed to the differences in the methods used.

The data in each column show each country's average percent correct for items in that content area and the international average across all countries for the content area (shown as the last entry in the column). Looking down each of the columns in turn, two findings become apparent. First, the countries that did well on the overall test generally did well in each of the various content areas, and those that did poorly overall also tended to do so in each of the content areas. There are differences between the relative standing of countries within each of the content areas and their overall standing, but these differences are small when sampling error is considered.

Second, the international averages show that the different content areas in the TIMSS test were not equally difficult for the students taking the test. The life science content area was the least difficult for both grades. On average, the items in this content area were answered correctly by 64% of the fourth-graders and 55% of the third-graders across countries. Internationally, the items in the content area called environmental issues and the nature of science (international averages of 51% at fourth grade, 40% at third grade) were the most difficult items for the students at both grades.

It is important to keep these differences in average difficulty in mind when reading across the rows of the tables. These differences mean that for many countries, students will appear to have higher than average performance in life science and lower than average performance in environmental issues and the nature of science. For example, even though the fourth-grade students in Korea performed above the international average in life science, they still performed less well in this area than they did on the test as a whole. That is, simply comparing performance across the rows gives an unclear picture of each country's relative performance across the content areas because the varying difficulty level of the items in each area has not been taken into account.

[3] Table A.1 in Appendix A provides details about the distributions of items across the content areas, by format and score points (taking into account multi-part items and items scored for partial credit).

[4] The IRT scale scores provide better estimates of overall achievement, because they take the difficulty of items into account. This is important in a study such as TIMSS, where different students take overlapping but somewhat different sets of items.

Table 2.1

Average Percent Correct by Science Content Areas Upper Grade (Fourth Grade*)

Country	Science Overall (97 items)	Earth Science (17 items)	Life Science (41 items)	Physical Science (30 items)	Environmental Issues and the Nature of Science (9 items)
Korea	74 (0.4)	72 (0.5)	76 (0.4)	75 (0.5)	70 (0.8)
Japan	70 (0.3)	66 (0.4)	73 (0.3)	70 (0.4)	62 (0.6)
United States	66 (0.5)	64 (0.7)	71 (0.6)	60 (0.6)	65 (0.8)
Czech Republic	65 (0.5)	64 (0.6)	71 (0.5)	62 (0.7)	56 (0.9)
Singapore	64 (0.8)	58 (0.8)	70 (0.8)	64 (0.8)	53 (1.1)
Canada	64 (0.6)	62 (0.6)	68 (0.6)	61 (0.7)	56 (0.7)
†[2] England	63 (0.6)	61 (0.6)	68 (0.6)	60 (0.8)	56 (1.0)
Hong Kong	62 (0.7)	61 (0.6)	68 (0.7)	60 (0.8)	50 (1.1)
Ireland	61 (0.6)	60 (0.8)	66 (0.6)	57 (0.7)	55 (0.9)
Norway	60 (0.6)	60 (0.6)	67 (0.7)	55 (0.7)	53 (0.9)
New Zealand	60 (0.9)	57 (0.9)	66 (0.9)	57 (1.1)	54 (1.2)
† Scotland	60 (0.8)	58 (0.9)	65 (0.8)	57 (0.8)	53 (1.2)
Iceland	55 (0.7)	55 (0.7)	60 (0.8)	52 (0.7)	47 (1.2)
Greece	54 (0.8)	52 (0.9)	61 (0.9)	49 (0.9)	43 (1.2)
Cyprus	51 (0.5)	48 (0.7)	55 (0.5)	50 (0.7)	42 (1.0)
Portugal	50 (0.7)	50 (0.8)	54 (0.8)	49 (0.9)	39 (1.0)
Iran, Islamic Rep.	40 (0.7)	38 (0.7)	44 (0.7)	40 (0.9)	26 (0.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):					
Australia	66 (0.5)	61 (0.6)	72 (0.5)	63 (0.7)	63 (0.8)
Austria	66 (0.7)	62 (0.8)	72 (0.7)	64 (0.8)	54 (1.0)
[1] Latvia (LSS)	56 (0.8)	57 (1.0)	60 (0.8)	54 (0.9)	46 (1.2)
Netherlands	67 (0.5)	61 (0.6)	73 (0.5)	65 (0.6)	61 (0.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):					
Slovenia	64 (0.7)	64 (0.7)	68 (0.7)	61 (0.8)	54 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):					
Hungary	62 (0.6)	62 (0.7)	66 (0.6)	59 (0.8)	50 (0.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):					
[1] Israel	57 (0.8)	51 (0.8)	61 (0.9)	55 (0.9)	51 (1.3)
Kuwait	39 (0.5)	36 (0.6)	45 (0.6)	37 (0.5)	25 (0.7)
Thailand	49 (0.9)	48 (0.9)	52 (0.8)	46 (1.0)	48 (1.4)
International Average Percent Correct	59 (0.1)	57 (0.1)	64 (0.1)	57 (0.2)	51 (0.2)

*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Table 2.2

Average Percent Correct by Science Content Areas
Lower Grade (Third Grade*)

Country	Science Overall (97 items)	Earth Science (17 items)	Life Science (41 items)	Physical Science (30 items)	Environmental Issues and the Nature of Science (9 items)
Korea	67 (0.5)	64 (0.6)	70 (0.5)	67 (0.6)	60 (0.8)
Japan	61 (0.3)	58 (0.4)	65 (0.3)	61 (0.5)	52 (0.7)
United States	56 (0.6)	55 (0.7)	62 (0.7)	51 (0.7)	52 (0.9)
Czech Republic	55 (0.6)	53 (0.7)	61 (0.6)	51 (0.6)	41 (0.9)
†[2] England	55 (0.6)	53 (0.6)	60 (0.7)	52 (0.8)	45 (1.0)
Canada	53 (0.5)	52 (0.7)	59 (0.6)	50 (0.6)	44 (0.8)
Singapore	53 (0.9)	51 (0.9)	58 (0.9)	52 (0.9)	41 (1.1)
Hong Kong	53 (0.6)	52 (0.6)	58 (0.7)	50 (0.7)	36 (0.8)
Ireland	51 (0.7)	50 (0.7)	56 (0.7)	48 (0.8)	44 (0.9)
New Zealand	51 (0.9)	48 (0.8)	57 (1.0)	47 (0.9)	43 (1.2)
Norway	46 (0.7)	47 (0.7)	52 (0.8)	41 (0.9)	34 (0.8)
Greece	44 (0.7)	43 (0.8)	51 (0.8)	40 (0.8)	33 (1.1)
Iceland	42 (0.6)	44 (0.8)	47 (0.8)	40 (0.6)	30 (0.9)
Portugal	41 (0.8)	40 (0.8)	46 (0.8)	40 (0.8)	29 (0.9)
Cyprus	39 (0.5)	40 (0.5)	43 (0.6)	38 (0.7)	30 (0.7)
Iran, Islamic Rep.	30 (0.7)	29 (0.9)	33 (0.8)	30 (0.7)	20 (0.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):					
Australia	57 (0.7)	54 (0.8)	63 (0.7)	53 (0.8)	50 (1.0)
Austria	55 (0.8)	54 (1.0)	61 (0.9)	51 (1.0)	41 (1.1)
[1] Latvia (LSS)	48 (0.9)	48 (1.0)	52 (0.9)	46 (1.0)	38 (1.0)
Netherlands	56 (0.7)	49 (0.7)	63 (0.7)	53 (0.8)	48 (0.9)
Scotland	51 (0.7)	50 (0.7)	57 (0.8)	48 (0.8)	42 (1.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):					
Slovenia	53 (0.5)	52 (0.6)	58 (0.6)	51 (0.7)	42 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):					
Hungary	50 (0.8)	47 (0.9)	55 (0.8)	48 (0.9)	39 (1.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):					
Thailand	42 (1.2)	41 (1.4)	45 (1.3)	39 (1.2)	39 (1.8)
International Average Percent Correct	50 (0.2)	49 (0.2)	55 (0.2)	48 (0.2)	40 (0.2)

*Third grade in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

To facilitate more meaningful comparisons across rows, TIMSS has developed profiles of relative performance, which are shown for both grades in Table 2.3. These profiles are designed to show whether participating countries performed better or worse in some content areas than they did on the test as a whole, after adjusting for the differing difficulty of the items in each of the content areas.[5] An up-arrow indicates that a country did significantly better in a content area than it did on the test as a whole, a down-arrow indicates significantly lower performance, and a circle indicates that the country's performance in a content area is not very different from its performance on the test as a whole.[6]

Table 2.3 reveals that many countries performed relatively better or worse in some content areas than they did overall. In fact, each country in the fourth grade except Canada, England and Scotland had at least one content area in which it did relatively better or worse than it did on the test as a whole (at the third grade, Latvia(LSS), Slovenia, and Hungary are also exceptions). Although countries that did well in one content area tended to do well in others, there were still significant performance differences by content area among countries. For example, Austria, the Czech Republic, Hong Kong, the Netherlands, Norway, and Greece all performed relatively better in life science than they did on the test as a whole at both grades, while Korea, Japan, and Thailand performed relatively less well. Korea, Japan, Singapore, Portugal, and Iran performed relatively better in physical science at both grades, while Australia, the United States, Ireland, Norway, New Zealand, and Thailand did not perform as well in this area as they did on the test as a whole. This is consistent with the existence of differing curricular patterns and approaches among countries as discussed in the curriculum analysis report, *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*.[7]

[5] In performing the computations, the first step was to adjust the average percents to make all content areas equally difficult so that the comparisons would not reflect the various difficulties of the items in the content areas. The next step was to subtract these adjusted percentages for each content area from a country's average percentage over all four content areas. If the overall percentage of correct items by students in a country was the same as the adjusted average for that country for each of the content areas, then these differences would all be zero. The standard errors for these differences were computed, and then each difference was examined for statistical significance. This approach is similar to testing interaction terms in the analysis of variance. The jackknife method was used to compute the standard error of each interaction term. The significance level was adjusted using the Bonferroni method, assuming 4 x 26 (content areas by countries) comparisons at the fourth grade and 4 x 24 at the third grade.

[6] The statistics are not independent. That is, a country cannot do better (or worse) than its average on all scales, since a country's differences must add up to zero. However, it is possible for a country to have no statistically significant differences in performance.

[7] Schmidt, W.H., Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G. (in press). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science.* Dordrecht, the Netherlands: Kluwer Academic Publishers.

Table 2.3

Profiles of Relative Performance in Science Content Areas - Lower and Upper Grades (Third and Fourth Grades*)

Third Grade					Fourth Grade				
Country	Earth Science	Life Science	Physical Science	Environmental Issues and the Nature of Science	Country	Earth Science	Life Science	Physical Science	Environmental Issues and the Nature of Science
Korea					Korea				
Japan					Japan				
United States					United States				
†[2] England					Czech Republic				
Czech Republic					Singapore				
Singapore					Canada				
Canada					†[2] England				
Hong Kong					Hong Kong				
Ireland					Ireland				
New Zealand					Norway				
Norway					† Scotland				
Iceland					New Zealand				
Portugal					Iceland				
Cyprus					Cyprus				
Iran, Islamic Rep.					Portugal				
Greece					Iran, Islamic Rep.				
					Greece				
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):									
Australia					Australia				
Austria					Austria				
[1] Latvia (LSS)					[1] Latvia (LSS)				
Netherlands					Netherlands				
Scotland									
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):									
Slovenia					Slovenia				
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):									
Hungary					Hungary				
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):									
Thailand					[1] Israel				
					Kuwait				
					Thailand				

= Significantly higher than the country's overall average performance after adjusting for the difficulty of the content area

= No significant difference from the country's overall average performance after adjusting for the difficulty of the content area

= Significantly lower than the country's overall average performance after adjusting for the difficulty of the content area

*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

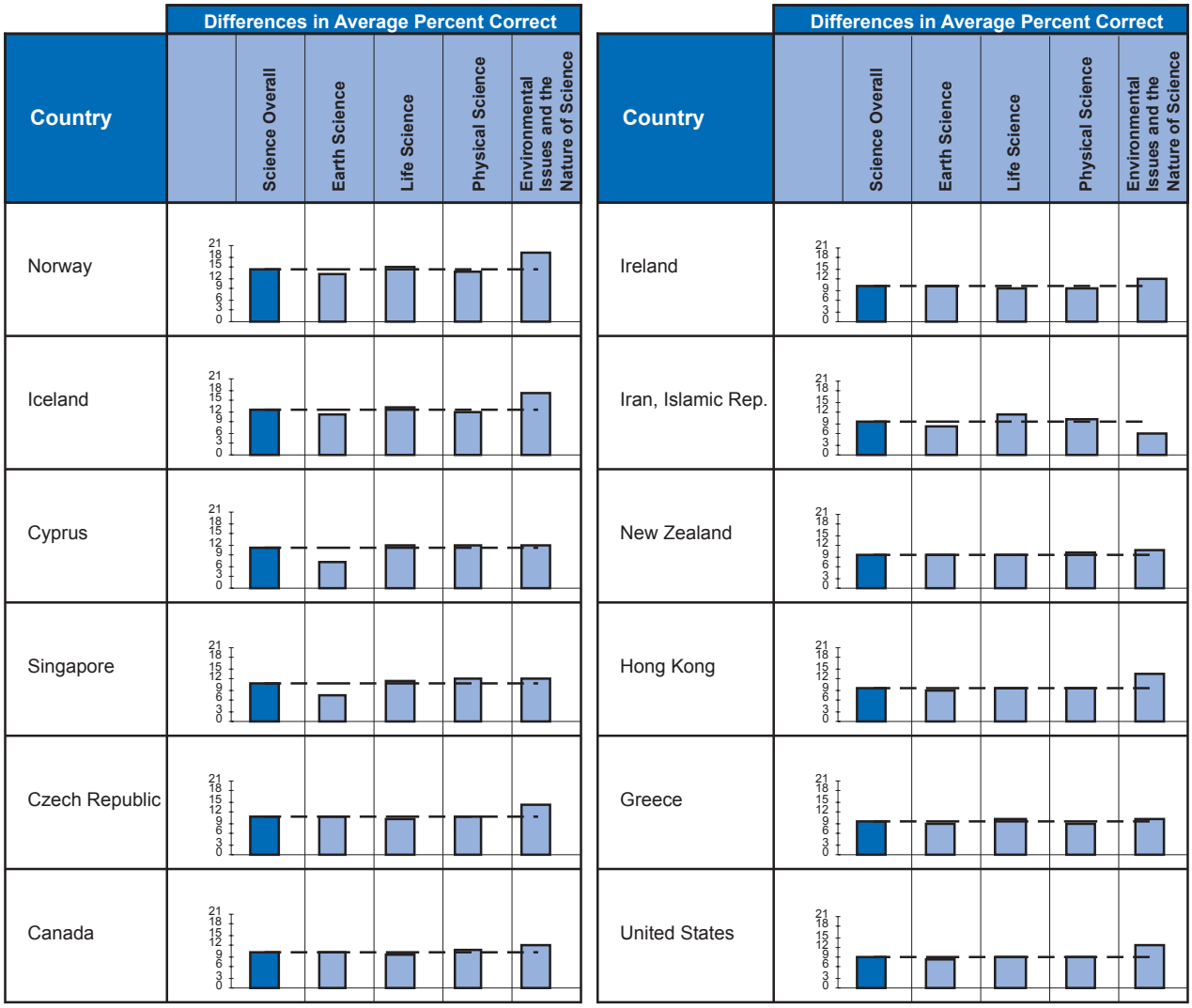
What Are the Increases in Achievement Between the Lower and Upper Grades?

Figure 2.1, which profiles the increases in average percent correct between the third and fourth grade for each country across content areas, also reflects these curricular differences. The countries are presented in descending order by the amount of overall increase between the grades, starting with Norway, Iceland, and Cyprus, all of which had increases of 11% to 15% in overall percentage correct. As an aid in the comparison between the increase for the science test overall and each of the four content areas, a dashed line indicating the overall between-grade increase is shown in each country's profile. Differences between grades were about nine percentage points for many of the countries, with a difference as small as 7% in Korea.

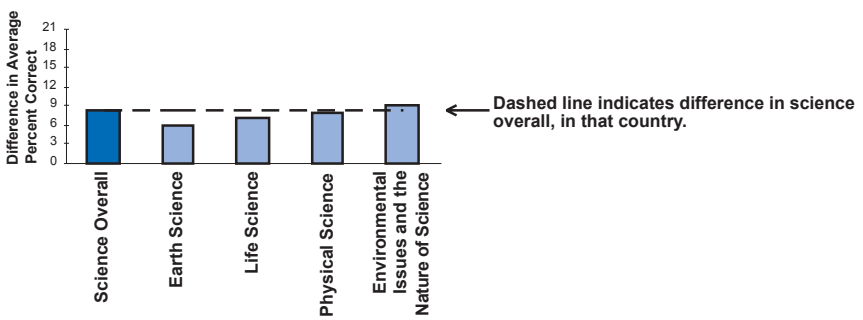
These results show that for the majority of countries, the performance differences between grades were fairly similar across content areas, particularly across life science and physical science, the content areas with most items in the TIMSS science test. There were several countries with moderate between-grade increases that were comparable across all content areas, including Canada, New Zealand, Greece, Portugal and Latvia(LSS), for example. Environmental issues and the nature of science was the content area that showed the greatest increase in many countries. This is particularly noticeable for Norway, Iceland, the Czech Republic, Hong Kong, the United States, and Australia. This may be a reflection of an informal environmentally-based approach to science teaching at these grades in some countries. Several smaller increases than the overall increase were observed in earth science, indicating that some countries may place less emphasis on this content area in the fourth grade.

Figure 2.1

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Science Content Areas



Legend:

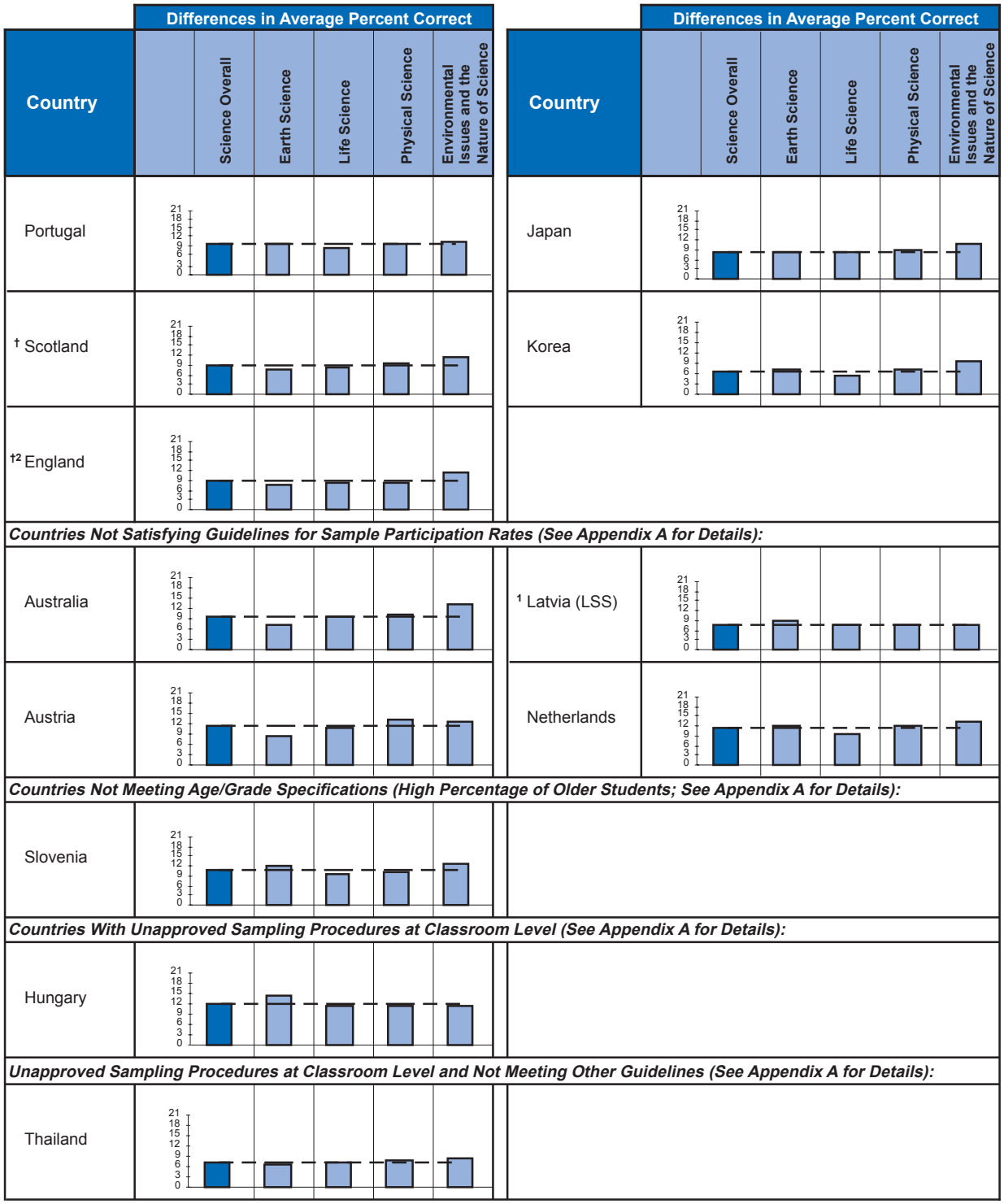


*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 2.1 (Continued)

Difference in Average Percent Correct Between Lower and Upper Grades (Third and Fourth Grades*) Overall and in Science Content Areas



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

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

Tables 2.4 and 2.5 present the gender differences in terms of average percent correct for the science content areas for fourth-grade students and third-grade students, respectively. The gender differences in overall science performance shown in these tables agree well with the gender differences in scaled scores presented in Chapter 1, particularly at the fourth grade.

The science content area data reveal few significant gender differences across countries in life science or environmental issues and the nature of science at either grade level, but many significant gender differences in earth science, and to a lesser extent in physical science. In both the third and fourth grades, gender differences in earth science and physical science reflected advantages for boys. In earth science, the boys had significantly higher averages than girls in 17 countries[8] at the fourth grade and in 16 countries at the third grade. In physical science, the corresponding results revealed advantages for boys in 10 and 8 countries respectively. Even where the differences between boys and girls were not statistically significant, the direction of the differences favored boys in both content areas at both grades in most countries.

In life science and for the items covering environmental issues and the nature of science, girls and boys had similar performances at both grades. In life science, there were very few gender differences in average performance. Fourth-grade boys did better than girls in the Netherlands, and third-grade boys did better in the Czech Republic, Hong Kong, Korea, and Portugal. Girls performed better than boys at both grade levels in New Zealand. For the items in the area of environmental issues and the nature of science, fourth-grade girls had higher achievement than boys in two countries – New Zealand and Slovenia – while boys had higher achievement in Austria. At the third grade, there were no significant differences in average performance for this content area except in Canada and Thailand, where girls performed better than boys.

[8] Significance tests for gender differences are adjusted for multiple comparisons across content areas, but not across countries. Statements about the number of gender differences observed across countries may therefore overestimate the number of differences in the populations concerned.

Table 2.4

Average Percent Correct for Boys and Girls by Science Content Areas Upper Grade (Fourth Grade*)

Country	Science Overall		Earth Science		Life Science	
	Boys	Girls	Boys	Girls	Boys	Girls
Canada	64 (0.7)	63 (0.6)	63 (0.9)	60 (0.7)	68 (0.7)	69 (0.8)
Cyprus	51 (0.7)	50 (0.6)	49 (0.9)	46 (0.7)	55 (0.7)	54 (0.7)
Czech Republic	67 (0.6)	64 (0.7)	67 (0.8)	61 (0.8)	72 (0.6)	71 (0.7)
†2 England	64 (0.8)	63 (0.6)	63 (0.8)	60 (0.8)	68 (0.7)	68 (0.6)
Greece	54 (1.0)	53 (1.0)	52 (1.2)	52 (0.9)	61 (0.9)	61 (1.1)
Hong Kong	63 (0.8)	61 (0.7)	63 (0.7)	59 (0.6)	69 (0.8)	67 (0.7)
Iceland	56 (0.8)	54 (0.8)	57 (1.3)	52 (0.8)	60 (0.9)	60 (1.0)
Iran, Islamic Rep.	41 (1.0)	39 (0.9)	40 (1.0)	35 (0.7)	44 (1.2)	44 (0.9)
Ireland	61 (0.7)	61 (0.8)	62 (0.9)	59 (1.1)	65 (0.7)	66 (0.9)
Japan	70 (0.4)	69 (0.4)	68 (0.5)	65 (0.6)	73 (0.5)	73 (0.4)
Korea	75 (0.5)	73 (0.5)	73 (0.6)	70 (0.7)	76 (0.5)	75 (0.6)
New Zealand	59 (1.2)	61 (0.9)	58 (1.2)	57 (1.0)	64 (1.2)	68 (0.9)
Norway	61 (0.8)	60 (0.7)	61 (1.0)	58 (0.8)	66 (0.9)	67 (0.8)
Portugal	50 (0.9)	50 (0.8)	50 (1.0)	49 (0.8)	53 (0.9)	54 (0.9)
† Scotland	61 (0.9)	60 (0.8)	60 (0.9)	56 (0.9)	65 (0.9)	66 (0.9)
Singapore	65 (0.9)	64 (1.0)	59 (0.9)	57 (1.0)	70 (0.9)	69 (1.0)
United States	67 (0.6)	65 (0.6)	65 (0.7)	62 (0.9)	72 (0.7)	71 (0.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	67 (0.6)	65 (0.6)	64 (0.7)	59 (0.7)	72 (0.6)	72 (0.5)
Austria	67 (0.9)	64 (0.7)	64 (0.9)	60 (1.0)	72 (0.9)	72 (0.8)
1 Latvia (LSS)	55 (0.9)	57 (1.0)	56 (1.1)	57 (1.2)	59 (0.9)	61 (1.2)
Netherlands	70 (0.7)	65 (0.7)	65 (0.8)	58 (0.8)	75 (0.7)	71 (0.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	64 (0.7)	63 (0.8)	65 (0.7)	63 (0.9)	68 (0.9)	68 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	63 (0.8)	60 (0.7)	64 (0.9)	60 (0.8)	67 (0.8)	66 (0.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
1 Israel	58 (1.1)	57 (0.8)	53 (1.2)	50 (1.0)	62 (1.3)	61 (0.9)
Thailand	49 (1.2)	49 (0.8)	48 (1.2)	47 (0.9)	52 (1.0)	53 (0.8)

= Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

*Fourth grade in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1 National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Table 2.4 (Continued)

Average Percent Correct for Boys and Girls by Science Content Areas – Upper Grade (Fourth Grade*)

Country	Physical Science		Environmental Issues and the Nature of Science	
	Boys	Girls	Boys	Girls
Canada	63 (0.9)	59 (0.8)	55 (1.1)	57 (0.7)
Cyprus	51 (0.8)	49 (0.8)	42 (1.2)	42 (1.1)
Czech Republic	65 (0.8)	59 (0.8)	56 (1.2)	56 (1.2)
†[2] England	62 (1.0)	59 (0.8)	55 (1.2)	58 (1.2)
Greece	51 (1.1)	47 (1.1)	43 (1.7)	43 (1.5)
Hong Kong	62 (1.0)	58 (0.9)	51 (1.3)	49 (1.2)
Iceland	54 (1.0)	49 (0.8)	48 (1.9)	46 (1.4)
Iran, Islamic Rep.	41 (1.2)	39 (1.1)	25 (1.2)	26 (1.3)
Ireland	58 (0.9)	56 (0.8)	55 (1.0)	55 (1.3)
Japan	71 (0.5)	69 (0.6)	62 (0.8)	63 (0.7)
Korea	76 (0.7)	73 (0.5)	69 (1.1)	71 (1.0)
New Zealand	57 (1.5)	56 (1.1)	51 (1.7)	57 (1.3)
Norway	57 (1.0)	53 (0.9)	53 (1.3)	52 (1.1)
Portugal	50 (1.1)	48 (1.0)	39 (1.3)	40 (1.2)
† Scotland	59 (1.0)	56 (0.9)	52 (1.5)	55 (1.2)
Singapore	65 (1.0)	63 (1.0)	53 (1.4)	54 (1.4)
United States	62 (0.7)	59 (0.7)	64 (0.9)	66 (0.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	64 (0.9)	61 (0.7)	63 (1.0)	63 (1.0)
Austria	67 (1.1)	60 (0.8)	56 (1.3)	51 (1.0)
[1] Latvia (LSS)	55 (1.1)	54 (1.0)	45 (1.5)	47 (1.2)
Netherlands	68 (1.0)	61 (0.8)	61 (1.1)	61 (1.3)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	63 (0.9)	59 (0.9)	53 (1.2)	56 (1.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	62 (1.0)	57 (1.0)	49 (1.2)	51 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
[1] Israel	56 (1.2)	55 (0.9)	52 (1.6)	52 (1.4)
Thailand	47 (1.4)	46 (1.0)	47 (1.8)	49 (1.4)

= Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

*Fourth grade in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Table 2.5

Average Percent Correct for Boys and Girls by Science Content Areas Lower Grade (Third Grade*)

Country	Science Overall		Earth Science		Life Science	
	Boys	Girls	Boys	Girls	Boys	Girls
Canada	54 (0.7)	53 (0.6)	53 (0.8)	50 (0.8)	59 (0.7)	59 (0.7)
Cyprus	40 (0.5)	39 (0.7)	41 (0.6)	39 (0.6)	43 (0.7)	43 (0.8)
Czech Republic	56 (0.7)	53 (0.7)	55 (0.8)	50 (0.9)	62 (0.8)	60 (0.7)
†[2] England	56 (0.9)	54 (0.7)	56 (0.8)	51 (0.7)	60 (0.9)	59 (0.7)
Greece	45 (0.9)	43 (0.8)	44 (1.0)	42 (0.9)	52 (1.0)	50 (0.9)
Hong Kong	54 (0.6)	51 (0.7)	54 (0.6)	50 (0.9)	60 (0.8)	57 (0.8)
Iceland	44 (0.8)	41 (0.8)	45 (1.1)	42 (1.1)	47 (1.0)	46 (1.1)
Iran, Islamic Rep.	30 (1.0)	30 (0.8)	31 (1.2)	28 (1.2)	33 (1.2)	33 (0.9)
Ireland	52 (0.9)	50 (0.8)	51 (1.0)	49 (0.9)	56 (0.9)	56 (0.8)
Japan	61 (0.4)	61 (0.4)	59 (0.5)	57 (0.5)	65 (0.4)	65 (0.5)
Korea	69 (0.5)	65 (0.6)	66 (0.8)	62 (0.7)	71 (0.5)	68 (0.7)
New Zealand	50 (1.1)	51 (0.9)	49 (1.0)	47 (0.9)	55 (1.2)	59 (1.1)
Norway	47 (0.8)	45 (1.0)	48 (1.0)	45 (1.2)	53 (0.9)	51 (1.1)
Portugal	42 (0.8)	40 (1.0)	42 (0.9)	38 (1.0)	47 (0.9)	44 (1.1)
† Scotland	52 (0.8)	51 (0.8)	51 (0.8)	49 (0.9)	57 (0.9)	57 (0.9)
Singapore	54 (1.0)	53 (0.9)	52 (1.0)	49 (1.0)	58 (1.0)	58 (1.0)
United States	57 (0.8)	56 (0.7)	56 (0.9)	54 (0.7)	62 (1.0)	62 (0.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):						
Australia	57 (1.0)	57 (0.7)	54 (1.2)	53 (0.8)	62 (1.1)	63 (0.7)
Austria	55 (1.2)	54 (0.8)	54 (1.6)	53 (0.9)	61 (1.3)	62 (0.9)
[1] Latvia (LSS)	48 (1.0)	49 (0.9)	49 (1.2)	47 (1.1)	51 (1.1)	54 (1.0)
Netherlands	57 (0.8)	55 (0.7)	51 (1.0)	47 (0.7)	63 (0.9)	63 (0.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):						
Slovenia	54 (0.7)	51 (0.7)	54 (0.8)	50 (0.8)	59 (0.8)	57 (0.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):						
Hungary	51 (0.8)	49 (0.9)	50 (1.0)	45 (1.0)	55 (0.8)	55 (1.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):						
Thailand	41 (1.2)	42 (1.4)	41 (1.3)	41 (1.6)	44 (1.3)	46 (1.5)

= Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

*Three grade in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Table 2.5 (Continued)

Average Percent Correct for Boys and Girls by Science Content Areas Lower Grade (Third Grade*)

Country	Physical Science		Environmental Issues and the Nature of Science	
	Boys	Girls	Boys	Girls
Canada	51 (0.8)	48 (0.7)	42 (1.0)	46 (1.0)
Cyprus	39 (0.7)	37 (0.9)	31 (0.8)	29 (1.0)
Czech Republic	54 (0.9)	49 (0.8)	41 (1.2)	42 (1.3)
†[2] England	53 (1.1)	51 (0.8)	45 (1.4)	44 (1.0)
Greece	42 (1.0)	39 (0.9)	34 (1.6)	32 (1.1)
Hong Kong	52 (0.8)	49 (0.8)	36 (1.0)	36 (1.2)
Iceland	43 (1.2)	38 (1.0)	30 (1.2)	30 (0.9)
Iran, Islamic Rep.	30 (1.0)	30 (0.9)	20 (1.2)	20 (0.9)
Ireland	49 (1.1)	46 (0.9)	44 (1.4)	43 (1.1)
Japan	60 (0.7)	61 (0.6)	51 (0.9)	52 (1.0)
Korea	69 (0.7)	65 (0.7)	60 (1.1)	61 (1.1)
New Zealand	48 (1.1)	46 (1.0)	42 (1.6)	43 (1.4)
Norway	43 (1.0)	40 (1.2)	35 (1.1)	33 (1.2)
Portugal	41 (0.9)	38 (1.1)	29 (1.1)	29 (1.1)
† Scotland	50 (0.9)	46 (0.9)	42 (1.3)	41 (1.2)
Singapore	53 (1.1)	51 (0.9)	41 (1.5)	41 (1.1)
United States	53 (0.8)	50 (0.9)	51 (1.3)	53 (1.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	54 (1.2)	51 (0.9)	49 (1.3)	51 (1.2)
Austria	52 (1.4)	50 (1.1)	40 (1.6)	42 (1.4)
[1] Latvia (LSS)	47 (1.2)	46 (0.9)	38 (1.2)	38 (1.3)
Netherlands	55 (1.0)	51 (0.8)	49 (1.2)	47 (1.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):				
Slovenia	53 (0.9)	48 (1.0)	42 (1.1)	42 (1.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):				
Hungary	49 (1.1)	47 (1.0)	39 (1.1)	39 (1.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):				
Thailand	39 (1.2)	39 (1.4)	37 (1.9)	42 (1.8)

= Difference from other gender statistically significant at .05 level, adjusted for multiple comparisons

*Three grade in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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), 1994-95.

Chapter 3

Performance on Items Within Each Science Content Area

This chapter presents five to six example items within each of the science content areas, including the performance on these items for each of the TIMSS countries. The example items were selected to illustrate the different topics covered within each content area as well as the different performance expectations. The items also were chosen to show the range of item formats used within each area. To provide some sense of what types of items were answered correctly by higher-performing as compared to lower-performing students, the items show a range of difficulty within each content area. Finally, it should be noted that all these items and others have been released for use by the public.[1]

The presentation for each of the content areas begins with a brief description of the major topics and student performance expectations included in the content area. This description is followed by a series of tables, one for each of the example items, showing the percent correct for each of the TIMSS countries at both the third and fourth grades. If the item also was included in the TIMSS science test at the seventh and eighth grades, it is so designated, and the international averages are shown for those grades for purposes of comparison. Each table also presents the example item in its entirety. The correct answer is circled for multiple-choice items and shown in the answer space for short-answer items. For extended-response questions, the answer shown exemplifies the type of student responses that were given full credit. All of the responses shown have been reproduced from students' actual test booklets.

After the tables showing the country-by-country results, there is a figure relating achievement on each of the example items to performance on the TIMSS international science scale. This "difficulty map" provides a pictorial representation of achievement on the scale in relation to achievement on the items.

What Have Students Learned About Earth Science?

Items in the earth science category measure students' knowledge of the scientific principles related to earth features, earth processes, and the earth in the solar system. Tables 3.1 through 3.5 show the percentage of correct responses across the TIMSS countries for each of five example items (Example Items 1-5) together with the corresponding example item.

The basic knowledge that the moon is illuminated by the sun was required for a correct response to Example Item 1 (Table 3.1). The majority of students in most countries responded correctly to this item, with international averages of 64% and 70% for the third and fourth grade, respectively. In about half of the countries, at

[1] The IEA retained about one-third of the TIMSS items as secure for possible future use in measuring international trends in mathematics and science achievement. All remaining items are available for general use.

least 70% of fourth-grade students responded correctly. In several of these countries (England, Hong Kong, Korea, Norway, Portugal, Singapore, and United States), at least 70% of the third-grade students also responded correctly. In contrast, in the Czech Republic and Hungary, where more than 75% percent of fourth-grade students responded correctly, the average percent correct was less than 60% at the third grade, indicating a substantial increase in performance from third to fourth grade.

Example Item 2 asked students to draw on their knowledge of the earth's resources and physical cycles to explain why a plain containing a river might be both a good place (Part 2A) and a bad place (Part 2B) for farming (Table 3.2). The majority of fourth graders and nearly half of the third graders internationally were able to answer the first part of this open-ended item (international averages of 48% and 62% for third- and fourth-grade students), with the percentage of correct responses ranging from 23% in Kuwait to 91% in Korea for the fourth grade and from 25% in Portugal to 81% in Korea for the third grade. Students were given credit for mentioning that the soil was fertile, good, or abundant; that the river would provide irrigation or water for animals; that there was plenty of space or flat areas for farmland; or for any other acceptable reason related to facilitating farming. Both fourth- and third-grade students found the second part of this item to be quite difficult, with less than a quarter of students internationally providing a correct reason for why the plain is not a good place for farming (16% and 23% for third and fourth grade). The percentage of correct responses ranged from a high of 45% in the fourth grade in the Netherlands to less than 20% at both the third and fourth grade in several countries. Reasons that were given credit in Part B included the possibility of flooding, wind or water erosion, and other problems related to farming. This example item was also included in the TIMSS assessment at the middle-school level, permitting the performance of seventh- and eighth-grade students to be compared with those of the primary-school students in the same set of countries. As seen in the shaded portion of Table 3.2, seventh- and eighth-grade students internationally demonstrated a higher performance on this item, with more than 80% providing a correct response to Part 2A, but still less than 50% responding correctly to Part 2B.

The majority of both third- and fourth-grade students had difficulty with Example Item 3 (Table 3.3), which required them to provide a short explanation for why snow remains at the top of a mountain. Students were given credit for responses related to temperature, amount of snow, or other acceptable explanations related to atmospheric or weather differences between the upper and lower parts of mountains. Nearly half of fourth-grade students (46%) and 31% of third-grade students internationally provided a correct response. The percent correct in the third grade was more than 15% lower than that in the fourth grade for many countries. In ten countries, at least 50% of fourth-grade students responded correctly (Canada, Czech Republic, England, Hungary, Iceland, Japan, Korea, the Netherlands, Norway, United States). The highest performances were observed in Japan and Korea, with more than 70% correct in the fourth grade, compared with about 20% in Kuwait and Thailand.

Students were also required to use their knowledge of temperature and weather in Example Item 4 (Table 3.4), which involved interpreting data in a table to determine in which town it would snow. Internationally, students found this multiple-choice item to be of comparable difficulty to Example Item 3, with less than half of the students responding correctly (32% at third grade and 44% at fourth grade). At the fourth grade, the percentage of correct responses ranged from about 25% in Kuwait, Portugal and Thailand to 60% or more in the Czech Republic, Hong Kong, Japan, and the Netherlands. In the majority of countries, the performance on Example Item 4 was comparable to or somewhat lower than that on Example Item 3. Notable exceptions were Hong Kong and Austria, where the percentage of correct responses on Example Item 4 were about 20% higher at both grade levels, with 63% for Hong Kong and 52% for Austria at the fourth grade level compared to 46% and 30% for Example Item 3, respectively.

Example Item 5 was one of the most difficult earth science items, requiring students to provide an explanation for the different size of the sun and moon based on their distances from the earth. The international average percents correct were 21% and 30% for third and fourth grade students, respectively. In the majority of countries, between 20% and 35% of third-grade students and between 30% and 45% of fourth-grade students responded correctly. The highest performances were in Australia, Austria, Japan, Korea, and Norway, with 40% to 46% correct at the fourth grade. In comparison, in Cyprus, Greece, Iran, and Portugal, 15% or less of students at both grades responded correctly. This item was of moderate difficulty for students in the seventh and eighth grades, with international average percentages in the 50% to 60% range.

The international item difficulty map shown in Figure 3.1 depicts the relationship between performance on the TIMSS international science scale and achievement on the five example items for earth science.[2] The international achievement on each example item is indicated both by the third- and fourth-grade international average percent correct and by the international science scale value, or item difficulty level, for each item. Since the scale was developed based on the performance of students at both grades in all countries, the international scale values apply to both grades and to all countries.

In Figure 3.1, the item results are placed on the scale at the point where students at the corresponding achievement level were more likely than not (65% probability) to answer the question correctly. Items at higher scale values are the more difficult items. For example, students scoring at or above 485 on the science scale were likely to answer correctly the question about why the moon shines at night (Example Item 1) but not the question about the advantages of farming by a river (Example Item 2A), while students scoring at or above 537 were also likely to answer this second item correctly.

[2] The three-digit item label shown in the lower right corner of the box locating each example item on the item difficulty map refers to the original item identification number used in the student test booklets.

The international average of 524 on the science scale at the fourth grade indicates that students from many countries at this grade would be likely to correctly answer the lower-difficulty items, such as Example Item 1, but not the more difficult items. With item difficulties for most of the earth science items ranging from about 450 to 700, students internationally found many of the earth science items to be rather difficult. These results, however, varied dramatically across countries. In Korea, with an average scale value of 597, fourth-grade students were likely to respond correctly to more of the earth science items than the students in other, lower-performing countries. This is reflected in Korea's average percent correct at the fourth grade for the earth science items, which was 72% compared to 57% internationally.

Table 3.1 Earth Science

Percent Correct for Example Item 1
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	63 (2.9)	68 (2.9)
Cyprus	54 (2.7)	54 (2.4)
Czech Republic	56 (2.7)	76 (2.1)
†[2]England	75 (2.5)	72 (2.6)
Greece	65 (4.0)	67 (3.4)
Hong Kong	85 (1.5)	87 (1.8)
Iceland	63 (3.7)	64 (2.8)
Iran, Islamic Rep.	43 (3.5)	56 (2.8)
Ireland	68 (2.9)	69 (2.3)
Japan	51 (2.2)	58 (2.3)
Korea	77 (2.3)	76 (2.3)
New Zealand	54 (3.1)	64 (3.1)
Norway	70 (2.5)	85 (2.6)
Portugal	71 (2.6)	77 (2.9)
†Scotland	65 (2.4)	63 (2.6)
Singapore	81 (1.5)	86 (1.2)
United States	71 (1.6)	75 (1.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	61 (3.1)	70 (2.1)
Austria	64 (2.9)	79 (2.5)
[1]Latvia (LSS)	57 (3.4)	62 (3.5)
Netherlands	66 (2.6)	81 (2.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	65 (3.1)	72 (2.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	50 (2.7)	78 (2.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	52 (3.0)
Kuwait	- -	58 (2.9)
Thailand	53 (3.5)	64 (2.5)
International Average Percent Correct	64 (0.6)	70 (0.5)

Example 1

Moon shining at night.

The Moon produces no light, and yet it shines at night. Why is this?

A. The Moon reflects the light from the Sun.

B. The Moon rotates at a very high speed.

C. The Moon is covered with a thin layer of ice.

D. The Moon has many craters.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.2 Earth Science

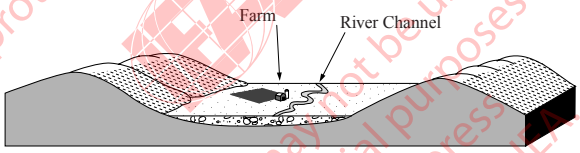
Percent Correct for Example Item 2A
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	52 (2.2)	68 (3.2)
Cyprus	37 (2.2)	56 (2.0)
Czech Republic	37 (2.0)	54 (2.3)
†2England	63 (2.0)	74 (1.7)
Greece	40 (2.7)	62 (2.4)
Hong Kong	45 (2.3)	65 (2.3)
Iceland	26 (2.8)	38 (2.5)
Iran, Islamic Rep.	28 (1.9)	40 (2.1)
Ireland	55 (2.0)	70 (2.1)
Japan	60 (1.6)	75 (1.5)
Korea	81 (1.8)	91 (0.9)
New Zealand	57 (2.7)	69 (2.6)
Norway	30 (2.0)	56 (2.5)
Portugal	25 (2.3)	49 (2.5)
†Scotland	60 (1.9)	72 (1.9)
Singapore	64 (1.6)	78 (1.4)
United States	66 (2.4)	83 (1.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	64 (2.0)	77 (1.5)
Austria	33 (2.3)	51 (2.6)
1Latvia (LSS)	33 (2.5)	52 (2.3)
Netherlands	52 (2.1)	62 (2.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	43 (2.6)	59 (2.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	50 (1.9)	69 (1.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1Israel	- -	59 (2.6)
Kuwait	- -	23 (1.4)
Thailand	49 (3.1)	69 (2.3)
International Average Percent Correct	48 (0.5)	62 (0.4)
	Seventh Grade	Eighth Grade
	81 (0.4)	83 (0.4)

Example 2A

River on the plain: good place for farming.

The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

Because there is a river where the farmers could get fresh water.

b. Write down one reason why this plain is NOT a good place for farming.

The river could over flow during a rain storm.

Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
2National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.2 Earth Science (Continued)

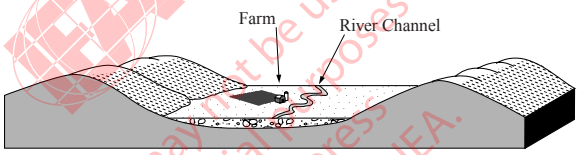
Percent Correct for Example Item 2B
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	16 (1.8)	25 (1.7)
Cyprus	4 (0.9)	9 (1.1)
Czech Republic	18 (1.8)	22 (1.5)
†2 England	32 (2.3)	40 (1.9)
Greece	8 (1.3)	13 (1.6)
Hong Kong	4 (0.6)	9 (0.9)
Iceland	6 (1.2)	12 (1.7)
Iran, Islamic Rep.	7 (1.4)	10 (1.5)
Ireland	26 (2.4)	36 (2.1)
Japan	8 (0.8)	12 (1.1)
Korea	25 (2.1)	32 (2.3)
New Zealand	23 (2.1)	32 (2.1)
Norway	8 (1.3)	16 (1.8)
Portugal	6 (1.2)	11 (1.2)
† Scotland	17 (1.4)	27 (1.7)
Singapore	10 (0.8)	19 (1.2)
United States	21 (1.5)	28 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	18 (2.4)	24 (1.4)
Austria	17 (1.8)	20 (2.1)
1 Latvia (LSS)	14 (1.9)	20 (2.2)
Netherlands	28 (2.1)	45 (2.4)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	22 (1.9)	36 (2.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	23 (1.8)	35 (2.0)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	26 (2.1)
Kuwait	- -	7 (0.8)
Thailand	21 (3.7)	25 (1.9)
International Average Percent Correct	16 (0.4)	23 (0.3)
	Seventh Grade	Eighth Grade
	41 (0.4)	44 (0.4)

Example 2B

River on the plain: bad place for farming.

The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

Because there is a river where the farmers could get fresh water.

b. Write down one reason why this plain is NOT a good place for farming.

The river could over flow during a rain storm.

Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1National Desired Population does not cover all of International Desired Population (see Table A.2). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
2National Defined Population covers less than 90 percent of National Desired Population (see Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.3 Earth Science

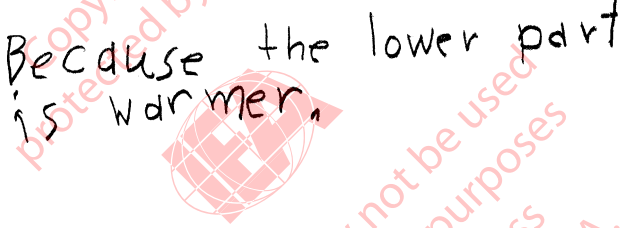
Percent Correct for Example Item 3
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	37 (2.6)	54 (3.3)
Cyprus	20 (2.2)	29 (2.1)
Czech Republic	42 (2.4)	60 (2.5)
†[2] England	33 (2.9)	54 (2.3)
Greece	18 (2.4)	28 (3.1)
Hong Kong	27 (2.4)	46 (2.7)
Iceland	28 (2.9)	50 (3.6)
Iran, Islamic Rep.	20 (2.9)	42 (3.1)
Ireland	32 (2.9)	41 (2.4)
Japan	61 (2.5)	73 (1.9)
Korea	54 (2.9)	70 (2.6)
New Zealand	24 (2.4)	41 (3.3)
Norway	44 (3.5)	64 (3.3)
Portugal	22 (3.0)	33 (2.7)
† Scotland	32 (2.4)	48 (3.2)
Singapore	19 (1.8)	33 (2.3)
United States	36 (2.5)	53 (2.4)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	28 (2.5)	37 (1.8)
Austria	20 (3.5)	30 (3.1)
[1] Latvia (LSS)	30 (3.4)	47 (3.0)
Netherlands	32 (3.0)	52 (3.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	28 (2.6)	47 (3.4)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	51 (2.7)	67 (2.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	46 (3.7)
Kuwait	- -	22 (1.8)
Thailand	16 (3.8)	24 (3.1)
International Average Percent Correct	31 (0.6)	46 (0.6)

Example 3

Snow on mountains.

Sometimes mountains can still have snow on their tops when the snow on the lower parts of the mountains has melted. What makes this happen?



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.4 Earth Science

Percent Correct for Example Item 4
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	30 (2.3)	47 (2.7)
Cyprus	25 (2.5)	32 (2.7)
Czech Republic	44 (2.9)	60 (2.8)
†[2]England	27 (2.2)	32 (2.6)
Greece	17 (2.0)	30 (2.8)
Hong Kong	49 (2.6)	63 (2.6)
Iceland	25 (3.2)	36 (3.7)
Iran, Islamic Rep.	21 (2.8)	31 (2.6)
Ireland	24 (2.2)	38 (2.5)
Japan	49 (2.8)	69 (2.0)
Korea	46 (2.7)	56 (2.3)
New Zealand	24 (2.3)	39 (3.2)
Norway	32 (3.1)	44 (3.3)
Portugal	21 (2.4)	26 (2.4)
†Scotland	24 (2.6)	31 (2.8)
Singapore	31 (1.8)	41 (2.0)
United States	37 (2.8)	54 (2.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	36 (1.8)	46 (2.3)
Austria	44 (2.9)	52 (3.6)
[1]Latvia (LSS)	32 (3.7)	48 (3.5)
Netherlands	32 (2.9)	60 (2.9)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	35 (3.5)	55 (2.9)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	31 (2.4)	49 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	44 (2.8)
Kuwait	- -	27 (1.9)
Thailand	24 (3.8)	27 (3.0)
International Average Percent Correct	32 (0.6)	44 (0.5)

Example 4

Temperature/precipitation table.

This table shows the temperature and precipitation (rain or snow) in four different towns on the same day.

	Town A	Town B	Town C	Town D
Lowest Temperature	13°C	-9°C	22°C	-12°C
Highest Temperature	25°C	-1°C	30°C	-4°C
Precipitation (rain or snow)	0 cm	5 cm	2.5 cm	0 cm

Where did it snow?

A. Town A
B. Town B
C. Town C
D. Town D

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

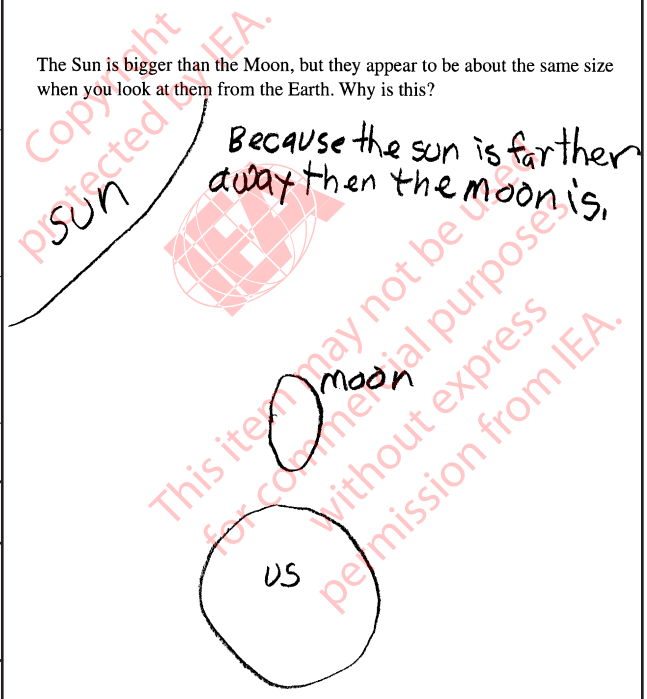
Table 3.5 Earth Science

Percent Correct for Example Item 5
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	29 (1.9)	36 (1.7)
Cyprus	6 (1.0)	9 (1.4)
Czech Republic	20 (1.7)	38 (2.1)
†[2]England	26 (1.7)	35 (2.1)
Greece	9 (1.5)	12 (1.5)
Hong Kong	21 (1.7)	30 (2.0)
Iceland	21 (2.3)	38 (2.4)
Iran, Islamic Rep.	9 (2.1)	12 (1.5)
Ireland	25 (2.1)	33 (1.9)
Japan	30 (1.6)	43 (1.6)
Korea	33 (1.8)	46 (2.0)
New Zealand	25 (2.3)	34 (2.1)
Norway	24 (2.5)	43 (2.3)
Portugal	10 (1.4)	15 (1.7)
†Scotland	21 (1.7)	36 (2.2)
Singapore	20 (1.6)	27 (1.7)
United States	21 (1.9)	33 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	30 (1.7)	44 (1.7)
Austria	29 (3.1)	40 (2.3)
[1]Latvia (LSS)	22 (2.1)	30 (2.4)
Netherlands	24 (2.0)	38 (2.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	22 (2.3)	29 (2.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	16 (1.5)	33 (1.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	25 (2.2)
Kuwait	- -	16 (1.4)
Thailand	13 (2.2)	18 (2.1)
International Average Percent Correct	21 (0.4)	30 (0.4)
	Seventh Grade	Eighth Grade
	53 (0.6)	59 (0.6)

Example 5

Size of sun and moon.



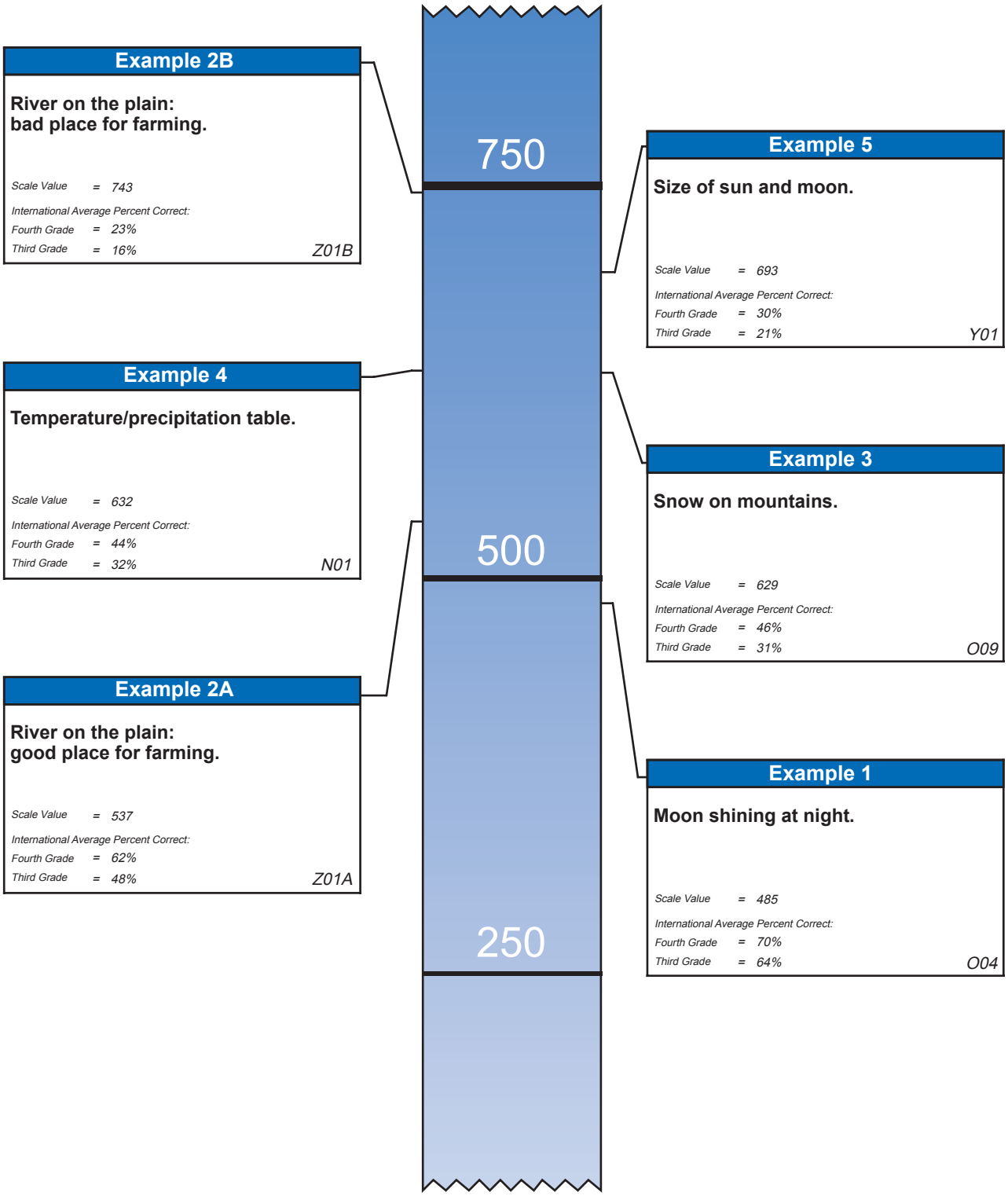
Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.1

International Difficulty Map for Earth Science Example Items Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international science scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

What Have Students Learned About Life Science?

The life science content area contains the largest portion of items on the science test. Items in this category cover a broad range of content areas including human biology and topics related to the structure, diversity, classification, processes, cycles, and interactions of plant and animal life. To answer these items, students were required to demonstrate and apply their knowledge of both simple and complex information. The percentages of correct responses for six example items (Example Items 6-11) illustrating the life science content area are shown in Tables 3.6 through 3.11.

The vast majority of students in both third and fourth grades demonstrated knowledge of the life cycle of insects by correctly identifying the butterfly as the adult stage of the caterpillar in Example Item 6, with international average percents correct of 82% and 85% for the third and fourth grades, respectively (Table 3.6). In the majority of countries, nearly 90% or more of students at both grade levels responded correctly. In only seven countries did less than three-quarters respond correctly (Cyprus, Greece, Iceland, Iran, Kuwait, Latvia, and Portugal), with percents correct ranging from 45% in Kuwait to 71% in Iceland at the fourth grade.

As seen in Table 3.7, knowledge of the importance of skin protection against the harmful rays of the sun (Example Item 7) also was demonstrated by the majority of students internationally (65% and 76%). A much broader range of performance across countries was found for this item, with the percentage of correct responses ranging from 28% in Iran to 93% in Australia at the fourth grade. Students in most countries, particularly at the third grade, found this item to be more difficult than Example Item 6, with most countries having percentages of correct responses in the range of 80% to 90% at the fourth grade and 65% to 80% at the third grade. Only Ireland and Australia had 90% correct responses or more at the fourth grade. In contrast to the majority of countries, Cyprus, Greece, and Portugal performed somewhat higher on this item than on Example Item 6.

Somewhat fewer students internationally demonstrated knowledge of basic nutrition as measured by Example Item 8 (Table 3.8), with 58% and 65% of students responding correctly at the third and fourth grades. Across countries, the percentages of correct responses at the fourth grade ranged from less than 50% in Cyprus (44%), Greece (46%), Iran (39%), Kuwait (45%), and Thailand (45%) to 80% or more in Austria (92%), the Czech Republic (83%), Hungary (82%), the Netherlands (93%), and Slovenia (80%). In most countries, there was not a large difference in performance between third- and fourth-grade students. The largest across-grade difference was found in Hungary, where the percentage of correct responses increased from 66% in third grade to 82% in fourth grade. Internationally, this item was answered correctly by about three-quarters of seventh- and eighth-grade students.

In Example Item 9 (Table 3.9), students were asked to apply their knowledge of animal behavior and describe two ways in which animals protect themselves. Correct responses included references to defensive or offensive actions, the use of specific animal features such as poison, scent, or appearance, and the like. The majority of fourth-grade students and nearly half of third-grade students internationally were able

to provide one correct reason (46% and 60% correct at the third and fourth grades). Providing a second way proved to be much more difficult for both third- and fourth-grade students, with less than half of the students giving two correct ways (29% and 42%). In the majority of countries, about 60% to 80% of fourth-grade students provided at least one correct reason – with more than 80% in the Netherlands (83%) and Japan (92%). At least 50% of fourth-grade students in Canada, Ireland, Israel, New Zealand, Norway, and Singapore and more than 60% in Australia, the Netherlands, and the United States provided a second correct answer. In general, there was a considerable across-grade difference for this item. In particular, in Greece, Hong Kong, Norway, and Latvia the percentage providing at least one correct reason increased from 40% or less in third grade to at least 60% in fourth grade.

Students in both grades found Example Item 10 (Table 3.10), requiring knowledge of the parts of a plant, to be more difficult. Less than half of the students in the third and fourth grades internationally answered correctly (39% and 46%), with about half of the countries having less than 40% correct at the fourth grade. In many countries, including Australia, Canada, England, Iceland, Iran, Ireland, Kuwait, New Zealand, Norway, Portugal, Scotland, and the United States, nearly half or more of fourth-grade students incorrectly answered that seeds develop from the root of the plant (answer C). In most countries, fourth-grade students did not perform substantially higher than third-grade students, although in Hong Kong, Hungary, and Singapore, the percentage of correct responses increased from less than half in the third grade to more than 60% in the fourth grade. The between-grade increase was most dramatic for Singapore, with 64% correct at the fourth grade compared to 26% at the third grade. In contrast, relatively high performances were found at both grade levels for the Czech Republic, with 65% and 79% at the third and fourth grades, respectively.

One of the more difficult life science items was Example Item 11 (Table 3.11), an open-ended item that required students to demonstrate their understanding of the function of the heart. Internationally, 28% of third-grade students and 40% of fourth-grade students provided a correct response that mentioned the pumping or supplying of blood to other parts of the body. The across-country performance at the fourth grade ranged from less than 20% in Cyprus (18%), Hong Kong (14%), Kuwait (12%), and Thailand (13%) to more than 60% in Australia (69%), England (61%), and the United States (64%), with slightly less than half the countries at or above the 50% correct level. In only two countries were more than half of the third-grade students also able to provide a correct response – Australia (54%) and the United States (55%).

Figure 3.2 presents the international difficulty map for the life science example items. In comparison with the earth science items, the item difficulties for the majority of life science items ranged from about 330 to 640, indicating that, internationally, students were likely to answer a larger portion of the life science items correctly.

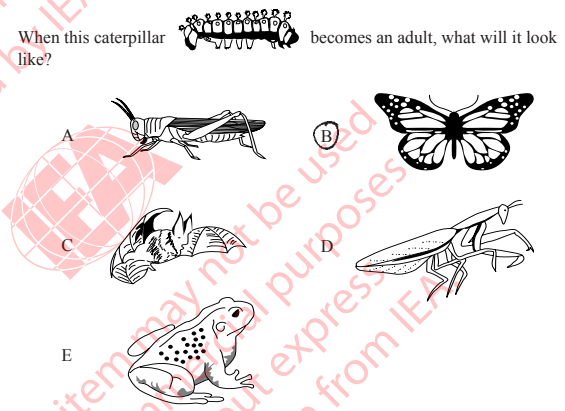
Table 3.6 Life Science

Percent Correct for Example Item 6
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	96 (1.0)	98 (0.5)
Cyprus	54 (2.9)	64 (2.9)
Czech Republic	90 (1.5)	96 (1.0)
†[2]England	92 (1.3)	96 (1.0)
Greece	52 (3.4)	67 (2.9)
Hong Kong	92 (1.4)	97 (0.7)
Iceland	65 (3.9)	71 (3.1)
Iran, Islamic Rep.	60 (3.6)	69 (2.7)
Ireland	89 (1.7)	94 (1.3)
Japan	93 (1.2)	95 (0.9)
Korea	93 (1.3)	90 (1.8)
New Zealand	89 (2.1)	95 (1.8)
Norway	91 (1.6)	97 (0.9)
Portugal	54 (2.8)	59 (3.0)
†Scotland	93 (1.4)	94 (1.3)
Singapore	92 (1.2)	94 (0.9)
United States	96 (1.0)	97 (0.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	94 (1.5)	96 (0.7)
Austria	91 (1.9)	94 (1.6)
[1]Latvia (LSS)	59 (3.5)	63 (3.3)
Netherlands	95 (1.3)	97 (1.1)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	83 (2.5)	87 (1.9)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	79 (2.6)	85 (2.2)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	81 (2.6)
Kuwait	- -	45 (2.5)
Thailand	68 (3.0)	76 (3.0)
International Average Percent Correct	82 (0.5)	85 (0.4)

Example 6

Adult stage of caterpillar.



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.7 Life Science

Percent Correct for Example Item 7
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	73 (1.8)	85 (2.2)
Cyprus	65 (3.0)	76 (2.2)
Czech Republic	79 (1.9)	89 (1.6)
†[2]England	75 (2.4)	87 (2.0)
Greece	63 (2.8)	68 (2.9)
Hong Kong	76 (2.2)	85 (1.8)
Iceland	55 (3.3)	74 (2.6)
Iran, Islamic Rep.	25 (2.6)	28 (2.4)
Ireland	72 (2.4)	90 (1.7)
Japan	56 (2.5)	61 (2.3)
Korea	81 (2.1)	83 (1.8)
New Zealand	69 (3.1)	81 (2.7)
Norway	62 (3.3)	85 (2.3)
Portugal	53 (3.1)	77 (2.7)
†Scotland	64 (2.8)	80 (2.6)
Singapore	58 (2.2)	74 (1.8)
United States	75 (2.3)	83 (1.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	83 (2.0)	93 (1.0)
Austria	74 (2.7)	83 (2.9)
[1]Latvia (LSS)	44 (3.5)	51 (3.6)
Netherlands	77 (2.5)	83 (2.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	72 (2.9)	85 (2.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	60 (2.8)	69 (2.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	83 (2.6)
Kuwait	- -	53 (2.6)
Thailand	55 (3.9)	63 (3.1)
International Average Percent Correct	65 (0.6)	76 (0.5)

Example 7

Why use sunscreen.

What is the MOST important reason for people to use a sunscreen when they are outside in sunlight?

A. It protects the skin against dangerous rays from the sun.

B. It makes the skin more tanned.

C. It makes the skin smooth.

D. It makes the skin feel cooler.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.8 Life Science

Percent Correct for Example Item 8
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	49 (2.3)	58 (3.4)
Cyprus	36 (3.0)	44 (2.6)
Czech Republic	75 (2.1)	83 (2.1)
†[2]England	59 (2.7)	58 (2.7)
Greece	41 (2.7)	46 (3.0)
Hong Kong	75 (2.1)	74 (2.6)
Iceland	56 (4.2)	65 (3.5)
Iran, Islamic Rep.	40 (2.8)	39 (2.4)
Ireland	55 (2.7)	62 (2.5)
Japan	53 (2.1)	64 (1.7)
Korea	68 (2.9)	79 (2.1)
New Zealand	48 (3.2)	55 (3.2)
Norway	59 (3.3)	77 (2.7)
Portugal	51 (2.5)	57 (2.9)
†Scotland	61 (2.6)	59 (2.4)
Singapore	62 (2.0)	72 (1.9)
United States	50 (3.3)	62 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	47 (3.1)	57 (2.6)
Austria	79 (2.7)	92 (1.3)
[1]Latvia (LSS)	63 (3.0)	73 (3.2)
Netherlands	91 (1.7)	93 (1.7)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	72 (3.2)	80 (2.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	66 (2.9)	82 (2.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	72 (3.5)
Kuwait	- -	45 (1.9)
Thailand	40 (3.0)	45 (3.7)
International Average Percent Correct	58 (0.6)	65 (0.5)
	Seventh Grade	Eighth Grade
	72 (0.5)	75 (0.5)

Example 8

Why eat fruits and vegetables.

What is the BEST reason for including fruits and leafy vegetables in a healthy diet?

A. They have a high water content.

B. They are the best source of protein.

C. They are rich in minerals and vitamins.

D. They are the best source of carbohydrates.

Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

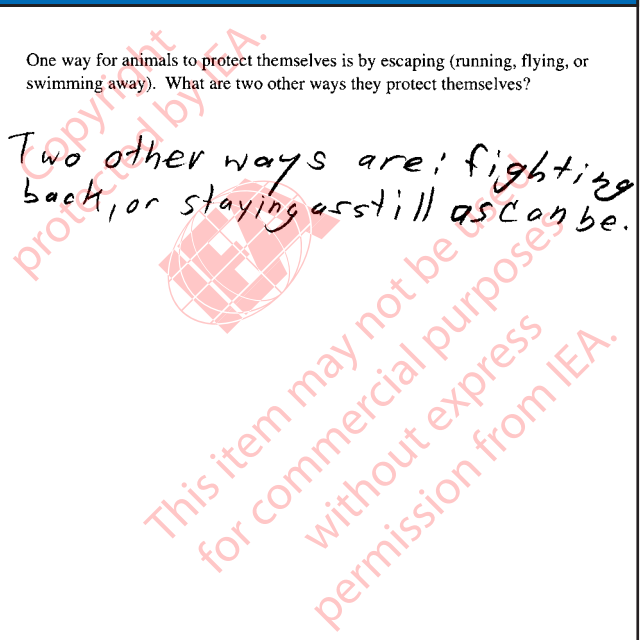
Table 3.9 Life Science

Percent Correct for Example Item 9 - One Way Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	60 (1.6)	72 (2.1)
Cyprus	22 (2.0)	38 (2.4)
Czech Republic	46 (1.9)	62 (2.2)
†[2]England	53 (1.9)	67 (1.9)
Greece	38 (2.7)	61 (2.4)
Hong Kong	35 (1.9)	61 (2.2)
Iceland	33 (2.3)	48 (2.7)
Iran, Islamic Rep.	22 (2.3)	35 (2.3)
Ireland	54 (2.2)	67 (1.7)
Japan	87 (1.0)	92 (1.0)
Korea	67 (2.0)	80 (1.7)
New Zealand	52 (2.4)	64 (2.3)
Norway	38 (2.3)	65 (2.3)
Portugal	30 (2.3)	47 (2.4)
†Scotland	51 (2.0)	64 (2.2)
Singapore	50 (1.7)	69 (1.6)
United States	61 (2.3)	77 (1.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	60 (2.4)	75 (1.5)
Austria	52 (2.4)	61 (2.4)
[1]Latvia (LSS)	40 (2.3)	60 (2.6)
Netherlands	63 (2.0)	83 (1.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	47 (2.2)	67 (2.0)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	39 (2.2)	43 (1.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	66 (2.7)
Kuwait	- -	28 (1.7)
Thailand	11 (1.9)	20 (1.7)
International Average Percent Correct	46 (0.4)	60 (0.4)

Example 9

Ways animals protect themselves.



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.9 Life Science (Continued)

Percent Correct for Example Item 9 - Two Ways Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct		Example 9
	Third Grade	Fourth Grade	Ways animals protect themselves.
Canada	44 (2.3)	56 (1.7)	
Cyprus	11 (1.6)	23 (1.9)	
Czech Republic	29 (1.8)	44 (2.0)	
†[2]England	38 (2.1)	46 (2.1)	
Greece	21 (1.8)	35 (2.8)	
Hong Kong	26 (1.8)	47 (2.3)	
Iceland	17 (1.9)	36 (2.6)	
Iran, Islamic Rep.	17 (1.9)	25 (2.2)	
Ireland	36 (2.2)	53 (2.0)	
Japan	23 (1.3)	31 (1.4)	
Korea	41 (2.4)	49 (2.3)	
New Zealand	34 (2.4)	51 (2.5)	
Norway	27 (2.1)	50 (2.6)	
Portugal	6 (0.9)	14 (1.6)	
†Scotland	33 (1.7)	47 (2.1)	
Singapore	35 (1.6)	52 (2.0)	
United States	48 (2.6)	64 (1.6)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	47 (2.3)	63 (1.7)	
Austria	30 (2.5)	41 (2.4)	
[1]Latvia (LSS)	25 (1.9)	35 (2.5)	
Netherlands	48 (2.1)	61 (2.0)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	27 (2.4)	41 (2.4)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	34 (2.2)	37 (1.9)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
[1]Israel	- -	52 (3.0)	
Kuwait	- -	15 (1.2)	
Thailand	7 (1.8)	11 (1.5)	
International Average Percent Correct	29 (0.4)	42 (0.4)	

One way for animals to protect themselves is by escaping (running, flying, or swimming away). What are two other ways they protect themselves?

Two other ways are: fighting back, or staying as still as can be.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.10 Life Science

Percent Correct for Example Item 10
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	24 (2.0)	33 (2.7)
Cyprus	42 (3.4)	44 (2.5)
Czech Republic	65 (2.5)	79 (2.0)
†[2]England	29 (2.6)	35 (2.7)
Greece	28 (3.0)	37 (3.1)
Hong Kong	47 (2.4)	62 (2.7)
Iceland	28 (4.7)	29 (3.9)
Iran, Islamic Rep.	28 (2.6)	23 (2.7)
Ireland	18 (2.4)	22 (2.2)
Japan	60 (2.3)	68 (2.1)
Korea	51 (3.0)	55 (2.7)
New Zealand	31 (3.2)	33 (3.0)
Norway	28 (3.2)	33 (3.2)
Portugal	20 (3.0)	20 (2.3)
†Scotland	24 (2.3)	26 (2.5)
Singapore	26 (1.9)	64 (1.7)
United States	30 (2.0)	37 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	33 (2.8)	38 (2.4)
Austria	59 (3.5)	71 (2.6)
[1]Latvia (LSS)	67 (2.8)	66 (2.8)
Netherlands	40 (2.5)	46 (3.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	55 (3.0)	68 (2.7)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	45 (2.6)	65 (2.5)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	45 (3.6)
Kuwait	- -	22 (1.8)
Thailand	52 (3.7)	69 (3.3)
International Average Percent Correct	39 (0.6)	46 (0.5)

Example 10

Seeds in plants.

Seeds develop from which part of a plant?

A. Flower
B. Leaf
C. Root
D. Stem

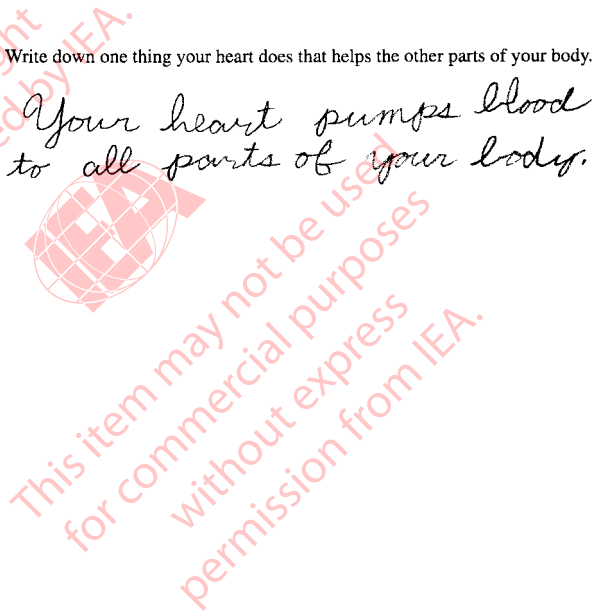
*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.11 Life Science

Percent Correct for Example Item 11
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct		Example 11
	Third Grade	Fourth Grade	Function of the heart.
Canada	36 (1.7)	49 (1.8)	
Cyprus	8 (1.1)	18 (1.7)	
Czech Republic	31 (2.0)	35 (2.2)	
†[2]England	45 (2.1)	61 (1.8)	
Greece	16 (1.6)	34 (2.4)	
Hong Kong	6 (0.9)	14 (1.4)	
Iceland	21 (2.9)	33 (2.8)	
Iran, Islamic Rep.	6 (1.2)	23 (2.0)	
Ireland	34 (2.0)	49 (2.2)	
Japan	21 (1.5)	39 (1.8)	
Korea	28 (1.9)	34 (2.1)	
New Zealand	41 (2.6)	53 (3.1)	
Norway	30 (2.2)	51 (2.6)	
Portugal	19 (2.0)	27 (1.7)	
†Scotland	37 (2.0)	53 (2.3)	
Singapore	22 (2.0)	59 (2.2)	
United States	55 (2.0)	64 (1.6)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):			
Australia	54 (2.3)	69 (2.1)	
Austria	26 (2.7)	57 (2.8)	
[1]Latvia (LSS)	24 (2.3)	33 (2.9)	
Netherlands	28 (1.8)	36 (2.1)	
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):			
Slovenia	46 (2.1)	49 (2.3)	
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):			
Hungary	20 (2.0)	30 (2.0)	
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):			
[1]Israel	- -	37 (2.6)	
Kuwait	- -	12 (1.1)	
Thailand	8 (1.8)	13 (1.6)	
International Average Percent Correct	28 (0.4)	40 (0.4)	

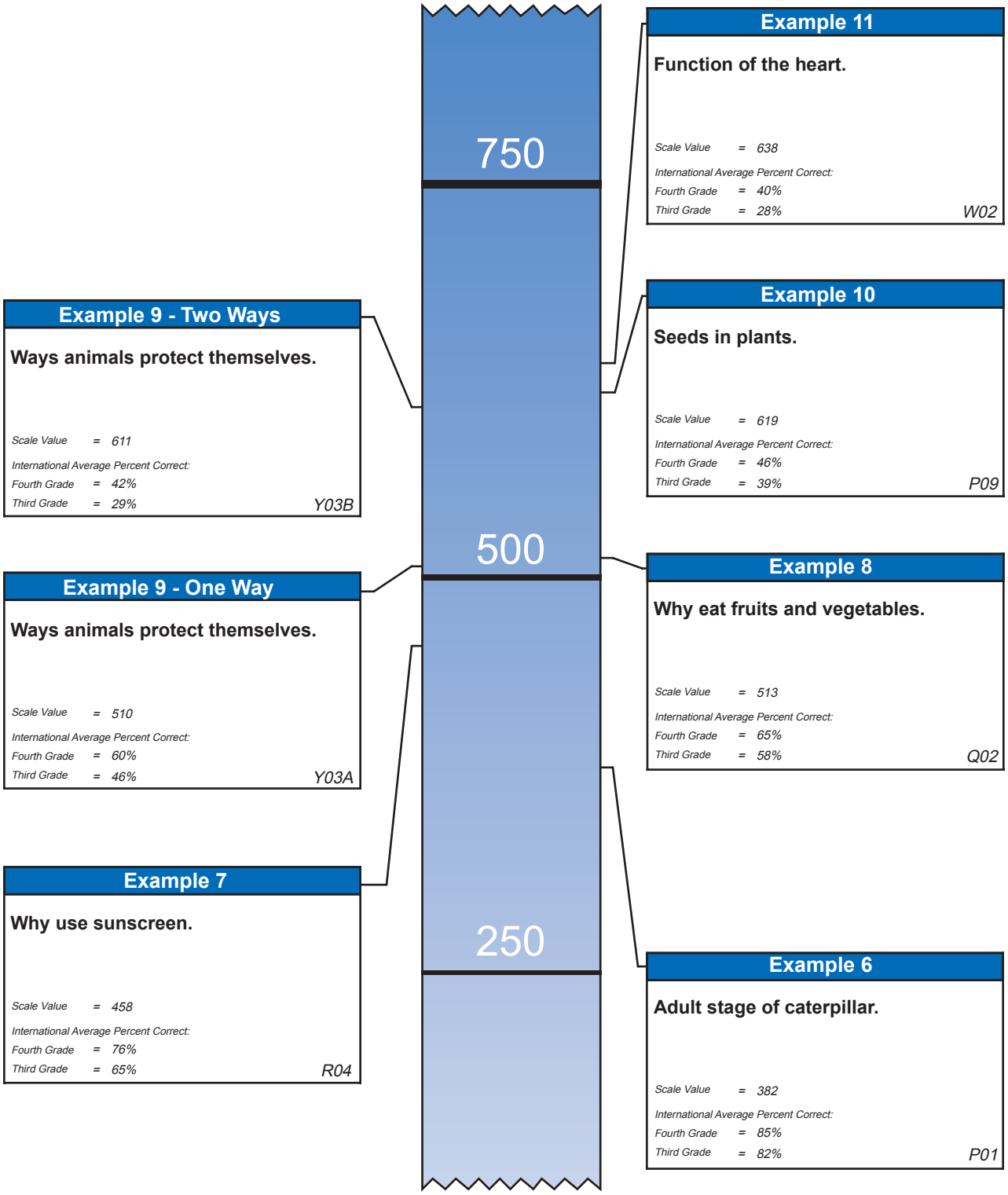


*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.2

International Difficulty Map for Life Science Example Items Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international science scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

What Have Students Learned About Physical Science?

Major topics covered by the physical science items include properties of matter; energy and physical processes; forces and motion; and physical or chemical changes. Students were asked to solve problems and demonstrate their knowledge of these physical science principles. Six example items (Example Items 12-17) are included to illustrate the range of item types and content areas as well as student performance in physical science. The percentages of correct responses results for these items are shown in Tables 3.12 through 3.17.

Example Item 12 (Table 3.12) required students to supply explanations that demonstrated knowledge of the need for oxygen in order for a flame to burn. Internationally, 64% of fourth-grade and 49% of third-grade students were able to provide a correct response that explained the loss of oxygen or air (using either scientific or non-scientific language) resulting from isolating the flame. Moderate to substantial between-grade increases were found in many countries, which is consistent with a higher level of content coverage at the fourth grade. The most pronounced of these was Singapore, where 78% of fourth-grade students provided a correct response, compared with only 39% of third-grade students. There were also substantial between-grade increases in Cyprus and Greece, where the percentages of correct responses increased from 20 - 25% at the third grade to at least 50% at the fourth grade. A notable exception to the lower performance of third-grade students was Korea, where about three-quarter of students in both grades (73% and 74%) responded correctly. The highest performances on this item at both grades were in the Czech Republic (80% and 85%) and Slovenia (78% and 94%). These higher performance levels are comparable to what was found for seventh- and eighth-grade students internationally when this item was tested at those levels.

In Example Item 13 (Table 3.13), students demonstrated their knowledge of the conversion of the energy in food to the physical energy required to push a bicycle. About half of the students internationally answered correctly (45% at third grade and 52% at fourth). In the majority of countries, performances ranged from 50% to 65% correct at the fourth grade, with the highest performances of 70% correct found in Iceland and the Netherlands. This item was particularly difficult for students in Cyprus and Thailand, where less than 30% of both third and fourth graders responded correctly. In comparison with Example Item 12, there was little increase in performance between the lower- and upper-grade students across countries, with the most noticeable increases found in Norway (40% compared to 61%).

Understanding of the relative speed of light was required in Example Item 14 (Table 3.14), which was rather difficult for students internationally. Less than half of the students in either grade were able to identify the correct response (31% and 41%). While there was some increase in performance between the third and fourth grades in most countries, in only six countries was the percentage of correct responses at the fourth-grade level at least 50% – Australia (59%), England (50%), Japan (58%),

Korea (64%), New Zealand (56%), and Slovenia (50%). Internationally, both an airplane and sound were selected by about one-quarter of students as traveling faster than light.

Students internationally also had considerable difficultly with Example Item 15 (Table 3.15), with 27% of third-grade and 37% of fourth-grade students receiving full credit. Full credit on this item required an explanation for why loose sugar crystals dissolve more quickly than cubes. Although about 70% or more of fourth-grade students in most countries identified loose sugar as the form that would dissolve more quickly, far fewer students were able to support their answer with an explanation based on the size of the crystals, the compactness of the cubes or other acceptable reasons. Performance across countries varied widely, ranging from less than 10% to more than 70% at the fourth grade. The highest performances on this item were in Japan, Korea, and the Netherlands, all of which had about 60% of third-grade and 70% or more of fourth-grade students receiving full credit.

Example Item 16 (Table 3.16) was similar in international difficulty to Example Item 15. This item, which required an understanding of the concept of increased buoyancy in salt water compared with fresh water, was answered correctly by 30% of third-grade and 34% of fourth-grade students. A common misconception was that the block would sink when placed in salt water (answer A). There was little variation in performance across countries on this item. The percentage of correct responses ranged from about 30% to 45% at the fourth grade in most countries, and only in Korea did more than half of the fourth-grade students answer correctly. There was also little increase in performance across grades in most countries, indicating that coverage of this topic was not included by the fourth-grade level.

Example 17 (Table 3.17), related to fluid behavior, was an extremely difficult item for the third- and fourth-grade students, with international percents correct of 15% and 21% respectively. Less than 30% of students in all countries indicated that, although the water can was tipped, the surface of the water would remain horizontal and at about the same vertical level. In about 40% of the student responses internationally the surface level of the water was incorrectly drawn at an angle corresponding to the tipping angle of the water can. This item was moderately difficult for seventh- and eighth-grade students internationally, about half of whom provided a correct response.

The international difficulty map showing the physical science example items appears in Figure 3.3. With item difficulties for most of the physical science items ranging from about 425 to 675, this content area was of comparable difficulty to earth science, and the majority of students internationally had considerable difficulty on the more complex physical science items.

Table 3.12 Physical Science

Percent Correct for Example Item 12
Lower and Upper Grades (Third and Fourth Grades*)

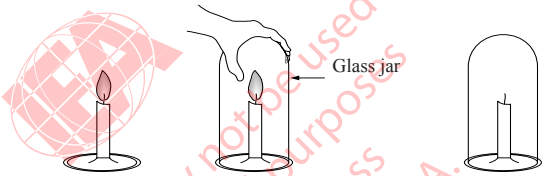
Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	52 (2.2)	61 (4.3)
Cyprus	25 (2.7)	56 (3.3)
Czech Republic	80 (1.7)	85 (1.9)
†[2] England	52 (2.6)	66 (2.7)
Greece	20 (2.2)	50 (3.1)
Hong Kong	46 (2.4)	68 (2.9)
Iceland	38 (3.3)	62 (3.8)
Iran, Islamic Rep.	23 (2.5)	33 (3.3)
Ireland	42 (3.0)	62 (3.1)
Japan	38 (2.3)	48 (2.4)
Korea	73 (2.9)	74 (2.5)
New Zealand	55 (3.1)	66 (3.3)
Norway	51 (3.9)	75 (3.1)
Portugal	37 (3.3)	63 (3.2)
† Scotland	45 (2.8)	66 (2.5)
Singapore	39 (2.4)	78 (1.5)
United States	52 (2.9)	62 (2.7)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	59 (3.4)	69 (2.5)
Austria	58 (3.3)	83 (2.9)
[1] Latvia (LSS)	51 (3.6)	62 (3.1)
Netherlands	60 (3.3)	74 (2.6)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	78 (2.6)	94 (1.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	64 (2.7)	77 (2.3)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1] Israel	- -	60 (3.2)
Kuwait	- -	39 (2.4)
Thailand	25 (4.4)	37 (4.5)
International Average Percent Correct	49 (0.6)	64 (0.6)

Seventh Grade	Eighth Grade
88 (0.4)	91 (0.3)

Example 12

Glass over candle.

When a glass jar is placed over a lighted candle, the flame goes out.



Why does this happen?

Because there is no air in so it goes right out.

Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.13 Physical Science

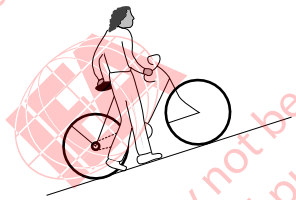
Percent Correct for Example Item 13
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	53 (2.7)	63 (2.5)
Cyprus	29 (2.7)	29 (2.6)
Czech Republic	52 (3.0)	54 (2.7)
†2 England	53 (3.0)	61 (2.5)
Greece	31 (3.2)	31 (2.8)
Hong Kong	52 (3.3)	54 (2.8)
Iceland	60 (3.2)	70 (2.6)
Iran, Islamic Rep.	27 (2.9)	47 (3.0)
Ireland	45 (2.9)	52 (2.7)
Japan	56 (2.6)	63 (2.4)
Korea	62 (2.6)	65 (2.3)
New Zealand	42 (3.1)	50 (3.1)
Norway	40 (3.6)	61 (3.2)
Portugal	46 (3.2)	44 (3.0)
† Scotland	45 (3.1)	51 (2.8)
Singapore	48 (2.1)	64 (2.1)
United States	54 (2.5)	60 (2.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	55 (3.7)	59 (2.2)
Austria	42 (3.5)	66 (3.1)
1 Latvia (LSS)	41 (3.5)	44 (3.5)
Netherlands	53 (2.9)	70 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	45 (3.1)	46 (2.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	28 (2.2)	42 (2.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	52 (3.7)
Kuwait	- -	32 (2.3)
Thailand	20 (3.1)	25 (2.4)
International Average Percent Correct	45 (0.6)	52 (0.5)

Example 13

Girl's source of energy.

Keisha is pushing her bicycle up a hill. Where does Keisha get the energy to push her bicycle?



A. From the food she has eaten

B. From the exercise she did earlier

C. From the ground she is walking on

D. From the bicycle she is pushing

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1 National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

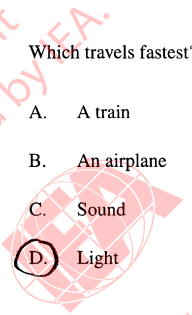
Table 3.14 Physical Science

Percent Correct for Example Item 14
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	34 (3.3)	44 (2.8)
Cyprus	23 (2.5)	23 (2.1)
Czech Republic	38 (2.5)	53 (2.4)
†[2]England	33 (2.7)	50 (2.4)
Greece	21 (2.6)	29 (2.8)
Hong Kong	28 (2.0)	44 (3.1)
Iceland	26 (3.8)	37 (3.8)
Iran, Islamic Rep.	43 (3.4)	34 (2.9)
Ireland	32 (2.9)	39 (2.7)
Japan	52 (2.6)	58 (2.4)
Korea	37 (2.7)	64 (3.0)
New Zealand	38 (2.9)	56 (3.4)
Norway	30 (2.9)	48 (3.4)
Portugal	22 (2.3)	33 (2.5)
†Scotland	25 (2.6)	34 (2.7)
Singapore	32 (2.0)	38 (2.2)
United States	33 (2.9)	43 (1.9)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	46 (2.6)	59 (1.9)
Austria	34 (3.0)	43 (2.9)
[1]Latvia (LSS)	27 (2.5)	41 (3.2)
Netherlands	17 (2.5)	27 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	29 (2.8)	50 (3.3)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	34 (2.6)	49 (2.6)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	43 (2.6)
Kuwait	- -	16 (1.6)
Thailand	16 (2.5)	22 (3.2)
International Average Percent Correct	31 (0.6)	41 (0.5)

Example 14

What travels fastest.



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

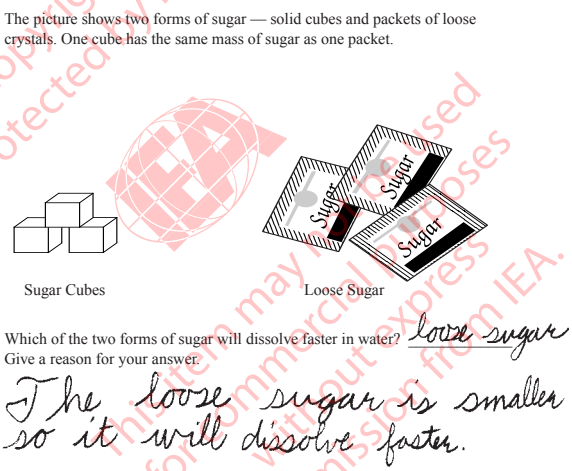
Table 3.15 Physical Science

Percent Correct for Example Item 15
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	28 (1.5)	46 (2.1)
Cyprus	13 (1.3)	27 (1.7)
Czech Republic	36 (2.3)	44 (1.9)
†[2]England	30 (1.9)	42 (2.0)
Greece	14 (1.7)	20 (1.7)
Hong Kong	28 (2.2)	40 (2.2)
Iceland	5 (1.2)	8 (1.4)
Iran, Islamic Rep.	2 (0.6)	5 (0.9)
Ireland	29 (2.2)	43 (2.1)
Japan	64 (1.5)	72 (1.4)
Korea	61 (1.8)	75 (2.1)
New Zealand	24 (1.8)	37 (2.5)
Norway	8 (1.3)	18 (1.7)
Portugal	13 (1.4)	22 (1.9)
†Scotland	28 (2.1)	40 (2.0)
Singapore	28 (1.4)	45 (1.7)
United States	28 (1.7)	43 (1.6)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	29 (2.0)	42 (1.6)
Austria	27 (2.3)	47 (2.3)
[1]Latvia (LSS)	24 (2.1)	33 (2.4)
Netherlands	58 (2.0)	70 (2.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	15 (1.7)	32 (2.4)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	20 (1.6)	29 (1.9)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	32 (2.3)
Kuwait	- -	16 (1.1)
Thailand	23 (3.4)	30 (2.6)
International Average Percent Correct	27 (0.4)	37 (0.4)

Example 15

Dissolving sugar.



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.16 Physical Science

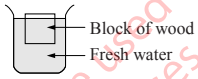
Percent Correct for Example Item 16
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	29 (2.6)	36 (2.6)
Cyprus	27 (3.2)	37 (2.6)
Czech Republic	33 (2.5)	35 (2.3)
†[2]England	28 (2.5)	29 (2.5)
Greece	28 (2.9)	32 (2.6)
Hong Kong	33 (2.4)	44 (3.1)
Iceland	30 (4.1)	29 (3.2)
Iran, Islamic Rep.	18 (2.6)	20 (2.6)
Ireland	29 (2.6)	34 (3.2)
Japan	27 (2.0)	37 (2.0)
Korea	46 (2.5)	54 (2.6)
New Zealand	28 (2.7)	34 (3.4)
Norway	36 (3.1)	41 (3.5)
Portugal	15 (1.7)	20 (2.2)
†Scotland	29 (2.5)	31 (2.2)
Singapore	32 (1.6)	40 (1.9)
United States	25 (2.7)	31 (1.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	31 (3.2)	32 (1.9)
Austria	41 (3.0)	43 (3.2)
[1]Latvia (LSS)	26 (2.8)	26 (2.9)
Netherlands	24 (2.3)	31 (3.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	33 (2.5)	46 (3.2)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	31 (2.6)	24 (2.4)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	38 (2.7)
Kuwait	- -	33 (2.2)
Thailand	32 (2.7)	24 (2.9)
International Average Percent Correct	30 (0.6)	34 (0.5)

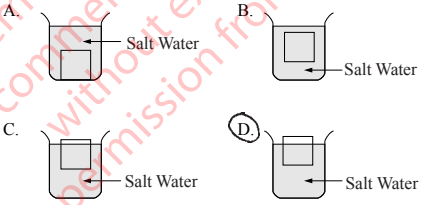
Example 16

Block floating in water.

The picture shows a block of wood floating in fresh water.



If this block were placed in salt water from the ocean, which picture shows what would happen?



*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.17 Physical Science

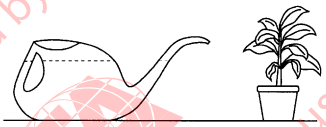
Percent Correct for Example Item 17
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	13 (1.8)	22 (1.8)
Cyprus	11 (1.9)	13 (2.0)
Czech Republic	22 (2.5)	28 (2.6)
†2 England	21 (2.0)	29 (2.3)
Greece	16 (2.4)	17 (2.1)
Hong Kong	19 (1.9)	28 (2.6)
Iceland	10 (1.7)	17 (2.2)
Iran, Islamic Rep.	5 (1.5)	10 (1.6)
Ireland	12 (1.8)	19 (2.3)
Japan	18 (2.0)	27 (2.1)
Korea	22 (2.6)	26 (2.7)
New Zealand	13 (2.3)	17 (2.5)
Norway	17 (2.1)	21 (3.0)
Portugal	14 (2.2)	20 (2.3)
† Scotland	17 (2.2)	15 (1.7)
Singapore	15 (1.2)	32 (1.7)
United States	12 (1.6)	21 (1.8)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	15 (1.8)	20 (1.6)
Austria	14 (2.3)	25 (3.5)
1 Latvia (LSS)	26 (2.8)	30 (3.2)
Netherlands	15 (2.4)	28 (2.4)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	18 (2.5)	25 (2.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	16 (1.8)	26 (2.7)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
1 Israel	- -	13 (2.2)
Kuwait	- -	8 (1.0)
Thailand	8 (1.6)	15 (2.5)
International Average Percent Correct	15 (0.4)	21 (0.5)
	Seventh Grade	Eighth Grade
	47 (0.6)	53 (0.6)

Example 17

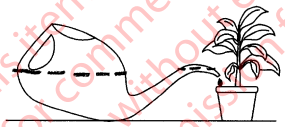
Tipped watering can.

A watering can is almost filled with water as shown.



The watering can is tipped so that the water just begins to drip through the spout.

Draw a line to show where the surface of the water in the can is now.

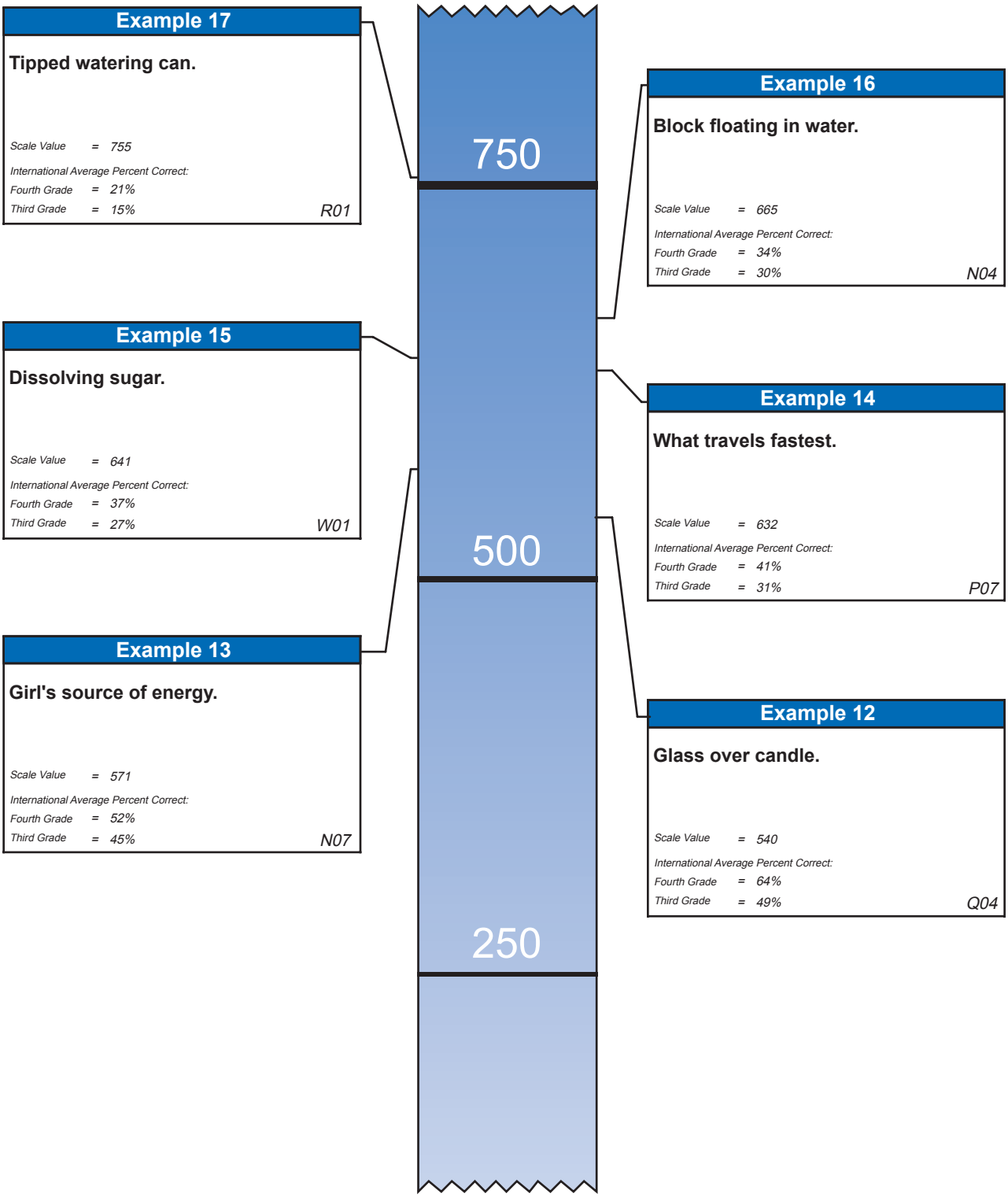


Note: Item also tested at seventh and eighth grades.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
1 National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

Figure 3.3

International Difficulty Map for Physical Science Example Items Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international science scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

What Have Students Learned About Environmental Issues and the Nature of Science?

The fourth science category includes four items about environmental and resource issues, three items covering the nature of scientific knowledge, and one item involving the influence of science and technology on society. Four of these items (Example Items 18-21) are presented in Tables 3.18 through 3.21 with their percents correct, illustrating the types of items and student performance expectations covered in these science areas.

Example Item 18 (Table 3.18), one of the items related to environmental issues, required students to write about two ways people could help reduce air pollution. Nearly half of fourth graders (48%) and 31% of third graders internationally were able to provide at least one correct way. Fewer students provided a second correct way (21% and 34%). Credit was given for any acceptable responses mentioning specific ways to reduce air pollution. Internationally, the most common ways given were related to reducing pollution by motor vehicles; reducing industrial pollution and stopping smoking were also common responses across countries. In the majority of countries, half or more of fourth-grade students provided at least one correct way, with more than 60% correct in Australia (67%), Austria (62%), Korea (67%), the Netherlands (66%), and Slovenia (69%). The percentages of correct responses for the third-grade students in these higher-performing countries were in the range of 40% to 50%. Only in Australia and the Netherlands were more than half of fourth-grade students able to provide a second correct way.

Both Example Items 19 and 20 are related to the nature of scientific knowledge. Example Item 19 (Table 3.19) required students to demonstrate an understanding of what is meant by a physical observation. Less than half of both third- and fourth-grade students internationally answered this item correctly (34% and 43%), although between 50% and 60% of fourth-grade students responded correctly in 11 countries (Australia, Canada, England, Ireland, Japan, Korea, the Netherlands, New Zealand, Norway, Scotland, and the United States). Example Item 20 (Table 3.20), requiring students to identify the correct way to design an investigation of growing seeds, was more difficult. Internationally, only 29% of third graders and 36% of fourth graders identified the correct response, with percents correct at the fourth grade ranging from 25% to less than 50% in nearly all countries. In three countries – Korea, Singapore, and the United States – students performed substantially higher, with more than 60% correct at the fourth grade.

Example Item 21 (Table 3.21) was the most difficult item related to environmental issues. In this item, students were required to demonstrate their understanding of pollution and its environmental effects by writing an explanation for how oil spills are harmful to the environment. Full credit was given for extended responses that referred to water, air, or beach pollution as well as their harmful effect on living things or the earth. Internationally, about a quarter of fourth-grade students (27%) and only 16% of third-grade students provided responses that were given full credit. Across

countries, percents correct at the fourth grade ranged from less than 10% in Hong Kong and Iran to more than 50% in Japan (53%) and Korea (64%). In general, this item was extremely difficult for third-grade students, with less than 20% correct in all countries except Australia, Canada, Japan, Korea, New Zealand, and the United States. Only in Korea did half or more of both the third- and fourth-grade students provide a fully correct response, but about half of students in both grades internationally received at least partial credit.

The international difficulty map for the example items in the content area of environmental issues and the nature of science in Figure 3.4 shows that these items, ranging in item difficulty from 580 to 686, were relatively challenging for third- and fourth-grade students internationally.

Table 3.18 Environmental Issues and the Nature of Science

Percent Correct for Example Item 18 - One Way Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	31 (1.4)	46 (2.2)
Cyprus	17 (1.7)	36 (2.0)
Czech Republic	33 (1.8)	55 (1.9)
†[2]England	36 (2.2)	52 (2.1)
Greece	17 (1.8)	33 (2.0)
Hong Kong	24 (1.4)	39 (1.8)
Iceland	23 (2.3)	50 (2.7)
Iran, Islamic Rep.	10 (1.8)	18 (1.6)
Ireland	29 (2.2)	46 (2.0)
Japan	41 (1.9)	57 (1.7)
Korea	52 (2.0)	67 (2.2)
New Zealand	28 (2.2)	41 (2.2)
Norway	25 (2.2)	50 (2.5)
Portugal	12 (1.5)	24 (1.8)
†Scotland	29 (2.3)	49 (2.3)
Singapore	28 (2.3)	44 (1.9)
United States	45 (2.2)	59 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	50 (2.4)	67 (1.7)
Austria	46 (3.2)	62 (3.0)
[1]Latvia (LSS)	34 (2.7)	54 (2.4)
Netherlands	43 (2.1)	66 (2.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	44 (2.3)	69 (2.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	25 (1.9)	52 (2.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	38 (3.0)
Kuwait	- -	18 (1.3)
Thailand	30 (4.2)	49 (3.0)
International Average Percent Correct	31 (0.5)	48 (0.4)

Example 18

Reducing air pollution.

Write down two different things that people can do to help reduce air pollution.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.18 Environmental Issues and the Nature of Science (Continued)

Percent Correct for Example Item 18 - Two Ways Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	22 (1.5)	33 (2.0)
Cyprus	10 (1.4)	25 (2.1)
Czech Republic	19 (1.5)	38 (2.0)
†[2]England	21 (2.0)	35 (2.2)
Greece	14 (1.6)	24 (1.6)
Hong Kong	17 (1.2)	35 (2.3)
Iceland	12 (1.7)	32 (2.7)
Iran, Islamic Rep.	3 (0.8)	8 (1.2)
Ireland	18 (1.3)	33 (1.8)
Japan	30 (1.5)	44 (1.6)
Korea	39 (2.4)	49 (2.2)
New Zealand	17 (1.6)	31 (2.6)
Norway	15 (1.7)	41 (2.3)
Portugal	5 (1.0)	10 (1.3)
†Scotland	18 (1.8)	35 (2.1)
Singapore	21 (1.9)	37 (2.0)
United States	37 (1.6)	48 (1.5)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	35 (2.6)	51 (1.6)
Austria	29 (2.6)	46 (2.8)
[1]Latvia (LSS)	16 (2.1)	29 (2.3)
Netherlands	33 (2.0)	56 (2.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	24 (1.8)	47 (2.6)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	15 (1.5)	23 (1.6)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	28 (2.3)
Kuwait	- -	11 (1.1)
Thailand	24 (3.5)	36 (2.8)
International Average Percent Correct	21 (0.4)	34 (0.4)

Example 18

Reducing air pollution.

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.19 Environmental Issues and the Nature of Science

Percent Correct for Example Item 19
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	37 (2.3)	54 (3.5)
Cyprus	22 (2.3)	29 (2.3)
Czech Republic	38 (2.7)	47 (2.8)
†[2]England	41 (2.9)	53 (3.0)
Greece	27 (3.0)	28 (2.5)
Hong Kong	35 (2.6)	47 (2.7)
Iceland	19 (2.5)	27 (4.2)
Iran, Islamic Rep.	19 (2.5)	21 (2.3)
Ireland	36 (2.7)	51 (2.8)
Japan	43 (2.1)	56 (2.2)
Korea	49 (2.7)	59 (3.0)
New Zealand	38 (3.4)	50 (3.5)
Norway	34 (2.7)	54 (3.0)
Portugal	25 (2.7)	32 (3.0)
†Scotland	38 (2.4)	50 (3.3)
Singapore	37 (1.8)	44 (2.0)
United States	43 (2.6)	58 (2.1)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	40 (3.0)	57 (2.2)
Austria	31 (2.9)	42 (3.6)
[1]Latvia (LSS)	31 (3.6)	33 (3.2)
Netherlands	38 (2.9)	53 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	32 (2.9)	38 (3.1)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	34 (2.7)	44 (3.1)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	40 (3.6)
Kuwait	- -	18 (1.8)
Thailand	36 (3.5)	37 (3.4)
International Average Percent Correct	34 (0.6)	43 (0.6)

Example 19

Observations of objects in bag.

Four children can feel and smell an object inside a bag, but they cannot see it. Which of the following is NOT an observation about the object?

A. "It is flat at one end and round at the other."

B. "It smells like peppermint."

C. "It has a bump on it."

D. "I hope it is candy."

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.20 Environmental Issues and the Nature of Science

Percent Correct for Example Item 20
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	30 (2.2)	43 (3.1)
Cyprus	24 (2.9)	27 (2.5)
Czech Republic	26 (2.9)	40 (2.9)
†[2]England	33 (2.4)	43 (2.5)
Greece	21 (2.2)	30 (2.8)
Hong Kong	25 (1.8)	36 (2.5)
Iceland	30 (2.7)	40 (3.9)
Iran, Islamic Rep.	18 (2.6)	14 (2.1)
Ireland	24 (2.3)	29 (2.4)
Japan	- -	- -
Korea	56 (2.9)	66 (2.7)
New Zealand	33 (2.8)	39 (3.2)
Norway	23 (2.7)	30 (2.5)
Portugal	19 (2.4)	25 (2.4)
†Scotland	32 (2.9)	36 (2.6)
Singapore	43 (2.0)	62 (2.1)
United States	43 (3.2)	61 (2.0)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	34 (2.3)	49 (3.1)
Austria	19 (2.5)	35 (2.9)
[1]Latvia (LSS)	24 (2.9)	23 (3.0)
Netherlands	27 (3.1)	36 (3.2)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	28 (2.7)	36 (2.5)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	21 (2.0)	19 (2.2)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	26 (2.4)
Kuwait	- -	25 (1.5)
Thailand	30 (2.8)	40 (3.0)
International Average Percent Correct	29 (0.5)	36 (0.5)

Example 20

Growing seeds in light or dark.

To find out whether seeds grow better in the light or dark, you could put some seeds on pieces of damp paper and

A. keep them in a warm, dark place

B. keep one group in a light place and another in a dark place

C. keep them in a warm, light place

D. put them in a light or dark place that is cool

*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade. Internationally comparable data are unavailable for Japan on Example 20.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 3.21 Environmental Issues and the Nature of Science

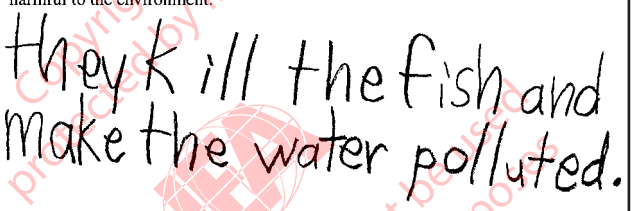
Percent Correct for Example Item 21
Lower and Upper Grades (Third and Fourth Grades*)

Country	Percent Correct	
	Third Grade	Fourth Grade
Canada	20 (1.3)	30 (2.2)
Cyprus	9 (1.3)	18 (1.6)
Czech Republic	12 (1.4)	22 (2.0)
†[2]England	19 (1.8)	28 (2.0)
Greece	14 (1.7)	25 (2.6)
Hong Kong	3 (0.5)	9 (1.5)
Iceland	6 (1.2)	20 (2.2)
Iran, Islamic Rep.	3 (0.8)	7 (1.0)
Ireland	17 (1.3)	30 (1.8)
Japan	42 (1.8)	53 (1.7)
Korea	51 (2.2)	64 (2.3)
New Zealand	24 (2.1)	38 (2.2)
Norway	10 (1.4)	21 (1.9)
Portugal	17 (1.8)	29 (2.1)
†Scotland	14 (1.5)	23 (1.8)
Singapore	10 (1.4)	21 (1.7)
United States	27 (1.8)	46 (1.3)
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):		
Australia	23 (1.7)	37 (2.4)
Austria	11 (1.5)	29 (2.7)
[1]Latvia (LSS)	16 (2.2)	24 (2.3)
Netherlands	10 (1.3)	20 (2.0)
Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):		
Slovenia	12 (1.8)	21 (1.8)
Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):		
Hungary	15 (1.8)	26 (1.8)
Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):		
[1]Israel	- -	36 (2.3)
Kuwait	- -	11 (1.0)
Thailand	9 (1.5)	14 (1.7)
International Average Percent Correct	16 (0.3)	27 (0.4)

Example 21

Oil spills.

Write as completely as possible why large oil spills in rivers and seas are harmful to the environment.

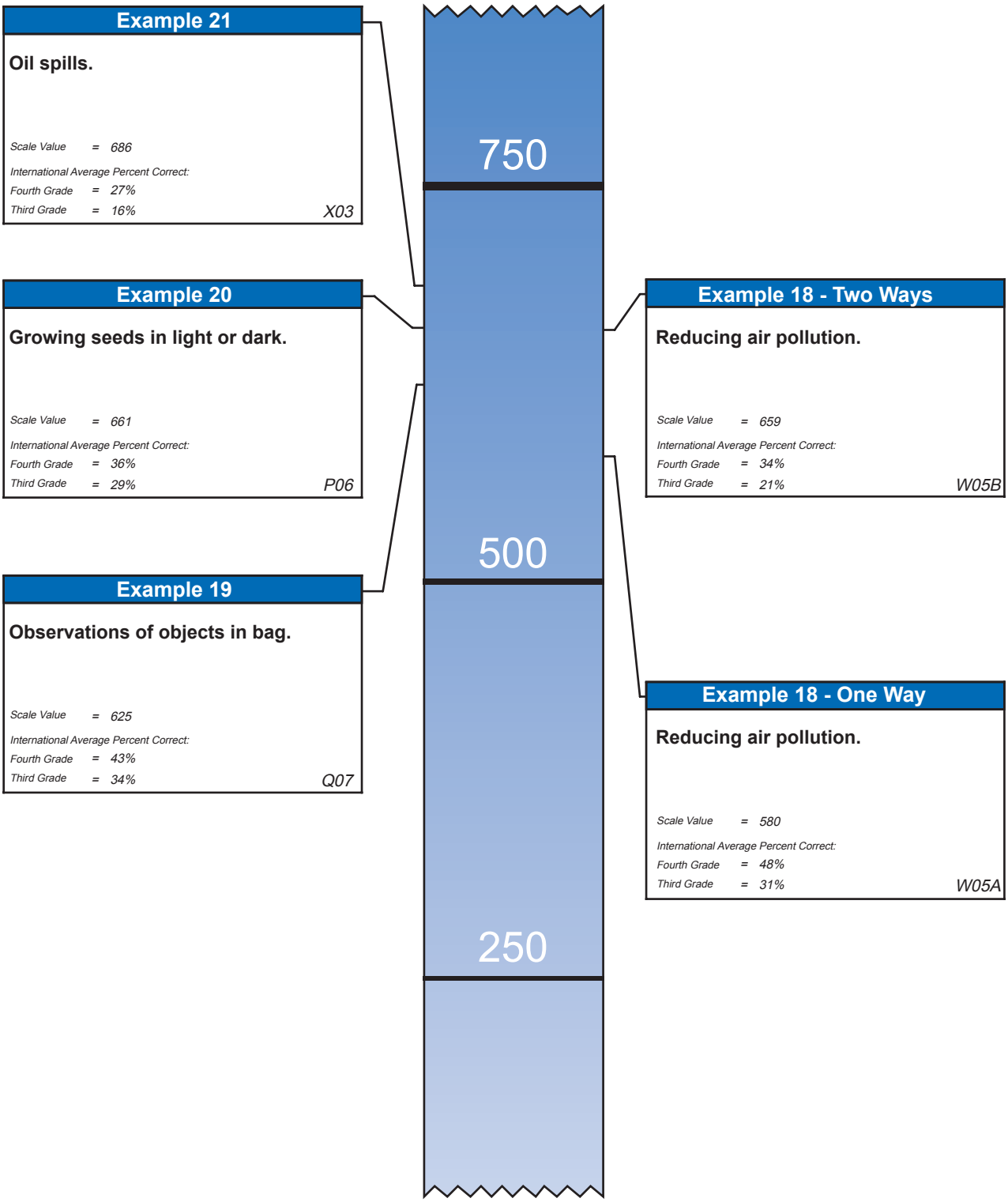


*Third and fourth grades in most countries; See Table 2 for information about the grades tested in each country.
†Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).
[1]National Desired Population does not cover all of International Desired Population (see Table A.2). 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 Table A.2).
( ) 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. Israel and Kuwait did not test at the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 3.4

International Difficulty Map for Environmental Issues and the Nature of Science Example Items – Lower and Upper Grades (Third and Fourth Grades*)



*Third and fourth grades in most countries; see Table 2 for information about the grades tested in each country.
NOTE: Each item was placed onto the TIMSS international science scale based on students' performance in both grades. Items are shown at the point on the scale where students with that level of proficiency had a 65 percent probability of providing a correct response.

Chapter 4

Students' Backgrounds and Attitudes Towards the Sciences

To provide an educational context for interpreting the science achievement results, TIMSS collected a full range of descriptive information from students about their backgrounds as well as their activities in and out of school. This chapter presents fourth-grade students' responses to a selected subset of these questions. In an effort to explore the degree to which the students' home and social environment fostered academic development, some of the questions presented herein address the availability of educational resources in the home. Another group of questions is provided to help examine whether or not students typically spend their out-of-school time in ways that support their in-school academic performance. Because students' attitudes and opinions about science reflect what happens in school and their perceptions of the value of science in broader social contexts, results also are described for several questions from the affective domain. Specifically, these questions asked students to express their opinions about the abilities necessary for success in science and indicate their attitudes towards the subject.

What Educational Resources Do Students Have in Their Homes?

Students specifically were asked about the availability at home of three types of educational resources – a dictionary, a study desk or table for their own use, and a computer. Table 4.1 reveals that in most countries, fourth-grade students with all three of these educational study aids had higher science achievement than students who did not have ready access to these study aids. In most countries, a high percentage (80% or more) of students reported having a dictionary in their homes. There was more variation among countries in the percentages of students reporting their own study desk or table. For the three study aids, the greatest variation was in the number of fourth-grade students reporting having a home computer. In more than one-third of the countries, the majority of students reported having a computer in the home, including the 80% or more who so reported in England, Iceland, the Netherlands, and Scotland. It is possible that these percentages include computers used for entertainment purposes, such as computer games. In most countries, however, including these four, the reports of fourth graders were quite consistent with those of their eighth-grade counterparts in TIMSS.[1]

The number of books in the home can be an indicator of a home environment that values literacy and the acquisition of knowledge, and offers general academic support. Table 4.2 presents fourth-grade students' reports about the number of books in their homes in relation to their achievement on the TIMSS science test. In most countries,

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

Table 4.1

Students' Reports on Educational Aids in the Home: Dictionary, Study Desk/Table and Computer - Science - Upper Grade (Fourth Grade*)

Country	Have All Three Educational Aids		Do Not Have All Three Educational Aids		Have Dictionary	Have Study Desk/Table for Own Use	Have Computer
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Percent of Students	Percent of Students
Australia	50 (1.0)	578 (3.1)	50 (1.0)	547 (3.8)	78 (1.0)	93 (0.6)	63 (1.1)
Austria	50 (1.4)	565 (3.3)	50 (1.4)	565 (4.0)	95 (0.6)	82 (1.2)	61 (1.5)
Canada	41 (1.2)	574 (3.7)	59 (1.2)	532 (3.0)	85 (0.8)	78 (1.0)	52 (1.1)
Cyprus	29 (1.0)	487 (3.7)	71 (1.0)	474 (3.5)	84 (0.8)	89 (0.7)	35 (1.0)
Czech Republic	25 (1.2)	580 (4.8)	75 (1.2)	550 (2.9)	82 (1.0)	78 (0.9)	33 (1.3)
England	68 (1.3)	564 (3.5)	32 (1.3)	525 (4.3)	93 (0.6)	80 (1.0)	88 (0.9)
Greece	20 (1.0)	510 (4.5)	80 (1.0)	500 (3.7)	90 (0.9)	88 (1.0)	23 (1.1)
Hong Kong	31 (1.1)	541 (4.1)	69 (1.1)	530 (4.0)	98 (0.3)	75 (1.2)	37 (1.2)
Hungary	28 (1.4)	564 (4.3)	72 (1.4)	520 (3.3)	69 (1.3)	87 (0.8)	37 (1.4)
Iceland	60 (1.6)	517 (3.8)	40 (1.6)	492 (3.9)	79 (1.3)	92 (0.6)	81 (1.1)
Iran, Islamic Rep.	r 3 (0.5)	422 (9.4)	97 (0.5)	425 (4.1)	r 39 (2.0)	r 34 (2.1)	r 8 (0.8)
Ireland	58 (1.2)	552 (3.4)	42 (1.2)	525 (4.1)	95 (0.5)	74 (1.1)	79 (0.9)
Israel	r 67 (2.0)	512 (4.3)	33 (2.0)	499 (5.6)	r 97 (0.6)	r 95 (0.6)	r 70 (1.9)
Japan	- -	- -	- -	- -	- -	- -	- -
Korea	22 (1.0)	612 (3.2)	78 (1.0)	593 (1.9)	93 (0.6)	91 (0.7)	23 (1.0)
Kuwait	40 (1.6)	420 (3.7)	60 (1.6)	392 (3.2)	70 (1.2)	75 (1.4)	66 (1.3)
Latvia (LSS)	18 (1.2)	513 (7.2)	82 (1.2)	513 (5.4)	84 (1.0)	95 (0.6)	21 (1.3)
Netherlands	69 (1.3)	568 (3.3)	31 (1.3)	540 (4.0)	88 (0.8)	95 (0.7)	80 (1.2)
New Zealand	43 (1.3)	555 (4.1)	57 (1.3)	517 (6.2)	93 (0.7)	78 (1.4)	53 (1.5)
Norway	44 (1.4)	550 (3.7)	56 (1.4)	518 (3.8)	76 (1.2)	92 (0.8)	56 (1.3)
Portugal	26 (1.4)	502 (4.4)	74 (1.4)	474 (4.4)	89 (1.1)	64 (1.5)	34 (1.7)
Scotland	64 (1.1)	549 (4.0)	36 (1.1)	516 (4.8)	91 (0.9)	75 (1.1)	89 (0.6)
Singapore	40 (1.3)	575 (5.9)	60 (1.3)	528 (4.2)	96 (0.3)	89 (0.5)	44 (1.3)
Slovenia	36 (1.4)	561 (3.7)	64 (1.4)	538 (3.7)	82 (1.0)	87 (0.9)	43 (1.3)
Thailand	1 (0.5)	~ ~	99 (0.5)	471 (4.6)	35 (2.6)	33 (2.2)	3 (0.6)
United States	49 (1.5)	587 (3.5)	51 (1.5)	546 (3.5)	93 (0.5)	85 (0.7)	56 (1.6)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

the more books students reported in the home, the higher their science achievement. Although the main purpose of the question was to gain some information about the relative importance of academic pursuits in the students' home environments rather than to determine the actual number of books in students' homes, there was a substantial amount of variation from country to country in fourth-grade students' reports about the number of books in their homes. In Hong Kong, Iran, Kuwait, Portugal, and Thailand, 40% or more of the students reported 25 or fewer books in the home. Conversely, 40% or more of the students in Australia and Latvia (LSS) reported more than 200 books in their homes. The number of books in the home reported by fourth-grade students in most countries agreed well with the number reported by their compatriots in eighth grade,[2] although there was a tendency for fourth-grade students to report a lower number than eighth-grade students in some countries, notably Iran, Portugal, and Thailand.

Students who speak a language at home that is different from the language of the school may sometimes be at a disadvantage in learning situations, particularly in the early grades of school. Table 4.3 presents fourth-grade students' reports of the frequency with which they speak the language of the TIMSS science test at home. In almost all of the countries, with the exception of Iran, Kuwait, Singapore, and Thailand, most students reported that they always or almost always speak the language of the test at home. Most certainly, these relatively high percentages reflect the effort expended by the participating countries to test in more than one language when necessary. However, in some countries, such as Iran, Kuwait, and Thailand, testing in all possible dialects and languages was prohibitive. Interestingly, all students in Singapore were tested in English, even though for most them, English is only sometimes (71%) or never (9%) spoken in the home. In most of the countries, students tested in the language almost always spoken in the home had higher science achievement than their counterparts who reported speaking the language of the test only sometimes or never.

Table 4.4 presents information about whether students' parents were born in the country. In about half the participating countries, 80% or more of the fourth graders reported that both their parents were born in that country. In Australia, Canada, Hong Kong, Israel, New Zealand, and Singapore, 30% or more of the students reported that at least one parent not born in the country. The patterns in relation to achievement varied substantially from country to country. In several countries, there was no relationship between the number of the students' parents born in the country and science achievement (e.g., Hong Kong, Israel, and Singapore). In about one-quarter of the countries, students having both parents born in the country had the highest achievement and, in turn, those with one parent born in the country outperformed their counterparts with neither parent born in the country (e.g., Austria, Canada, Cyprus, England, Greece, and the United States).

[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: The IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Table 4.2

Students' Reports on the Number of Books in the Home Science - Upper Grade (Fourth Grade*)

Country	None or Very Few (0-10 Books)		About One Shelf (11-25 Books)		About One Bookcase (26-100 Books)		About Two Bookcases (101-200 Books)		Three or More Bookcases (More than 200 Books)	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	3 (0.4)	476 (10.2)	7 (0.4)	512 (6.3)	23 (0.7)	556 (3.2)	24 (0.6)	567 (3.9)	44 (1.0)	581 (3.0)
Austria	9 (0.8)	506 (7.0)	17 (0.9)	538 (4.9)	35 (1.7)	570 (6.1)	18 (1.2)	583 (4.5)	21 (1.5)	595 (3.7)
Canada	5 (0.6)	470 (8.7)	13 (1.0)	524 (7.8)	29 (0.9)	549 (3.5)	20 (0.6)	568 (3.5)	33 (1.3)	565 (3.2)
Cyprus	11 (0.7)	453 (5.3)	26 (1.2)	472 (3.9)	28 (1.2)	490 (4.1)	16 (0.9)	496 (4.3)	19 (1.0)	495 (4.4)
Czech Republic	2 (0.3)	~ ~	10 (0.7)	520 (5.5)	38 (1.3)	547 (3.1)	25 (1.0)	566 (3.7)	25 (1.2)	587 (5.2)
England	7 (0.6)	474 (5.8)	13 (0.9)	505 (5.7)	26 (1.0)	542 (3.8)	23 (1.0)	569 (5.0)	31 (1.2)	586 (4.1)
Greece	r 11 (1.2)	465 (7.7)	27 (1.2)	496 (4.5)	36 (1.3)	521 (2.9)	15 (1.0)	529 (8.0)	12 (0.8)	532 (8.4)
Hong Kong	23 (1.2)	511 (4.5)	27 (0.9)	530 (3.9)	28 (1.2)	550 (3.8)	11 (0.7)	548 (4.8)	11 (1.0)	548 (5.1)
Hungary	5 (0.6)	484 (9.2)	11 (0.7)	492 (5.8)	30 (1.3)	525 (3.4)	19 (0.8)	547 (4.7)	35 (1.6)	562 (3.6)
Iceland	2 (0.4)	~ ~	12 (0.9)	476 (6.7)	30 (1.1)	502 (4.8)	24 (1.3)	513 (3.9)	33 (1.0)	524 (4.6)
Iran, Islamic Rep.	54 (2.4)	405 (3.8)	24 (1.6)	440 (3.8)	11 (1.1)	442 (8.4)	3 (0.4)	450 (8.3)	7 (0.8)	454 (9.4)
Ireland	9 (0.8)	477 (6.5)	19 (1.1)	515 (4.8)	30 (0.9)	545 (4.0)	20 (1.0)	567 (4.2)	23 (1.2)	568 (4.2)
Israel	r 6 (0.6)	491 (10.1)	18 (1.5)	498 (6.3)	36 (1.2)	511 (4.4)	19 (1.2)	517 (5.8)	20 (1.3)	510 (6.4)
Japan	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Korea	11 (0.6)	558 (4.4)	11 (0.6)	572 (3.7)	32 (1.0)	595 (2.5)	25 (0.8)	608 (3.0)	22 (0.9)	620 (2.8)
Kuwait	27 (1.4)	385 (2.7)	24 (1.0)	399 (3.4)	22 (1.2)	411 (4.7)	9 (0.6)	430 (4.9)	17 (1.2)	434 (5.8)
Latvia (LSS)	4 (0.4)	461 (9.0)	8 (0.7)	491 (7.7)	25 (1.3)	518 (8.9)	21 (1.0)	525 (6.2)	42 (1.7)	524 (4.6)
Netherlands	6 (0.8)	506 (9.3)	13 (0.9)	532 (4.4)	33 (1.3)	553 (3.3)	23 (1.2)	574 (3.7)	25 (1.6)	578 (4.2)
New Zealand	7 (0.8)	438 (10.7)	9 (0.7)	476 (6.9)	22 (1.2)	532 (6.3)	23 (1.0)	554 (4.6)	39 (1.7)	558 (4.6)
Norway	3 (0.5)	469 (10.7)	10 (0.7)	486 (6.1)	27 (1.0)	522 (4.0)	23 (0.9)	540 (3.7)	37 (1.2)	555 (4.5)
Portugal	28 (1.9)	449 (5.8)	29 (1.3)	486 (3.7)	25 (1.3)	507 (3.4)	9 (0.8)	520 (4.9)	9 (1.1)	520 (6.9)
Scotland	10 (1.0)	459 (5.9)	15 (1.0)	501 (5.2)	25 (1.0)	536 (4.7)	20 (0.9)	556 (4.6)	31 (1.5)	575 (4.4)
Singapore	9 (0.6)	478 (4.0)	21 (0.9)	503 (5.1)	36 (0.8)	552 (4.0)	18 (0.8)	582 (6.0)	16 (1.1)	598 (7.4)
Slovenia	6 (0.8)	487 (10.5)	20 (1.2)	517 (4.1)	37 (1.2)	550 (3.0)	18 (0.9)	567 (4.4)	18 (1.3)	574 (5.2)
Thailand	47 (2.1)	456 (4.5)	28 (1.1)	474 (5.2)	17 (1.1)	494 (5.4)	4 (0.6)	513 (11.5)	4 (0.5)	506 (15.9)
United States	8 (0.6)	483 (5.9)	13 (0.7)	519 (4.3)	24 (0.7)	561 (3.2)	22 (0.6)	584 (3.3)	34 (1.2)	596 (3.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.3

Students' Reports on Frequency with Which They Speak the Language of the Test at Home - Science - Upper Grade (Fourth Grade*)

Country	Never		Sometimes		Always or Almost Always	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	1 (0.2)	~ ~	9 (0.9)	518 (7.9)	89 (1.0)	568 (2.6)
Austria	3 (0.6)	520 (15.2)	14 (1.2)	491 (7.7)	83 (1.5)	575 (4.5)
Canada	1 (0.2)	~ ~	13 (1.2)	501 (5.1)	86 (1.2)	559 (2.7)
Cyprus	3 (0.4)	449 (9.5)	9 (0.8)	477 (6.2)	88 (0.9)	480 (3.1)
Czech Republic	1 (0.2)	~ ~	3 (0.5)	533 (11.0)	96 (0.5)	558 (3.2)
England	1 (0.2)	~ ~	6 (0.8)	503 (9.9)	93 (0.8)	554 (3.6)
Greece	r 2 (0.4)	~ ~	7 (0.7)	459 (8.8)	90 (0.9)	505 (3.5)
Hong Kong	- -	- -	- -	- -	- -	- -
Hungary	x x	x x	x x	x x	x x	x x
Iceland	1 (0.3)	~ ~	10 (0.9)	491 (8.7)	89 (1.0)	509 (3.4)
Iran, Islamic Rep.	23 (2.2)	383 (4.9)	22 (1.7)	409 (6.3)	54 (2.8)	437 (5.0)
Ireland	3 (0.3)	447 (6.5)	5 (0.6)	490 (8.8)	92 (0.8)	546 (3.2)
Israel	r 2 (0.3)	~ ~	15 (1.2)	504 (7.2)	83 (1.2)	509 (4.2)
Japan	- -	- -	- -	- -	- -	- -
Korea	1 (0.1)	~ ~	10 (0.7)	586 (4.2)	89 (0.7)	599 (2.0)
Kuwait	13 (1.5)	402 (4.8)	37 (2.2)	412 (4.2)	50 (2.4)	398 (4.9)
Latvia (LSS)	1 (0.3)	~ ~	7 (0.8)	478 (7.9)	92 (0.8)	516 (5.1)
Netherlands	5 (0.9)	546 (7.5)	11 (1.4)	524 (8.5)	84 (1.7)	565 (2.9)
New Zealand	2 (0.2)	~ ~	11 (1.0)	461 (7.7)	87 (1.1)	544 (4.8)
Norway	r 2 (0.3)	~ ~	8 (0.9)	485 (11.0)	90 (1.0)	535 (3.4)
Portugal	r 2 (0.3)	~ ~	4 (0.5)	476 (10.1)	94 (0.5)	482 (4.0)
Scotland	- -	- -	- -	- -	- -	- -
Singapore	9 (0.6)	486 (5.2)	71 (1.3)	538 (4.2)	20 (1.5)	607 (7.3)
Slovenia	1 (0.2)	~ ~	9 (0.9)	504 (5.4)	90 (1.0)	551 (3.6)
Thailand	11 (1.6)	439 (12.3)	29 (2.4)	464 (5.2)	60 (2.9)	482 (5.4)
United States	2 (0.2)	~ ~	13 (1.1)	513 (5.7)	85 (1.1)	576 (3.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate. An "x" indicates data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.4

Students' Reports on Whether or Not Their Parents Were Born in the Country - Science - Upper Grade (Fourth Grade*)

Country	Neither Parent Born in Country		One Parent Born in Country		Both Parents Born in Country	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	19 (1.2)	550 (5.9)	20 (0.9)	565 (4.6)	61 (1.1)	568 (2.7)
Austria	11 (0.9)	502 (10.1)	9 (0.7)	556 (6.5)	80 (1.2)	574 (2.8)
Canada	17 (1.5)	523 (5.3)	14 (0.5)	543 (4.7)	69 (1.6)	559 (3.1)
Cyprus	3 (0.4)	444 (9.2)	11 (0.8)	468 (5.7)	85 (0.9)	480 (3.3)
Czech Republic	2 (0.3)	~ ~	8 (0.6)	541 (5.7)	89 (0.7)	560 (3.1)
England	r 9 (1.2)	517 (8.4)	15 (0.9)	545 (5.9)	76 (1.8)	560 (3.7)
Greece	5 (0.6)	453 (8.9)	10 (0.9)	483 (9.3)	85 (1.0)	506 (3.4)
Hong Kong	38 (1.8)	535 (4.4)	21 (0.9)	537 (4.2)	41 (1.8)	531 (4.1)
Hungary	2 (0.3)	~ ~	3 (0.3)	515 (11.8)	95 (0.4)	534 (3.4)
Iceland	1 (0.2)	~ ~	6 (0.6)	512 (9.9)	93 (0.7)	507 (3.3)
Iran, Islamic Rep.	r 5 (0.7)	421 (5.7)	4 (0.4)	400 (7.1)	91 (0.8)	424 (4.2)
Ireland	2 (0.3)	~ ~	10 (0.7)	532 (6.0)	88 (0.8)	541 (3.3)
Israel	r 32 (2.2)	504 (5.2)	24 (1.2)	507 (5.8)	44 (1.9)	510 (4.5)
Japan	- -	- -	- -	- -	- -	- -
Korea	0 (0.1)	~ ~	1 (0.2)	~ ~	99 (0.2)	598 (1.8)
Kuwait	10 (0.7)	423 (8.1)	16 (0.7)	401 (3.6)	74 (1.1)	401 (3.2)
Latvia (LSS)	2 (0.3)	~ ~	16 (0.9)	503 (5.8)	82 (0.9)	516 (5.1)
Netherlands	r 8 (1.7)	500 (8.6)	6 (0.6)	552 (6.9)	86 (1.6)	565 (2.8)
New Zealand	11 (0.9)	512 (6.2)	21 (1.0)	538 (5.7)	68 (1.4)	534 (5.5)
Norway	4 (0.7)	476 (10.6)	7 (0.5)	528 (7.4)	89 (1.0)	534 (3.3)
Portugal	5 (0.6)	458 (10.8)	8 (0.6)	487 (7.1)	86 (0.9)	481 (3.9)
Scotland	9 (0.9)	564 (8.2)	19 (0.9)	540 (5.2)	72 (1.4)	533 (4.4)
Singapore	12 (0.6)	554 (5.4)	21 (0.5)	544 (5.7)	68 (0.7)	547 (5.2)
Slovenia	12 (1.2)	514 (4.3)	9 (0.6)	548 (6.2)	79 (1.4)	551 (3.7)
Thailand	2 (0.4)	~ ~	3 (0.3)	411 (11.4)	96 (0.6)	475 (4.5)
United States	12 (1.2)	514 (6.2)	10 (0.7)	544 (5.0)	78 (1.3)	577 (3.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

As shown in Table 4.5, most of the students reported having been born in the country in which they were tested. The largest percentages of students reporting that they had not been born in the country (from 10% to 18%) were in Cyprus, Hong Kong, Iceland, Israel, Kuwait, the Netherlands, New Zealand, and Scotland. For about half the countries, those students born elsewhere had lower average science achievement than their classmates born in the country.

Table 4.5

Students' Reports on Whether or Not They Were Born in the Country
Science - Upper Grade (Fourth Grade*)

Country	Yes		No	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	91 (0.9)	564 (2.9)	9 (0.9)	553 (6.2)
Austria	91 (1.3)	569 (2.7)	9 (1.3)	522 (23.0)
Canada	93 (0.7)	554 (2.8)	7 (0.7)	503 (8.4)
Cyprus	88 (0.9)	477 (3.1)	12 (0.9)	477 (6.1)
Czech Republic	98 (0.2)	557 (3.1)	2 (0.2)	~ ~
England	93 (0.7)	555 (3.3)	7 (0.7)	507 (8.7)
Greece	92 (0.6)	503 (3.4)	8 (0.6)	463 (6.9)
Hong Kong	82 (2.0)	536 (3.8)	18 (2.0)	521 (5.4)
Hungary	98 (0.3)	534 (3.4)	2 (0.3)	~ ~
Iceland	87 (2.3)	506 (2.9)	13 (2.3)	508 (11.0)
Iran, Islamic Rep.	92 (0.8)	422 (4.1)	8 (0.8)	378 (4.8)
Ireland	96 (0.5)	540 (3.4)	4 (0.5)	546 (10.0)
Israel r	84 (1.5)	508 (4.1)	16 (1.5)	505 (7.0)
Japan	- -	- -	- -	- -
Korea	99 (0.2)	597 (1.8)	1 (0.2)	~ ~
Kuwait	87 (1.0)	402 (3.1)	13 (1.0)	399 (6.6)
Latvia (LSS)	97 (0.5)	515 (5.0)	3 (0.5)	461 (10.3)
Netherlands	89 (0.9)	564 (3.1)	11 (0.9)	521 (6.2)
New Zealand	90 (0.7)	533 (5.0)	10 (0.7)	519 (9.2)
Norway	96 (0.5)	532 (3.4)	4 (0.5)	492 (13.9)
Portugal	94 (0.6)	483 (3.6)	6 (0.6)	445 (13.8)
Scotland	90 (0.8)	535 (4.2)	10 (0.8)	549 (8.9)
Singapore	93 (0.6)	547 (5.1)	7 (0.6)	554 (6.6)
Slovenia	96 (0.5)	548 (3.4)	4 (0.5)	499 (8.6)
Thailand	100 (0.0)	472 (4.8)	0 (0.0)	~ ~
United States	93 (0.5)	571 (3.0)	7 (0.5)	502 (6.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are the Academic Expectations of Students, Their Families, and Their Friends?

Tables 4.6, 4.7, and 4.8 present fourth-grade students' reports about how they themselves, their mothers, and their friends feel about the importance of doing well in mathematics and science in comparison with non-academic activities. For most of the countries, from 80% to 95% of the students agreed or strongly agreed that it was important to do well in science. Countries with very high percentages of students agreeing that it was important to do well included the Czech Republic (96%), Greece (96%), Hungary (97%), Iran (97%), and the United States (97%). Only Japan, Korea, and Thailand had less than 80% of students agreeing that it was important to do well in science. Compared with science, somewhat more students agreed or strongly agreed that it was important to do well in mathematics.

For the most part, fourth-grade students indicated that their mothers' opinions about the importance of these academic activities corresponded very closely to their own feelings. In contrast, however, students reported that their friends were not in as much agreement about the importance of academic success, particularly in science.

Students' reports of their friends' opinions about the importance of doing well in science varied substantially across countries, ranging from a low of 62% in Japan to a high of 91% in Portugal. Countries where less than two-thirds of fourth graders reported that their friends agreed or strongly agreed it was important to do well in science included Israel (65%), Japan (62%), Korea (58%), and the Netherlands (54%).

Although students' friends reportedly were in general agreement about the importance of doing well in mathematics, the percentages were generally in the 70s and 80s, rather than the 90s as for the students themselves. According to students, their friends were in the lowest degree of agreement about doing well in mathematics in Korea (59%).

For purposes of comparison, fourth-grade students also were asked about the importance of two non-academic activities – having time to have fun and being good at sports. In most countries, high percentages of the students (more than 90%) felt it was important to have time to have fun. The percentages in agreement were similar to those agreeing that it was important to do well in mathematics and science in many countries. Generally, there was less agreement about the importance of being good at sports. It needs to be emphasized, however, that the relative rankings given to the four activities by students varied from country to country. Interestingly, in both Hong Kong and Singapore there was much less agreement about the importance of having time to have fun than in other countries (58% and 57%, respectively). In Hong Kong and Thailand, only about two-thirds of students reported that they think it is important to do well in sports, compared with percentages in the 80s and 90s in most other countries.

In nearly all countries, 80% or more of the fourth-grade students reported that their mothers agreed that it was important to have time to have fun. The exceptions were Greece (75%), Hong Kong (31%), Iran (76%), Korea (66%), Kuwait (71%), Singapore (46%), and Thailand (76%), where students reported from 4% to 27% lower agreement for their mothers than for themselves. According to students, their mothers give a moderate to high degree of support to the importance of being good at sports. In nearly all countries the percentages of students reporting such agreement were in the 70s, 80s, and 90s, except in Hong Kong (36%), Korea (67%), Thailand (57%), and the United States (69%).

As might be anticipated, students reported that most of their friends agreed that it was important to have fun – more than 90% in all countries except Cyprus (79%), Greece (82%), Hong Kong (65%), Iran (76%), Israel (76%), Korea (78%), Kuwait (75%), Thailand (84%), and Singapore (65%). Internationally, fourth graders reported that their friends generally were in moderate agreement that it was important to do well in sports.

Table 4.6

Students' Reports on Whether They Think It Is Important to Do Various Activities - Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Yes			
	Do Well in Science	Do Well in Mathematics	Have Time to Have Fun	Be Good at Sports
Australia	91 (0.8)	95 (0.4)	95 (0.4)	88 (0.6)
Austria	94 (0.6)	95 (0.6)	92 (0.7)	87 (1.1)
Canada	95 (0.5)	97 (0.3)	96 (0.5)	83 (0.7)
Cyprus	93 (0.6)	97 (0.4)	85 (1.1)	88 (1.0)
Czech Republic	96 (0.4)	96 (0.4)	94 (0.5)	88 (0.8)
England	94 (0.6)	97 (0.4)	93 (0.5)	90 (0.7)
Greece	96 (0.6)	97 (0.4)	80 (1.2)	80 (1.0)
Hong Kong	90 (0.9)	96 (0.4)	58 (1.3)	63 (1.3)
Hungary	97 (0.3)	98 (0.3)	98 (0.3)	86 (0.8)
Iceland	87 (1.6)	96 (0.5)	91 (0.8)	93 (0.7)
Iran, Islamic Rep.	97 (0.5)	96 (0.5)	r 80 (1.7)	r 91 (1.1)
Ireland	90 (0.8)	97 (0.4)	96 (0.3)	90 (0.7)
Israel	r 94 (0.6)	r 97 (0.5)	r 94 (0.8)	r 92 (0.8)
Japan	72 (0.9)	75 (0.8)	94 (0.4)	75 (0.7)
Korea	69 (1.0)	72 (1.0)	73 (1.0)	73 (1.0)
Kuwait	95 (0.5)	96 (0.5)	75 (1.2)	80 (1.3)
Latvia (LSS)	93 (0.6)	96 (0.4)	92 (0.7)	88 (1.0)
Netherlands	84 (1.2)	93 (0.7)	r 93 (0.8)	86 (1.1)
New Zealand	90 (0.7)	96 (0.5)	95 (0.7)	91 (0.6)
Norway	91 (1.0)	94 (0.6)	97 (0.4)	80 (0.9)
Portugal	94 (0.7)	94 (0.6)	90 (0.9)	89 (1.0)
Scotland	93 (0.6)	97 (0.3)	94 (0.5)	92 (0.5)
Singapore	94 (0.4)	98 (0.2)	57 (1.6)	81 (0.9)
Slovenia	94 (0.6)	94 (0.6)	89 (0.7)	92 (0.6)
Thailand	79 (1.3)	80 (1.3)	81 (1.1)	67 (1.4)
United States	97 (0.3)	98 (0.3)	94 (0.4)	82 (0.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.7

Students' Reports on Whether Their Mothers Think It Is Important to Do Various Activities - Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Yes			
	Do Well in Science	Do Well in Mathematics	Have Time to Have Fun	Be Good at Sports
Australia	91 (0.8)	96 (0.3)	92 (0.6)	82 (0.7)
Austria	93 (0.5)	96 (0.5)	88 (0.9)	74 (1.5)
Canada	95 (0.3)	98 (0.3)	92 (0.7)	74 (0.9)
Cyprus	91 (0.7)	96 (0.5)	80 (1.5)	80 (1.1)
Czech Republic	95 (0.5)	96 (0.5)	91 (0.7)	81 (0.9)
England	94 (0.6)	98 (0.3)	90 (0.8)	87 (0.9)
Greece	96 (0.4)	96 (0.5)	75 (1.4)	72 (1.3)
Hong Kong	80 (0.9)	95 (0.4)	31 (1.0)	36 (1.2)
Hungary	96 (0.4)	97 (0.4)	99 (0.2)	77 (1.0)
Iceland	88 (1.4)	98 (0.4)	83 (1.3)	90 (0.8)
Iran, Islamic Rep.	r 96 (0.6)	r 96 (0.7)	r 76 (1.7)	r 85 (1.3)
Ireland	91 (0.8)	98 (0.3)	95 (0.5)	84 (0.8)
Israel	r 93 (0.7)	r 97 (0.5)	r 88 (1.0)	r 76 (1.4)
Japan	- -	- -	- -	- -
Korea	64 (1.2)	70 (1.1)	66 (1.3)	67 (0.9)
Kuwait	94 (0.7)	94 (0.5)	71 (1.5)	71 (1.4)
Latvia (LSS)	92 (0.5)	95 (0.6)	85 (1.2)	80 (1.0)
Netherlands	78 (1.3)	92 (0.6)	85 (1.4)	72 (1.3)
New Zealand	90 (0.8)	95 (0.5)	92 (0.8)	87 (1.2)
Norway	94 (0.6)	96 (0.5)	96 (0.6)	73 (1.2)
Portugal	93 (0.8)	93 (0.6)	87 (1.0)	82 (1.1)
Scotland	93 (0.6)	98 (0.3)	93 (0.5)	87 (0.8)
Singapore	91 (0.6)	96 (0.4)	46 (1.4)	70 (1.1)
Slovenia	88 (0.9)	89 (0.8)	83 (0.9)	86 (0.9)
Thailand	79 (1.3)	79 (1.2)	76 (1.2)	57 (1.8)
United States	98 (0.2)	98 (0.2)	88 (0.8)	69 (0.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Data are reported as percent of students.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.8

Students' Reports on Whether Their Friends Think That It Is Important to Do Various Activities - Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Yes			
	Do Well in Science	Do Well in Mathematics	Have Time to Have Fun	Be Good at Sports
Australia	68 (0.9)	76 (0.8)	95 (0.4)	86 (0.5)
Austria	76 (1.6)	83 (1.4)	91 (0.8)	82 (1.2)
Canada	73 (1.0)	81 (0.8)	96 (0.4)	82 (0.7)
Cyprus	75 (1.4)	85 (0.8)	79 (1.1)	83 (0.9)
Czech Republic	85 (1.1)	88 (0.9)	93 (0.6)	84 (1.0)
England	71 (1.3)	78 (1.2)	93 (0.6)	88 (0.7)
Greece	90 (0.8)	93 (0.6)	82 (1.1)	76 (1.1)
Hong Kong	73 (1.2)	84 (1.2)	65 (1.0)	59 (1.0)
Hungary	80 (1.0)	84 (0.9)	94 (0.6)	80 (1.1)
Iceland	75 (1.9)	87 (1.0)	92 (0.9)	88 (0.9)
Iran, Islamic Rep.	87 (1.7)	r 87 (1.7)	r 76 (1.9)	r 83 (1.6)
Ireland	68 (1.6)	79 (1.2)	96 (0.4)	90 (0.6)
Israel	r 65 (1.5)	r 70 (1.5)	r 76 (1.2)	r 78 (0.9)
Japan	62 (0.9)	70 (0.7)	92 (0.4)	75 (0.7)
Korea	58 (1.0)	59 (1.1)	78 (1.1)	64 (0.9)
Kuwait	86 (1.2)	88 (1.0)	75 (1.4)	76 (1.2)
Latvia (LSS)	78 (1.2)	88 (1.0)	92 (0.6)	82 (1.2)
Netherlands	54 (2.1)	65 (2.0)	92 (0.7)	72 (1.5)
New Zealand	67 (1.3)	76 (1.2)	96 (0.6)	88 (0.9)
Norway	77 (1.4)	83 (1.3)	97 (0.5)	82 (1.0)
Portugal	91 (0.8)	91 (0.8)	93 (0.6)	88 (1.0)
Scotland	68 (1.2)	78 (1.0)	95 (0.5)	89 (0.8)
Singapore	87 (0.7)	94 (0.4)	65 (1.6)	81 (1.0)
Slovenia	86 (0.9)	89 (0.8)	90 (0.6)	91 (0.8)
Thailand	74 (1.5)	76 (1.4)	84 (1.1)	63 (1.4)
United States	69 (0.8)	72 (0.9)	95 (0.4)	83 (0.9)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Data are reported as percent of students.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

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

Even though education may be thought to be the dominant activity of school-aged children, young people actually spend much more of their time outside of school. Some of this out-of-school time is spent at furthering academic development – for example, in studying or doing homework in school subjects. Table 4.9 presents fourth-grade students' reports about the amount of time they spend studying science or doing homework in science on a normal school day. Students in most countries reported spending between half an hour and an hour per day studying science. Fourth-graders in Australia, Iceland, Ireland, Japan, the Netherlands, New Zealand, Norway, and Scotland were at the lower end of the range, reporting an average of about one half hour or less per day (0.3 to 0.5 of an hour). Those in Greece, Hungary, Iran, Kuwait, Portugal, Singapore, and Slovenia reported one hour or more of science homework per day, on average, with Iran at more than two hours. More than half the students in Australia, Iceland, the Netherlands, New Zealand, Norway, and Scotland reported spending no time at all on science homework.

The relationship between time spent doing science homework and students' average science achievement was curvilinear in many countries, with the highest achievement being associated with a moderate amount of homework per day (up to one hour). This pattern suggests that, compared with their higher-achieving counterparts, the lower-performing students may do less homework, either because they do not do it or because their teachers do not assign it, or more homework, perhaps because they need to spend the extra time to keep up academically. In many countries, students doing up to one hour a day of homework had higher average science achievement than students spending no time on homework. The greatest differences were in Latvia(LSS), and Portugal. Students reporting more than one hour of homework had lower average science achievement in most countries. Only in Iran, Japan, and Korea did students reporting more than one hour of homework have average science achievement as high as those reporting less than one hour.

The students also were asked about a variety of other ways they could spend their time out of school. Fourth graders were asked about watching television, playing computer games, playing or talking with friends, doing jobs at home, playing sports, and reading books for enjoyment. Their reports about the amount of time spent daily in each of these activities are shown in Table 4.10. Granted, some television programming and some computer games are targeted at developing children's academic abilities, and leisure reading also can be related to higher academic achievement. Still, much fare on television is not educationally related, and fourth-grade students in many countries reported spending nearly as much time each day watching television – an average of about two hours per day – as they did doing homework. Fourth graders in many countries also appear to spend about two hours per day playing or talking with friends, and nearly two hours playing sports. The time spent on leisure activities is not additive, because students often do these activities

Table 4.9

Students' Reports on the Amount of Out-of-School Time Spent Studying Science or Doing Science Homework on a Normal School Day
Science - Upper Grade (Fourth Grade*)

Country	No Time		Less than 1 Hour		1 Hour or More		Average Hours [1]
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	
Australia	55 (1.3)	566 (3.3)	33 (1.3)	570 (3.5)	12 (0.8)	536 (7.1)	0.4 (0.02)
Austria	11 (1.8)	563 (6.7)	56 (1.8)	573 (4.4)	33 (1.7)	553 (4.1)	0.9 (0.03)
Canada	38 (1.7)	552 (3.7)	46 (1.3)	559 (3.6)	16 (1.1)	533 (4.9)	0.6 (0.03)
Cyprus	21 (1.2)	469 (4.9)	51 (1.9)	489 (3.4)	28 (1.5)	466 (3.7)	0.8 (0.03)
Czech Republic	15 (0.9)	555 (5.6)	68 (1.2)	562 (3.3)	17 (1.0)	549 (3.8)	0.6 (0.02)
England	- -	- -	- -	- -	- -	- -	- -
Greece	8 (0.9)	475 (13.5)	46 (1.6)	510 (3.7)	47 (1.5)	499 (3.3)	1.3 (0.03)
Hong Kong	9 (1.0)	506 (4.9)	63 (1.7)	542 (3.5)	28 (1.1)	524 (4.7)	0.9 (0.02)
Hungary	10 (0.8)	504 (6.0)	51 (1.3)	543 (3.9)	39 (1.4)	529 (3.6)	1.0 (0.03)
Iceland	61 (2.0)	513 (4.3)	30 (1.6)	507 (4.9)	9 (0.8)	484 (9.1)	0.3 (0.02)
Iran, Islamic Rep.	5 (0.7)	392 (7.9)	23 (1.5)	430 (7.3)	72 (1.5)	429 (4.2)	2.1 (0.06)
Ireland	46 (2.1)	544 (3.5)	45 (2.0)	552 (4.3)	9 (0.6)	490 (5.8)	0.4 (0.02)
[2] *Israel*	r 23 (1.6)	507 (5.4)	47 (1.9)	515 (5.3)	30 (1.9)	492 (4.7)	r 0.9 (0.04)
Japan	41 (1.8)	566 (2.3)	48 (1.5)	580 (2.0)	11 (0.6)	584 (3.4)	0.4 (0.02)
Korea	26 (0.9)	589 (3.6)	46 (0.9)	600 (2.4)	28 (1.0)	604 (2.8)	0.8 (0.02)
Kuwait	6 (0.9)	376 (9.8)	38 (1.3)	414 (3.3)	57 (1.4)	400 (3.8)	1.8 (0.05)
[2] *Latvia (LSS)*	11 (1.0)	487 (6.5)	69 (1.6)	529 (6.1)	20 (1.3)	496 (5.8)	0.8 (0.03)
Netherlands	r 56 (3.3)	563 (3.5)	34 (2.7)	563 (4.2)	10 (1.3)	535 (6.0)	r 0.4 (0.03)
New Zealand	55 (1.7)	534 (6.5)	32 (1.6)	546 (5.2)	13 (0.9)	511 (6.9)	0.5 (0.02)
Norway	51 (1.8)	535 (3.7)	41 (1.7)	540 (4.6)	8 (0.8)	523 (7.4)	0.4 (0.02)
Portugal	4 (0.5)	428 (13.2)	53 (1.7)	493 (4.3)	43 (1.6)	475 (4.2)	1.3 (0.03)
Scotland	62 (1.8)	541 (4.8)	31 (1.8)	540 (4.8)	7 (0.7)	494 (10.3)	0.3 (0.02)
Singapore	- -	- -	- -	- -	- -	- -	- -
Slovenia	4 (0.6)	510 (12.6)	56 (1.5)	553 (3.2)	40 (1.6)	545 (4.0)	1.0 (0.03)
Thailand	46 (1.9)	480 (4.1)	29 (1.3)	471 (5.7)	24 (1.6)	458 (8.2)	0.7 (0.03)
United States	23 (1.2)	558 (4.1)	54 (1.2)	582 (3.3)	24 (1.2)	542 (3.4)	0.8 (0.02)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.
[2] Modified response categories for Israel and Latvia: 3-5 hours = 4; More than 5 hours = 7.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.10

Students' Reports on How They Spend Their Leisure Time on a Normal School Day[1] - Science - Upper Grade (Fourth Grade*)

Country	Average Hours Watching Television or Videos	Average Hours Playing Computer Games	Average Hours Playing or Talking with Friends	Average Hours Doing Jobs at Home	Average Hours Playing Sports	Average Hours Reading a Book for Enjoyment
Australia	2.0 (0.05)	0.8 (0.02)	1.2 (0.03)	1.1 (0.02)	1.6 (0.03)	0.9 (0.02)
Austria	1.4 (0.04)	0.7 (0.03)	2.9 (0.06)	1.0 (0.04)	1.9 (0.05)	1.3 (0.05)
Canada	1.9 (0.04)	0.6 (0.02)	1.5 (0.04)	1.1 (0.03)	1.8 (0.03)	1.1 (0.03)
Cyprus	1.8 (0.05)	0.6 (0.03)	1.6 (0.05)	1.4 (0.04)	0.9 (0.04)	1.3 (0.04)
Czech Republic	1.7 (0.04)	0.6 (0.03)	2.4 (0.05)	1.2 (0.03)	1.6 (0.04)	1.0 (0.02)
England	2.2 (0.04)	1.2 (0.04)	1.5 (0.04)	0.9 (0.03)	1.7 (0.04)	1.0 (0.03)
Greece	1.3 (0.04)	0.7 (0.03)	1.2 (0.03)	1.3 (0.04)	1.8 (0.04)	1.6 (0.05)
Hong Kong	1.5 (0.04)	0.6 (0.03)	0.7 (0.03)	0.9 (0.02)	0.8 (0.02)	1.0 (0.02)
Hungary	2.3 (0.05)	0.9 (0.03)	1.9 (0.04)	1.8 (0.05)	1.7 (0.03)	1.3 (0.04)
Iceland	1.2 (0.04)	0.7 (0.03)	1.5 (0.06)	0.8 (0.04)	1.3 (0.04)	1.0 (0.03)
Iran, Islamic Rep.	r 1.3 (0.05)	0.3 (0.03)	r 1.1 (0.04)	r 1.7 (0.06)	r 1.2 (0.04)	r 1.3 (0.06)
Ireland	1.9 (0.05)	0.9 (0.04)	1.1 (0.04)	1.1 (0.03)	1.8 (0.04)	1.1 (0.03)
[2] *Israel*	r 2.5 (0.06)	r 1.1 (0.07)	r 1.8 (0.07)	r 1.3 (0.04)	r 2.1 (0.07)	r 1.4 (0.06)
Japan	1.9 (0.03)	0.8 (0.02)	1.4 (0.03)	0.8 (0.02)	1.3 (0.03)	0.9 (0.02)
Korea	1.5 (0.03)	0.3 (0.02)	1.0 (0.03)	0.7 (0.02)	0.7 (0.02)	1.0 (0.02)
Kuwait	1.4 (0.03)	1.1 (0.04)	1.0 (0.03)	1.4 (0.05)	1.7 (0.04)	1.3 (0.03)
[2] *Latvia (LSS)*	2.3 (0.07)	r 0.8 (0.06)	1.9 (0.06)	1.3 (0.05)	1.2 (0.05)	1.3 (0.05)
Netherlands	1.7 (0.06)	0.9 (0.03)	3.0 (0.06)	0.9 (0.03)	1.6 (0.05)	0.9 (0.03)
New Zealand	2.0 (0.06)	0.9 (0.04)	1.3 (0.04)	1.0 (0.03)	1.5 (0.04)	1.0 (0.03)
Norway	1.7 (0.04)	0.7 (0.03)	2.9 (0.05)	1.0 (0.03)	1.5 (0.04)	0.8 (0.03)
Portugal	1.5 (0.05)	0.7 (0.04)	1.2 (0.04)	0.9 (0.03)	1.4 (0.05)	1.1 (0.03)
Scotland	1.9 (0.06)	1.0 (0.04)	1.6 (0.05)	0.9 (0.03)	1.9 (0.04)	1.0 (0.03)
Singapore	- -	- -	- -	- -	- -	- -
Slovenia	1.5 (0.04)	0.7 (0.03)	1.2 (0.04)	1.7 (0.05)	1.8 (0.04)	1.3 (0.03)
Thailand	1.1 (0.09)	0.2 (0.02)	1.0 (0.06)	1.2 (0.03)	1.0 (0.03)	0.9 (0.03)
United States	2.0 (0.04)	0.8 (0.03)	1.5 (0.04)	1.2 (0.02)	2.0 (0.03)	1.2 (0.03)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1] Average hours based on: No time = 0; Less than 1 hour = .5; 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.
[2] Modified response categories for Israel and Latvia: 3-5 hours = 4; More than 5 hours = 7.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

simultaneously (e.g., talk with friends and watch television). Nevertheless, it does appear that in most countries at least as much time is spent on some of these largely non-academic activities as on studying and doing science homework.

The relationship between science achievement and amount of time spent watching television on a normal school day was similar across countries to that between achievement and time spent doing homework (see Table 4.11). In more than half the TIMSS countries, the highest science achievement was associated with watching from one to two hours of television per day. This was the most common response, reflecting from 23% to 46% of the students for all countries. That watching less than one hour of television per day generally was associated with lower average science achievement than watching one to two hours in many countries most likely has little to do with the influence of television viewing on science achievement. For these students, low television viewing may be a surrogate socio-economic indicator, suggesting something about children's access to television sets across countries. Because students with fewer socio-economic advantages generally perform less well than their counterparts academically, it may be that students who reported less than one hour watching television each day simply do not have television sets in their homes, or come from homes with only one television set where they have less opportunity to spend a lot of time watching their choice of programming.

In general, beyond one to two hours of television viewing per day, the more television fourth graders reported watching, the lower their science achievement, although there were several countries where students watching three to four hours of television did not have lower achievement than those watching one to two hours. In most countries, however, students watching more than four hours of television per day had the lowest average science achievement. In more than half of the countries, 10% or more of the students reported watching more than four hours of television each day. The countries with the highest percentages of such students included Australia (15%), England (18%), Hungary (20%), New Zealand (19%), and the United States (17%).

Table 4.11

Students' Reports on the Hours Spent Watching Television and Videos on a Normal School Day - Science - Upper Grade (Fourth Grade*)

Country	Less than 1 Hour		1 to 2 Hours		3 to 4 Hours		More than 4 Hours	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	32 (1.0)	565 (4.4)	36 (0.8)	572 (2.7)	17 (0.7)	565 (2.9)	15 (1.0)	536 (6.3)
Austria	41 (1.7)	559 (3.5)	43 (1.7)	574 (5.1)	9 (0.8)	574 (5.6)	7 (0.7)	531 (8.7)
Canada	36 (1.0)	554 (4.4)	37 (0.9)	559 (2.9)	14 (0.7)	546 (4.3)	13 (0.9)	529 (4.8)
Cyprus	34 (1.7)	476 (4.0)	41 (1.4)	481 (3.8)	15 (0.9)	478 (4.3)	10 (0.8)	470 (4.9)
Czech Republic	32 (1.4)	551 (4.2)	44 (1.3)	565 (3.6)	15 (0.8)	560 (3.8)	9 (0.8)	549 (5.0)
England	28 (1.3)	544 (4.6)	38 (1.0)	570 (4.1)	16 (0.9)	571 (4.8)	18 (0.9)	533 (4.8)
Greece	53 (1.4)	501 (3.7)	32 (1.5)	511 (3.9)	8 (0.7)	496 (8.6)	7 (0.6)	472 (10.9)
Hong Kong	48 (1.4)	531 (3.5)	31 (0.9)	543 (3.8)	12 (0.7)	537 (5.1)	9 (0.6)	510 (9.1)
Hungary	21 (1.2)	541 (4.9)	42 (1.2)	542 (3.4)	17 (0.8)	534 (4.7)	20 (1.2)	504 (4.8)
Iceland	53 (1.6)	510 (4.5)	33 (1.4)	510 (4.3)	9 (0.8)	489 (8.2)	5 (0.6)	486 (7.9)
Iran, Islamic Rep.	r 52 (2.1)	414 (4.4)	35 (1.7)	440 (5.8)	7 (0.7)	433 (6.4)	6 (0.7)	433 (8.7)
Ireland	33 (1.3)	529 (3.9)	37 (1.1)	550 (4.2)	16 (1.0)	556 (4.6)	14 (0.9)	529 (5.7)
[1] *Israel*	r 23 (1.3)	504 (5.6)	40 (1.3)	509 (4.3)	25 (1.2)	506 (5.8)	12 (0.9)	501 (7.9)
Japan	33 (0.8)	561 (2.0)	36 (0.9)	584 (2.5)	20 (0.6)	579 (3.0)	11 (0.6)	580 (4.3)
Korea	43 (1.0)	592 (2.5)	35 (0.9)	605 (2.4)	16 (0.8)	602 (3.6)	7 (0.5)	590 (5.8)
Kuwait	59 (1.1)	404 (3.0)	23 (1.0)	409 (3.7)	9 (0.5)	397 (4.7)	10 (0.5)	388 (6.5)
[1] *Latvia (LSS)*	32 (1.3)	502 (5.9)	37 (1.5)	536 (7.3)	19 (1.1)	522 (6.6)	12 (1.0)	486 (6.2)
Netherlands	36 (1.4)	556 (4.2)	39 (1.2)	562 (4.1)	15 (0.9)	572 (3.4)	9 (1.0)	536 (4.8)
New Zealand	36 (1.5)	538 (6.3)	31 (1.4)	554 (4.6)	15 (0.9)	537 (8.6)	19 (1.2)	487 (8.3)
Norway	33 (1.4)	523 (4.8)	46 (1.3)	538 (3.8)	14 (0.8)	555 (6.0)	8 (0.7)	528 (7.1)
Portugal	48 (1.8)	478 (4.7)	35 (1.5)	490 (4.0)	9 (0.7)	486 (8.2)	9 (0.9)	467 (6.5)
Scotland	37 (1.3)	535 (4.8)	36 (1.1)	546 (4.7)	13 (0.7)	543 (6.6)	14 (1.2)	515 (6.1)
Singapore	- -	- -	- -	- -	- -	- -	- -	- -
Slovenia	41 (1.6)	541 (4.3)	40 (1.3)	552 (3.5)	12 (0.9)	557 (5.9)	6 (0.7)	541 (7.3)
Thailand	65 (2.2)	470 (4.6)	23 (1.3)	483 (5.8)	5 (0.6)	483 (8.2)	6 (1.7)	445 (10.4)
United States	32 (0.9)	565 (3.9)	36 (0.7)	580 (3.9)	15 (0.8)	580 (3.8)	17 (0.7)	531 (3.8)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1] Modified response categories for Israel and Latvia: 3-5 hours; More than 5 hours.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

How Do Students Perceive Success in Science?

Table 4.12 presents fourth-grade students' perceptions about doing well in science. In every country the majority of students agreed or strongly agreed that they did well in science, and these perceptions were supported by the science achievement results: those who agreed that they usually do well performed better, on average, than those who disagreed. Interestingly, in several countries, notably New Zealand, Norway, and Scotland, the fourth graders who strongly agreed that they usually do well had lower average achievement than those who merely agreed.

Figure 4.1 indicates that in all countries, both boys and girls agreed that they did well in the sciences – a perception that did not always coincide with their achievement on the TIMSS science test. Only in Ireland was there a significant difference between boys and girls, with girls having higher perceptions of success than boys. It is interesting that the lower self-perceptions reported by eighth-grade girls[3] in England, Hong Kong, Japan, New Zealand, Norway, Scotland, and Singapore about doing well in science were not in evidence among their fourth-grade compatriots.

Students were asked about the necessity of various attributes or activities for doing well in science (see Table 4.13). There was considerable variation from country to country in the percentage of fourth-grade students agreeing that natural talent or ability were important to doing well in science, although the majority of students in every country were in agreement. The percentage agreeing ranged from 57% in the Czech republic to 90% or more in Hungary, Iran, Korea, and Kuwait. Internationally, relatively fewer students agreed that good luck was important to doing well, although the majority were of that opinion in more than half of the countries. The countries where more than 70% of the fourth-graders agreed that good luck was needed to do well in science included Hungary, Iran, Kuwait, and Latvia (LSS).

Internationally, there was a high degree of agreement among students that a lot of hard work studying at home was necessary in order to do well in science. Percentages of agreement were in the 80s and 90s for most countries and in the 70s for the Netherlands and Thailand. The variation was substantial from country to country regarding students' agreement with the need to memorize the textbook or notes. In Iceland, Iran, Japan, and Kuwait, 90% or more of the fourth-grade students agreed or strongly agreed that memorization was important to doing well in science. In contrast, fewer than 50% agreed in the Netherlands.

[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: The IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Table 4.12

Students' Reports on Their Self-Perceptions About Usually Doing Well in the Sciences - Upper Grade (Fourth Grade*)

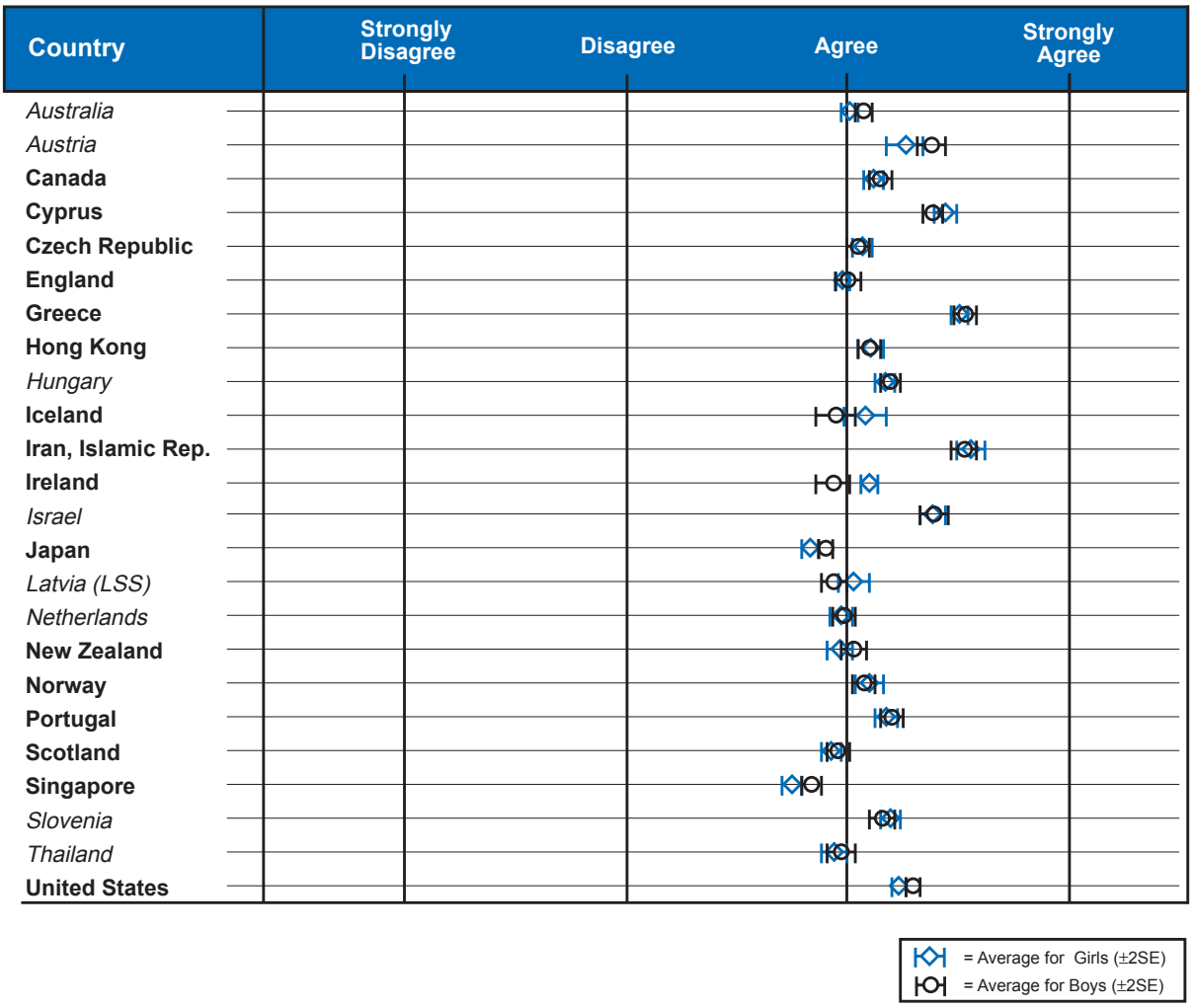
Country	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	4 (0.4)	503 (10.0)	11 (0.8)	531 (6.4)	63 (1.0)	571 (2.5)	22 (0.9)	578 (4.6)
Austria	2 (0.4)	~ ~	12 (1.1)	520 (6.3)	36 (1.3)	554 (3.9)	49 (1.8)	587 (4.5)
Canada	3 (0.4)	499 (8.5)	10 (0.6)	514 (5.2)	59 (1.3)	554 (3.3)	29 (1.2)	564 (5.2)
Cyprus	2 (0.3)	~ ~	6 (0.6)	456 (8.9)	42 (1.3)	481 (4.0)	51 (1.5)	482 (3.1)
Czech Republic	3 (0.3)	490 (8.0)	16 (1.0)	517 (4.6)	55 (1.1)	563 (3.4)	27 (1.0)	578 (4.3)
England	5 (0.5)	497 (7.5)	13 (0.7)	536 (5.2)	61 (1.0)	563 (3.7)	21 (0.9)	553 (4.8)
Greece	1 (0.2)	~ ~	4 (0.5)	458 (12.3)	35 (1.4)	500 (3.8)	60 (1.4)	507 (3.6)
Hong Kong	3 (0.3)	457 (11.0)	13 (0.8)	512 (5.9)	55 (1.0)	537 (3.3)	29 (1.3)	545 (4.7)
Hungary	2 (0.2)	~ ~	12 (0.8)	496 (5.3)	54 (1.3)	532 (3.5)	33 (1.3)	549 (4.3)
Iceland	9 (1.4)	503 (8.1)	11 (1.1)	492 (6.5)	50 (1.4)	515 (4.6)	30 (1.6)	505 (4.7)
Iran, Islamic Rep.	r 2 (0.3)	~ ~	3 (0.4)	384 (8.4)	36 (1.8)	424 (5.2)	60 (1.8)	426 (4.5)
Ireland	7 (0.7)	507 (7.7)	10 (0.8)	520 (5.1)	58 (1.3)	548 (3.1)	25 (1.3)	544 (5.4)
Israel	r 3 (0.4)	470 (12.1)	7 (0.7)	501 (9.4)	39 (1.7)	512 (4.1)	51 (1.8)	509 (4.6)
Japan	2 (0.2)	~ ~	21 (0.8)	541 (2.5)	67 (0.9)	579 (1.8)	11 (0.7)	619 (3.5)
Korea	- -	- -	- -	- -	- -	- -	- -	- -
Kuwait	5 (0.6)	400 (8.5)	8 (0.6)	378 (5.3)	36 (1.0)	399 (2.7)	52 (1.4)	412 (3.4)
Latvia (LSS)	2 (0.4)	~ ~	20 (1.3)	504 (9.1)	53 (1.5)	521 (5.0)	24 (1.6)	513 (6.0)
Netherlands	3 (0.4)	527 (10.9)	15 (0.8)	545 (5.9)	62 (1.1)	560 (3.5)	20 (1.2)	573 (4.7)
New Zealand	6 (0.7)	492 (9.8)	13 (0.9)	511 (6.7)	57 (1.3)	547 (4.0)	24 (1.3)	526 (9.9)
Norway	4 (0.5)	506 (10.5)	11 (0.8)	525 (6.3)	58 (1.5)	542 (3.4)	27 (1.6)	527 (5.2)
Portugal	3 (0.5)	421 (10.0)	9 (0.8)	453 (7.6)	53 (1.2)	490 (4.0)	35 (1.3)	486 (5.0)
Scotland	5 (0.5)	505 (9.9)	14 (0.7)	523 (6.0)	63 (1.2)	549 (3.9)	18 (1.0)	525 (6.7)
Singapore	4 (0.4)	460 (7.5)	25 (1.0)	528 (6.2)	58 (1.0)	562 (5.0)	13 (0.7)	568 (6.5)
Slovenia	1 (0.3)	~ ~	12 (0.7)	514 (4.1)	53 (1.3)	544 (3.5)	33 (1.3)	566 (5.0)
Thailand	5 (0.6)	442 (9.5)	22 (1.1)	465 (4.6)	43 (1.5)	483 (5.4)	29 (1.3)	466 (6.0)
United States	2 (0.2)	~ ~	7 (0.5)	512 (5.2)	52 (0.9)	565 (2.7)	39 (0.9)	585 (4.0)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.1

Gender Differences in Students' Self-Perceptions About Usually Doing Well in the Sciences - Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Data for Korea are not available.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.13

Students' Reports on Things Necessary to Do Well in the Sciences Upper Grade (Fourth Grade*)

Country	Percent of Students Responding Agree or Strongly Agree			
	Natural Talent/Ability	Good Luck	Lots of Hard Work Studying at Home	Memorize the Textbook or Notes
Australia	84 (0.8)	59 (1.3)	82 (0.9)	67 (1.1)
Austria	72 (1.9)	54 (1.7)	84 (1.3)	69 (1.8)
Canada	82 (0.8)	50 (1.4)	89 (0.7)	64 (1.3)
Cyprus	69 (1.8)	58 (2.3)	96 (0.4)	75 (1.8)
Czech Republic	57 (1.6)	65 (1.4)	87 (0.7)	68 (1.6)
England	- -	- -	- -	- -
Greece	63 (1.3)	46 (1.5)	87 (0.9)	74 (1.7)
Hong Kong	72 (1.2)	19 (0.8)	96 (0.3)	69 (2.1)
Hungary	95 (0.4)	75 (1.1)	89 (0.7)	85 (0.9)
Iceland	78 (1.4)	61 (1.6)	88 (1.2)	90 (1.0)
Iran, Islamic Rep.	r 96 (0.5)	r 75 (2.4)	r 93 (0.6)	r 90 (1.0)
Ireland	87 (0.9)	65 (1.4)	89 (0.8)	74 (1.4)
Israel	r 69 (1.6)	r 44 (1.8)	r 96 (0.5)	r 67 (1.6)
Japan	79 (0.9)	53 (1.2)	88 (0.6)	93 (0.5)
Korea	90 (0.6)	61 (1.0)	94 (0.5)	84 (0.8)
Kuwait	92 (0.5)	78 (1.4)	88 (0.8)	90 (0.8)
Latvia (LSS)	75 (1.7)	84 (1.3)	91 (0.9)	61 (2.2)
Netherlands	65 (1.6)	r 28 (1.8)	r 73 (1.8)	r 30 (2.3)
New Zealand	84 (1.1)	65 (1.3)	86 (1.0)	72 (1.4)
Norway	93 (0.6)	59 (1.6)	88 (0.9)	82 (1.0)
Portugal	85 (1.3)	67 (2.1)	96 (0.4)	85 (1.1)
Scotland	- -	- -	- -	- -
Singapore	88 (0.8)	37 (1.5)	94 (0.4)	76 (1.2)
Slovenia	81 (1.5)	62 (2.1)	93 (0.7)	52 (2.0)
Thailand	77 (1.3)	63 (1.7)	70 (1.9)	87 (1.0)
United States	62 (1.0)	46 (1.2)	93 (0.3)	71 (1.0)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

What Are Students' Attitudes Towards Science?

To collect information on fourth-grade students' perceptions of science, TIMSS asked them a series of questions about the importance and enjoyability of science and science subject areas. Students' perceptions about the value of learning the sciences may be considered as both an input and outcome variable, because their attitudes towards science subjects can be related to educational achievement in ways that reinforce higher or lower performance. That is, students who do well in the sciences generally have more positive attitudes towards the science subjects, and thus tend to perform better.

Table 4.14 summarizes students' responses to the questions about how much they like or dislike science. In more than one-third of the countries, a positive relationship was observed between a stronger liking of science and higher achievement. Even though the pattern was not uniform across countries, the students who reported either liking science or liking it a lot generally had higher achievement than students who reported disliking it to some degree Four-fifths or more of the fourth-graders in every country except the Netherlands indicated they liked science or liked science a lot. In the Netherlands, a third of the students reported that they disliked science.

The data in Figure 4.2 reveal that, on average, in the majority of the countries there was no significant difference between boys and girls in their degree of liking for the sciences. However, a greater percentage of boys reported liking science in Austria, Japan, and Korea, and a greater percentage of girls in Iceland and Ireland.

Three statements reflecting student attitudes to science ("I like science," "I enjoy learning science," and "science is boring") were combined to form an index of overall attitude to science. Table 4.15 characterizes student attitudes in terms of this index. Not surprisingly, the results are very similar to those in Table 4.14, with the majority of students in every country expressing positive or strongly positive attitudes. Table 4.15 does reveal a strong positive relationship between attitude to science and science achievement in many countries. Figure 4.3 confirms that in most countries, attitude to science is not related to gender, although boys had more positive attitudes in Austria, Japan, and Korea, while girls had more positive attitudes in Iceland, Ireland, and Latvia (LSS).

Table 4.14

Students' Reports on How Much They Like Science
Upper Grade (Fourth Grade*)

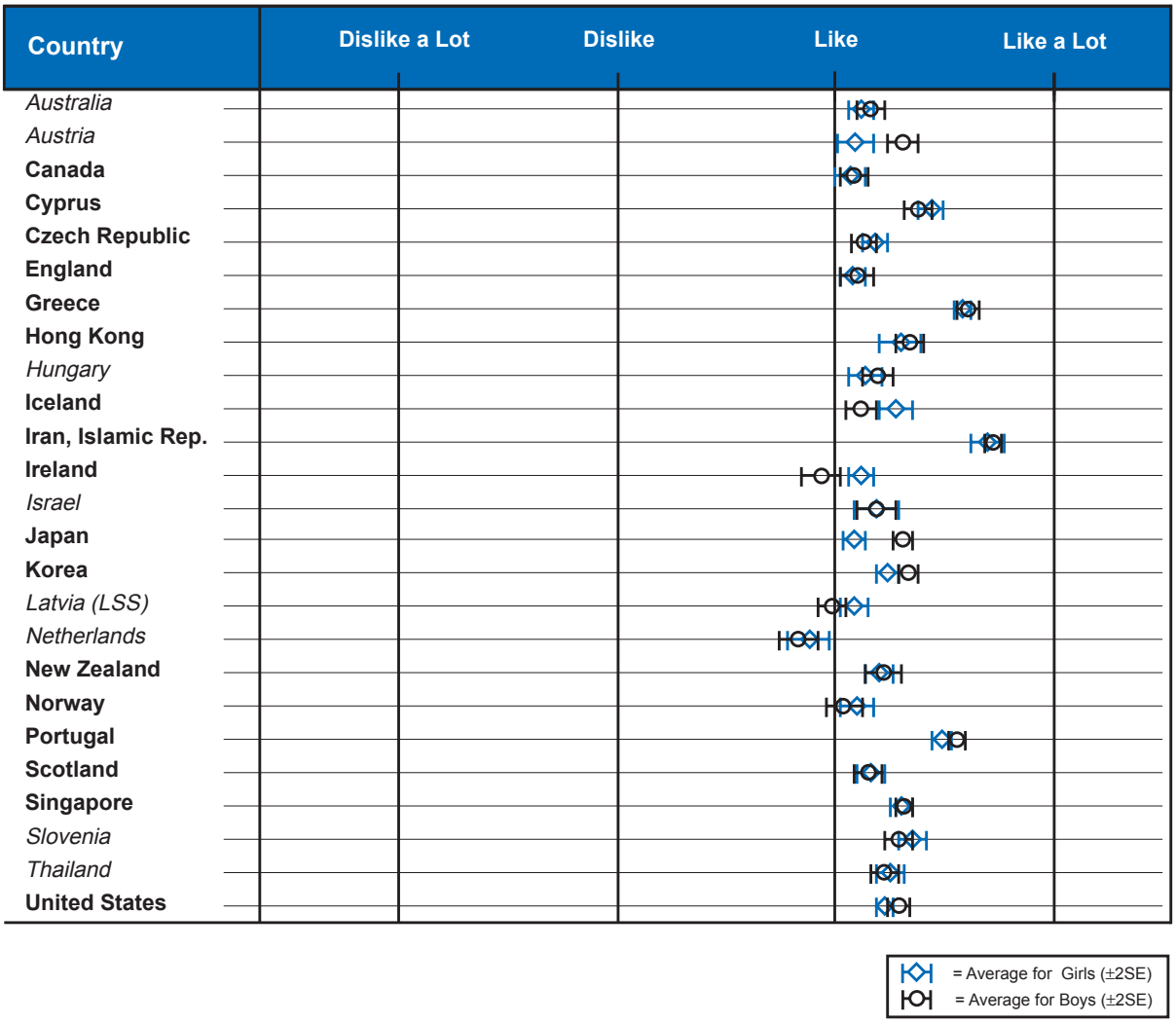
Country	Dislike a Lot		Dislike		Like		Like a Lot	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	8 (0.6)	535 (6.1)	10 (0.6)	562 (5.0)	43 (0.8)	566 (2.8)	39 (1.1)	573 (3.6)
Austria	8 (0.8)	542 (6.0)	12 (0.7)	550 (5.1)	30 (1.2)	557 (3.6)	49 (1.4)	578 (4.6)
Canada	7 (0.8)	536 (5.5)	13 (0.8)	542 (3.6)	46 (1.0)	551 (3.8)	34 (1.2)	557 (4.1)
Cyprus	4 (0.5)	467 (6.9)	6 (0.7)	458 (9.1)	36 (1.5)	483 (3.8)	54 (1.8)	479 (3.4)
Czech Republic	5 (0.5)	541 (7.5)	12 (0.8)	545 (5.7)	46 (1.0)	556 (3.2)	37 (1.4)	565 (3.7)
England	9 (0.8)	534 (6.3)	10 (0.5)	551 (7.3)	45 (1.2)	559 (3.7)	36 (1.2)	553 (4.3)
Greece	2 (0.3)	~ ~	3 (0.3)	497 (8.4)	29 (1.3)	499 (4.1)	66 (1.4)	504 (3.4)
Hong Kong	4 (0.9)	504 (15.4)	6 (0.7)	509 (7.4)	45 (1.2)	533 (3.9)	45 (1.7)	541 (4.3)
Hungary	5 (0.7)	514 (8.7)	11 (0.8)	522 (5.4)	46 (1.2)	530 (3.7)	38 (1.5)	544 (4.4)
Iceland	7 (1.1)	501 (8.9)	7 (0.8)	496 (9.4)	45 (1.6)	507 (5.0)	41 (1.5)	515 (4.2)
Iran, Islamic Rep.	r 1 (0.4)	~ ~	2 (0.4)	~ ~	22 (1.3)	424 (4.0)	75 (1.5)	423 (4.7)
Ireland	9 (0.9)	523 (6.8)	13 (0.9)	532 (4.7)	44 (1.0)	544 (3.8)	34 (1.3)	548 (4.2)
Israel	r 7 (0.8)	513 (8.2)	11 (1.0)	516 (6.8)	39 (1.6)	507 (5.3)	43 (2.2)	506 (4.6)
Japan	2 (0.2)	~ ~	12 (0.9)	553 (3.6)	49 (0.9)	571 (2.2)	36 (1.0)	587 (2.0)
Korea	2 (0.2)	~ ~	10 (0.7)	582 (3.9)	46 (1.2)	594 (2.3)	42 (1.3)	607 (2.3)
Kuwait	4 (0.5)	397 (9.1)	4 (0.4)	379 (8.1)	21 (1.1)	396 (4.7)	71 (1.6)	408 (2.8)
Latvia (LSS)	7 (0.7)	480 (7.3)	14 (1.0)	512 (7.3)	48 (1.4)	514 (6.4)	31 (1.5)	523 (6.0)
Netherlands	10 (1.0)	547 (5.8)	23 (1.3)	552 (4.2)	39 (1.2)	561 (3.9)	28 (1.6)	566 (4.5)
New Zealand	9 (0.8)	512 (11.0)	8 (0.8)	524 (8.3)	37 (1.5)	544 (5.6)	46 (1.5)	530 (6.1)
Norway	8 (0.7)	522 (6.4)	14 (1.0)	539 (6.0)	42 (1.0)	535 (3.9)	36 (1.6)	536 (4.5)
Portugal	1 (0.2)	~ ~	4 (0.4)	444 (10.1)	38 (1.1)	477 (4.7)	58 (1.2)	488 (3.8)
Scotland	8 (0.6)	513 (7.4)	10 (0.6)	530 (7.0)	40 (1.1)	544 (4.5)	42 (1.3)	541 (5.0)
Singapore	3 (0.2)	481 (10.2)	7 (0.5)	515 (9.2)	47 (1.0)	540 (4.5)	44 (1.2)	566 (5.8)
Slovenia	3 (0.4)	527 (8.6)	8 (0.7)	542 (6.5)	42 (1.4)	547 (3.5)	47 (1.7)	548 (4.5)
Thailand	2 (0.3)	~ ~	12 (1.1)	455 (6.4)	46 (1.4)	476 (4.6)	40 (1.7)	474 (6.0)
United States	6 (0.4)	529 (6.2)	9 (0.6)	548 (5.8)	38 (0.9)	570 (3.8)	47 (1.2)	573 (3.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.2

Gender Differences in Liking the Sciences
Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 4.15

Students' Overall Attitudes[1] Towards Science
Upper Grade (Fourth Grade*)

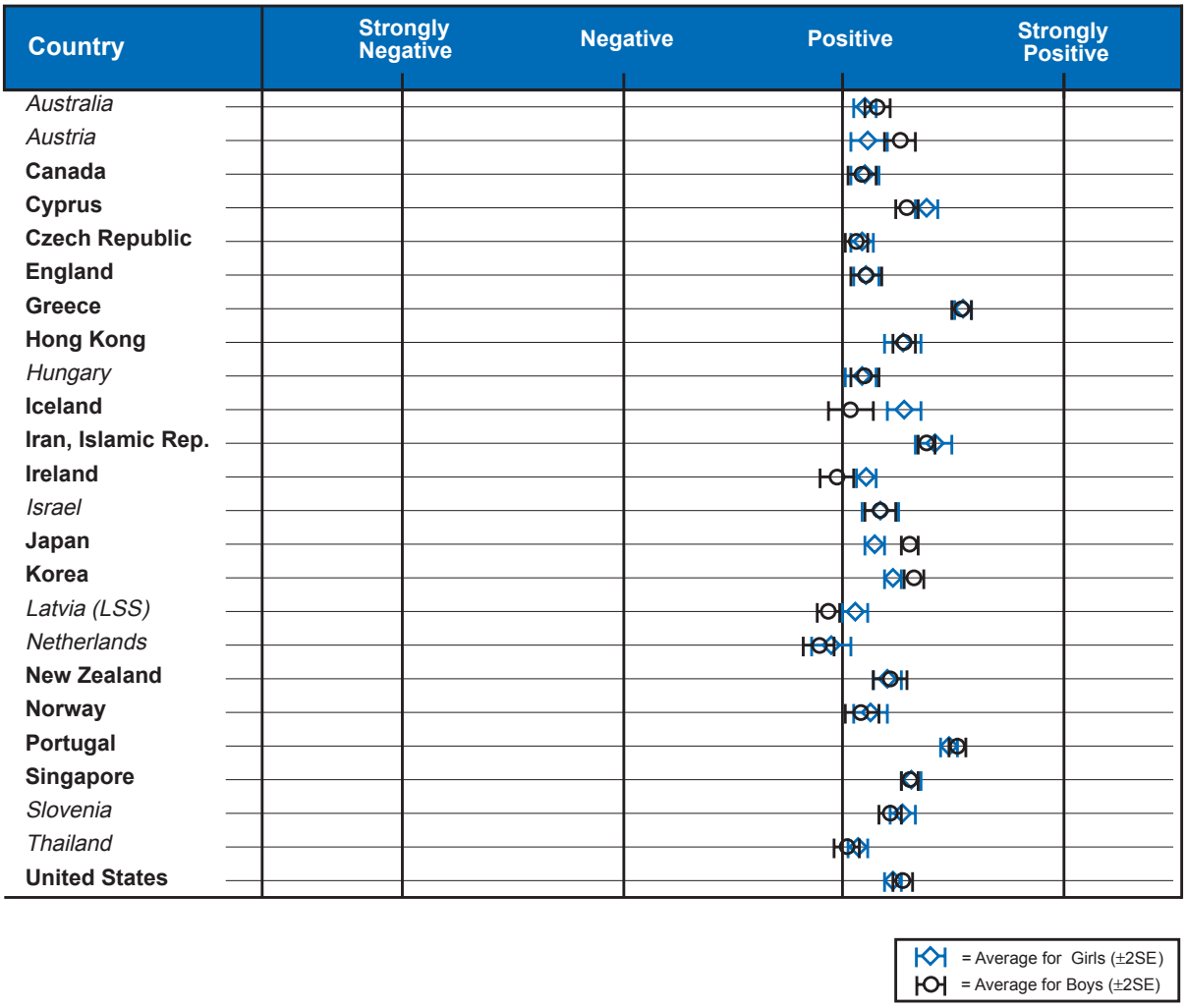
Country	Strongly Negative		Negative		Positive		Strongly Positive	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	5 (0.4)	546 (6.9)	14 (0.8)	548 (5.1)	46 (0.8)	559 (2.8)	36 (1.0)	582 (3.5)
Austria	5 (0.6)	556 (7.5)	16 (1.0)	547 (3.7)	34 (1.2)	556 (3.7)	45 (1.6)	579 (4.9)
Canada	5 (0.6)	543 (6.1)	15 (0.9)	538 (4.0)	46 (0.9)	545 (4.3)	34 (1.1)	564 (4.1)
Cyprus	1 (0.2)	~ ~	10 (0.8)	454 (6.9)	42 (1.3)	470 (3.8)	47 (1.6)	491 (3.2)
Czech Republic	2 (0.3)	~ ~	16 (0.9)	541 (4.3)	54 (0.9)	552 (3.3)	28 (1.2)	576 (4.2)
England	6 (0.6)	551 (8.5)	14 (0.9)	538 (5.7)	44 (1.1)	549 (3.9)	36 (1.2)	563 (3.7)
Greece	1 (0.2)	~ ~	4 (0.5)	490 (8.8)	34 (1.4)	485 (4.7)	61 (1.3)	512 (3.0)
Hong Kong	2 (0.4)	~ ~	9 (1.4)	506 (6.8)	50 (1.4)	525 (4.0)	39 (1.6)	551 (3.8)
Hungary	3 (0.5)	523 (10.6)	16 (1.0)	518 (4.2)	49 (1.1)	525 (3.7)	32 (1.2)	553 (4.6)
Iceland	6 (0.8)	498 (8.9)	13 (1.0)	500 (6.6)	42 (1.4)	503 (5.1)	40 (1.9)	518 (4.2)
Iran, Islamic Rep.	1 (0.2)	~ ~	5 (0.5)	404 (6.7)	49 (1.6)	405 (3.8)	46 (1.8)	440 (4.9)
Ireland	4 (0.5)	531 (9.3)	17 (1.0)	522 (4.4)	48 (1.1)	539 (3.8)	30 (1.3)	556 (4.5)
Israel r	4 (0.6)	516 (8.3)	13 (1.1)	513 (7.0)	43 (1.3)	504 (4.3)	39 (2.0)	510 (4.8)
Japan	1 (0.2)	~ ~	11 (0.8)	550 (3.8)	53 (0.9)	569 (2.1)	35 (1.1)	590 (2.0)
Korea	1 (0.2)	~ ~	11 (0.7)	573 (5.0)	48 (1.1)	590 (2.2)	40 (1.3)	613 (2.3)
Kuwait	1 (0.2)	~ ~	8 (0.8)	381 (6.2)	40 (1.0)	380 (4.4)	50 (1.4)	425 (2.6)
Latvia (LSS)	2 (0.4)	~ ~	19 (1.1)	500 (7.1)	55 (1.3)	514 (6.1)	24 (1.2)	522 (5.3)
Netherlands	8 (0.7)	561 (6.2)	21 (1.3)	553 (4.4)	44 (1.2)	556 (4.0)	28 (1.5)	568 (4.2)
New Zealand	4 (0.5)	514 (14.4)	12 (1.0)	513 (8.1)	43 (1.5)	526 (6.2)	41 (1.6)	547 (5.1)
Norway	4 (0.5)	526 (11.0)	17 (1.1)	528 (6.1)	43 (1.0)	530 (3.9)	36 (1.6)	543 (4.4)
Portugal	0 (0.1)	~ ~	4 (0.4)	431 (13.3)	41 (1.2)	462 (5.3)	54 (1.4)	500 (3.4)
Scotland	- -	- -	- -	- -	- -	- -	- -	- -
Singapore	1 (0.1)	~ ~	9 (0.5)	496 (8.6)	49 (1.0)	533 (4.5)	41 (1.2)	575 (5.8)
Slovenia	2 (0.3)	~ ~	13 (0.9)	531 (6.4)	46 (1.2)	539 (3.9)	40 (1.4)	560 (3.7)
Thailand	1 (0.2)	~ ~	15 (1.1)	446 (6.2)	64 (1.0)	472 (4.6)	20 (1.2)	493 (7.3)
United States	3 (0.3)	547 (7.6)	13 (0.7)	542 (5.6)	40 (0.9)	557 (4.1)	44 (1.2)	583 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1] Index of overall attitudes towards science is based on average of responses to the following statements:
1) I like science; 2) I enjoy learning science; 3) Science is boring (reversed scale).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates a 70-84% student response rate.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 4.3

Gender Differences in Students' Overall Attitudes [1] Towards Science Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1]Index of overall attitudes towards mathematics is based on average of responses to the following statements:
1) I like science; 2) I enjoy learning science; 3) Science is boring (reversed scale).
Data for Scotland not available.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Chapter 5

Teachers and Instruction

Teachers and the instructional approaches they use are fundamental in building students' understanding of science. Primary among their many duties and responsibilities, teachers structure and guide the pace of individual, small-group, and whole-class work to present new material, engage students in scientific tasks, and help deepen students' grasp of the science being studied. Teachers may help students use technology and laboratory equipment to investigate scientific ideas, develop their understanding of scientific approaches to problem solving, and promote positive attitudes towards science. They also may assign homework and conduct informal as well as formal assessments to monitor progress in student learning, make instructional decisions, and evaluate achievement outcomes.

Effective science teaching is a complex endeavor requiring knowledge of the subject matter of science, understanding of student learning, and appreciation of the pedagogy of science. It can be fostered through institutional support and adequate resources. Teachers also can support each other in planning instructional strategies, devising real-world applications of scientific concepts, and developing sequences that move students from concrete tasks to the ability to think for themselves and explore scientific theories.

TIMSS administered a background questionnaire to teachers to gather information about their backgrounds and training. The questionnaire also asked about how they spend their school-related time and how science classes are organized.

This chapter presents the results of teachers' responses to some of these questions. Because the sampling for the teacher questionnaires was based on participating students, the responses to the teacher questionnaire do not necessarily represent all of the fourth-grade teachers in each of the TIMSS countries. Rather, they represent teachers of the representative samples of students assessed. It is important to note that in this report, the student is always the unit of analysis, even when information from the teachers' questionnaires is being reported. Using the student as the unit of analysis makes it possible to describe the instruction received by representative samples of students. Although this approach may provide a different perspective 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 the primary grades, students generally are taught mathematics and science by a single classroom teacher who provides instruction in all subjects. Accordingly, the international version of the teacher questionnaire for the primary grades was prepared as a single document asking about demographic information and instruction in both mathematics and science. However, in some countries, a portion or even all of the

students are taught mathematics and science by different teachers, and it was difficult to make provisions for both teachers to complete the questionnaire. Also, because countries were required to sample two classes (from adjacent grades), it was possible for an individual to be the mathematics and/or science teacher of both the upper- and lower-grade classes. In order to keep the response burden for teachers to a minimum, no teacher was asked to respond to more than one questionnaire, even where that teacher taught mathematics and/or science to more than one of the sampled classes. These situations, together with the fact that teachers sometimes did not complete the questionnaire assigned to them, meant that each country had some percentage of students for whom no teacher questionnaire information was available. The tables in this chapter contain special notation regarding response rates. For a country where teacher responses were available for 70% to 84% of the students, an "r" is included next to the data for that country. When teacher responses were available for 50% to 69% of the students, an "s" is included next to the data for that country. When teacher responses were available for fewer than 50% of the students, an "x" replaces the data.

Another consequence of the desire to minimize the teacher response burden was that teacher questionnaires had to be as short as possible. Since science is not emphasized as much as mathematics in primary school in many countries, relatively fewer questions pertaining to science were included in the teacher questionnaires.

Who Delivers Science Instruction?

This section provides information about the science teaching force in each of the participating countries, in terms of certification, degrees, age, gender, and years of teaching experience.

Table 5.1 summarizes information gathered from each country about the requirements for the certification held by the majority of the third- and fourth-grade teachers. In many countries, the type of education required for qualification includes a university degree. In other countries, study at a teacher training institution is required, or even both a university degree and study at a teacher training institution. The number of years of post-secondary education required for a teaching qualification ranged from two years in Iran and Singapore to as much as six years in Canada, although many countries reported three or four years. All of the countries except Greece and Kuwait reported that teaching practice was required. A large number of countries reported that an evaluation or examination was required for certification. The countries not having such a requirement included Canada, Greece, Iran, Israel, Korea, Portugal, and the United States.

Table 5.2 contains teachers' reports on their age and gender. If a constant supply of teachers were entering the teaching force, devoting their careers to the classroom, and then retiring, one might expect approximately equal percentages of students taught by teachers in their 20s, 30s, 40s, and 50s, and this does appear to hold for some countries. In most countries, however, the majority of the fourth-grade students were

Table 5.1

Requirements for Certification Held by the Majority of Lower- and Upper-Grade (Third and Fourth Grade*) Teachers[1]

Country	Type of Education Required for Qualification	Number of Years of Post-Secondary Education Required	Teaching or Practice Experience Required	Evaluation or Examination Required
Australia	University or Teacher Training Institution	3–4	yes	yes
Austria	Teacher Training Institution	3	yes	yes
Canada	University	4–6	yes	no
Cyprus	Teacher Training Institution	3	yes	yes
Czech Republic	University	4	yes	yes
[2] England	University or Higher Education Institution	3–5	yes	yes
[3] Greece	Post-Secondary Non-University Teacher Training Institution	4	no	no
Hong Kong	Teacher Training Institution	2 or 3	yes	yes
Hungary	Teacher Training Institution	3	yes	yes
Iceland	University	3	yes	yes
Iran	Teacher Training Institution	2	yes	no
Ireland	University College	3	yes	yes
Israel	Teacher Training Institution	3	yes	no
Japan	University	4	yes	yes
Korea	University	4	yes	no
Kuwait	University	4	no	yes
Latvia	Teacher Training Institution	3	yes	yes
Netherlands	Teacher Training Institution	3[4]	yes	yes
New Zealand	Teacher Training Institution	3	yes	yes
Norway	Teacher Training Institution	3[5]	yes	yes
Portugal	Teacher Training Institution	3[6]	yes	no
Scotland	University or Teacher Training Institution	4	yes	yes
Singapore	Teacher Training Institution	2	yes	yes
Slovenia	University	4	yes	yes
Thailand	University or Teacher Training Institution	4	yes	yes
[7] United States	University	4	yes	no

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.
[1] Certification pertains to the majority (more than 50%) of teachers of lower- and upper-grade students in each country.
[2] England: The majority of teachers of primary schools students will have studied education and their specialist subject concurrently for 4 years with honors) or 3 years (B. Ed without honors). Some, however, will have studied their specialist subject for a degree (B. Sc. or B.A.) for 3 or 4 years followed by a one-year post graduate course. All teachers who qualified since 1975 are graduates. Some teachers who qualified before this date hold teachers' certificates but are not graduates.
[3] Greece: The vast majority of primary school teachers are Post-Secondary Non-University Teacher Training Institute graduates (last graduates 1990). Only a small fraction of existing teachers are graduates of the newly founded University Education Departments (first graduates 1989).
[4] Netherlands: As of August 1984 a 4-year teacher training program integrating training for kindergarten and primary education is required. Before August 1994, 3 years of teacher training were required for primary education.
[5] Norway: Until 1965 2 years of post-secondary education were required. Between 1965 and 1995 3 years were required. As of 1996, new certified teachers are required to have completed 4 years of post-secondary education.
[6] Portugal: Until 1986 2 years of post-secondary education were required. As of 1986 3 years are required.
[7] United States: Certification requirements vary considerably according to state in the United States. Information in this table represents the most typical requirements across states.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95. Information provided by TIMSS National Research Coordinators.

Table 5.2

Teachers' Reports on Their Age and Gender
Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Taught by Teachers				Percent of Students Taught by Teachers	
	29 Years or Under	30 - 39 Years	40 - 49 Years	50 Years or Older	Female	Male
Australia	21 (3.0)	31 (3.4)	35 (3.4)	12 (2.2)	65 (4.0)	35 (4.0)
Austria	10 (2.6)	29 (4.6)	47 (5.0)	15 (3.4)	78 (4.3)	22 (4.3)
Canada	6 (1.6)	25 (3.8)	43 (3.1)	26 (2.6)	74 (3.5)	26 (3.5)
Cyprus	s 47 (5.9)	20 (4.4)	22 (5.3)	11 (3.3)	s 69 (4.5)	31 (4.5)
Czech Republic	r 13 (3.2)	21 (3.4)	21 (3.6)	45 (4.1)	r 95 (1.8)	5 (1.8)
England	16 (3.8)	17 (4.0)	50 (5.1)	17 (3.3)	75 (3.5)	25 (3.5)
Greece	12 (2.8)	41 (4.3)	33 (4.1)	14 (2.9)	49 (4.6)	51 (4.6)
Hong Kong	- -	- -	- -	- -	- -	- -
Hungary	8 (2.3)	43 (4.7)	29 (3.8)	21 (3.7)	90 (2.7)	10 (2.7)
Iceland	10 (1.7)	34 (5.5)	47 (5.1)	8 (2.1)	83 (3.8)	17 (3.8)
Iran, Islamic Rep.	42 (4.2)	43 (4.5)	14 (2.8)	1 (0.8)	54 (4.3)	46 (4.3)
Ireland	17 (3.3)	31 (4.1)	31 (4.5)	22 (4.1)	69 (3.9)	31 (3.9)
Israel	24 (4.6)	46 (5.9)	21 (4.4)	9 (2.7)	95 (1.6)	5 (1.6)
Japan	12 (2.7)	40 (4.1)	38 (4.5)	11 (2.3)	61 (3.9)	39 (3.9)
Korea	22 (3.2)	29 (3.0)	33 (3.9)	16 (2.8)	64 (3.8)	36 (3.8)
Kuwait	s 22 (4.1)	50 (4.8)	20 (3.7)	8 (2.9)	s 57 (2.9)	43 (2.9)
Latvia (LSS)	23 (4.0)	37 (4.1)	15 (3.2)	26 (4.1)	98 (1.2)	2 (1.2)
Netherlands	17 (3.3)	29 (4.1)	40 (4.6)	14 (3.4)	35 (4.3)	65 (4.3)
New Zealand	21 (3.4)	27 (3.3)	37 (4.3)	15 (2.5)	69 (3.5)	31 (3.5)
Norway	8 (2.6)	14 (3.6)	42 (4.7)	36 (4.8)	78 (3.9)	22 (3.9)
Portugal	6 (2.3)	21 (3.5)	48 (4.2)	25 (3.8)	95 (1.9)	5 (1.9)
Scotland	19 (3.1)	21 (3.6)	40 (4.6)	19 (3.4)	92 (2.1)	8 (2.1)
Singapore	38 (4.1)	15 (2.7)	28 (3.5)	19 (2.7)	78 (2.9)	22 (2.9)
Slovenia	12 (3.1)	34 (4.9)	30 (4.5)	24 (4.6)	92 (2.6)	8 (2.6)
Thailand	4 (2.3)	54 (5.2)	29 (4.7)	13 (4.1)	57 (6.1)	43 (6.1)
United States	17 (2.8)	22 (2.9)	37 (4.3)	24 (4.0)	86 (2.5)	14 (2.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

taught science by teachers in their 30s or 40s. Very few countries seemed to have a comparatively younger teaching force, with only Cyprus, Iran, and Singapore having 25% or more of the students with science teachers in their 20s or younger. Twelve countries (Australia, Cyprus, Greece, Hungary, Iran, Israel, Japan, Korea, Kuwait, Latvia (LSS), Singapore, and Thailand) had the majority of students with teachers in their 30s or younger. Countries with comparatively larger percentages of older teachers included Canada, the Czech Republic, Latvia (LSS), Norway, and Portugal, where 25% or more of the fourth-grade students had science teachers in their 50s or older.

In every country except Greece and the Netherlands, the majority of fourth-grade students were taught science by female teachers. Countries with particularly large percentages of female teachers included the Czech Republic, Hungary, Israel, Latvia (LSS), Portugal, Scotland, and Slovenia, where 90% or more of the fourth-grade students were taught science by female teachers.

As might be expected from the differences in teachers' ages from country to country, the TIMSS data indicate differences in teacher experience across countries (see Table 5.3). The countries with younger teaching forces tended to have more students taught by less experienced teachers. At least half the fourth-grade students in Cyprus, Iran, and Kuwait had science teachers with 10 years or less of experience. In all of the other countries, the majority of students were taught science by teachers with more than 10 years of teaching experience. In the Czech Republic and Portugal more than half the students had science teachers with over 20 years of experience.

The relationship between years of teaching experience and science achievement is not clear in many countries. In about one-fourth of the countries, the fourth-grade students with the most experienced teachers (more than 20 years) had higher science achievement than did those with less experienced teachers (five years or fewer). This may reflect the practice of giving teachers with more seniority the more advanced classes. However, there were also several countries where the students with less experienced teachers had higher achievement than did those with the most experienced teachers.

Table 5.3

Teachers' Reports on Their Years of Teaching Experience
Science - Upper Grade (Fourth Grade*)

Country	0 - 5 Years		6-10 Years		11-20 Years		More than 20 Years	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r 14 (2.3)	572 (5.6)	23 (3.1)	556 (6.0)	38 (3.5)	566 (5.6)	25 (3.4)	560 (5.6)
Austria	10 (2.7)	566 (8.5)	11 (3.3)	571 (6.0)	31 (4.1)	552 (6.8)	47 (4.9)	571 (5.6)
Canada	10 (1.7)	537 (7.0)	17 (2.9)	553 (8.4)	27 (3.3)	545 (6.4)	46 (3.5)	554 (4.5)
Cyprus	s 53 (6.2)	485 (5.8)	12 (3.5)	470 (12.7)	9 (3.0)	471 (10.3)	27 (5.2)	482 (9.6)
Czech Republic	r 16 (3.1)	541 (7.7)	9 (2.6)	541 (8.1)	18 (3.0)	561 (6.7)	56 (4.4)	561 (5.5)
England	18 (3.5)	555 (8.0)	16 (3.6)	556 (12.6)	34 (4.0)	548 (5.5)	33 (4.2)	553 (7.3)
Greece	11 (2.5)	503 (21.8)	22 (3.3)	493 (5.0)	31 (4.1)	498 (6.3)	36 (4.0)	505 (6.3)
Hong Kong	- -	- -	- -	- -	- -	- -	- -	- -
Hungary	7 (2.6)	529 (12.7)	11 (2.9)	526 (9.6)	42 (4.6)	534 (4.3)	40 (4.7)	533 (6.6)
Iceland	23 (4.0)	513 (3.4)	21 (4.6)	504 (9.9)	34 (5.5)	508 (5.8)	22 (4.5)	501 (7.0)
Iran, Islamic Rep.	33 (4.1)	400 (10.7)	19 (3.9)	416 (7.0)	40 (4.6)	425 (7.0)	8 (2.6)	443 (9.1)
Ireland	10 (2.9)	527 (17.9)	14 (3.4)	532 (7.7)	32 (4.1)	542 (5.6)	44 (4.6)	543 (5.8)
Israel	r 35 (5.3)	503 (7.5)	13 (3.6)	515 (9.4)	32 (4.9)	506 (6.1)	20 (4.0)	486 (8.2)
Japan	11 (2.8)	570 (6.1)	10 (2.5)	570 (4.9)	57 (3.6)	575 (2.2)	22 (3.0)	574 (4.2)
Korea	12 (2.6)	594 (7.7)	23 (3.4)	601 (3.3)	27 (3.5)	598 (4.0)	38 (3.8)	594 (3.1)
Kuwait	s 21 (3.9)	401 (6.9)	29 (4.0)	404 (9.4)	44 (5.0)	397 (6.5)	6 (1.8)	439 (12.9)
Latvia (LSS)	15 (3.5)	487 (9.5)	16 (3.2)	501 (12.6)	33 (4.5)	510 (8.7)	36 (4.8)	527 (8.6)
Netherlands	14 (2.5)	548 (8.6)	11 (2.9)	550 (7.9)	39 (3.9)	563 (3.7)	36 (4.8)	556 (6.2)
New Zealand	23 (3.8)	525 (11.2)	15 (2.9)	539 (14.6)	39 (4.6)	523 (8.0)	22 (3.3)	550 (7.7)
Norway	10 (3.0)	529 (9.8)	8 (2.7)	517 (9.6)	32 (4.8)	531 (5.4)	50 (5.4)	527 (5.0)
Portugal	6 (2.0)	444 (20.7)	9 (2.0)	468 (9.0)	15 (3.0)	479 (8.2)	70 (3.9)	484 (4.9)
Scotland	25 (3.8)	526 (8.5)	19 (3.3)	550 (8.1)	33 (4.3)	531 (9.8)	23 (3.9)	546 (8.2)
Singapore	34 (4.1)	555 (9.5)	9 (2.2)	561 (16.2)	11 (2.4)	557 (17.7)	46 (3.7)	535 (6.1)
Slovenia	10 (2.7)	538 (10.8)	14 (3.5)	542 (8.1)	32 (4.9)	543 (6.9)	44 (4.9)	547 (4.8)
Thailand	r 28 (4.5)	457 (11.1)	16 (4.1)	477 (14.8)	45 (6.9)	478 (8.9)	12 (5.1)	507 (38.8)
United States	21 (2.8)	558 (6.7)	18 (2.8)	578 (4.8)	29 (2.6)	574 (5.5)	32 (3.0)	569 (6.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

How Do Science Teachers Spend Their School-Related Time?

Countries vary considerably in the degree of emphasis placed on science instruction in the primary school years. While in some countries science occupies a prominent position in the fourth-grade curriculum, in others science instruction is just beginning, and is sometimes integrated with other subjects such as social or environmental studies. In TIMSS, teachers were asked about the average amount of time science is taught to their class each week. The results, displayed in Table 5.4, confirm the picture of international differences in instructional time for science at the fourth grade.

In half the countries, a large majority of students were taught by teachers who reported that science is taught for less than two hours in their classrooms. Countries where teachers reported the least amount of science teaching included Australia, Ireland, Latvia (LSS), the Netherlands, New Zealand, Norway, and Scotland. In Austria, Japan, Korea, Kuwait, and Singapore the norm for science teaching was between two and three hours, with more than 95% of students taught by teachers who reported teaching science for this amount of time. In five countries, Canada, England, Portugal, Thailand, and the United States, more than 20% of students had three hours of more of science weekly. The relationship within countries between time spent teaching science and student achievement was inconsistent.

Since science teaching is sometimes integrated with other instructional activities in primary school, teachers were asked whether or not science is taught mainly as a separate subject in their class in many of the countries. A large majority of students were taught science as a separate subject, including Israel, Japan, Korea, Kuwait, and Singapore, where this was true for 100% of fourth-grade students (Table 5.5). Among countries where large percentages of students were not taught science as a separate subject were Iceland, Ireland, New Zealand, Norway, Portugal, Scotland, and Thailand. In countries where teacher reports indicated that either approach may be found, generally there were no large differences in the time spent teaching science between those to whom science is taught as a separate subject and the others.

In many countries around the world, primary school classes are taught by a single teacher who is responsible for teaching all subjects in the curriculum. However, there are also many variations on this model, and in some countries it is customary for the classroom teacher to call on specialized teachers to teach particular subjects, such as science, music, or art. Figure 5.1 classifies the TIMSS countries according to the percentage of students who were taught both mathematics and science by a single classroom teacher. In most of the countries, almost all students were taught by teachers who teach both mathematics and science. The major exceptions were Hong Kong, Israel, and Kuwait, where most students had different teachers for mathematics and science.

In addition to the time spent in class on science instruction, teachers were asked about the number of hours per week spent on selected school-related activities outside the regular school day. Table 5.6 presents the results. For example, on average, fourth-grade students in Australia had science teachers who spent 1.1 hours per week preparing

Table 5.4

Teachers' Reports on Average Number of Hours Science is Taught Weekly to Their Science Class - Upper Grade (Fourth Grade*)

Country	Less Than 1 Hour		1 Hour to < 2		2 Hours to < 3		3 Hours or More	
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement
Australia	r 35 (3.9)	556 (5.0)	55 (4.0)	568 (5.9)	5 (1.5)	562 (18.1)	5 (2.1)	562 (8.4)
Austria	0 (0.0)	~ ~	0 (0.0)	~ ~	97 (1.8)	566 (3.6)	3 (1.8)	540 (30.3)
Canada	8 (2.0)	536 (10.1)	42 (3.8)	542 (5.1)	27 (3.3)	567 (5.4)	23 (3.2)	550 (4.6)
Cyprus	x x	x x	x x	x x	x x	x x	x x	x x
Czech Republic	2 (1.1)	~ ~	79 (3.6)	557 (3.9)	3 (1.4)	572 (6.8)	16 (3.2)	563 (7.3)
England	6 (1.7)	540 (8.7)	27 (4.1)	548 (7.5)	44 (4.8)	556 (5.9)	23 (3.8)	550 (8.2)
Greece	- -	- -	- -	- -	- -	- -	- -	- -
Hong Kong	13 (3.4)	530 (13.3)	84 (3.7)	534 (4.3)	2 (1.5)	~ ~	1 (0.8)	~ ~
Hungary	6 (2.2)	556 (13.3)	72 (4.1)	529 (3.7)	8 (3.0)	521 (8.4)	14 (3.1)	549 (10.5)
Iceland	r 17 (4.1)	513 (7.3)	41 (5.6)	504 (7.7)	30 (5.1)	499 (6.5)	12 (4.3)	523 (6.8)
Iran, Islamic Rep.	- -	- -	- -	- -	- -	- -	- -	- -
Ireland	47 (5.0)	536 (5.6)	40 (4.4)	540 (5.8)	11 (3.1)	550 (7.1)	2 (0.9)	~ ~
Israel	r 0 (0.0)	~ ~	53 (5.6)	508 (5.5)	32 (5.8)	494 (6.9)	15 (4.3)	493 (10.6)
Japan	2 (1.3)	~ ~	1 (0.6)	~ ~	95 (1.8)	575 (1.8)	2 (1.2)	~ ~
Korea	0 (0.0)	~ ~	1 (0.6)	~ ~	95 (1.8)	597 (1.9)	5 (1.7)	588 (10.3)
Kuwait	s 0 (0.0)	~ ~	1 (0.7)	~ ~	96 (2.0)	402 (3.9)	4 (1.8)	416 (42.2)
Latvia (LSS)	89 (2.9)	505 (5.7)	5 (2.2)	538 (47.2)	5 (2.2)	532 (11.9)	1 (0.8)	~ ~
Netherlands	38 (5.1)	559 (4.0)	44 (4.8)	556 (4.5)	9 (2.6)	556 (7.2)	9 (2.7)	549 (20.1)
New Zealand	r 29 (4.2)	542 (8.3)	48 (4.4)	536 (6.1)	14 (3.1)	537 (17.2)	9 (2.6)	509 (21.2)
Norway	s 73 (5.0)	527 (5.4)	27 (5.0)	535 (7.6)	0 (0.0)	~ ~	0 (0.0)	~ ~
Portugal	2 (1.1)	~ ~	3 (1.4)	486 (28.2)	12 (3.1)	474 (8.8)	84 (3.6)	481 (4.8)
Scotland	r 35 (4.7)	543 (5.9)	44 (4.7)	534 (6.4)	14 (3.3)	531 (13.2)	7 (2.5)	529 (12.5)
Singapore	0 (0.0)	~ ~	4 (1.5)	548 (18.9)	96 (1.5)	547 (5.1)	0 (0.0)	~ ~
Slovenia	3 (1.9)	544 (18.9)	60 (5.3)	541 (4.6)	18 (4.0)	550 (9.5)	19 (3.4)	548 (6.8)
Thailand	r 2 (1.2)	~ ~	9 (3.5)	463 (21.5)	17 (6.1)	469 (16.5)	73 (6.6)	477 (6.5)
United States	r 9 (2.1)	562 (11.5)	16 (2.9)	550 (10.2)	33 (3.8)	578 (5.9)	42 (4.1)	565 (5.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
An "x" indicates teacher response data available for <50% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.5

Teachers' Reports on Whether Science is Taught Mainly as a Separate Subject – Upper Grade (Fourth Grade*)

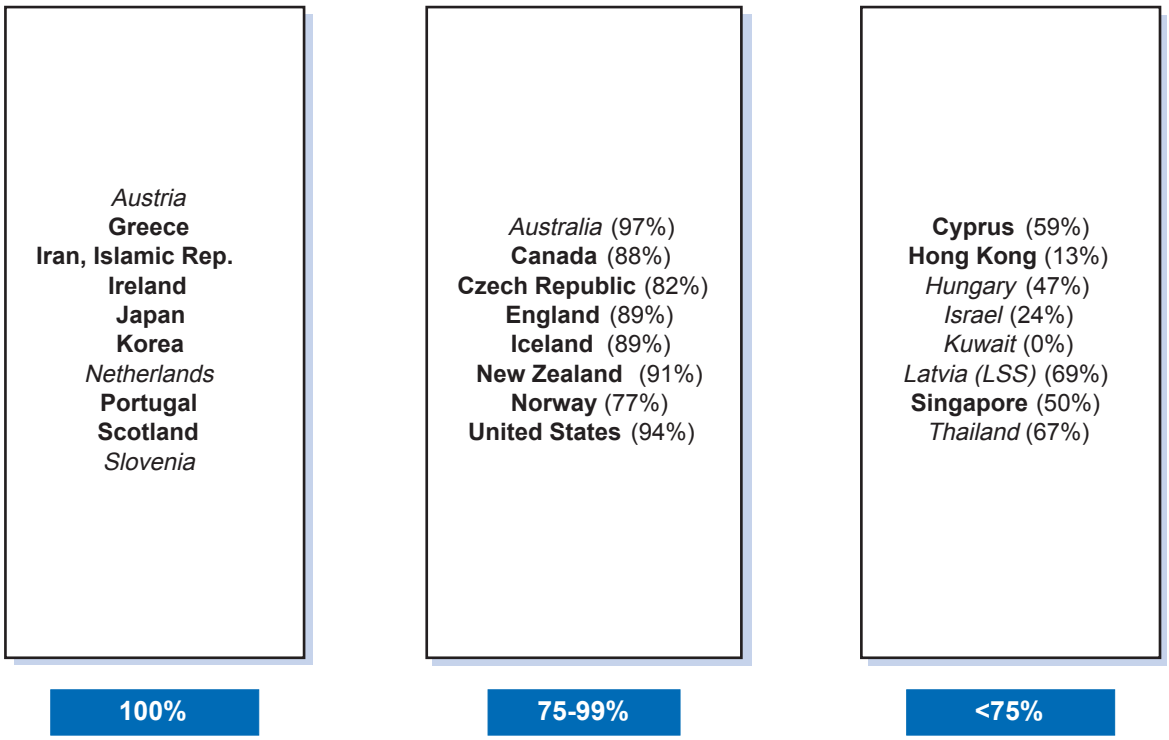
Country	Yes		No	
	Percent of Students	Average Hours of Science Taught Weekly	Percent of Students	Average Hours of Science Taught Weekly
Australia	r 51 (4.4)	1.0 (0.04)	49 (4.4)	1.4 (0.17)
Austria	- -	- -	- -	- -
Canada	68 (3.6)	2.2 (0.11)	32 (3.6)	2.3 (0.31)
Cyprus	x x	x x	x x	x x
Czech Republic	95 (1.6)	1.8 (0.05)	5 (1.6)	1.8 (0.30)
England	74 (4.9)	2.2 (0.08)	26 (4.9)	2.2 (0.24)
Greece	- -	- -	- -	- -
Hong Kong	91 (2.7)	1.1 (0.03)	9 (2.7)	1.5 (0.28)
Hungary	87 (2.7)	1.8 (0.09)	13 (2.7)	2.9 (0.59)
Iceland	r 21 (4.5)	1.3 (0.17)	79 (4.5)	1.9 (0.15)
Iran, Islamic Rep.	- -	- -	- -	- -
Ireland	16 (3.1)	0.9 (0.14)	84 (3.1)	1.0 (0.07)
Israel	r 100 (0.0)	2.4 (0.22)	0 (0.0)	~ ~
Japan	100 (0.0)	2.2 (0.02)	0 (0.0)	~ ~
Korea	100 (0.0)	2.7 (0.03)	0 (0.0)	~ ~
Kuwait	s 100 (0.0)	2.2 (0.03)	0 (0.0)	~ ~
Latvia (LSS)	99 (1.0)	0.8 (0.03)	1 (1.0)	~ ~
Netherlands	81 (3.7)	1.2 (0.08)	19 (3.7)	1.5 (0.21)
New Zealand	46 (4.9)	1.4 (0.13)	54 (4.9)	1.4 (0.13)
Norway	0 (0.0)	~ ~	100 (0.0)	0.8 (0.04)
Portugal	22 (4.0)	4.0 (0.25)	78 (4.0)	4.4 (0.18)
Scotland	18 (3.1)	1.1 (0.10)	82 (3.1)	1.3 (0.12)
Singapore	100 (0.0)	2.0 (0.01)	0 (0.0)	~ ~
Slovenia	72 (5.0)	2.0 (0.10)	28 (5.0)	2.3 (0.28)
Thailand	r 1 (1.0)	~ ~	99 (1.0)	4.1 (0.26)
United States	r 83 (2.7)	2.7 (0.13)	17 (2.7)	2.6 (0.23)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (-) indicates data are not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.
An "x" indicates teacher response data available for <50% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.1

Percent of Students Who Are Taught Both Mathematics and Science by a Single Classroom Teacher[1] - Upper Grade (Fourth Grade*)



*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1] Based on information provided by schools. Teachers were classified as teaching: (1) mathematics, (2) science, or (3) both mathematics and science to the sampled classes. Percentages reflect those students taught by category (3) teachers.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.6

Average Number of Hours[1] Students' Teachers Spend on Various School-Related Activities Outside the Formal School Day During the School Week Science - Upper Grade (Fourth Grade*)

Country	Preparing or Grading Tests	Reading and Grading Student Work	Planning Lessons by Self	Meeting with Students Outside Classroom Time	Meeting with Parents	Professional Reading and Development	Keeping Students' Records	Administrative Tasks
Australia	r 1.1 (0.1)	2.8 (0.1)	r 2.9 (0.1)	r 0.7 (0.1)	r 0.8 (0.1)	1.4 (0.1)	1.3 (0.1)	3.0 (0.1)
Austria	2.6 (0.2)	4.0 (0.1)	3.3 (0.1)	0.3 (0.0)	0.8 (0.1)	1.5 (0.1)	1.1 (0.1)	1.5 (0.1)
Canada	1.7 (0.1)	2.8 (0.1)	2.9 (0.1)	1.0 (0.1)	0.6 (0.0)	1.1 (0.1)	1.3 (0.1)	2.3 (0.1)
Cyprus	s 2.2 (0.1)	s 2.5 (0.2)	s 3.3 (0.2)	s 0.3 (0.2)	s 0.7 (0.1)	s 1.4 (0.2)	s 0.9 (0.1)	s 1.3 (0.1)
Czech Republic	r 2.7 (0.1)	r 3.1 (0.1)	r 3.5 (0.2)	r 1.2 (0.1)	r 0.5 (0.0)	r 1.8 (0.1)	r 1.1 (0.1)	r 1.0 (0.1)
England	r 0.9 (0.1)	4.0 (0.1)	3.5 (0.1)	1.0 (0.1)	0.8 (0.1)	1.3 (0.1)	1.5 (0.1)	3.3 (0.1)
Greece	2.5 (0.1)	2.1 (0.1)	r 1.9 (0.1)	r 0.3 (0.0)	0.9 (0.0)	1.9 (0.1)	r 0.5 (0.1)	r 1.1 (0.1)
Hong Kong	- -	- -	- -	- -	- -	- -	- -	- -
Hungary	2.6 (0.1)	2.8 (0.1)	3.6 (0.1)	1.6 (0.1)	0.9 (0.0)	2.0 (0.1)	0.7 (0.1)	2.2 (0.1)
Iceland	1.0 (0.1)	3.0 (0.2)	3.7 (0.1)	0.6 (0.1)	0.7 (0.1)	1.3 (0.1)	1.3 (0.1)	2.3 (0.2)
Iran, Islamic Rep.	2.2 (0.1)	2.2 (0.1)	2.0 (0.1)	1.2 (0.1)	1.3 (0.1)	1.0 (0.1)	1.7 (0.1)	1.1 (0.1)
Ireland	1.2 (0.1)	2.1 (0.2)	1.6 (0.1)	0.3 (0.0)	0.4 (0.0)	0.6 (0.1)	0.8 (0.1)	1.0 (0.1)
Israel	3.1 (0.2)	2.9 (0.2)	3.7 (0.2)	r 1.3 (0.1)	1.1 (0.1)	r 3.3 (0.1)	r 1.7 (0.2)	1.9 (0.2)
Japan	2.4 (0.1)	3.0 (0.1)	2.7 (0.1)	1.3 (0.1)	0.4 (0.0)	2.1 (0.1)	1.7 (0.1)	2.4 (0.1)
Korea	1.5 (0.1)	2.2 (0.1)	2.1 (0.1)	1.4 (0.1)	0.5 (0.0)	1.5 (0.1)	1.3 (0.1)	2.0 (0.1)
Kuwait	s 2.3 (0.1)	s 2.4 (0.1)	s 2.1 (0.2)	s 0.3 (0.1)	s 0.9 (0.1)	s 1.1 (0.1)	s 1.6 (0.2)	s 1.4 (0.1)
Latvia (LSS)	1.9 (0.1)	2.6 (0.1)	2.7 (0.1)	2.1 (0.2)	1.0 (0.1)	1.4 (0.1)	r 1.0 (0.1)	1.2 (0.1)
Netherlands	1.5 (0.1)	3.8 (0.1)	2.6 (0.1)	0.9 (0.1)	0.8 (0.0)	1.1 (0.1)	0.9 (0.1)	2.8 (0.1)
New Zealand	1.3 (0.1)	2.6 (0.1)	3.1 (0.1)	0.7 (0.1)	0.7 (0.0)	1.5 (0.1)	1.7 (0.1)	3.3 (0.1)
Norway	r 1.3 (0.1)	r 2.4 (0.1)	r 3.9 (0.1)	r 0.6 (0.1)	r 0.7 (0.1)	r 0.7 (0.1)	r 0.8 (0.0)	r 1.7 (0.1)
Portugal	2.4 (0.1)	2.7 (0.1)	2.4 (0.1)	0.6 (0.1)	0.7 (0.0)	1.4 (0.1)	0.9 (0.1)	1.5 (0.1)
Scotland	r 0.8 (0.1)	r 3.2 (0.1)	3.3 (0.1)	0.2 (0.0)	r 0.4 (0.0)	1.1 (0.1)	1.1 (0.1)	2.5 (0.1)
Singapore	3.0 (0.1)	4.1 (0.1)	2.5 (0.1)	2.0 (0.1)	0.6 (0.0)	1.6 (0.1)	1.2 (0.1)	2.4 (0.1)
Slovenia	2.3 (0.1)	2.1 (0.1)	3.7 (0.2)	1.1 (0.1)	1.3 (0.1)	2.2 (0.2)	0.8 (0.1)	1.9 (0.1)
Thailand	r 2.4 (0.2)	2.5 (0.2)	r 2.9 (0.2)	r 1.8 (0.2)	r 1.7 (0.2)	r 1.9 (0.2)	r 1.6 (0.2)	1.9 (0.2)
United States	2.2 (0.1)	3.1 (0.1)	2.5 (0.1)	0.9 (0.1)	0.7 (0.0)	1.3 (0.1)	1.5 (0.1)	2.2 (0.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
[1]Average hours based on: No time = 0, Less than 1 hour = .5, 1-2 hours = 1.5; 3-4 hours = 3.5; More than 4 hours = 5.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

or grading tests, and another 2.8 hours per week reading and grading student work. Their teachers spent 2.9 hours per week on lesson planning and 1.5 hours combined on meeting students and parents. They spent 1.4 hours on professional reading and development, and 4.3 hours on record-keeping and administrative tasks combined. Across countries, teachers reported that grading tests, grading student work, and lesson planning were the most time-consuming activities, averaging as much as almost 10 hours per week in Singapore. In general, teachers also reported several hours per week spent on keeping students' records and other administrative tasks.

Opportunities to meet with colleagues to plan curriculum or teaching approaches enable teachers to expand their views of science, their resources for teaching, and their repertoire of teaching and learning skills. Table 5.7 contains teachers' reports on how often they meet with other teachers in their subject area to discuss and plan curriculum or teaching approaches. Teachers of the majority of the students reported weekly or even daily planning meetings in 17 countries, with the largest percentages in the Czech Republic, England, Hungary, Japan, Kuwait, and Norway. In the remaining countries, however, most students were taught science by teachers who reported only limited opportunities to plan curriculum or teaching approaches with other teachers (monthly or even yearly meetings).

Most educational systems provide curriculum guides on either a national or regional basis to ensure that teachers, parents, and other interested parties have a clear understanding of what is intended to be taught in each subject. Table 5.8 displays the percentage of students taught by teachers who reported varying degrees of familiarity with national and regional guides in science. Generally teachers reported a fairly high degree of familiarity with one or another curriculum guide. Countries where more than a third of the students were taught by teachers who reported that they were unfamiliar with their country's curriculum guides included Austria, the Czech Republic, Japan, and the United States.

Table 5.7

Teachers' Reports on How Often They Meet with Other Teachers in Their Subject Area to Discuss and Plan Curriculum or Teaching Approaches Science - Upper Grade (Fourth Grade*)

Country		Percent of Students Taught by Teachers			
		Never or Once/Twice a Year	Monthly or Every Other Month	Once, Twice, or Three Times a Week	Almost Every Day
Australia		7 (1.8)	32 (3.5)	51 (3.8)	10 (2.7)
Austria		19 (4.4)	23 (4.6)	36 (4.6)	22 (4.1)
Canada		33 (3.4)	34 (3.5)	27 (2.5)	6 (1.8)
Cyprus	s	13 (3.4)	13 (4.5)	64 (5.6)	11 (4.0)
Czech Republic	r	3 (1.5)	13 (2.7)	31 (4.4)	52 (4.7)
England		4 (1.6)	12 (3.0)	72 (4.1)	13 (3.0)
Greece		32 (3.9)	26 (3.3)	26 (3.7)	16 (3.3)
Hong Kong		- -	- -	- -	- -
Hungary		2 (1.0)	13 (3.1)	45 (4.5)	41 (4.5)
Iceland		16 (1.5)	13 (4.1)	69 (4.1)	1 (1.2)
Iran, Islamic Rep.		4 (1.5)	26 (4.3)	54 (4.9)	16 (3.2)
Ireland		46 (5.0)	42 (4.7)	7 (2.0)	5 (1.5)
Israel		10 (3.6)	42 (5.9)	41 (6.4)	7 (3.3)
Japan		5 (1.7)	14 (3.0)	61 (4.2)	20 (3.9)
Korea		17 (3.0)	24 (3.5)	41 (4.2)	18 (3.2)
Kuwait	s	7 (2.5)	1 (0.9)	75 (4.0)	17 (3.8)
Latvia (LSS)		14 (3.3)	28 (4.1)	32 (4.6)	26 (3.8)
Netherlands		36 (4.4)	33 (4.4)	29 (3.8)	2 (1.5)
New Zealand		10 (2.4)	17 (3.3)	60 (4.4)	13 (2.6)
Norway		4 (1.5)	7 (2.5)	82 (3.5)	7 (2.7)
Portugal		10 (2.6)	62 (4.4)	17 (3.4)	11 (2.8)
Scotland		9 (2.3)	37 (4.3)	40 (4.0)	14 (2.9)
Singapore		11 (2.0)	64 (3.7)	21 (3.2)	4 (1.6)
Slovenia		4 (2.3)	33 (4.9)	31 (4.4)	32 (4.7)
Thailand	r	62 (5.7)	23 (5.3)	13 (4.5)	1 (0.9)
United States		19 (3.4)	21 (3.4)	49 (3.6)	11 (2.1)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.8

Teachers' Reports on Their Familiarity With National and Regional Science Curriculum Guides
Science - Upper Grade (Fourth Grade*)

Country	Percent of Students by Teachers' Familiarity With						
	National Curriculum Guide			Regional Curriculum Guide			
	Not Familiar	Fairly Familiar	Very Familiar	Not Familiar	Fairly Familiar	Very Familiar
Australia	r 43 (4.0)	42 (4.1)	15 (2.8)	r 15 (3.3)	54 (4.7)	31 (4.3)
Austria	- -	- -	- -	40 (4.9)	28 (4.3)	32 (4.9)
Canada	- -	- -	- -	11 (2.5)	38 (3.3)	51 (2.6)
Cyprus	s 6 (1.9)	39 (6.0)	55 (6.1)	- -	- -	- -
Czech Republic	r 44 (4.9)	43 (4.5)	13 (3.1)	r 92 (2.6)	7 (2.5)	1 (0.8)
England	- -	- -	- -	- -	- -	- -
Greece	r 26 (3.3)	54 (4.2)	20 (3.4)	- -	- -	- -
Hong Kong	- -	- -	- -	- -	- -	- -
Hungary	- -	- -	- -	- -	- -	- -
Iceland	17 (5.0)	69 (5.8)	14 (3.6)	- -	- -	- -
Iran, Islamic Rep.	31 (4.6)	46 (5.3)	23 (4.1)	- -	- -	- -
Ireland	4 (2.0)	58 (4.7)	38 (4.5)	- -	- -	- -
Israel	r 11 (3.8)	40 (6.0)	50 (5.5)	r 37 (5.1)	29 (5.3)	34 (4.7)
Japan	34 (4.0)	61 (4.3)	5 (2.1)	58 (4.1)	41 (4.2)	1 (1.0)
Korea	18 (3.2)	58 (4.0)	24 (3.9)	56 (3.8)	37 (3.9)	7 (2.2)
Kuwait	s 0 (0.0)	18 (4.2)	82 (4.2)	- -	- -	- -
Latvia (LSS)	6 (2.2)	35 (4.5)	60 (4.8)	r 46 (5.1)	25 (4.5)	29 (5.1)
Netherlands	19 (3.6)	69 (4.2)	12 (3.2)	- -	- -	- -
New Zealand	9 (1.9)	59 (4.1)	32 (4.0)	76 (3.6)	20 (3.5)	5 (1.5)
Norway	2 (1.2)	69 (4.6)	29 (4.5)	r 61 (4.5)	29 (5.0)	10 (3.3)
Portugal	32 (4.4)	17 (3.2)	52 (4.4)	- -	- -	- -
Scotland	- -	- -	- -	- -	- -	- -
Singapore	2 (0.9)	54 (3.5)	44 (3.6)	- -	- -	- -
Slovenia	47 (4.7)	36 (4.6)	17 (3.7)	3 (2.1)	11 (3.7)	86 (4.2)
Thailand	r 22 (4.8)	28 (5.5)	50 (5.7)	r 56 (7.6)	34 (7.5)	10 (3.7)
United States	- -	- -	- -	r 36 (2.8)	39 (2.7)	25 (3.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

How Are Science Classes Organized?

Instructional organization can subsume many factors, including the diversity of the students placed into classrooms, economic factors such as the array of instructional resources available to the student population as well as for use within classrooms, the typical size of classes, and practices regarding in-class grouping. Often, how instruction is organized can influence the implemented curriculum and the opportunities of students.

Figure 5.2 provides information on teacher reports about several factors that might limit how they teach their science classes. The results are presented visually via pie graphs. The percentage of teachers reporting that a particular factor limited how they teach science either "quite a lot" or "a great deal" also is shown next to each graph. In most countries, the challenge of dealing with students of differing academic abilities is mentioned most often, with Greece, Hungary, Iceland, and Iran in the lead. Since tracking or streaming is relatively rare in the primary grades, it is perhaps not surprising that many teachers reported that the differing academic abilities of their students limited how they teach science. Also mentioned frequently as limiting factors were disruptive students (Iceland, Korea, and Portugal), and, in some countries, the burden of dealing with students with special needs (Greece, Hungary, Iceland, Iran, Kuwait, and Portugal). Inadequate physical facilities, and shortage of equipment for use in demonstrations, were reported to limit teaching in Greece, Iran, Kuwait, Latvia (LSS), and Thailand.

In some countries, large classes and high student/teacher ratios cause problems for teachers in carrying out their professional duties. The majority of students in almost half the countries (Australia, Greece, Iceland, Iran, Ireland, Korea, Kuwait, New Zealand, Portugal, and Slovenia) were taught by teachers who reported that high student/teacher ratios limited their teaching approach. Even among the other countries, however, only the teachers in Austria and Latvia (LSS) reported that student/teachers ratios affected instruction for fewer than 20% of the students.

Table 5.9 presents teachers' reports about the size of fourth-grade science classes for the TIMSS countries. The data reveal rather large variations from country to country. Norway had the smallest fourth-grade science classes, with an average of 19 students per class and 57% of students in classes of 20 or fewer students. According to teachers, science classes were relatively small in a number of countries. The average number of students in class was 25 or fewer in 13 countries. For example, 90% or more of the students were in science classes of 30 or fewer students in Austria, Canada, the Czech Republic, Greece, Hungary, Iceland, Latvia (LSS), Norway, Portugal, Slovenia, and the United States. At the other end of the spectrum, the average size of science classes in Korea was 43 students, and 69% of the students in that country were in science classes with more than 40 students. In Hong Kong, Japan, Korea, and Singapore, more than two-thirds of the students were in classes with more than 30 students (more than 90% in Korea and Singapore).

Figure 5.2

Teachers' Reports on What Factors Limit How They Teach Class Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
Australia	r 45	r 27	r 38	r 31	r 24	r 51
Austria	47	1	10	7	7	15
Canada	49	27	47	30	26	45
Czech Republic	r 64	r 23	r 40	r 48	r 28	r 38
Greece	81	r 60	44	r 65	50	64
Hungary	r 93	s 55	s 42	r 47	s 38	r 47
Iceland	86	r 53	55	r 50	r 46	68
Iran, Islamic Rep.	81	75	45	79	55	58
Ireland	69	28	37	28	20	54
Japan	60	-	-	28	-	41

Percent for "Quite a Lot" or "A Great Deal" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
Countries where data were not available or where teacher response data were available for <50% of students are omitted from figure (Cyprus, England Hong Kong, Israel, and Singapore).
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.2 (Continued)

Teachers' Reports on What Factors Limit How They Teach Class Science - Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Each Factor Limiting How They Teach Class "Quite A Lot" or "A Great Deal"					
	Students with Different Academic Abilities	Students with Special Needs	Disruptive Students	Shortage of Equipment for Use in Demonstrations and Other Exercises	Inadequate Physical Facilities	High Student/Teacher Ratio
Korea	69	41	64	54	27	62
Kuwait	s 65	s 58	s 49	s 73	s 53	s 81
Latvia (LSS)	30	13	22	77	64	13
Netherlands	63	21	31	18	19	r 35
New Zealand	45	26	27	31	25	59
Norway	r 56	r 34	r 25	r 38	r 13	r 45
Portugal	74	66	74	59	23	r 53
Scotland	63	32	31	11	21	39
Slovenia	24	16	50	61	46	52
Thailand	r 70	r 44	r 21	r 71	r 65	r 50
United States	r 41	r 19	r 32	r 24	r 15	r 39

Percent for "Quite a Lot" or "A Great Deal" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are not available.
Countries where data were not available or where teacher response data were available for <50% of students are omitted from figure (Cyprus, England Hong Kong, Israel, and Singapore).
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table 5.9

Teachers' Reports on Average Size of Science Class
Upper Grade (Fourth Grade*)

Country	1 - 20 Students		21 - 30 Students		31 - 40 Students		41 or More Students		Average Number of Students
	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	Percent of Students	Mean Achievement	
Australia	r 17 (3.1)	582 (5.3)	64 (4.9)	558 (5.3)	19 (4.8)	555 (9.2)	0 (0.0)	~ ~	r 25 (0.6)
Austria	50 (5.0)	572 (5.8)	50 (5.0)	557 (4.2)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.5)
Canada	21 (3.0)	567 (8.0)	72 (3.0)	547 (2.8)	7 (1.4)	549 (8.6)	0 (0.2)	~ ~	24 (0.4)
Cyprus	x x	x x	x x	x x	x x	x x	x x	x x	x x
Czech Republic	32 (3.6)	544 (4.5)	65 (3.7)	560 (3.5)	3 (1.4)	636 (38.0)	0 (0.0)	~ ~	22 (0.4)
England	9 (2.7)	559 (13.7)	53 (4.9)	549 (5.2)	38 (5.0)	557 (6.5)	0 (0.0)	~ ~	28 (0.5)
Greece	45 (3.9)	496 (6.0)	53 (4.0)	499 (5.3)	2 (1.1)	~ ~	0 (0.0)	~ ~	21 (0.4)
Hong Kong	0 (0.4)	~ ~	13 (4.2)	516 (19.0)	74 (4.9)	536 (4.5)	13 (3.2)	559 (7.3)	36 (0.5)
Hungary	40 (3.6)	517 (5.6)	55 (3.9)	542 (4.2)	5 (2.1)	539 (17.4)	0 (0.0)	~ ~	22 (0.4)
Iceland	45 (4.9)	503 (4.5)	55 (4.9)	510 (5.1)	0 (0.0)	~ ~	0 (0.0)	~ ~	20 (0.4)
Iran, Islamic Rep.	17 (3.7)	379 (8.4)	24 (3.9)	413 (5.9)	38 (4.2)	436 (7.5)	21 (3.7)	430 (8.0)	32 (0.9)
Ireland	27 (2.8)	539 (5.5)	33 (4.3)	536 (6.9)	41 (4.7)	546 (4.6)	0 (0.0)	~ ~	26 (0.6)
Israel	r 7 (2.9)	512 (18.8)	46 (5.5)	502 (6.3)	46 (6.0)	499 (6.3)	0 (0.0)	~ ~	r 30 (0.6)
Japan	3 (0.8)	577 (7.8)	29 (3.5)	570 (3.2)	67 (3.6)	575 (2.2)	1 (1.1)	~ ~	32 (0.4)
Korea	2 (1.0)	~ ~	6 (1.6)	574 (6.4)	24 (3.6)	590 (3.9)	69 (3.5)	602 (2.5)	43 (0.6)
Kuwait	s 0 (0.0)	~ ~	39 (5.2)	404 (7.1)	58 (4.9)	402 (5.5)	3 (2.2)	405 (15.3)	s 32 (0.4)
Latvia (LSS)	51 (4.1)	506 (7.6)	45 (3.8)	520 (7.5)	3 (1.6)	517 (17.7)	1 (0.9)	~ ~	21 (0.8)
Netherlands	29 (4.0)	558 (4.7)	52 (5.5)	552 (5.0)	19 (4.4)	567 (4.8)	0 (0.0)	~ ~	24 (0.7)
New Zealand	13 (2.4)	539 (9.0)	37 (4.2)	516 (9.8)	50 (4.4)	543 (6.0)	0 (0.0)	~ ~	29 (0.5)
Norway	57 (4.6)	528 (4.5)	43 (4.6)	527 (6.0)	0 (0.0)	~ ~	0 (0.0)	~ ~	19 (0.5)
Portugal	39 (3.8)	475 (7.3)	60 (3.7)	481 (5.1)	1 (0.6)	~ ~	0 (0.0)	~ ~	21 (0.4)
Scotland	15 (2.3)	553 (6.4)	70 (3.5)	531 (5.6)	14 (3.3)	540 (7.0)	1 (1.0)	~ ~	26 (0.5)
Singapore	0 (0.0)	~ ~	2 (0.8)	~ ~	68 (3.3)	542 (5.5)	30 (3.2)	566 (10.5)	39 (0.2)
Slovenia	32 (4.5)	537 (6.7)	68 (4.5)	548 (3.8)	0 (0.0)	~ ~	0 (0.0)	~ ~	23 (0.4)
Thailand	28 (4.2)	477 (5.3)	29 (5.0)	478 (11.2)	36 (5.7)	478 (11.9)	7 (5.2)	438 (2.7)	28 (2.0)
United States	r 23 (3.5)	563 (7.0)	67 (3.7)	575 (4.0)	9 (1.7)	527 (9.3)	1 (0.5)	~ ~	r 24 (0.4)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
( ) 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% students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Extensive research about class size in relation to achievement indicates that the existence of such a relationship is dependent on the situation. Dramatic reductions in class size can be related to gains in achievement, but the chief effects of smaller classes often are in relation to teacher attitudes and instructional behaviors. The TIMSS data illustrate the complexity of this issue. Across countries, two of the three highest-performing countries at the fourth grade – Korea and Japan – are among those with the largest science classes. Within countries, several show little or no relationship between achievement and class size, sometimes because students are almost all in classes of similar size. Within others, there appears to be a curvilinear relationship, or the students with higher achievement appear to be in larger classes. In some countries, larger classes may represent the more usual situation for teaching science, with smaller classes used primarily for students needing remediation or for students in the less-advanced tracks.

Teachers can adopt a variety of organizational and interactive approaches in science class. Whole-class instruction can be very efficient, because it requires less time on management functions and provides more time for developing science concepts. Teachers can make presentations, conduct discussions, or demonstrate procedures and applications to all students simultaneously. Both whole-class and independent work have been standard features of science classrooms. Students also can benefit from the type of cooperative learning that occurs with effective use of small-group work. Because they can help each other, students in groups can often handle challenging situations beyond their individual capabilities. Further, the positive affective impact of working together mirrors the use of science in the workplace.

Figure 5.3 provides a pictorial view of the emphasis on individual, group, and whole-class work as reported by the science teachers in the TIMSS countries. Because learning may be enhanced with teacher guidance and monitoring of individual and small-group activities, the frequency of lessons using each of these organizational approaches is shown both with and without assistance from the teacher. Internationally, teachers reported that working together as a class with the teacher teaching the whole class is a frequently used instructional approach. In more than half of the countries, 50% or more of the fourth-grade students were taught this way during most or all lessons. Students working individually with assistance from the teacher is also a popular approach, as is working in pairs or small groups with teacher assistance. Working without teacher assistance is less common in most countries. Working together as a class with students responding to one another was a common approach in Japan, Korea, and the Netherlands.

Figure 5.3

Teachers' Reports About Classroom Organization During Science Lessons
Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
Australia	r 15	r 24	r 12	r 6	r 28	r 19
Austria	5	47	28	5	23	12
Canada	21	36	18	5	35	14
Czech Republic	r 22	r 64	r 32	r 25	r 8	r 8
England	18	17	14	4	34	7
Greece	r 8	r 71	r 39	r 8	r 21	r 4
Hong Kong	15	67	22	0	11	0
Hungary	19	77	43	8	16	4
Iceland	r 1	r 29	r 26	r 2	r 17	r 6
Iran, Islamic Rep.	32	61	59	5	41	5
Ireland	15	59	14	7	5	2
Israel	r 30	r 42	r 40	r 21	r 37	r 23
Japan	51	68	18	4	24	12

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
Cyprus omitted from the figure; teacher response data available for <50% of students.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Figure 5.3 (Continued)

Teachers' Reports About Classroom Organization During Science Lessons
Upper Grade (Fourth Grade*)

Country	Percent of Students Whose Teachers Report Using Each Organizational Approach "Most or Every Lesson"					
	Work Together as a Class with Students Responding to One Another	Work Together as a Class with Teacher Teaching the Whole Class	Work Individually with Assistance from Teacher	Work Individually without Assistance from Teacher	Work in Pairs or Small Groups with Assistance from Teacher	Work in Pairs or Small Groups without Assistance from Teacher
Korea	49	59	64	17	65	24
Kuwait	s 9	s 48	s 52	s 6	s 56	s 8
Latvia (LSS)	39	91	60	35	23	12
Netherlands	47	75	17	9	8	9
New Zealand	28	18	21	14	39	20
Norway	r 38	r 57	r 20	r 1	r 19	r 6
Portugal	20	65	54	12	42	12
Scotland	r 5	r 15	r 5	r 4	r 29	r 7
Singapore	21	67	51	15	43	18
Slovenia	13	53	64	35	36	26
Thailand	r 6	r 49	r 41	r 8	r 34	r 13
United States	r 35	r 47	r 20	r 6	r 26	r 10

Percent for "Most or Every Lesson" →

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3).
Cyprus omitted from the figure; teacher response data available for <50% of students.
An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix A

Overview of TIMSS Procedures: Science Achievement Results for Third- and Fourth-Grade Students

History

TIMSS 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 curricular areas such as 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. Since the subjects of mathematics and science are related in many respects, the third studies were conducted together as an integrated effort.[1]

The number of participating countries, the number of grades tested, and the inclusion of both mathematics and science resulted in TIMSS becoming the largest, most complex IEA study to date and the largest international study of educational achievement ever undertaken. Traditionally, IEA studies have systematically worked toward gaining more in-depth understanding of how various factors contribute to the overall outcomes of schooling. Particular emphasis has been given to refining our understanding of students' opportunity to learn as this opportunity becomes successively defined and implemented by curricular and instructional practices. In an effort to extend what had been learned from previous studies and provide contextual and explanatory information, the magnitude of TIMSS expanded beyond the already substantial task of measuring achievement in two subject areas to also include a thorough investigation of curriculum and how it is delivered in classrooms around the world.

The Components of TIMSS

Continuing the approach of previous IEA studies, TIMSS addressed three conceptual levels of curriculum. The **intended curriculum** is composed of the mathematics and science instructional and learning goals as defined at the system level. The **implemented curriculum** is the mathematics and science curriculum as interpreted by

[1] Because a substantial amount of time has elapsed since earlier IEA studies in mathematics and science, curriculum and testing methods in these two subjects have undergone many changes. Since TIMSS has devoted considerable energy towards reflecting the most current educational and measurement practices, changes in items and methods as well as differences in the populations tested make comparisons of TIMSS results with those of previous studies very difficult. The focus of TIMSS is not on measuring achievement trends, but rather on providing up-to-date information about the current quality of education in mathematics and science.

teachers and made available to students. The **attained curriculum** is the mathematics and science content that students have learned and their attitudes towards these subjects. To aid in meaningful interpretation and comparison of results, TIMSS also collected extensive information about the social and cultural contexts for learning, many of which are related to variations among different educational systems.

Nearly 50 countries participated in one or more of the various components of the TIMSS data collection effort, including the curriculum analysis. To gather information about the intended curriculum, mathematics and science specialists within each participating country worked section by section through curriculum guides, textbooks, and other curricular materials to categorize aspects of these materials in accordance with detailed specifications derived from the TIMSS mathematics and science curriculum frameworks.[2] Initial results from this component of TIMSS can be found in two companion volumes: *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intention in School Mathematics* and *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*. [3]

To measure the attained curriculum, TIMSS tested more than half a million students in mathematics and science at five grade levels. TIMSS included testing at three separate populations:

Population 1. Students enrolled in the two adjacent grades that contained the largest proportion of 9-year-old students at the time of testing – third and fourth grade in most countries.

Population 2. Students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing – seventh and eighth grade in most countries.

Population 3. Students in their final year of secondary education. As an additional option, countries could test two special subgroups of these students:

1) Students taking advanced courses in mathematics, and
2) Students taking physics.

Countries participating in the study were required to administer tests to the students in the two grades at Population 2, but could choose whether or not to participate at the other levels. In about half of the countries at Populations 1 and 2, subsets of the upper-grade students who completed the written tests also participated in a performance assessment. In the performance assessment, students engaged in a number of hands-on mathematics and science activities. The students designed experiments, tested hypotheses, and recorded their findings. For example, in one task, students

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

[3] Schmidt, W.H., McKnight, C.C., Valverde, G.A., Houang, R.T., and Wiley, D. E. (1997). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Dordrecht, the Netherlands: Kluwer Academic Publishers. Schmidt, W.H., Raizen, S.A., Britton, E.D., Bianchi, L.J., and Wolfe, R.G., (in press). *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Science*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

were asked to design and conduct a controlled experiment to measure the effect of water temperature on the rate at which tablets dissolve, requiring organization and interpretation of data to draw conclusions and explain results. Figure A.1 shows the countries that participated in the various components of TIMSS achievement testing.

TIMSS also administered a broad array of questionnaires to collect data about how the curriculum is implemented in classrooms, including the instructional practices used to deliver it. The questionnaires also were used to collect information about the social and cultural contexts for learning. Questionnaires were administered at the country level about decision-making and organizational features within their educational systems. The students who were tested answered questions pertaining to their attitudes towards mathematics and science, 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, textbook use, 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. In addition, a volume was compiled that presents descriptions of the educational systems of the participating countries.[4]

With its enormous array of data, TIMSS has numerous possibilities for policy-related research, focused studies related to students' understandings of mathematics and science subtopics and processes, and integrated analyses linking the various components of TIMSS. The initial round of reports is only the beginning of a number of research efforts and publications aimed at increasing our understanding of how mathematics and science education functions across countries, investigating what impacts student performance, and helping to improve mathematics and science education.

[4] Robitaille, D.F. (Ed.). (1997). *National Contexts for Mathematics and Science Education: An Encyclopedia of the Education Systems Participating in TIMSS.* Vancouver, B.C.: Pacific Educational Press.

Figure A.1

Countries Participating in Components of TIMSS Testing

Country	Population 1		Population 2		Population 3		
	Written Test	Performance Assessment	Written Test	Performance Assessment	Mathematics & Science Literacy	Advanced Mathematics	Physics
Argentina			●				
Australia	●	●	●	●	●	●	●
Austria	●		●		●	●	●
Belgium (Fl)			●				
Belgium (Fr)			●				
Bulgaria			●				
Canada	●	●	●	●	●	●	●
Colombia			●	●			
Cyprus	●	●	●	●	●	●	●
Czech Republic	●	●	●	●	●	●	●
Denmark			●	●	●	●	●
England	●		●	●			
France			●		●	●	●
Germany			●		●	●	●
Greece	●		●			●	
Hong Kong	●	●	●	●			
Hungary	●		●		●		
Iceland	●		●		●		
Indonesia	●		●				
Iran, Islamic Rep.	●	●	●	●			
Ireland	●		●				
Israel	●	●	●	●	●	●	●
Italy	●		●		●		
Japan	●		●				
Korea	●		●				
Kuwait	●		●				
Latvia	●		●				●
Lithuania			●		●	●	
Mexico	●		●		●	●	●
Netherlands	●		●	●	●		
New Zealand	●	●	●	●	●		
Norway	●		●	●	●		●
Philippines			●				
Portugal	●	●	●	●			
Romania			●	●			
Russian Federation			●		●	●	●
Scotland	●		●	●			
Singapore	●		●	●			
Slovak Republic			●				
Slovenia	●	●	●	●	●	●	●
South Africa			●		●		
Spain			●	●			
Sweden			●	●	●	●	●
Switzerland			●	●	●	●	●
Thailand	●		●				
United States	●	●	●	●	●	●	●

Developing the TIMSS Science Test

The TIMSS curriculum framework underlying the science tests at all three populations was developed by groups of science educators with input from the TIMSS National Research Coordinators (NRCs). As shown in Figure 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 motivations in science.[5]

Working within the science curriculum framework, science test specifications were developed for each population that included items representing a wide range of science topics and eliciting a range of skills from the students. The tests were developed through an international consensus involving input from experts in science and measurement specialists. The TIMSS Subject Matter Advisory Committee, including distinguished scholars from 10 countries, ensured that the test reflected current thinking and priorities in the sciences. The items underwent an iterative development and review process, with one of the pilot testing efforts involving 43 countries. Every effort was made to help ensure that the tests represented the curricula of the participating countries and that the items did not exhibit any bias towards or against particular countries, including modifying specifications in accordance with data from the curriculum analysis component, obtaining ratings of the items by subject-matter specialists within the participating countries, and conducting thorough statistical item analysis of data collected in the pilot testing. The final forms of the test were endorsed by the NRCs of the participating countries.[6] In addition, countries had an opportunity to match the content of the test to their curricula at the third and fourth grades. They identified items measuring topics not covered in their intended curriculum. The information from this Test-Curriculum Matching Analysis indicates that omitting such items has little effect on the overall pattern of results (see Appendix B).

Table A.1 presents the five content areas included in the Population 1 science test and the numbers of items and score points in each category. Distributions also are included for the five performance categories derived from the performance expectations aspect of the curriculum framework. Approximately one-fourth of the items were in the free-response format, requiring students to generate and write their own answers. Designed to represent approximately one-third of students' response time,

[5] 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, B.C.: Pacific Educational Press.

[6] For a full discussion of the TIMSS test development effort, please see: Garden, R.A. and Orpwood, G. (1996). "TIMSS Test Development" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College; and Garden, R.A. (1996). "Development of the TIMSS Achievement Items" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No.2: Research Questions and Study Design*. Vancouver, B.C.: Pacific Educational Press.

some free-response questions asked for short answers while others required extended responses where students needed to show their work or provide 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). This, in addition to the fact that several items had two parts, means that the total number of score points available for analysis somewhat exceeds the number of items included in the test.

The TIMSS instruments were prepared in English and translated into the additional languages used for testing. In addition, it sometimes was necessary to adapt the international versions for cultural purposes, including the 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 and using two or more independent translations, 3) consultation with subject-matter experts regarding cultural adaptations to ensure that the meaning and difficulty of items did not change, 4) verification of the quality of the translations by professional translators from an independent translation company, 5) corrections by the national centers in accordance with the suggestions made, 6) verification that corrections were implemented, and 7) a series of statistical checks after the testing to detect items that did not perform comparably across countries.[7]

[7] More details about the translation verification procedures can be found in Mullis, I.V.S., Kelly, D.L., and Haley, K. (1996). "Translation Verification Procedures" in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection*. Chestnut Hill, MA: Boston College; and Maxwell, B. (1996). "Translation and Cultural Adaptation of the TIMSS Instruments" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.

Figure A.2

The Three Aspects and Major Categories of the Science Framework

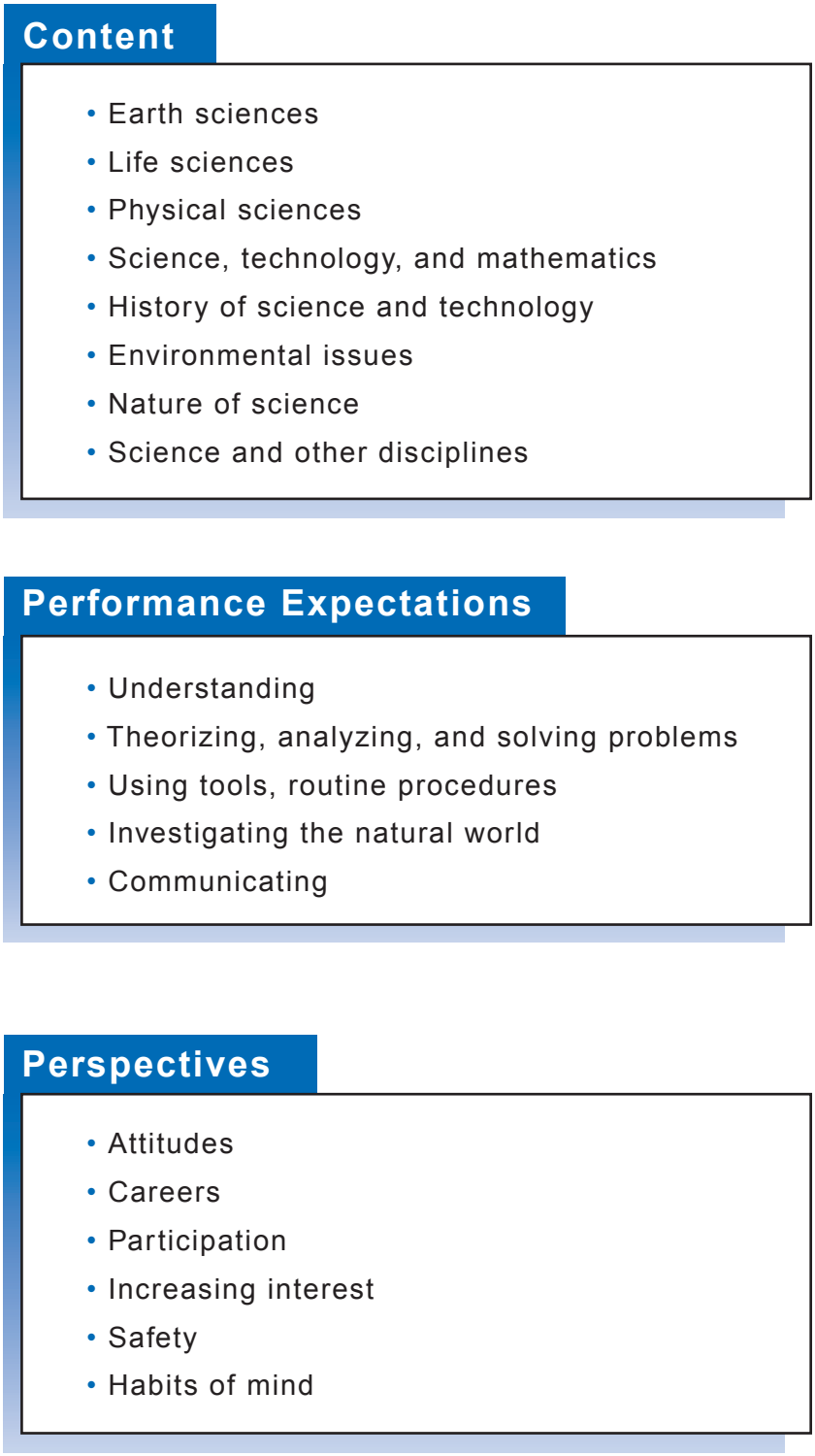


Table A.1

Distribution of Science Items by Content Reporting Category and Performance Expectation - Population 1

Content Category	Percentage of Items	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items	Number of Score Points[1]
Earth Science	18%	17	13	2	2	18
Life Science	42%	41	33	5	3	43
Physical Science	31%	30	23	4	3	33
Environmental Issues and the Nature of Science	9%	9	5	2	2	11
Total	100%	97	74	13	10	105

Performance Expectation	Percentage of Items	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items	Number of Score Points[1]
Understanding Simple Information	45%	44	42	1	1	44
Understanding Complex Information	31%	30	21	5	4	34
Theorizing, Analyzing and Solving Problems	14%	14	3	6	5	18
Using Tools, Routine Procedures, and Science Processes	6%	6	5	1	0	6
Investigating the Natural World	3%	3	3	0	0	3

[1] In scoring the tests correct answers to most items were worth one point. However, responses to some constructed-response items were evaluated for partial credit with a fully correct answer awarded up to two points. In addition, some items had two parts. Thus, the number of score points exceeds the number of items in the test.

Because results are rounded to the nearest whole number some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

TIMSS Test Design

Not all of the students in Population 1 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. The TIMSS Population 1 test consisted of eight booklets, with each booklet requiring 64 minutes of student response time. The booklets were designed to be administered in two consecutive testing sessions with a 15- to 20-minute break in between. Students took four clusters of items (37 minutes) prior to the break and three clusters of items (27 minutes) after the break. In accordance with the design, the mathematics and science items were assembled into 26 different clusters (labeled A through Z). Cluster A was designed to take students 10 minutes to complete and the remaining clusters were designed to take 9 minutes each. In all, the design provided a total of 235 unique testing minutes, 118 for mathematics and 117 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.[8]

Sample Implementation and Participation Rates

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 the available sampling information and on the quality 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. This documentation was used by the International Study Center in consultation with Statistics Canada, the sampling referee, and the Technical Advisory Committee to evaluate the quality of the samples.

In a few situations where it was not possible to implement TIMSS testing for all of Population 1, as specified by the international desired definition (all students in the two adjacent grades with the greatest proportion of 9-year-olds), countries were permitted to define a national desired population that did not include part of the international desired population. Table A.2 shows any differences in coverage between the international and national desired populations. Most participants achieved 100% coverage (24 out of 26). The countries with less than 100% coverage are annotated in tables in this report. Israel and Latvia, as a matter of practicality, needed to define

[8] The design is fully documented in Adams, R. and Gonzalez, E. (1996). "Design of the TIMSS Achievement Instruments" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design*. Vancouver, B.C.: Pacific Education Press; and 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.

their tested population according to the structure of their school systems. Because coverage fell below 65% for Latvia, the Latvian results have been labeled "Latvia (LSS)," for Latvian Speaking Schools, throughout the report.

Within the desired population, countries could define a population that excluded a small percentage (less than 10%) 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 remote areas). Table A.2 also shows that the degree of such exclusions was small. Only England exceeded the 10% limit, and this is annotated in the tables in this report. This primarily was because schools which were taking part in trials for National Curriculum Assessment (5.8 % of students) were excluded.

Countries were required to test the two adjacent grades with the greatest proportion of 9-year-olds. Table A.3 presents, for each country, the percentage of 9-year-olds in the lower grade tested, the percentage in the upper grade, and the percentage in the upper and lower grades combined.

Within countries, TIMSS used a two-stage sample design at Population 1, where the first stage involved selecting 150 public and private schools within each country. Within each school, the basic approach required countries to use random procedures to select one mathematics class at the fourth grade and one at the third grade (or the corresponding upper and lower grades in that country). All of the students in those two classes were to participate in the TIMSS testing. This approach was designed to yield a representative sample of 7,500 students per country, with approximately 3,750 students at each grade.[9] Typically, between 450 and 3,750 students responded to each item at each grade level, depending on the booklets in which the items were located.

Countries were required to obtain a participation rate of at least 85% of both schools and students, or a combined rate (the product of school and student participation) of 75%. Tables A.4 through A.8 present the participation rates and achieved sample sizes for the fourth and third grades.

[9] The sample design for TIMSS is described in detail in Foy, P., Rust, K. and Schleicher, A. (1996). "TIMSS Sample 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.

Table A.2

Coverage of TIMSS Target Population

The International Desired Population is defined as follows:
Population 1 - All students enrolled in the two adjacent grades with the largest proportion of 9-year-old students at the time of testing.

Country	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Australia	100%		0.1%	1.6%	1.8%
Austria	100%		2.6%	0.2%	2.8%
Canada	100%		2.5%	3.6%	6.2%
Cyprus	100%		3.1%	0.1%	3.2%
Czech Republic	100%		4.1%	0.0%	4.1%
[2] England	100%		8.6%	3.5%	12.1%
Greece	100%		1.5%	4.0%	5.4%
Hong Kong	100%		2.6%	0.0%	2.7%
Hungary	100%		3.8%	0.0%	3.8%
Iceland	100%		1.9%	4.3%	6.2%
Iran, Islamic Rep.	100%		0.3%	1.0%	1.3%
Ireland	100%		5.3%	1.6%	6.9%
[1] Israel	72%	Hebrew Public Education System	1.1%	0.1%	1.2%
Japan	100%		3.0%	0.0%	3.0%
Korea	100%		3.9%	2.6%	6.6%
Kuwait	100%		0.0%	0.0%	0.0%
[1] Latvia (LSS)	60%	Latvian-speaking schools	2.1%	0.0%	2.1%
Netherlands	100%		4.0%	0.4%	4.4%
New Zealand	100%		0.7%	0.6%	1.3%
Norway	100%		1.1%	2.0%	3.1%
Portugal	100%		6.6%	0.7%	7.3%
Scotland	100%		2.4%	4.3%	6.7%
Singapore	100%		0.0%	0.0%	0.0%
Slovenia	100%		1.9%	0.0%	1.9%
Thailand	100%		6.8%	1.5%	8.3%
United States	100%		0.4%	4.3%	4.7%

[1] National Desired Population does not cover all of International Desired Population. 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.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.3

Coverage of 9-Year-Old Students

Country	Percent of 9-Year-Olds in Lower Grade (Third Grade*)	Percent of 9-Year-Olds in Upper Grade (Fourth Grade*)	Percent of 9-Year-Olds in Both Grades
Australia	65	29	94
Austria	72	15	87
Canada	46	48	94
Cyprus	35	63	98
Czech Republic	75	15	91
England	58	41	99
Greece	11	88	99
Hong Kong	43	50	93
Hungary	70	19	89
Iceland	15	84	99
Iran, Islamic Rep.	51	32	83
Ireland	68	23	92
Israel	-	-	-
Japan	91	9	99
Korea	67	24	91
Kuwait	-	-	-
Latvia (LSS)	55	21	76
Netherlands	63	30	93
New Zealand	50	49	99
Norway	38	62	100
Portugal	45	48	93
Scotland	23	76	99
Singapore	80	17	98
Slovenia	60	0	60
Thailand	60	11	71
United States	61	34	95

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.
Because results are rounded to the nearest whole number some totals may appear inconsistent.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.4

School Participation Rates and Sample Sizes

Upper Grade (Fourth Grade*)

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	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[1]		Total Number of Schools That Participated
						Procedural	Other	
Australia	66	69	268	268	169	9	0	178
Austria	51	72	150	150	71	31	31	133
Canada	90	90	423	420	390	0	0	390
Cyprus	97	97	150	150	146	0	0	146
Czech Republic	91	94	215	215	181	7	0	188
England	63	88	150	145	92	35	0	127
Greece	93	93	187	187	174	0	0	174
Hong Kong	84	84	156	148	124	0	0	124
Hungary	100	100	150	150	150	0	0	150
Iceland	95	95	153	151	144	0	0	144
Iran, Islamic Rep.	100	100	180	180	180	0	0	180
Ireland	94	96	175	173	161	4	0	165
Israel	40	40	100	100	40	0	47	87
Japan	93	96	150	150	137	4	0	141
Korea	100	100	150	150	150	0	0	150
Kuwait	100	100	150	150	150	0	0	150
Latvia (LSS)	74	74	169	169	125	0	0	125
Netherlands	31	62	196	196	63	67	0	130
New Zealand	80	99	150	150	120	29	0	149
Norway	85	94	150	148	126	13	0	139
Portugal	95	95	150	150	143	0	0	143
Scotland	78	83	184	184	143	9	0	152
Singapore	100	100	191	191	191	0	0	191
Slovenia	81	81	150	150	121	0	0	121
Thailand	96	96	155	155	154	0	0	154
United States	85	85	220	213	182	0	0	182

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

[1] Replacement schools selected in accordance with the TIMSS sampling procedures are listed in the "procedural" column. Those selected using unapproved methods are listed in the "other" column and were not included in the computation of school participation rates.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.5

Student Participation Rates and Sample Sizes

Upper Grade (Fourth Grade*)

Country	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 Students Eligible	Number of Students Absent	Total Number of Students Assessed
Australia	96	6930	37	104	6789	282	6507
Austria	96	2779	12	6	2761	116	2645
Canada	96	9193	81	268	8844	436	8408
Cyprus	86	3972	4	3	3965	589	3376
Czech Republic	92	3555	7	0	3548	280	3268
England	95	3489	73	122	3294	168	3126
Greece	95	3358	6	116	3236	183	3053
Hong Kong	98	4475	0	1	4474	63	4411
Hungary	92	3272	0	0	3272	266	3006
Iceland	90	2149	23	101	2025	216	1809
Iran, Islamic Rep.	97	3521	5	36	3480	95	3385
Ireland	93	3134	14	40	3080	207	2873
Israel	94	2486	0	3	2483	132	2351
Japan	97	4453	0	0	4453	147	4306
Korea	95	2971	133	0	2838	26	2812
Kuwait	95	4578	34	0	4544	226	4318
Latvia (LSS)	93	2390	12	1	2377	161	2216
Netherlands	96	2639	0	4	2635	111	2524
New Zealand	96	2627	82	20	2525	104	2421
Norway	97	2391	16	42	2333	76	2257
Portugal	96	2994	15	16	2963	110	2853
Scotland	92	3735	0	139	3596	295	3301
Singapore	98	7274	14	0	7260	121	7139
Slovenia	94	2720	3	0	2717	151	2566
Thailand	100	3042	0	50	2992	0	2992
United States	94	8224	61	412	7751	455	7296

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.6

School Participation Rates and Sample Sizes

Lower Grade (Third Grade*)

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	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[1]		Total Number of Schools That Participated
						Proce-dural	Other	
Australia	66	69	268	264	166	9	0	175
Austria	49	70	150	149	68	29	31	128
Canada	88	88	423	418	375	0	0	375
Cyprus	98	98	150	150	147	0	0	147
Czech Republic	91	93	215	215	180	7	0	187
England	64	88	150	145	93	35	0	128
Greece	91	91	187	187	171	0	0	171
Hong Kong	84	84	156	147	123	0	0	123
Hungary	99	99	150	150	149	0	0	149
Iceland	95	95	153	152	144	0	0	144
Iran, Islamic Rep.	99	99	180	180	178	0	0	178
Ireland	94	96	175	173	160	4	0	164
Israel	-	-	-	-	-	-	-	-
Japan	93	95	150	150	137	5	0	142
Korea	100	100	150	150	150	0	0	150
Kuwait	-	-	-	-	-	-	-	-
Latvia (LSS)	73	73	169	168	123	0	0	123
Netherlands	29	62	196	195	60	69	0	129
New Zealand	80	99	150	150	120	29	0	149
Norway	83	92	150	148	124	12	0	136
Portugal	95	95	150	150	143	0	0	143
Scotland	77	81	184	184	142	8	0	150
Singapore	100	100	191	191	191	0	0	191
Slovenia	81	81	150	149	122	0	0	122
Thailand	96	96	155	154	153	0	0	153
United States	86	86	220	217	186	0	0	186

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.
[1] Replacement schools selected in accordance with the TIMSS sampling procedures are listed in the "procedural" column. Those selected using unapproved methods are listed in the "other" column and were not included in the computation of school participation rates.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.7

Student Participation Rates and Sample Sizes

Lower Grade (Third Grade*)

Country	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 Students Eligible	Number of Students Absent	Total Number of Students Assessed
Australia	95	5138	31	92	5015	274	4741
Austria	96	2655	10	6	2639	113	2526
Canada	96	8433	77	307	8049	455	7594
Cyprus	85	3913	5	2	3906	598	3308
Czech Republic	93	3484	8	0	3476	220	3256
England	94	3468	70	158	3240	184	3056
Greece	94	3263	4	133	3126	171	2955
Hong Kong	99	4455	0	2	4453	57	4396
Hungary	94	3270	0	0	3270	232	3038
Iceland	91	2017	19	89	1909	211	1698
Iran, Islamic Rep.	98	3504	12	49	3443	82	3361
Ireland	94	3127	14	39	3074	185	2889
Israel	-	-	-	-	-	-	-
Japan	97	4433	0	0	4433	127	4306
Korea	94	2969	138	2	2829	52	2777
Kuwait	-	-	-	-	-	-	-
Latvia (LSS)	94	2218	8	0	2210	156	2054
Netherlands	96	2923	0	14	2909	119	2790
New Zealand	95	2733	91	9	2633	129	2504
Norway	97	2362	8	59	2295	76	2219
Portugal	97	2790	13	31	2746	96	2650
Scotland	90	3663	0	187	3476	344	3132
Singapore	98	7223	14	0	7209	179	7030
Slovenia	95	2659	5	0	2654	133	2521
Thailand	100	2945	0	74	2871	1	2870
United States	95	4280	40	201	4039	220	3819

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table A.8

Overall Participation Rates

Lower and Upper Grades (Third and Fourth Grades*)

Country	Upper Grade		Lower Grade	
	Overall Participation Before Replacement (Weighted Percentage)	Overall Participation After Replacement (Weighted Percentage)	Overall Participation Before Replacement (Weighted Percentage)	Overall Participation After Replacement (Weighted Percentage)
Australia	63	66	62	65
Austria	49	69	46	67
Canada	86	86	84	84
Cyprus	83	83	83	83
Czech Republic	84	86	85	87
England	60	83	61	83
Greece	88	88	86	86
Hong Kong	83	83	83	83
Hungary	92	92	93	93
Iceland	86	86	86	86
Iran, Islamic Rep.	97	97	97	97
Ireland	88	90	88	91
Israel	38	38	-	-
Japan	90	92	90	93
Korea	95	95	94	94
Kuwait	95	95	-	-
Latvia (LSS)	69	69	69	69
Netherlands	29	59	28	60
New Zealand	77	95	76	95
Norway	82	91	81	89
Portugal	92	92	92	92
Scotland	71	76	69	73
Singapore	98	98	98	98
Slovenia	76	76	77	77
Thailand	96	96	96	96
United States	80	80	81	81

*Third and Fourth grades in most countries; see Table 2 for information about the grades tested in each country.
A dash (–) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Indicating Compliance with Sampling Guidelines in the Report

Figure A.3 shows how countries have been grouped in tables reporting achievement results. Countries that complied with the TIMSS guidelines for grade selection and classroom sampling, and that achieved acceptable participation rates, are shown in the first panel of Figure A.3. An acceptable participation rate was at least 85% of both the schools and students or a combined rate (the product of school and student participation) of 75% with or without replacement schools. Countries that met the guidelines only after including replacement schools are annotated. These countries (17 at the fourth grade and 16 at the third grade) appear in the tables in Chapters 1, 2, and 3 ordered by achievement.

Countries that did not reach at least 50% school participation without the use of replacement schools, or that failed to reach the sampling participation standard even with the inclusion of replacement schools, are shown in the second panel of Figure A.3. These countries are presented in a separate section of the achievement tables in Chapters 1, 2, and 3 in alphabetical order, and are shown in tables in Chapters 4 and 5 in italics.

To provide a better curricular match, Slovenia elected to test its third- and fourth-grade students even though that meant not testing the two grades with the most 9-year-olds and resulted in its students being somewhat older than those in the other countries. Slovenia is also presented in a separate section of the achievement tables in Chapters 1, 2, and 3 and is shown in tables in Chapters 4 and 5 in italics. Table A.3 shows the percentages of 9-year-olds for each country in the grades tested.

Hungary did not completely comply with the guidelines for sampling classrooms at the fourth grade and thus its results are also presented in a separate section of the achievement tables in Chapters 1, 2, and 3 in alphabetical order, and are italicized in tables in Chapters 4 and 5. At the fourth grade, Israel, Kuwait, and Thailand also had difficulty complying with the classroom selection guidelines, but in addition had other difficulties (Kuwait tested a single grade with relatively few 9-year-olds; Israel had low sampling participation rates; Thailand had a high percentage of older students), and so these countries are also presented in separate sections in tables in Chapters 1, 2, and 3, and are italicized in tables in Chapters 4 and 5. Israel and Kuwait did not test at the lower grade.

Figure A.3

Countries Grouped for Reporting of Achievement According to Their Compliance with Guidelines for Sample Implementation and Participation Rates

	Fourth Grade	Third Grade
Countries satisfying guidelines for sample participation rates, grade selection and sampling procedures	Canada Cyprus Czech Republic †2 England Greece Hong Kong Iceland Iran, Islamic Rep. Ireland Japan Korea New Zealand Norway Portugal † Scotland Singapore United States	Canada Cyprus Czech Republic †2 England Greece Hong Kong Iceland Iran, Islamic Rep. Ireland Japan Korea New Zealand Norway Portugal Singapore United States
Countries not satisfying guidelines for sample participation	Australia Austria 1 Latvia (LSS) Netherlands	Australia Austria 1 Latvia (LSS) Netherlands Scotland
Countries not meeting age/grade specifications (high percentage of older students)	Slovenia	Slovenia
Countries with unapproved sampling procedures at the classroom level	Hungary	Hungary
Countries with unapproved sampling procedures at classroom level and not meeting other guidelines	1 Israel Kuwait Thailand	Thailand

†Met guidelines for sample participation rates only after replacement schools were included.
1National Desired Population does not cover all of International Desired Population (see Table 1). Because coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
2National Defined Population covers less than 90 percent of National Desired Population (see Table 1).

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

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 developed 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. The test administrator 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 as part of the NRC's report documenting procedures used in the study. In addition, the International Study Center considered it essential to establish some method to monitor compliance with standardized procedures. NRCs were each asked to nominate a person, such as a retired school teacher, to serve as the quality control monitor for his or her own country, and in almost all cases, the International Study Center adopted the NRC's first suggestion. The International Study Center developed manuals for the quality control 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.

The quality control monitors interviewed the NRCs about data collection plans and procedures. They also selected a sample of approximately 10 schools to visit, where they observed testing sessions and interviewed school coordinators.[10] Quality control monitors observed test administrations and interviewed school coordinators in 37 countries, and interviewed school coordinators or test administrators in 3 additional countries.

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 in a position to conduct the data collection in an efficient and professional manner. Similarly, the TIMSS tests appeared to have been administered in compliance with international procedures, including the activities preliminary to the testing session, the activities during the testing sessions, and the school-level activities related to receiving, distributing, and returning materials from the national centers.

[10] The results of the interviews and observations by the quality control monitors are presented in Martin, M.O., Hoyle, C.D., and Gregory, K.D. (1996). "Monitoring the TIMSS Data Collection" and "Observing the TIMSS Test Administration," both in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection*. Chestnut Hill, MA: Boston College.

Scoring the Free-Response Items

Because approximately 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 utilized two-digit codes with rubrics specific to each item. Development of the rubrics was led by the Norwegian TIMSS national center. The first digit designates the correctness level of the response. The second digit, combined with the first digit, represents a diagnostic code used to identify specific types of approaches, strategies, or common errors and misconceptions. Although not specifically used in this report, analyses of responses based on the second digit should provide insight into ways to help students better understand science concepts and problem-solving approaches.

To meet the goal of implementing reliable scoring procedures based on the TIMSS rubrics, the International Study Center prepared guides containing the rubrics and explanations of how to implement them, together with example student responses for the various rubric categories. These guides, together with more examples of student responses for practice in applying the rubrics, were used as a basis for an ambitious series of regional training sessions. The training sessions were designed to assist representatives of national centers who would then be responsible for training personnel in their respective countries to apply the two-digit codes reliably.[11]

To gather and document empirical information about the within-country agreement among scorers, TIMSS developed a procedure whereby systematic subsamples of approximately 10% of the students' responses were to be coded independently by two different readers. Table A.9 shows the average and range of the within-country percentage of exact agreement between scorers on the free-response items in the Population 1 science test for 16 countries. Unfortunately, lack of resources precluded several countries from providing this information. A high percentage of exact agreement was observed, with averages across the items for the correctness score ranging from 89% to 98% and an overall average of 94% across the 16 countries.

To provide information about the cross-country agreement among scorers, TIMSS conducted a special study at Population 2, where 39 scorers from 21 of the participating countries evaluated common sets of students' responses to more than half of the free-response items. Unfortunately, resources did not allow an international reliability study to be conducted for Population 1. However, the results of the international reliability study at Population 2 demonstrated a very high percentage of exact agreement on the correctness and diagnostic scores. 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.[12]

[11] The procedures used in the training sessions are documented in Mullis, I.V.S., Garden, R.A., and Jones, C.A. (1996). "Training for Scoring the TIMSS Free-Response Items" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I.* Chestnut Hill, MA: Boston College.

[12] Details about the reliability studies can be found in Mullis, I.V.S., and Smith, T.A. (1996). "Quality Control Steps for Free-Response Scoring" in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection.* Chestnut Hill, MA: Boston College.

Table A.9

TIMSS Within-Country Free-Response Coding Reliability Data for Population 1 Science Items*

Country	Correctness Score Agreement			Diagnostic Code Agreement		
	Average Percent of Exact Agreement Across Items	Range of Percent of Exact Agreement		Average Percent of Exact Agreement Across Items	Range of Percent of Exact Agreement	
		Min	Max		Min	Max
Australia	93	77	99	82	59	99
Canada	90	79	97	80	62	96
Czech Republic	95	82	100	91	77	100
England	97	93	100	91	83	99
Hong Kong	97	93	99	95	85	99
Ireland	96	91	100	91	85	99
Iran, Islamic Rep.	86	73	96	72	55	89
Israel	90	76	99	81	59	95
Japan	98	94	100	95	89	100
Netherlands	90	65	98	80	58	98
Norway	97	80	100	92	74	100
New Zealand	98	92	100	93	83	100
Portugal	94	85	99	90	73	98
Scotland	89	73	98	78	56	97
Singapore	97	92	100	94	87	99
United States	98	92	100	93	82	100
AVERAGE	94	83	99	87	72	98

*Based on 23 science items, including 4 multiple-part items.
Note: Percent agreement was computed separately for each part, and each part was treated as a separate item in computing averages and ranges.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Test Reliability

Table A.10 displays the science test reliability coefficient for each country for the lower and upper grades (usually third and fourth grades). This coefficient is the median KR-20 reliability across the eight test booklets. Median reliabilities in the lower grade ranged from .67 to .85 and in the upper grade from .70 to .83. The international median, shown in the last row of the table, is the median of the reliability coefficients for all countries. These international medians are .78 for the lower grade and .77 for the upper grade.

Data Processing

To ensure the availability of comparable, high-quality data for analysis, TIMSS engaged in a rigorous set of quality control steps to create the international database.[13] 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 IEA Data Processing Center, the data from each country underwent an exhaustive cleaning process. The data-cleaning process involved several iterative steps and procedures designed to identify, document, and correct deviations from the international instruments, file structures, and coding schemes. This 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 Australian Council for Educational Research (ACER), the International Study Center conducted a review of item statistics for each of the cognitive items in each of the countries to identify poorly performing items. Six countries had one or more science 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.

[13] These steps are detailed in Jungclaus, H. and Bruneforth, M. (1996). "Data Consistency Checking Across Countries" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume* I. Chestnut Hill, MA: Boston College.

Table A.10

Cronbach's Alpha Reliability Coefficients[1]
TIMSS Science Test
Lower and Upper Grades (Third and Fourth Grades*)

Country	Lower Grade	Upper Grade
Australia	0.84	0.80
Austria	0.81	0.74
Canada	0.78	0.80
Cyprus	0.71	0.73
Czech Republic	0.78	0.78
England	0.85	0.82
Greece	0.79	0.77
Hong Kong	0.74	0.75
Hungary	0.79	0.76
Iceland	0.76	0.78
Iran, Islamic Rep.	0.71	0.70
Ireland	0.80	0.77
Israel	-	0.76
Japan	0.73	0.70
Korea	0.70	0.71
Kuwait	-	0.74
Latvia (LSS)	0.78	0.75
Netherlands	0.67	0.70
New Zealand	0.84	0.83
Norway	0.81	0.79
Portugal	0.82	0.78
Scotland	0.83	0.82
Singapore	0.82	0.83
Slovenia	0.78	0.74
Thailand	0.76	0.75
United States	0.82	0.82
International Median	0.78	0.77

*Third and fourth grades in most countries; see Table 2 for more information about the grades tested in each country.
[1]The reliability coefficient for each country is the median KR-20 reliability across the eight test booklets. The international median is the median of the reliability coefficients for all countries.
A dash (-) indicates data are unavailable. Israel and Kuwait did not test the lower grade.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

IRT Scaling and Data Analysis

Two general analysis approaches were used for this report – item response theory scaling methods and average percent correct technology. The overall science results were summarized using an item response theory (IRT) scaling method (Rasch model). This scaling method produces a science score by averaging the responses of each student to the items that student took in a way that takes into account the difficulty of each item. The method 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. Analyses of the response patterns of students from participating countries indicated that, although the items in the test address a wide range of science content, the performance of the students across the items was sufficiently consistent to be usefully summarized in a single science score.

An IRT approach 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. The scale was standardized using students from both the grades tested. When all participating countries and grades are treated equally, the TIMSS scale average is 500 and the standard deviation is 100. Since the countries varied in size, each country was reweighted to contribute equally to the mean and standard deviation of the scale. The average of the scale scores was constructed to be the average of the 26 means of participants that were available at the fourth grade and the 24 means at the third grade. The average and standard deviation of the scale scores are arbitrary and do not affect scale interpretations.

The analytic approach underlying the results in Chapters 2 and 3 of this report involved calculating the percentage of correct answers for each item for each participating country (as well as the percentages of different types of incorrect responses). The percentage of correct responses were averaged to summarize science performance overall and in each of the content areas for each country as a whole and by gender. For items with more than one part, each part was analyzed separately in calculating the percentage of correct responses. Also, for items with more than one point awarded for full credit, the percentage of correct responses reflect an average of the points received by students in each country. This was achieved by including the percentage of students receiving one score point as well as the percentage receiving two score points in the calculations. Thus, the average percent correct is based on the number of score points rather than the number of items per se. An exception to this is the international average percent correct reported for example items, where the values reflect the percentage of students receiving full credit.

Estimating the Link Between Fourth- and Eighth-Grade Performance

Fifteen of the items in mathematics (15%) and 18 in science (19%) were included in the tests at both Populations 1 and 2. The difference in performance between the populations on these items was used to estimate the link between the third and fourth grades on one hand and the seventh and eighth grades on the other.

For each of the link items, the international item difficulty level from the IRT analyses for Population 1 was subtracted from the international difficulty level at Population 2. Investigations of the results indicated that the increases between the two populations were relatively stable across items, especially in mathematics. It also was determined that between-grade increases between the third and fourth grades and between the seventh and eighth grades on the link items were consistent with the between-grade increases observed on the entire pool of items for Populations 1 and 2, respectively. Thus, the average difference across items was used to estimate the difference in performance between the two populations.

In making the link, results for the third- and fourth-grade students were placed on the scale used to report seventh- and eighth-grade performance. Because of the difference in variances between the scales for Populations 1 and 2, it first was necessary to transform the Population 1 scales. The adjustment factor for mathematics was .96 and for science was 1.25. Next, a constant (121 scale points for mathematics and 283 for science) was subtracted from the Population 1 results for each country.

The country means for the third and fourth grades transformed to the seventh- and eighth-grade scale are shown in Table A.11. The results shown in Table A.11 are based on all items administered to the third and fourth graders. The relative standings of the countries are identical to those presented in Chapter 1. Since there were relatively few items in common, the size of the link is approximate. The standard errors for the third- and fourth-grade estimates incorporate an added component to account for the uncertainty of this approximation. Because the link is very approximate, the achievement increases between the third/fourth grades and the seventh/eighth grades must be interpreted with extreme caution.

Table A.11

Science Performance at the Third, Fourth, Seventh, and Eighth Grades* Based on the Population 2 (Seventh- and Eighth-Grade) Scale

Country	Third Grade Mean	Fourth Grade Mean	Seventh Grade Mean	Eighth Grade Mean
Australia	351 (14.9)	417 (14.4)	504 (3.6)	545 (3.9)
Austria	345 (15.0)	420 (14.5)	519 (3.1)	558 (3.7)
Canada	328 (14.2)	401 (14.4)	499 (2.3)	531 (2.6)
Cyprus	233 (14.2)	309 (14.5)	420 (1.8)	463 (1.9)
Czech Republic	332 (14.5)	410 (14.4)	533 (3.3)	574 (4.3)
England	338 (14.5)	404 (14.5)	512 (3.5)	552 (3.3)
Greece	272 (14.7)	336 (14.8)	449 (2.6)	497 (2.2)
Hong Kong	316 (14.5)	381 (14.6)	495 (5.5)	522 (4.7)
Hungary	295 (14.8)	379 (14.5)	518 (3.2)	554 (2.8)
Iceland	259 (14.5)	345 (14.5)	462 (2.8)	494 (4.0)
Iran, Islamic Rep.	160 (14.8)	235 (14.7)	436 (2.6)	470 (2.4)
Ireland	313 (14.6)	389 (14.5)	495 (3.5)	538 (4.5)
Israel	- -	345 (14.6)	- -	524 (5.7)
Japan	367 (14.0)	431 (14.1)	531 (1.9)	571 (1.6)
Korea	405 (14.2)	460 (14.1)	535 (2.1)	565 (1.9)
Kuwait	- -	217 (14.4)	- -	430 (3.7)
Latvia (LSS)	296 (15.0)	355 (15.2)	435 (2.7)	485 (2.7)
Netherlands	338 (14.4)	410 (14.4)	517 (3.6)	560 (5.0)
New Zealand	306 (15.3)	378 (15.2)	481 (3.4)	525 (4.4)
Norway	278 (14.7)	377 (14.6)	483 (2.9)	527 (1.9)
Portugal	244 (14.9)	314 (14.8)	428 (2.1)	480 (2.3)
Scotland	319 (14.9)	384 (14.8)	468 (3.8)	517 (5.1)
Singapore	324 (15.2)	398 (15.2)	545 (6.6)	607 (5.5)
Slovenia	323 (14.3)	396 (14.5)	530 (2.4)	560 (2.5)
Thailand	255 (16.1)	306 (15.2)	493 (3.0)	525 (3.7)
United States	353 (14.4)	421 (14.4)	508 (5.5)	534 (4.7)
International Average	306 (3.0)	370 (2.9)	492 (0.7)	527 (0.7)

*Third, fourth, seventh, and eighth grades in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Because population coverage falls below 65%, Latvia is annotated LSS for Latvian Speaking Schools only.
A dash (-) indicates data are unavailable. Israel and Kuwait did not test the third or seventh grades.
Note: Since there are only 17 science items in common in the tests given to the two grades, the estimate of the relationship is approximate. The standard errors for the third- and fourth-grade estimates incorporate an added component to account for the uncertainty of this approximation. The seventh- and eighth-grade means are the same as those reported in *Science Achievement in the Middle School Years: IEA's Third Mathematics and Science Study.*

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

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. 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% confidence interval for the corresponding population result.

Appendix B

Test-Curriculum Matching Analysis

When comparing student achievement across countries, it is important that the comparisons be as "fair" as possible. TIMSS has worked towards 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. Developing the TIMSS tests involved the interaction of experts in the sciences with representatives of the participating countries and testing specialists.[1] The National Research Coordinators (NRCs) from each country formally approved the TIMSS test, thus accepting it as being sufficiently fair to compare their students' science achievement with that of students from other countries.

Although the TIMSS test was developed to represent a set of agreed-upon science content areas, there are differences among the curricula of participating countries that result in various science topics being taught at different grades. To restrict test items not only to those topics in the curricula of all countries but also to those covered in the same sequence in all participating countries would severely limit test coverage and restrict the research questions about international differences that TIMSS is designed to address. The TIMSS tests, therefore, inevitably contain some items measuring topics unfamiliar to some students in some countries.

The Test-Curriculum Matching Analysis (TCMA) was developed and conducted to investigate the appropriateness of the TIMSS science test for third- and fourth-grade students in the participating countries, and to show how student performance for individual countries varied when based only on the test questions that were judged to be relevant to their own curriculum.[2]

To gather data about the extent to which the TIMSS tests were relevant to the curriculum of the participating countries, TIMSS asked the NRC of each country to report whether or not each item was in their country's intended curriculum at each of the two grades being tested. The NRC was asked to choose a person or persons who were very familiar with the curricula at the grades being tested to make the 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% of the students. The NRCs had considerable flexibility in selecting items and may have considered items inappropriate for other reasons. All participating countries except Austria and Thailand returned the information for analysis.

[1] See Appendix A for more information on the test development.

[2] Because there also may be curriculum areas covered in some countries that are not covered by the TIMSS tests, the TCMA does not provide complete information about how well the TIMSS tests cover the curricula of the countries.

Tables B.1 and B.2 present the TCMA results for the fourth and third grades, respectively. The first row of each table indicates that at both grades the countries varied substantially in the number of items considered appropriate. At the fourth grade, half of the countries indicated that items representing two-thirds or more of the score points (70 out of a possible 105) were appropriate,[3] with the percentage ranging from 100% in the United States to approximately 25% in Korea (25 score points) and Japan (29 score points). Fewer items were selected at the third grade, where about one-third of the countries selected at least half of the score points. All items were selected at the third grade as well as the fourth grade in the United States. At the third grade there were also several countries, including Ireland, Korea, and Japan, that retained less than 20% of the score points. That lower percentages of items were selected for the TCMA at the third grade is consistent with the instrument development process, which put more emphasis on the upper-grade curriculum. The low percentage of items considered appropriate for their curricula in several countries implies that science may not be emphasized at these grades by those countries.

Since most countries indicated that some items were not included in their intended curricula at the two grades tested, the question becomes whether the inclusion of these items had any effect on the international performance comparisons.[4] The TCMA results offer a method for answering this question, providing evidence that the relative standings of countries generally do not vary much for the different sets of items selected from the TIMSS science test.

The first column in Tables B.1 and B.2 shows the overall average percent correct for each country (as discussed in Chapter 2 and reproduced here for convenience in making comparisons). The countries are presented in the order of their overall performance, from highest to lowest. To interpret these tables, reading across a row provides the average percent correct for the students in that country on the items selected by each country listed across the top of the table. For example, at the fourth grade Korea, where the average percent correct was 77% on its own set of items, had 79% for the items selected by Japan, 78% for those selected by the Netherlands, 74% for those selected by Australia, and so forth. The column for a country shows how each of the other countries performed on the subset of items selected for its own students. Using the set of items selected by Hong Kong as an example, on average, 81% of these were answered correctly by the Korean students, 76% by the Japanese students, 74% by the Dutch, and so forth. The shaded diagonal elements in each table show how each country performed on the subset of items that it selected based on its own curriculum. Thus, the Hong Kong students themselves averaged 72% correct responses on the items identified by Hong Kong for the analysis.

[3] Of the 97 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 105. The TCMA uses the score points in order to give the same weight to items that they received in the test scoring.

[4] It should be noted that the performance levels presented in Tables B.1 and B.2 are based on the average percent correct as was done in Chapter 2, which is different from the average scale scores that were presented in Chapter 1. The cost and delay of scaling would have been prohibitive for the TCMA analyses.

Table B.1 Test-Curriculum Matching Analysis Results - Science - Upper Grade (Fourth Grade*)

Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.3 for corresponding standard errors)

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.

Country	Average Percent Correct on all Items	Korea	Japan	Netherlands	Australia	United States	Czech Republic	Singapore	Slovenia	Canada	England	Hong Kong	Hungary	Ireland	Norway	New Zealand	Scotland	Israel	Latvia (LSS)	Iceland	Greece	Cyprus	Portugal	Iran, Islamic Rep.	Kuwait
	(Number of Score Points Included)																								
	105	*25*	*29*	*68*	*80*	*105*	*95*	*52*	*98*	*93*	*53*	*42*	*49*	*27*	*62*	*90*	*45*	*33*	*104*	*94*	*71*	*61*	*84*	*85*	*85*
Korea	74 (0.4)	77	79	78	74	74	75	78	74	75	76	81	78	83	77	76	81	76	74	73	76	78	75	75	75
Japan	70 (0.3)	68	79	74	71	70	70	73	70	71	71	76	72	80	73	72	76	71	70	70	72	72	72	72	70
Netherlands	67 (0.5)	65	70	72	68	67	67	69	68	67	68	74	69	77	72	68	75	69	67	66	70	71	70	68	68
Australia	66 (0.5)	66	67	70	68	66	67	70	67	66	68	73	67	78	70	68	75	67	66	66	69	70	68	67	67
United States	66 (0.5)	65	67	70	67	66	66	70	66	66	69	73	67	78	70	67	75	69	66	66	69	69	68	67	67
Czech Republic	65 (0.5)	65	68	70	67	65	66	68	66	65	66	72	68	79	70	68	71	67	65	66	68	69	68	67	66
Singapore	64 (0.8)	62	70	69	65	64	65	71	64	65	66	74	68	76	68	66	72	65	64	64	67	68	66	66	66
Slovenia	64 (0.7)	61	64	68	64	64	64	66	64	64	65	70	65	74	69	66	69	64	64	65	66	67	66	65	64
Canada	64 (0.6)	64	64	67	65	64	64	66	64	63	64	71	64	76	67	65	71	65	64	63	66	67	65	64	64
England	63 (0.6)	63	64	67	64	63	63	66	64	63	65	71	65	76	68	65	71	64	63	63	66	67	65	64	64
Hong Kong	62 (0.7)	59	68	66	64	62	63	66	63	62	63	72	65	76	68	64	67	61	62	62	65	65	64	64	63
Hungary	62 (0.6)	60	62	66	62	62	62	64	63	61	62	69	65	73	67	63	66	62	62	62	65	65	63	63	62
Ireland	61 (0.6)	60	61	64	62	61	61	64	61	61	62	69	62	74	65	62	69	64	61	61	63	66	63	62	62
Norway	60 (0.6)	58	61	65	61	60	61	63	61	60	61	68	62	71	67	62	68	59	61	61	63	64	63	61	61
New Zealand	60 (0.9)	59	60	64	61	60	61	64	61	60	61	67	61	72	64	62	68	61	60	60	63	65	62	61	61
Scotland	60 (0.8)	59	61	64	61	60	60	64	61	60	62	69	62	73	65	62	69	61	60	60	63	65	62	61	61
Israel	57 (0.8)	56	58	61	57	57	57	61	57	57	59	65	59	69	61	58	65	58	57	57	59	60	60	58	57
Latvia (LSS)	56 (0.8)	55	56	60	57	56	56	59	57	56	56	63	59	66	61	58	62	56	56	57	58	59	58	58	57
Iceland	55 (0.7)	55	55	59	56	55	56	59	56	55	56	61	58	65	61	57	64	55	55	56	57	57	57	57	56
Greece	54 (0.8)	53	54	58	54	54	54	58	54	54	54	62	56	65	59	55	62	55	54	54	57	58	56	55	55
Cyprus	51 (0.5)	52	52	55	51	51	50	55	51	50	49	59	53	61	56	52	58	53	50	51	53	54	52	52	52
Portugal	50 (0.7)	50	50	54	51	50	50	53	51	49	50	57	52	59	55	52	57	52	50	50	52	53	53	51	50
Iran, Islamic Rep.	40 (0.7)	38	39	44	40	40	40	45	40	39	38	48	42	48	44	41	44	37	40	40	42	41	41	41	41
Kuwait	39 (0.5)	42	42	43	39	39	40	43	39	38	37	47	41	48	43	41	45	40	39	39	42	41	40	40	41
International Average	**60 (0.6)**	**59**	**61**	**64**	**60**	**60**	**60**	**63**	**60**	**60**	**60**	**67**	**62**	**71**	**64**	**61**	**67**	**61**	**60**	**60**	**62**	**63**	**61**	**61**	**60**

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
**Of the 97 items in the science test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 105 total score points.
( ) Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.3.
Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).
Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table B.2 Test-Curriculum Matching Analysis Results - Science - Lower Grade (Third Grade*)

Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.4 for corresponding standard errors)

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.

Country	Average Percent Correct on all Items	Korea	Japan	Australia	United States	Netherlands	Czech Republic	England	Canada	Singapore	Slovenia	Hong Kong	Scotland	Ireland	New Zealand	Hungary	Latvia (LSS)	Norway	Greece	Iceland	Portugal	Cyprus	Iran, Islamic Rep.
	(Number of Score Points Included)																						
	105	11	17	49	105	34	40	32	64	32	92	34	33	14	68	41	74	49	30	93	84	44	39
Korea	67 (0.5)	66	76	71	67	76	78	74	71	71	67	76	77	83	71	74	68	74	78	67	68	70	69
Japan	61 (0.3)	62	76	67	61	68	74	68	66	65	61	70	66	77	65	66	61	68	69	61	63	64	64
Australia	57 (0.8)	55	60	61	57	62	65	62	61	58	57	65	66	76	59	59	58	64	69	56	58	58	58
United States	56 (0.6)	57	60	62	56	62	66	62	61	58	57	66	66	75	58	59	58	66	69	56	58	58	59
Netherlands	56 (0.7)	57	60	61	56	66	67	62	60	55	57	67	65	72	58	61	59	66	68	55	58	59	59
Czech Republic	55 (0.6)	52	61	58	55	61	66	60	58	56	55	64	63	74	58	59	56	64	70	55	57	56	59
England	55 (0.7)	51	57	59	55	61	64	60	58	56	55	64	64	73	57	58	56	63	66	54	56	55	57
Canada	53 (0.5)	52	56	57	53	59	62	58	57	54	53	62	62	70	55	56	55	61	65	53	55	54	55
Singapore	53 (0.9)	54	65	58	53	61	66	62	58	61	52	65	62	74	56	60	54	61	64	53	55	57	57
Slovenia	53 (0.5)	46	55	55	53	58	65	58	56	54	53	62	62	72	54	57	54	62	65	54	55	54	54
Hong Kong	53 (0.6)	53	59	57	53	59	64	60	57	54	52	63	61	74	56	56	54	61	62	52	54	52	57
Scotland	51 (0.7)	48	55	56	51	58	62	57	55	53	52	61	61	71	53	56	53	60	64	51	53	53	54
Ireland	51 (0.7)	47	54	56	51	58	62	57	56	54	51	62	62	72	53	55	53	60	64	51	53	52	54
New Zealand	51 (0.9)	51	54	54	51	57	61	56	54	53	51	60	60	69	53	55	52	58	63	50	52	53	53
Hungary	50 (0.8)	44	55	52	50	55	61	55	53	52	51	61	57	67	52	55	50	58	65	50	51	52	53
Latvia (LSS)	48 (0.9)	43	50	50	48	54	60	53	51	51	49	58	56	64	51	54	50	57	62	49	51	52	52
Norway	46 (0.7)	41	48	49	46	50	56	49	49	45	46	55	55	61	48	49	48	56	60	46	48	48	49
Greece	44 (0.7)	35	43	46	44	49	54	48	49	45	45	55	56	63	46	49	46	54	59	45	46	46	45
Iceland	42 (0.6)	33	40	44	42	45	51	45	46	42	42	50	52	54	44	46	44	52	56	43	44	42	44
Portugal	41 (0.8)	31	45	43	41	45	51	45	44	44	41	51	48	55	43	45	43	50	53	41	43	44	44
Cyprus	39 (0.5)	33	43	41	39	45	52	44	43	43	39	50	47	57	42	43	41	48	52	40	41	44	40
Iran, Islamic Rep.	30 (0.7)	23	33	31	30	31	39	31	33	33	30	40	33	42	32	33	31	36	39	31	31	33	34
International Average	**51 (0.7)**	**47**	**55**	**54**	**51**	**56**	**61**	**56**	**54**	**53**	**51**	**60**	**59**	**68**	**53**	**55**	**52**	**59**	**63**	**51**	**52**	**53**	**53**

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
**Of the 97 items in the science test, some items had two parts and some extended-response items were scored on a two-scale, resulting in 105 total score points.
( ) Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.4.
Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).
Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

The international averages of each country's selected items presented across the last row of the tables show that the selection of items for the participating countries varied somewhat in average difficulty, ranging from 59% to 71% at the fourth grade and from 47% to 61% at third grade. Despite these differences, the overall picture provided by Tables B.1 and B.2 reveals that different item selections do not make a major difference in how well countries perform relative to each other. The items selected by some countries were more difficult than those selected by others. The relative performance of countries on the 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 percentage correct shows the difference between performance on this subset of items and performance on the test as a whole. In general, there were small increases in each country's performance on its own subset of items. To illustrate, the average percent correct for fourth-grade students in Korea was 74%. The diagonal element shows that Korean students had about the same average percent correct (77%) on the smaller set of items selected as relevant to the curriculum in Korea as they did overall. In the fourth grade, most countries had a difference of less than 5 percentage points between the two performance measures, with the largest difference of 13% for Ireland (74% compared to 61%). Performance differences between the entire TIMSS test and the subset of items selected for the TCMA were, in general, somewhat larger for third-grade students; several countries had an average performance that was 10 percentage points or more higher on the subsets of items selected for their own students – Japan, the Netherlands, the Czech Republic, Hong Kong, Scotland, Ireland, Norway, and Greece.

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 performance on the overall test in comparison to each other also had higher or lower relative performance on the different sets of items selected for the TCMA. For example, at the fourth grade, Korea had the highest average percent correct on the test as a whole and on all of the item selections, with Japan, the Netherlands, and Australia among the four highest-performing countries in almost 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 the most extreme example, consider the 27 score points selected by Ireland for the fourth grade. The Irish students did substantially better on these items than on the test as a whole, with 74% correct responses to these items, on average, compared to 61% average correct on the items on the test as a whole. However, all other countries also did better on these particular items, with an international average of 71% for the items selected by Ireland compared with 60% on the test as a whole. Insofar as countries

[5] Small differences in performance in these tables are not statistically significant. The standard errors for the estimated average percent correct statistics can found in Tables B.3 and B.4. We can say with 95% confidence that the value for the entire population will fall between the sample estimate plus or minus two standard errors.

rejected items that would be difficult for their own 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 relative standing of countries is largely unaffected.

Table B.3 Standard Errors for the Test-Curriculum Matching Analysis Results - Science - Upper Grade (Fourth Grade*)

See Table B.1 for the Test-Curriculum Matching Analysis Results

Instructions: Read ***across*** the row for the standard error for the score based on the test items included by each of the countries across the top.
Read ***down*** the column under a country name for the standard error for the score of the country down the left on the items included by the country listed on the top.
Read along the ***diagonal*** for the standard error for the score for each different country based on its own decisions about the test items to include.

Country	Average Percent Correct on all Items	Korea	Japan	Netherlands	Australia	United States	Czech Republic	Singapore	Slovenia	Canada	England	Hong Kong	Hungary	Ireland	Norway	New Zealand	Scotland	Israel	Latvia (LSS)	Iceland	Greece	Cyprus	Portugal	Iran, Islamic Rep.	Kuwait
	(Number of Score Points Included)																								
	105	25	29	68	80	105	95	52	98	93	53	42	49	27	62	90	45	33	104	94	71	61	84	85	85
Korea	74 (0.4)	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Japan	70 (0.3)	0.4	0.4	0.3	0.4	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4
Netherlands	67 (0.5)	0.7	0.7	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5
Australia	66 (0.5)	0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
United States	66 (0.5)	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Czech Republic	65 (0.5)	0.7	0.7	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.5
Singapore	64 (0.8)	0.9	0.9	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.9	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.9
Slovenia	64 (0.7)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.7
Canada	64 (0.6)	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.5	0.6	0.6	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6
England	63 (0.6)	0.8	0.8	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Hong Kong	62 (0.7)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7
Hungary	62 (0.6)	0.8	0.8	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.7	0.6	0.6	0.6
Ireland	61 (0.6)	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Norway	60 (0.6)	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6
New Zealand	60 (0.9)	1.1	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	1.0	0.9	1.0	1.0	0.9	0.9	1.1	1.0	0.9	0.9	0.9	1.0	0.9	0.9	0.9
Scotland	60 (0.8)	0.9	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Israel	57 (0.8)	1.0	1.1	0.8	0.8	0.8	0.8	1.0	0.8	0.9	1.0	0.9	0.9	0.9	0.8	0.8	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Latvia (LSS)	56 (0.8)	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.8	0.8	0.9	0.9	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.8
Iceland	55 (0.7)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.7	0.7	0.7
Greece	54 (0.8)	1.0	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.9	0.8	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.8	0.9	0.8
Cyprus	51 (0.5)	0.6	0.6	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.5	0.5
Portugal	50 (0.7)	0.9	1.0	0.8	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.7	0.8	0.9	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.7
Iran, Islamic Rep.	40 (0.7)	0.7	0.9	0.8	0.7	0.7	0.7	0.8	0.7	0.7	0.8	0.8	0.7	0.9	0.8	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Kuwait	39 (0.5)	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.6	0.8	0.6	0.6	0.7	0.6	0.5	0.5	0.6	0.6	0.6	0.5	0.6
International Average	**60 (0.6)**	**0.8**	**0.8**	**0.7**	**0.6**	**0.6**	**0.6**	**0.7**	**0.6**	**0.6**	**0.7**	**0.6**	**0.7**	**0.7**	**0.6**	**0.6**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.7**	**0.6**

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
**Of the 97 items in the science test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 105 total score points.
( ) Standard errors for the average percent of correct responses on all items appear in parentheses. The matrix contains standard errors corresponding to the average percent of correct responses based on TCMA subsets of items, as displayed in Table B.1. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).
Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table B.4 Standard Errors for the Test-Curriculum Matching Analysis Results - Science - Lower Grade (Third Grade*)

See Table B.3 for the Test-Curriculum Matching Analysis Results

Instructions: Read ***across*** the row for the standard error for the score based on the test items included by each of the countries across the top.
Read ***down*** the column under a country name for the standard error for the score of the country down the left on the items included by the country listed on the top.
Read along the ***diagonal*** for the standard error for the score for each different country based on its own decisions about the test items to include.

Country	Average Percent Correct on all Items	Korea	Japan	Australia	United States	Netherlands	Czech Republic	England	Canada	Singapore	Slovenia	Hong Kong	Scotland	Ireland	New Zealand	Hungary	Latvia (LSS)	Norway	Greece	Iceland	Portugal	Cyprus	Iran, Islamic Rep.
	(Number of Score Points Included)																						
	105	*11*	*17*	*49*	*105*	*34*	*40*	*32*	*64*	*32*	*92*	*34*	*33*	*14*	*68*	*41*	*74*	*49*	*30*	*93*	*84*	*44*	*39*
Korea	67 (0.5)	0.8	0.6	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Japan	61 (0.3)	0.5	0.5	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Australia	57 (0.8)	0.9	1.0	0.8	0.8	0.8	0.7	0.8	0.7	0.7	0.7	0.8	0.9	0.8	0.8	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7
United States	56 (0.6)	1.1	0.8	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.7	0.6	0.7	0.6	0.6	0.7	0.6	0.6	0.7	0.6
Netherlands	56 (0.7)	1.0	0.8	0.8	0.7	0.8	0.7	0.8	0.7	0.8	0.7	0.7	0.7	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8
Czech Republic	55 (0.6)	0.9	0.7	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.6	0.6	0.6	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
England	55 (0.7)	0.9	1.0	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.8
Canada	53 (0.5)	0.8	0.7	0.6	0.5	0.5	0.5	0.6	0.5	0.7	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.6
Singapore	53 (0.9)	0.8	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.8	0.9
Slovenia	53 (0.5)	1.0	0.7	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.7	0.7	0.5	0.6	0.5	0.5	0.7	0.5	0.5	0.5	0.7
Hong Kong	53 (0.6)	0.8	0.7	0.6	0.6	0.8	0.7	0.6	0.7	0.7	0.6	0.5	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6
Scotland	51 (0.7)	1.1	0.9	0.8	0.7	0.9	0.8	0.8	0.8	0.9	0.8	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.8
Ireland	51 (0.7)	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.9	0.7	0.7	0.6	0.7	0.8	0.6	0.7	0.7	0.8
New Zealand	51 (0.9)	1.4	1.1	1.0	0.9	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.1	1.1	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	1.0
Hungary	50 (0.8)	1.1	0.9	0.9	0.8	1.0	0.8	0.9	0.9	0.9	0.8	0.8	0.8	1.0	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8
Latvia (LSS)	48 (0.9)	1.2	1.0	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9
Norway	46 (0.7)	1.0	0.9	0.8	0.7	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.9	0.7	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.8
Greece	44 (0.7)	1.3	1.2	0.8	0.7	1.0	0.9	1.1	0.8	0.9	0.8	0.9	0.8	1.0	0.8	0.9	0.8	0.8	0.9	0.7	0.7	0.9	0.7
Iceland	42 (0.6)	1.1	1.1	0.7	0.6	0.8	0.8	0.8	0.6	0.8	0.6	0.7	0.9	0.8	0.7	0.8	0.7	0.7	0.8	0.6	0.7	0.8	0.7
Portugal	41 (0.8)	1.1	1.0	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Cyprus	39 (0.5)	1.0	0.8	0.5	0.5	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.7	0.8	0.6	0.7	0.5	0.6	0.6	0.5	0.5	0.6	0.6
Iran, Islamic Rep.	30 (0.7)	1.0	0.8	0.7	0.7	0.8	0.9	0.8	0.8	0.8	0.7	0.9	0.8	0.9	0.7	0.8	0.7	0.8	0.9	0.7	0.7	0.7	0.8
International Average	**51 (0.7)**	**1.0**	**0.9**	**0.7**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
**Of the 97 items in the science test, some items had two parts and some extended-response items were scored on a two-point scale, resulting in 105 total score points.
( ) Standard errors for the average percent of correct responses on all items appear in parentheses. The matrix contains standard errors corresponding to the average percent of correct responses based on TCMA subsets of items, as displayed in Table B.2. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).
Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix C

Percentiles and Standard Deviations of Achievement in Science

Table C.1

Percentiles of Achievement in Science
Upper Grade (Fourth Grade*)

Country	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Australia	403 (6.0)	502 (3.4)	568 (2.7)	626 (2.5)	707 (1.1)
Austria	429 (15.6)	513 (2.6)	568 (1.9)	619 (2.9)	692 (7.0)
Canada	409 (6.1)	493 (4.3)	552 (3.5)	607 (3.6)	691 (3.8)
Cyprus	348 (7.1)	427 (3.1)	476 (2.1)	528 (4.6)	595 (5.1)
Czech Republic	425 (3.9)	502 (3.2)	556 (3.8)	610 (3.8)	689 (2.9)
England	388 (7.8)	489 (3.3)	553 (4.4)	615 (2.8)	708 (8.6)
Greece	354 (8.5)	448 (4.0)	501 (4.0)	552 (5.1)	627 (4.0)
Hong Kong	401 (10.7)	483 (5.5)	536 (4.8)	585 (4.5)	657 (6.0)
Hungary	396 (6.4)	478 (3.5)	535 (3.3)	586 (5.8)	660 (6.9)
Iceland	360 (1.5)	447 (3.5)	507 (4.8)	564 (3.4)	632 (1.9)
Iran, Islamic Rep.	295 (4.0)	365 (3.9)	415 (3.1)	467 (5.5)	539 (4.1)
Ireland	388 (6.7)	487 (7.0)	544 (2.6)	596 (3.6)	674 (5.3)
Israel	366 (8.4)	446 (4.4)	506 (3.6)	564 (3.6)	646 (6.9)
Japan	453 (1.8)	527 (1.9)	576 (2.3)	624 (1.5)	687 (1.6)
Korea	481 (3.0)	554 (3.3)	600 (2.6)	643 (1.6)	704 (3.2)
Kuwait	260 (6.2)	345 (4.2)	401 (2.8)	458 (2.9)	541 (2.1)
Latvia (LSS)	378 (6.0)	457 (6.4)	510 (6.2)	563 (7.0)	649 (11.9)
Netherlands	448 (6.7)	514 (3.4)	556 (3.6)	602 (2.3)	661 (1.8)
New Zealand	364 (9.4)	471 (6.2)	534 (5.3)	598 (4.2)	683 (3.9)
Norway	387 (3.6)	476 (2.8)	534 (3.8)	592 (3.7)	663 (3.7)
Portugal	331 (6.7)	427 (3.6)	485 (3.6)	535 (3.8)	610 (3.6)
Scotland	376 (11.8)	472 (5.2)	540 (4.1)	598 (3.4)	687 (7.9)
Singapore	377 (6.0)	486 (4.3)	551 (6.9)	612 (7.6)	700 (7.8)
Slovenia	419 (7.6)	497 (4.5)	547 (4.0)	598 (2.5)	668 (9.3)
Thailand	353 (9.0)	424 (6.4)	474 (4.7)	520 (3.7)	589 (5.1)
United States	397 (5.7)	505 (5.0)	573 (4.0)	633 (3.1)	711 (4.3)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.2

Percentiles of Achievement in Science
Lower Grade (Third Grade*)

Country	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Australia	338 (9.8)	449 (5.5)	513 (4.6)	580 (5.7)	661 (4.9)
Austria	351 (6.9)	449 (6.4)	511 (4.7)	564 (5.8)	640 (5.6)
Canada	339 (7.4)	433 (4.7)	494 (2.4)	552 (2.4)	630 (3.7)
Cyprus	297 (4.2)	365 (4.1)	415 (2.0)	463 (2.5)	534 (4.2)
Czech Republic	355 (6.5)	434 (4.3)	493 (4.3)	553 (3.5)	635 (8.0)
England	328 (6.9)	435 (4.1)	501 (4.3)	568 (3.4)	662 (6.2)
Greece	305 (8.2)	392 (4.2)	447 (3.6)	501 (4.2)	575 (11.4)
Hong Kong	358 (3.1)	432 (4.0)	485 (2.6)	533 (4.4)	598 (5.3)
Hungary	316 (9.4)	406 (5.8)	468 (6.7)	526 (4.0)	606 (11.5)
Iceland	294 (4.2)	381 (4.2)	439 (4.0)	492 (2.8)	566 (2.2)
Iran, Islamic Rep.	232 (6.6)	303 (3.4)	357 (5.4)	407 (6.4)	479 (7.5)
Ireland	325 (10.5)	424 (6.0)	482 (3.5)	538 (5.0)	616 (4.0)
Israel	- -	- -	- -	- -	- -
Japan	399 (2.4)	476 (1.6)	524 (2.4)	571 (2.6)	637 (2.7)
Korea	432 (4.2)	507 (2.8)	556 (2.9)	600 (2.0)	667 (4.1)
Kuwait	- -	- -	- -	- -	- -
Latvia (LSS)	328 (6.7)	412 (3.8)	464 (4.0)	520 (6.8)	597 (10.0)
Netherlands	395 (4.2)	460 (4.0)	500 (2.2)	540 (2.3)	599 (3.6)
New Zealand	301 (18.9)	410 (5.3)	478 (6.4)	541 (4.8)	632 (5.2)
Norway	297 (5.3)	390 (3.2)	451 (2.8)	514 (4.0)	592 (6.6)
Portugal	253 (23.8)	366 (5.5)	428 (3.8)	486 (4.1)	574 (6.7)
Scotland	324 (7.1)	423 (4.4)	486 (7.5)	549 (4.8)	635 (7.0)
Singapore	320 (5.2)	421 (6.8)	489 (6.5)	556 (5.1)	647 (7.2)
Slovenia	357 (6.3)	435 (2.2)	487 (2.9)	541 (2.9)	617 (7.3)
Thailand	304 (8.6)	382 (8.9)	434 (4.9)	486 (9.1)	555 (10.8)
United States	352 (5.3)	450 (4.3)	515 (4.5)	575 (3.4)	662 (12.0)

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.
A dash (-) indicates data are not available. Israel and Kuwait did not test the lower grades.
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.3

Standard Deviations of Achievement in the Sciences Upper Grade (Fourth Grade*)

Country	Overall		Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Australia	562 (2.9)	93 (1.9)	569 (3.3)	97 (2.2)	556 (3.2)	88 (2.0)
Austria	565 (3.3)	80 (2.0)	572 (3.9)	80 (2.5)	556 (3.7)	79 (2.2)
Canada	549 (3.0)	86 (1.8)	553 (3.7)	89 (2.1)	545 (3.2)	82 (2.2)
Cyprus	475 (3.3)	76 (1.5)	480 (4.0)	79 (2.1)	471 (3.1)	72 (1.4)
Czech Republic	557 (3.1)	81 (1.5)	565 (3.4)	81 (1.8)	548 (3.6)	81 (1.9)
England	551 (3.3)	96 (1.6)	555 (4.0)	102 (2.3)	548 (3.4)	90 (1.9)
Greece	497 (4.1)	83 (3.3)	501 (4.5)	84 (3.4)	494 (4.3)	82 (3.7)
Hong Kong	533 (3.7)	78 (1.7)	540 (4.1)	80 (2.0)	526 (3.8)	73 (2.2)
Hungary	532 (3.4)	81 (1.3)	539 (3.8)	81 (1.9)	525 (3.9)	79 (1.8)
Iceland	505 (3.3)	85 (1.5)	514 (4.3)	88 (2.2)	496 (3.3)	81 (2.0)
Iran, Islamic Rep.	416 (3.9)	74 (1.7)	421 (5.9)	76 (2.5)	412 (4.7)	72 (1.8)
Ireland	539 (3.3)	85 (1.7)	543 (3.5)	87 (1.9)	536 (4.5)	82 (2.2)
Israel	505 (3.6)	86 (1.5)	512 (4.5)	87 (2.0)	501 (3.8)	86 (2.0)
Japan	574 (1.8)	73 (1.0)	580 (2.0)	77 (1.5)	567 (2.0)	68 (1.0)
Korea	597 (1.9)	68 (0.9)	604 (2.2)	70 (1.5)	590 (2.5)	66 (1.3)
Kuwait	401 (3.1)	85 (1.8)	389 (5.8)	92 (2.4)	414 (3.1)	75 (1.5)
Latvia (LSS)	512 (4.9)	84 (3.6)	512 (5.4)	87 (4.8)	513 (5.5)	80 (3.2)
Netherlands	557 (3.1)	66 (1.7)	570 (3.6)	65 (2.2)	544 (3.5)	64 (2.2)
New Zealand	531 (4.9)	97 (3.1)	527 (6.1)	104 (3.8)	535 (4.8)	89 (2.9)
Norway	530 (3.6)	86 (1.8)	534 (4.7)	90 (2.7)	526 (3.7)	82 (1.7)
Portugal	480 (4.0)	84 (2.4)	481 (4.5)	87 (2.5)	478 (4.2)	81 (3.2)
Scotland	536 (4.2)	93 (1.7)	538 (4.5)	98 (2.2)	533 (4.3)	89 (2.0)
Singapore	547 (5.0)	97 (2.0)	549 (5.4)	101 (2.2)	545 (6.3)	93 (2.5)
Slovenia	546 (3.3)	76 (1.7)	548 (3.3)	78 (1.9)	544 (4.0)	75 (2.2)
Thailand	473 (4.9)	71 (2.4)	471 (5.9)	73 (3.2)	474 (4.3)	69 (2.1)
United States	565 (3.1)	95 (1.4)	571 (3.3)	97 (1.9)	560 (3.3)	92 (1.5)

*Fourth grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table C.4

Standard Deviations of Achievement in the Sciences Lower Grade (Third Grade*)

Country	Overall		Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Australia	510 (4.3)	98 (2.1)	510 (5.6)	104 (3.4)	510 (4.3)	92 (1.5)
Austria	505 (4.6)	88 (2.7)	508 (6.9)	92 (4.0)	501 (4.0)	83 (2.2)
Canada	490 (2.5)	88 (1.3)	496 (3.2)	91 (1.9)	486 (2.9)	84 (1.4)
Cyprus	415 (2.5)	73 (1.5)	418 (2.7)	75 (1.7)	412 (3.0)	71 (2.0)
Czech Republic	494 (3.4)	85 (1.4)	503 (4.1)	86 (1.7)	485 (3.9)	82 (1.9)
England	499 (3.5)	101 (1.9)	503 (4.8)	106 (2.4)	495 (3.4)	95 (2.3)
Greece	446 (3.9)	82 (2.6)	453 (4.6)	85 (3.2)	439 (3.9)	79 (2.3)
Hong Kong	482 (3.3)	74 (1.5)	488 (3.4)	75 (1.9)	473 (3.8)	71 (1.6)
Hungary	464 (4.1)	89 (1.7)	472 (4.2)	89 (2.1)	460 (4.7)	88 (2.0)
Iceland	435 (3.3)	82 (1.7)	440 (4.0)	85 (2.6)	431 (3.9)	79 (2.0)
Iran, Islamic Rep.	356 (4.2)	76 (2.5)	359 (5.7)	79 (3.0)	354 (5.7)	73 (3.2)
Ireland	479 (3.7)	88 (1.8)	481 (4.6)	91 (2.1)	477 (4.4)	84 (2.4)
Israel	- -	- -	- -	- -	- -	- -
Japan	522 (1.6)	73 (0.8)	523 (2.1)	74 (1.3)	521 (2.0)	71 (1.2)
Korea	553 (2.4)	71 (1.2)	562 (2.8)	73 (1.6)	543 (2.7)	69 (1.4)
Kuwait	- -	- -	- -	- -	- -	- -
Latvia (LSS)	465 (4.5)	83 (3.6)	462 (5.2)	83 (4.3)	469 (4.8)	82 (3.3)
Netherlands	499 (3.2)	63 (2.2)	504 (3.8)	63 (2.7)	493 (3.1)	63 (2.1)
New Zealand	473 (5.2)	100 (2.9)	470 (5.9)	103 (3.7)	476 (5.7)	96 (3.6)
Norway	450 (3.9)	90 (2.0)	457 (4.6)	91 (2.4)	444 (4.5)	88 (2.4)
Portugal	423 (4.3)	96 (2.8)	431 (4.3)	96 (3.1)	415 (5.4)	94 (4.2)
Scotland	484 (4.2)	95 (2.4)	485 (4.4)	94 (2.4)	482 (4.7)	96 (3.1)
Singapore	488 (5.0)	99 (2.0)	491 (5.8)	104 (2.3)	484 (5.2)	93 (2.2)
Slovenia	487 (2.8)	78 (1.2)	496 (3.4)	80 (1.8)	478 (3.4)	75 (2.0)
Thailand	433 (6.6)	78 (4.2)	428 (6.5)	79 (4.2)	437 (7.1)	76 (4.6)
United States	511 (3.2)	94 (2.1)	514 (4.2)	97 (2.6)	508 (3.2)	90 (2.2)

*Third grade in most countries; see Table 2 for more information about the grades tested in each country.
( ) Standard errors appear in parentheses.
A dash (-) indicates data are not available. Israel and Kuwait did not test the lower grades.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Appendix D

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TIMSS was truly a collaborative effort among hundreds of individuals around the world. Staff from the national research centers, the international management, advisors, and funding agencies worked closely to design and implement the most ambitious study of international comparative achievement ever undertaken. TIMSS would not have been possible without the tireless efforts of all involved. Below, the individuals and organizations are acknowledged for their contributions. Given that implementing TIMSS has spanned more than seven 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 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.

MANAGEMENT AND OPERATIONS

Since 1993, TIMSS has been directed by the International Study Center at Boston College in the United States. Prior to this, the study was coordinated by the International Coordinating Center at the University of British Columbia in Canada. Although the study was directed centrally by the International Study Center and its staff members implemented various parts of TIMSS, important activities also were carried out in centers around the world. The data were processed centrally by the IEA Data Processing Center in Hamburg, Germany. Statistics Canada was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. The Australian Council for Educational Research conducted the scaling of the achievement data.

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NATIONAL RESEARCH COORDINATORS

The TIMSS National Research Coordinators and their staff had the enormous task of implementing the TIMSS design in their countries. 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 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 others, 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 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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