

# 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.<sup>1</sup> 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.

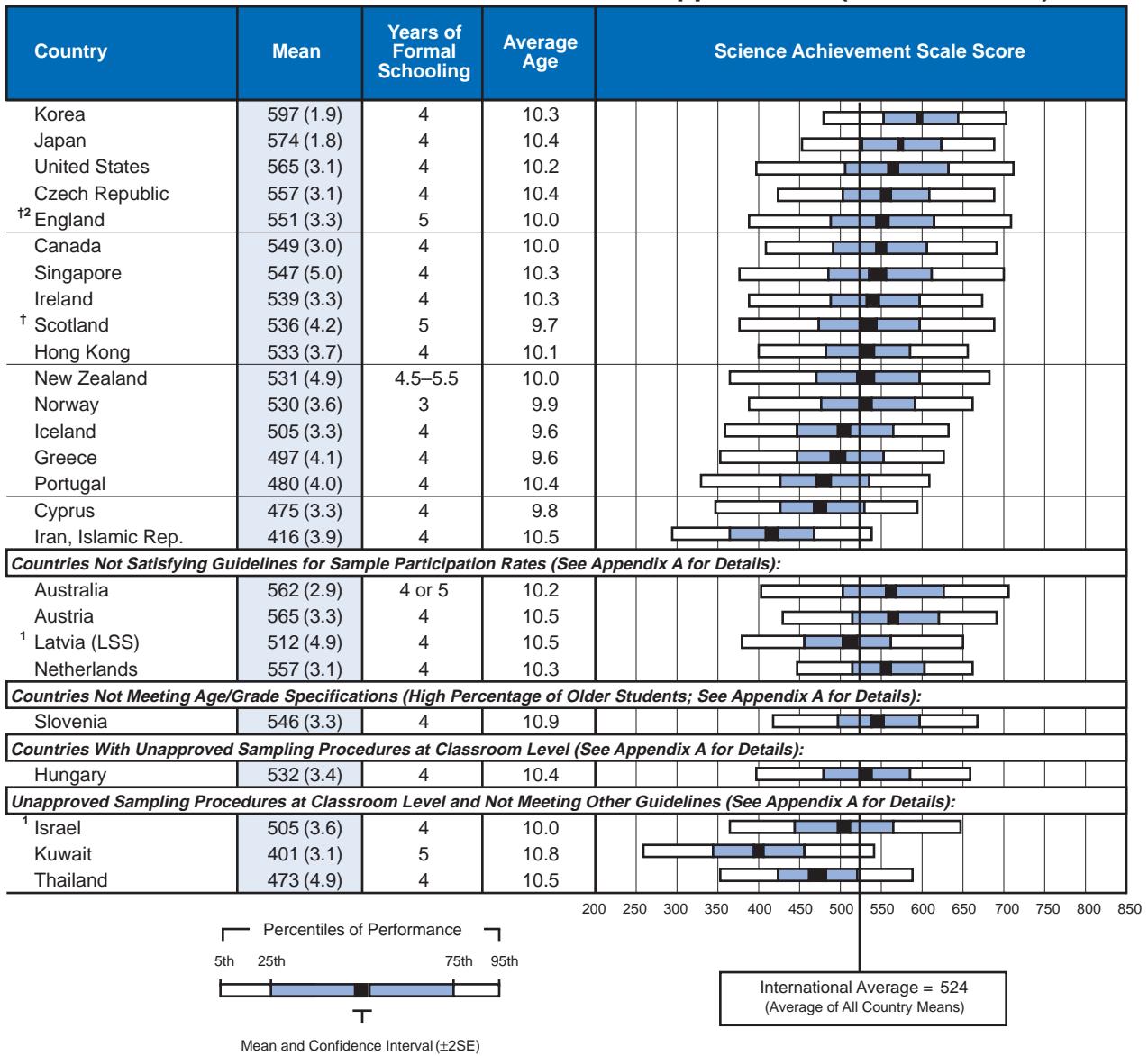
To aid in interpretation, the table also contains the years of formal schooling and average age of the students. Equivalence of chronological age does not necessarily mean that students have received the same number of years of formal schooling or studied the same curriculum. Notably, students in Norway 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

<sup>1</sup> 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\*)**



\*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.  
<sup>†</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).  
<sup>1</sup>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.  
<sup>2</sup>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.†

Country	Korea	Japan	United States	Austria	Australia	Netherlands	Czech Republic	England	Canada	Singapore	Slovenia	Ireland	Scotland	Hong Kong	Hungary	New Zealand	Norway	Latvia (LSS)	Israel	Iceland	Greece	Portugal	Cyprus	Thailand	Iran, Islamic Rep.	Kuwait
Korea		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▼		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	▼	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	●	●		●	●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	▼	●	●		●	●	●	▲	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	▼	▼	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	▼	▼	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	▼	▼	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Ireland	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Scotland	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲
Norway	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼	●	●	●	●	●		●	▲	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	▲	▲	▲	▲	▲
Israel	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	●	▲	▲	▲	▲	▲
Iceland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	▲	▲	▲	▲	▲
Greece	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	▲	▲	▲	▲
Portugal	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	▲	▲	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●		●	▲	▲
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		▲	▲
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼		●
Kuwait	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●

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.<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup> 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.

<sup>2</sup> Tables of the percentile values and standard deviations for all countries are presented in Appendix C.

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

<sup>4</sup> 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.<sup>5</sup> 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.

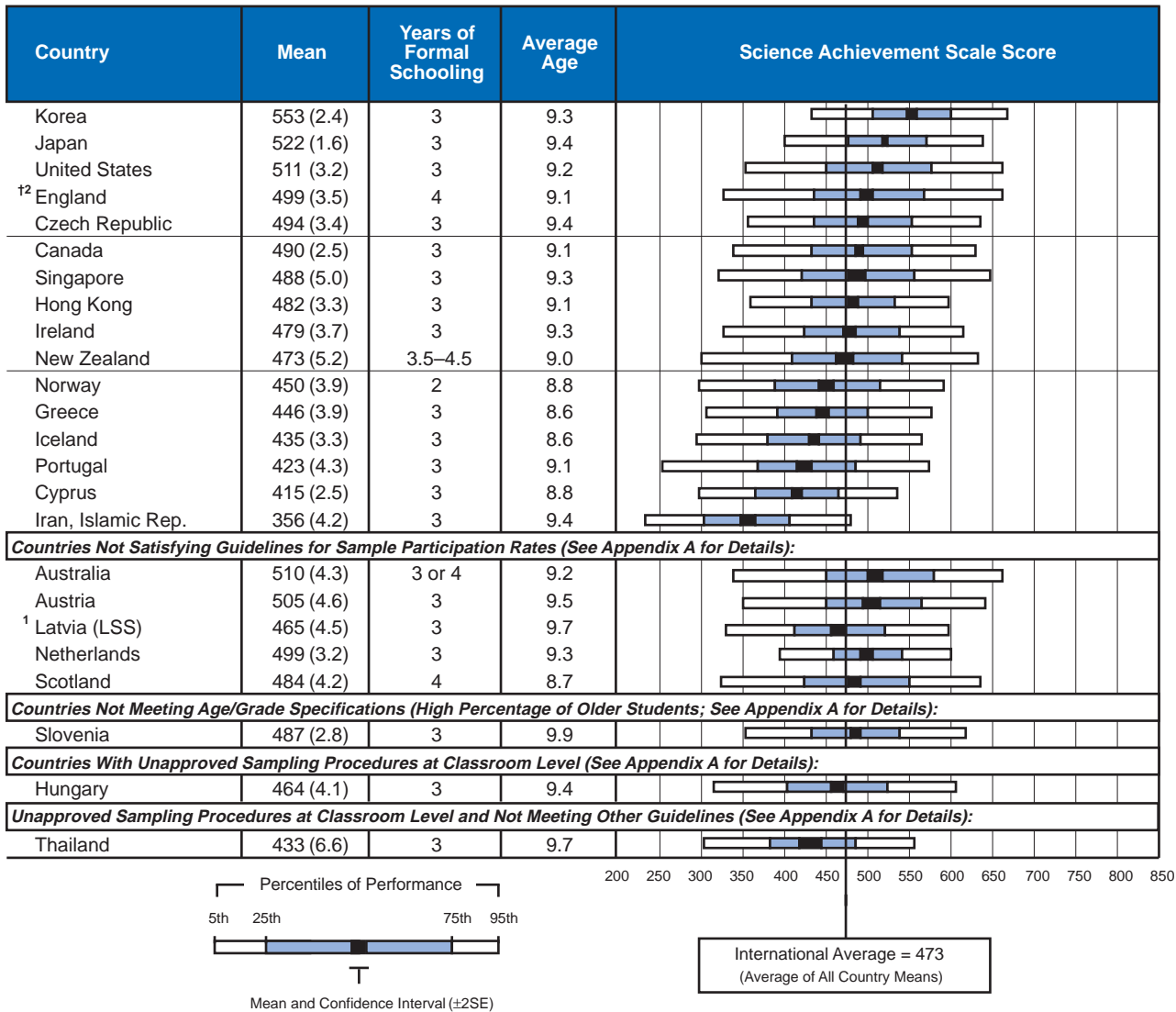
Performance in fourth grade was naturally somewhat higher than in third grade, since fourth-grade students have had one year more of schooling. The international average at the fourth grade (526) was 51 points higher than the international average of 475 at the third grade. Even though equivalent achievement 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.

---

<sup>5</sup> 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\*)**



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

<sup>1</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

<sup>1</sup>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.

<sup>2</sup>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.<sup>†</sup>

Country	Korea	Japan	United States	Australia	Austria	England	Netherlands	Czech Republic	Canada	Singapore	Slovenia	Scotland	Hong Kong	Ireland	New Zealand	Latvia (LSS)	Hungary	Norway	Greece	Iceland	Thailand	Portugal	Cyprus	Iran, Islamic Rep.
Korea		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Japan	▼		●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
United States	▼	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Australia	▼	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Austria	▼	▼	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
England	▼	▼	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Netherlands	▼	▼	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Czech Republic	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Canada	▼	▼	▼	▼	●	●	●	●		●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Singapore	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Slovenia	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲	▲
Scotland	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	●	●	▲	▲	▲	▲	▲	▲	▲	▲
Hong Kong	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●		●	●	●	▲	▲	▲	▲	▲	▲	▲	▲
Ireland	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲	▲
New Zealand	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲	▲
Latvia (LSS)	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●		●	●	▲	▲	▲	▲	▲	▲
Hungary	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	▲	▲	▲	▲	▲	▲
Norway	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	●	▲	▲	▲
Greece	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	●	▲	▲	▲
Iceland	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	▲	▲
Thailand	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●		●	●	▲
Portugal	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		●	▲
Cyprus	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●		▲
Iran, Islamic Rep.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

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<sup>6</sup> 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).<sup>7</sup> This finding is not unexpected given the challenge during TIMSS test development<sup>8</sup> 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,<sup>9</sup> where students begin school at a later age than in many other countries, had the largest increase between the lower and upper grades.

<sup>6</sup> 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.

<sup>7</sup> Please see Table A.11 in Appendix A.

<sup>8</sup> 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.

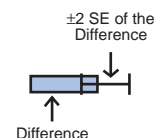
<sup>9</sup> In Norway, Grade 2 was chosen as the appropriate lower grade for TIMSS on the basis of the age distribution of the students.



**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)
<sup>12</sup> England	499 (3.5)	551 (3.3)	52 (4.8)
Japan	522 (1.6)	574 (1.8)	52 (2.4)
<sup>†</sup> 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)
<b>Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):</b>			
Australia	510 (4.3)	562 (2.9)	53 (5.2)
Austria	505 (4.6)	565 (3.3)	60 (5.7)
<sup>1</sup> Latvia (LSS)	465 (4.5)	512 (4.9)	47 (6.7)
Netherlands	499 (3.2)	557 (3.1)	58 (4.4)
<b>Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):</b>			
Slovenia	487 (2.8)	546 (3.3)	59 (4.4)
<b>Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):</b>			
Hungary	464 (4.1)	532 (3.4)	67 (5.3)
<b>Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):</b>			
Thailand	433 (6.6)	473 (4.9)	40 (8.2)

0 20 40 60 80 100



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

<sup>12</sup> Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

<sup>1</sup> 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.

<sup>2</sup> 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.

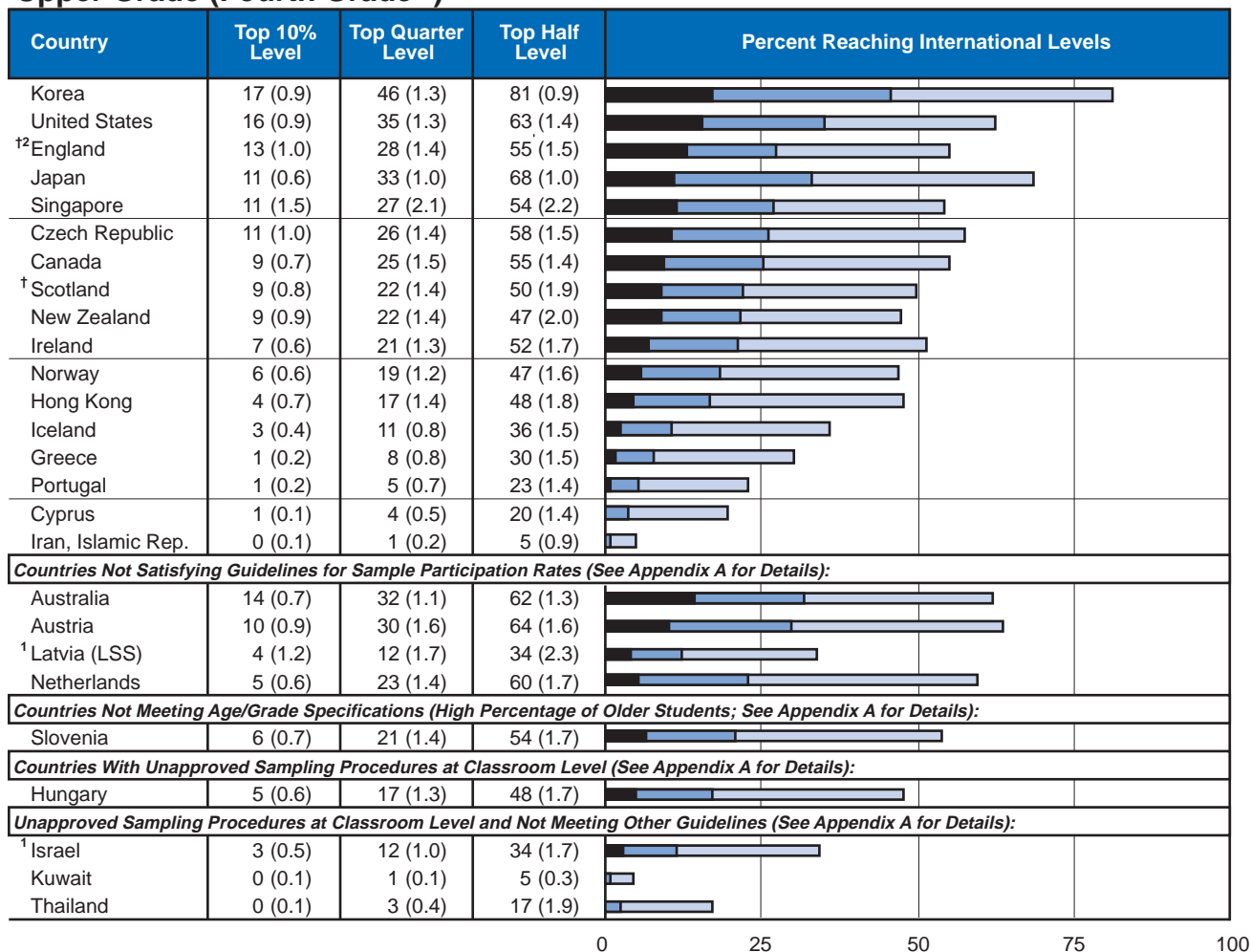
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

## 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.

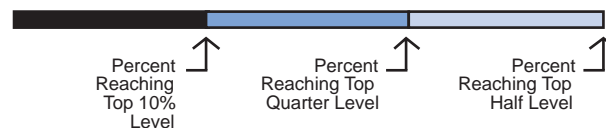
If every country had the same distribution of high-, medium-, and low-performing students, then each country would be expected to have approximately 10% of its students reaching the Top 10% level, 25% reaching the Top Quarter level, and 50% reaching the Top Half level. Although no country achieved exactly 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\*)**

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.

<sup>†</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

<sup>1</sup>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.

<sup>2</sup>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**

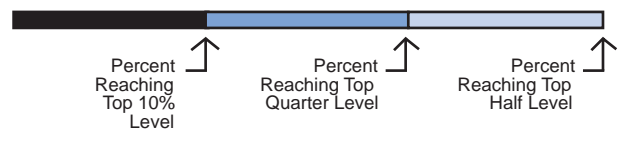
**Percentages of Students Achieving International Marker Levels in the Sciences  
Lower Grade (Third Grade\* )**

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)	
<sup>12</sup> 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)	
<b>Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):</b>				
Australia	16 (1.2)	34 (1.8)	60 (2.0)	
Austria	10 (1.4)	29 (2.2)	61 (1.8)	
<sup>1</sup> 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)	
<b>Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):</b>				
Slovenia	6 (0.6)	19 (1.2)	49 (1.5)	
<b>Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):</b>				
Hungary	5 (0.5)	16 (1.3)	41 (2.0)	
<b>Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):</b>				
Thailand	1 (0.6)	5 (1.9)	24 (3.4)	

0 25 50 75 100

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.  
<sup>1</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).  
<sup>1</sup>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.  
<sup>2</sup>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).<sup>10</sup>

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.<sup>11</sup> However, the gender difference is much less pervasive at third and fourth grades than at seventh and eighth grades.<sup>12</sup> 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.<sup>13</sup>

<sup>10</sup> The tests for statistical significance assumed independent samples of boys and girls in each country and have not been adjusted for multiple comparisons.

<sup>11</sup> 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.

<sup>12</sup> 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.

<sup>13</sup> 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)	Girls Score Higher	Boys Score Higher		
Singapore	549 (5.4)	545 (6.3)	4 (8.3)				
<sup>†</sup> 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)				
<sup>†2</sup> 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)	Gender difference statistically significant at .05 level.	Gender difference not statistically significant.		
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)				
<b>Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):</b>						Gender difference statistically significant at .05 level.	Gender difference not statistically significant.
Australia	569 (3.3)	556 (3.2)	13 (4.6)				
Austria	572 (3.9)	556 (3.7)	15 (5.3)				
<sup>1</sup> Latvia (LSS)	512 (5.4)	513 (5.5)	1 (7.7)				
Netherlands	570 (3.6)	544 (3.5)	26 (5.0)	Gender difference statistically significant at .05 level.	Gender difference not statistically significant.		
<b>Countries Not Meeting Age/Grade Specifications (High Percentage of Older Students; See Appendix A for Details):</b>							
Slovenia	548 (3.3)	544 (4.0)	4 (5.2)				
<b>Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):</b>							
Hungary	539 (3.8)	525 (3.9)	14 (5.4)				
<b>Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):</b>							
<sup>1</sup> Israel	512 (4.5)	501 (3.8)	11 (5.9)				
Thailand	471 (5.9)	474 (4.3)	3 (7.3)				

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

Gender difference statistically significant at .05 level.  
 Gender difference not statistically significant.



\*Fourth grade in most countries; see Table 2 for information about the grades tested in each country.  
<sup>†</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).  
<sup>1</sup>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.  
<sup>2</sup>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)	Girls Score Higher	Boys Score Higher
Ireland	481 (4.6)	477 (4.4)	4 (6.4)		
Iran, Islamic Rep.	359 (5.7)	354 (5.7)	5 (8.1)	Girls Score Higher	Boys Score Higher
Cyprus	418 (2.7)	412 (3.0)	6 (4.0)		
United States	514 (4.2)	508 (3.2)	6 (5.2)	Girls Score Higher	Boys Score Higher
Singapore	491 (5.8)	484 (5.2)	6 (7.7)		
New Zealand	470 (5.9)	476 (5.7)	7 (8.2)	Girls Score Higher	Boys Score Higher
<sup>12</sup> England	503 (4.8)	495 (3.4)	8 (5.9)		
Iceland	440 (4.0)	431 (3.9)	9 (5.6)	Girls Score Higher	Boys Score Higher
Canada	496 (3.2)	486 (2.9)	10 (4.3)		
Norway	457 (4.6)	444 (4.5)	13 (6.4)	Girls Score Higher	Boys Score Higher
Greece	453 (4.6)	439 (3.9)	14 (6.0)		
Hong Kong	488 (3.4)	473 (3.8)	15 (5.1)	Girls Score Higher	Boys Score Higher
Portugal	431 (4.3)	415 (5.4)	16 (6.9)		
Czech Republic	503 (4.1)	485 (3.9)	18 (5.6)	Girls Score Higher	Boys Score Higher
Korea	562 (2.8)	543 (2.7)	19 (3.9)		
<b>Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):</b>					
Australia	510 (5.6)	510 (4.3)	0 (7.1)	Girls Score Higher	Boys Score Higher
Austria	508 (6.9)	501 (4.0)	7 (7.9)		
<sup>1</sup> Latvia (LSS)	462 (5.2)	469 (4.8)	7 (7.1)	Girls Score Higher	Boys Score Higher
Netherlands	504 (3.8)	493 (3.1)	11 (4.9)		
Scotland	485 (4.4)	482 (4.7)	3 (6.5)	Girls Score Higher	Boys Score Higher
Slovenia	496 (3.4)	478 (3.4)	18 (4.8)		
<b>Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):</b>					
Hungary	472 (4.2)	460 (4.7)	12 (6.3)	Girls Score Higher	Boys Score Higher
Thailand	428 (6.5)	437 (7.1)	8 (9.6)		
<b>Unapproved Sampling Procedures at Classroom Level and Not Meeting Other Guidelines (See Appendix A for Details):</b>					
Thailand	428 (6.5)	437 (7.1)	8 (9.6)	Girls Score Higher	Boys Score Higher

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

	Gender difference statistically significant at .05 level.
	Gender difference not statistically significant.

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

<sup>†</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

<sup>1</sup>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.

<sup>2</sup>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.<sup>14</sup> 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.<sup>15</sup> 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<sup>16</sup> (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.

<sup>14</sup> 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.

<sup>15</sup> 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.

<sup>16</sup> 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%
<sup>†</sup> 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%
<sup>†2</sup> 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%
<b>Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):</b>							
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%
<sup>1</sup> 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%
<b>Countries With Unapproved Sampling Procedures at Classroom Level (See Appendix A for Details):</b>							
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.

<sup>†</sup>Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details).

<sup>1</sup>National Desired Population does not cover all of International Desired Population (see Table A.2).

<sup>2</sup>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*.<sup>17</sup>

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.

<sup>17</sup> 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		Eighth Grade	
Country	Mean Scale Score	Country	Mean Scale Score
<b>Korea</b>	597 (1.9)	<b>Singapore</b>	607 (5.5)
<b>Japan</b>	574 (1.8)	<b>Czech Republic</b>	574 (4.3)
<b>United States</b>	565 (3.1)	<b>Japan</b>	571 (1.6)
<i>Austria</i>	565 (3.3)	<b>Korea</b>	565 (1.9)
<i>Australia</i>	562 (2.9)	<i>Netherlands</i>	560 (5.0)
<i>Netherlands</i>	557 (3.1)	<i>Slovenia</i>	560 (2.5)
<b>Czech Republic</b>	557 (3.1)	<i>Austria</i>	558 (3.7)
<b>England</b>	551 (3.3)	<b>Hungary</b>	554 (2.8)
<b>Canada</b>	549 (3.0)	<b>England</b>	552 (3.3)
<b>Singapore</b>	547 (5.0)	<i>Australia</i>	545 (3.9)
<i>Slovenia</i>	546 (3.3)	<b>Ireland</b>	538 (4.5)
<b>Ireland</b>	539 (3.3)	<b>United States</b>	534 (4.7)
<b>Scotland</b>	536 (4.2)	<b>Canada</b>	531 (2.6)
<b>Hong Kong</b>	533 (3.7)	<b>Norway</b>	527 (1.9)
<i>Hungary</i>	532 (3.4)	<b>New Zealand</b>	525 (4.4)
<b>New Zealand</b>	531 (4.9)	<i>Thailand</i>	525 (3.7)
<b>Norway</b>	530 (3.6)	<i>Israel</i>	524 (5.7)
<i>Latvia (LSS)</i>	512 (4.9)	<b>Hong Kong</b>	522 (4.7)
<i>Israel</i>	505 (3.6)	<i>Scotland</i>	517 (5.1)
<b>Iceland</b>	505 (3.3)	<i>Greece</i>	497 (2.2)
<b>Greece</b>	497 (4.1)	<b>Iceland</b>	494 (4.0)
<b>Portugal</b>	480 (4.0)	<b>Latvia (LSS)</b>	485 (2.7)
<b>Cyprus</b>	475 (3.3)	<b>Portugal</b>	480 (2.3)
<b>Thailand</b>	473 (4.9)	<b>Iran, Islamic Rep.</b>	470 (2.4)
<b>Iran, Islamic Rep.</b>	416 (3.9)	<b>Cyprus</b>	463 (1.9)
<i>Kuwait</i>	401 (3.1)	<i>Kuwait</i>	430 (3.7)
International Average = 524 (0.7) (Average of All Country Means)		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.<sup>18</sup>

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.

<sup>18</sup> 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
<b>Iran, Islamic Rep.</b>	235 (14.7)	470 (2.4)	234 (14.9)
<i>Thailand</i>	306 (15.2)	525 (3.7)	220 (15.6)
<i>Kuwait</i>	217 (14.4)	430 (3.7)	213 (14.9)
<b>Singapore</b>	398 (15.2)	607 (5.5)	210 (16.2)
<i>Israel</i>	345 (14.6)	524 (5.7)	179 (15.7)
<i>Hungary</i>	379 (14.5)	554 (2.8)	175 (14.8)
<b>Portugal</b>	314 (14.8)	480 (2.3)	165 (14.9)
<b>Czech Republic</b>	410 (14.4)	574 (4.3)	164 (15.0)
<i>Slovenia</i>	396 (14.5)	560 (2.5)	164 (14.7)
<b>Greece</b>	336 (14.8)	497 (2.2)	161 (15.0)
<b>Cyprus</b>	309 (14.5)	463 (1.9)	154 (14.6)
<i>Netherlands</i>	410 (14.4)	560 (5.0)	150 (15.2)
<b>Norway</b>	377 (14.6)	527 (1.9)	150 (14.7)
<b>Ireland</b>	389 (14.5)	538 (4.5)	149 (15.2)
<b>England</b>	404 (14.5)	552 (3.3)	149 (14.9)
<b>Iceland</b>	345 (14.5)	494 (4.0)	148 (15.0)
<b>New Zealand</b>	378 (15.2)	525 (4.4)	147 (15.8)
<b>Hong Kong</b>	381 (14.6)	522 (4.7)	142 (15.4)
<b>Japan</b>	431 (14.1)	571 (1.6)	140 (14.2)
<i>Austria</i>	420 (14.5)	558 (3.7)	138 (14.9)
<b>Scotland</b>	384 (14.8)	517 (5.1)	133 (15.7)
<i>Latvia (LSS)</i>	355 (15.2)	485 (2.7)	130 (15.4)
<b>Canada</b>	401 (14.4)	531 (2.6)	130 (14.6)
<i>Australia</i>	417 (14.4)	545 (3.9)	127 (14.9)
<b>United States</b>	421 (14.4)	534 (4.7)	113 (15.2)
<b>Korea</b>	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.

