

# CHAPTER 6

# 6

## Teachers and Instruction

To provide information about science teachers and instruction, Chapter 6 presents teachers' reports on their background and training and their instructional practices. Information also is presented about the materials used in instruction, the activities students do in class, the use of computers in science lessons, the role of homework, and the reliance on different types of assessment approaches.






Teachers of science design and manage the learning environments that provide students with the opportunity needed to learn science. They structure the content and pace of lessons, introducing new material, selecting various instructional activities, and monitoring students' developing understanding of the science concepts being studied. Teachers may help students use technology and tools to investigate scientific ideas, analyze students' work for misconceptions, and promote positive attitudes toward science. They may also assign homework and conduct informal as well as formal assessments to evaluate achievement outcomes.

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

The teachers who completed the questionnaires were the science teachers of the students who took the TIMSS 1999 test. The general sampling procedure was to sample a mathematics class from each participating school, administer the test to those students, and ask both their mathematics and science teachers to complete a background questionnaire. In countries with separate science teachers, all science teachers of the students in the sampled mathematics classes were to complete questionnaires.<sup>1</sup> Thus, the information about instruction is tied directly to the students tested and the specific science classes in which they were taught. The data obtained from the science teacher background questionnaires appear in two types of displays. For some of the general information, data are presented together for all science teachers in all countries. For information that may be specific to the science subject, such as preparation to teach the sciences, instructional time in the sciences, and emphasis on experimental methods, the data are presented separately for the teachers of general/integrated science and of separate science subject areas. The latter type of display permits comparisons across the different science subjects taught in each country.

Because the sampling for the teacher questionnaires was based on participating students, teachers' responses do not necessarily represent all eighth-grade science teachers in each country. Rather, they represent teachers of the representative samples of students assessed.

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



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It is important to note that when information from the teachers' questionnaires is being reported, the student is always the unit of analysis. That is, the data shown are the percentages of students whose teachers reported on various characteristics or instructional strategies. Using the student as the unit of analysis makes it possible to describe the instruction received by representative samples of students. Although this perspective may differ from that obtained by simply collecting information from teachers, it is consistent with the TIMSS goals of providing information about the educational contexts and performance of students.

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

## What Preparation Do Teachers Have for Teaching Science?

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

As shown in Exhibit 6.1, internationally on average, 61 percent of students were taught by teachers between the ages of 30 and 49, 21 percent by teachers age 50 or older, and only 19 percent by teachers younger than age 30. The distribution in the age of teachers varies markedly from country to country. An aging teacher population is most evident in the following countries, where two-thirds or more of students had science teachers age 40 or older: Chile, Cyprus, the Czech Republic, Finland, Italy, Macedonia, and Moldova. In contrast, several countries had younger science teachers. Hong Kong, Iran, Jordan, South Africa, and Tunisia each had at least 30 percent of their students taught by teachers younger than age 30. Further, countries where at least 70 percent of students had teachers younger than age 40 were Hong Kong, Indonesia, Jordan, Malaysia, the Philippines, South Africa and Tunisia.

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

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

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

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## Exhibit 6.1 Age and Gender of Teachers

	Percentage of Students by Age of Teachers				Percentage of Students by Gender of Teachers	
	29 Years or Under	30 -39 Years	40-49 Years	50 Years or Older	Female	Male
Australia	16 (2.7)	31 (3.4)	34 (3.3)	19 (2.7)	43 (4.0)	57 (4.0)
Belgium (Flemish)	25 (2.8)	24 (3.1)	34 (3.5)	17 (2.5)	64 (3.9)	36 (3.9)
Bulgaria	13 (3.0)	27 (2.8)	33 (2.8)	27 (2.8)	81 (2.5)	19 (2.5)
Canada	21 (3.1)	31 (2.6)	31 (2.9)	18 (2.6)	41 (3.3)	59 (3.3)
Chile	5 (1.7)	23 (2.4)	46 (4.1)	26 (3.4)	72 (3.4)	28 (3.4)
Chinese Taipei	17 (3.0)	40 (3.9)	32 (3.7)	11 (2.6)	40 (3.7)	60 (3.7)
Cyprus	0 (0.0)	26 (1.5)	37 (2.5)	37 (2.0)	60 (2.6)	40 (2.6)
Czech Republic	12 (1.8)	20 (2.0)	21 (2.2)	47 (3.1)	74 (2.4)	26 (2.4)
England	24 (4.0)	23 (3.6)	31 (4.0)	22 (3.4)	43 (4.3)	57 (4.3)
Finland	8 (1.9)	22 (2.6)	34 (2.7)	35 (2.8)	63 (2.9)	37 (2.9)
Hong Kong, SAR	34 (4.3)	38 (4.6)	19 (3.6)	9 (2.7)	39 (4.2)	61 (4.2)
Hungary	11 (1.7)	25 (2.0)	37 (2.3)	27 (2.2)	72 (1.9)	28 (1.9)
Indonesia	21 (2.5)	55 (3.0)	18 (2.7)	6 (1.6)	49 (3.6)	51 (3.6)
Iran, Islamic Rep.	34 (3.9)	28 (4.5)	38 (4.1)	1 (0.7)	38 (4.3)	62 (4.3)
Israel	21 (3.0)	34 (4.0)	32 (3.6)	13 (2.9)	83 (2.7)	17 (2.7)
Italy	0 (0.0)	8 (2.0)	58 (4.1)	34 (3.8)	76 (3.1)	24 (3.1)
Japan	15 (3.1)	43 (4.2)	28 (3.8)	15 (2.8)	21 (3.6)	79 (3.6)
Jordan	40 (4.4)	41 (4.2)	16 (3.1)	3 (1.4)	48 (4.5)	52 (4.5)
Korea, Rep. of	17 (2.6)	49 (3.4)	22 (3.3)	12 (2.6)	59 (3.3)	41 (3.3)
Latvia (LSS)	10 (1.8)	29 (2.6)	27 (2.6)	34 (3.2)	77 (2.7)	23 (2.7)
Lithuania <sup>†</sup>	9 (1.5)	30 (2.3)	32 (2.4)	29 (2.4)	82 (1.9)	18 (1.9)
Macedonia, Rep. of	3 (0.7)	19 (1.9)	29 (2.6)	49 (2.6)	53 (2.1)	47 (2.1)
Malaysia	28 (3.1)	45 (4.4)	22 (3.2)	5 (1.8)	69 (3.8)	31 (3.8)
Moldova	12 (1.6)	20 (1.9)	28 (1.9)	40 (2.4)	72 (1.7)	28 (1.7)
Morocco	18 (2.1)	46 (3.4)	36 (3.0)	0 (0.0)	22 (2.3)	78 (2.3)
Netherlands	19 (2.9)	23 (3.3)	34 (3.8)	25 (3.2)	20 (2.6)	80 (2.6)
New Zealand	16 (2.7)	29 (3.8)	32 (3.3)	24 (3.6)	45 (3.8)	55 (3.8)
Philippines	29 (3.3)	41 (4.1)	21 (3.2)	10 (2.6)	80 (3.5)	20 (3.5)
Romania	16 (1.7)	23 (1.9)	24 (2.0)	38 (2.4)	75 (2.1)	25 (2.1)
Russian Federation	19 (1.7)	27 (1.6)	27 (1.7)	28 (2.0)	88 (1.2)	12 (1.2)
Singapore	25 (4.1)	22 (3.7)	26 (4.1)	26 (3.5)	68 (3.4)	32 (3.4)
South Africa	36 (4.2)	52 (4.6)	11 (2.1)	1 (0.5)	47 (3.5)	53 (3.5)
Thailand	24 (3.6)	34 (4.0)	32 (3.6)	10 (2.3)	63 (4.5)	37 (4.5)
Tunisia	31 (3.3)	41 (4.2)	21 (3.2)	7 (2.0)	60 (4.2)	40 (4.2)
Turkey	26 (3.4)	28 (3.9)	43 (4.1)	4 (1.2)	39 (4.0)	61 (4.0)
United States	20 (2.6)	19 (2.2)	29 (2.8)	32 (2.7)	48 (3.5)	52 (3.5)
<b>International Avg.</b>	19 (0.5)	31 (0.5)	30 (0.5)	21 (0.4)	58 (0.6)	42 (0.6)

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

Background data provided by teachers.

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

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

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

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

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



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

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

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

<sup>3</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*, Chestnut Hill, MA: Boston College.



## Exhibit 6.2 Preparation to Teach the Sciences

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

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

Background data provided by teachers.

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

<sup>2</sup> Includes teachers certified to teach any subject.

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

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




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

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

A dash (-) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.



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

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

<sup>a</sup> Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.

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

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

<sup>d</sup> Netherlands: Data for physics/chemistry teachers are reported in physics panel.



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

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

6.3



To gauge teachers' confidence to teach science topics, TIMSS constructed an index of teachers' confidence in their preparation to teach science (CPTS), presented in Exhibit 6.3. Teachers were asked how well prepared they felt to teach each of 10 science topics (e.g., earth's features and physical processes, chemical reactivity and transformation). Responses were given on a three-point scale; "very well prepared" was assigned a value of three, "somewhat prepared" two, and "not well prepared" one. Students were assigned to the high level of the index if their teachers reported that they felt very well prepared, on average across the 10 topics (2.75 or higher). The medium level indicates that teachers reported being somewhat to well prepared (averages from 2.25 to 2.75), and the low level that they reported being only somewhat prepared or less (averages less than 2.25). Because in some countries teachers specialize in separate science subjects, they could answer that they did not teach some of the topics. In computing the index value for each teacher, any topics that a teacher did not teach were excluded from the average.

In general, teachers reported only a moderate level of confidence in their preparation to teach science, with just 20 percent of students, on average internationally, taught by teachers who believed they were very well prepared and another 41 percent by teachers somewhat to well prepared. On average across countries, 39 percent of students had teachers with a low level of confidence, and more than half the students in nine countries – Chile, Hong Kong, Hungary, Japan, Korea, Latvia (LSS), Malaysia,



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

The detail for the 10 topics included in the index is provided in Exhibit R3.2 in the reference section. Teachers were most confident in their preparation to teach biology topics, with more than 50 percent of students, both internationally on average and in most countries, having teachers who reported feeling very well prepared to teach these topics. Teachers had less confidence in their preparation to teach earth science topics, particularly about the solar system and the universe, for which only 32 percent of students had teachers who felt they were very well prepared to teach it. Between 45 and 51 percent of students across countries had teachers who reported feeling very well prepared to teach chemistry or physics topics, compared with 39 percent for environmental and resource issues and 34 percent for scientific methods and inquiry skills.



Exhibit R3.3 shows principals' opinions about the degree to which shortages of qualified science teachers affect the capacity to provide instruction. On average internationally, principals reported that such shortages affect the quality of instruction some or a lot for 35 percent of students in countries with general/integrated science. In comparison, in countries with separate science subjects the percentages of students in schools reporting such shortages ranged from 25 percent for earth science teachers to 28 percent for physics. Bulgaria, Jordan, Malaysia, Moldova, Slovenia, Thailand, Tunisia, and Turkey reported shortages of qualified teachers affecting more than half their students.



Teachers' beliefs about science learning and instruction are to some degree related to their preparation. Exhibits R3.4 and R3.5 in the reference section show the percentages of eighth-grade students whose science teachers reported certain beliefs about science, the way science should be taught, and the importance of various abilities in achieving success in the discipline. In general, teachers revealed a fairly practical view of science. Across countries, there was substantial agreement that science is primarily a practical and structured guide for addressing real situations, and that it is important for teachers to give students prescriptive and sequential directions for doing science experiments. In nearly all countries, the majority of students had teachers who agreed that some students have a natural talent for science, and that all of the skills shown in Exhibit R3.5 (thinking in a sequential and procedural manner, being able to think creatively, understanding how science is



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## Exhibit 6.3 Index of Teachers' Confidence in Preparation to Teach Science (CPTS)

### Index of Teachers' Confidence in Preparation to Teach Science

Index based on teachers' responses to 10 questions about how prepared they feel to teach different science topics (see reference exhibit R3.2) based on a 3-point scale: 1 = not well prepared; 2 = somewhat prepared; 3 = very well prepared. Average is computed across the 10 items for items for which the teacher did not respond do not teach. High level indicates average is greater than or equal to 2.75. Medium level indicates average is greater than or equal to 2.25 and less than 2.75. Low level indicates average is less than 2.25.

	High CPTS		Medium CPTS		Low CPTS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Macedonia, Rep. of	53 (2.8)	463 (5.8)	35 (2.6)	457 (6.9)	12 (1.5)	442 (10.4)
Czech Republic	40 (2.8)	538 (4.8)	46 (2.8)	544 (5.8)	15 (2.4)	533 (6.2)
Indonesia	39 (4.4)	441 (7.7)	32 (3.6)	442 (7.5)	29 (3.3)	421 (6.9)
Turkey	36 (4.0)	443 (6.3)	47 (4.4)	430 (6.3)	17 (2.9)	420 (6.1)
Jordan	32 (4.1)	449 (7.7)	42 (4.3)	461 (6.0)	26 (4.1)	434 (8.7)
Cyprus	31 (2.4)	460 (3.4)	42 (2.2)	464 (3.2)	27 (2.1)	458 (6.2)
New Zealand	29 (3.6)	510 (9.0)	53 (3.9)	515 (7.4)	19 (3.2)	499 (8.7)
Romania	29 (2.5)	478 (7.9)	50 (2.5)	465 (6.4)	22 (2.3)	479 (7.9)
South Africa	29 (4.7)	240 (18.6)	38 (4.8)	265 (14.4)	33 (3.7)	225 (12.7)
United States <sup>r</sup>	27 (3.0)	526 (8.7)	55 (3.5)	519 (5.8)	18 (2.5)	511 (9.2)
Morocco	26 (3.0)	326 (7.2)	47 (2.5)	321 (5.7)	27 (2.4)	321 (5.0)
Bulgaria	23 (1.9)	520 (9.1)	42 (3.4)	511 (5.3)	35 (3.4)	506 (5.8)
Australia	22 (2.9)	548 (8.5)	56 (3.5)	540 (5.7)	22 (3.1)	535 (6.4)
Belgium (Flemish)	20 (2.5)	536 (9.2)	44 (3.2)	542 (4.7)	36 (3.3)	525 (7.1)
Iran, Islamic Rep.	20 (4.4)	434 (10.5)	40 (4.2)	452 (5.1)	40 (4.3)	450 (5.5)
Netherlands	19 (2.9)	550 (10.4)	45 (3.8)	545 (10.2)	35 (3.5)	543 (7.4)
Singapore	18 (3.3)	568 (14.4)	44 (4.1)	576 (10.4)	38 (4.4)	559 (13.1)
Finland	16 (2.3)	534 (7.0)	51 (3.2)	535 (4.2)	32 (2.9)	536 (3.9)
Moldova	16 (1.8)	451 (6.7)	38 (2.6)	466 (5.9)	46 (2.6)	458 (5.1)
Canada <sup>r</sup>	16 (2.4)	542 (5.3)	47 (3.2)	534 (3.6)	37 (2.8)	533 (4.6)
Israel	15 (2.4)	485 (8.7)	61 (3.8)	466 (7.2)	23 (3.2)	466 (9.8)
Philippines	15 (2.9)	384 (13.8)	43 (4.4)	337 (11.5)	42 (4.3)	340 (11.2)
Chinese Taipei	14 (3.0)	573 (7.9)	46 (4.8)	576 (5.9)	40 (4.5)	559 (6.3)
Italy	13 (2.8)	487 (11.6)	54 (3.9)	491 (5.6)	33 (3.4)	499 (5.9)
Thailand	13 (2.9)	499 (12.9)	30 (3.8)	486 (7.8)	58 (3.6)	476 (5.8)
Malaysia	9 (2.2)	498 (14.1)	30 (3.8)	500 (7.1)	61 (4.1)	488 (6.7)
Hong Kong, SAR	9 (2.3)	552 (12.4)	34 (4.1)	526 (6.1)	57 (4.3)	529 (5.4)
Hungary	8 (1.5)	575 (7.2)	34 (2.4)	546 (5.7)	58 (2.2)	552 (3.4)
Latvia (LSS)	8 (1.8)	515 (8.7)	40 (2.7)	508 (5.5)	52 (2.8)	500 (5.3)
Chile	7 (2.0)	419 (17.3)	27 (3.1)	450 (7.2)	66 (3.2)	411 (4.5)
Korea, Rep. of	6 (1.8)	543 (8.8)	32 (3.3)	552 (3.8)	62 (3.5)	548 (3.3)
Tunisia	6 (2.0)	441 (11.3)	21 (3.8)	429 (6.1)	73 (4.0)	429 (3.7)
Japan	3 (1.5)	564 (7.3)	15 (3.1)	548 (6.0)	82 (3.1)	549 (2.6)
England	--	--	--	--	--	--
Lithuania <sup>†</sup>	--	--	--	--	--	--
Russian Federation	--	--	--	--	--	--
<b>International Avg.</b>	20 (0.5)	487 (1.7)	41 (0.6)	485 (1.1)	39 (0.6)	477 (1.2)

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

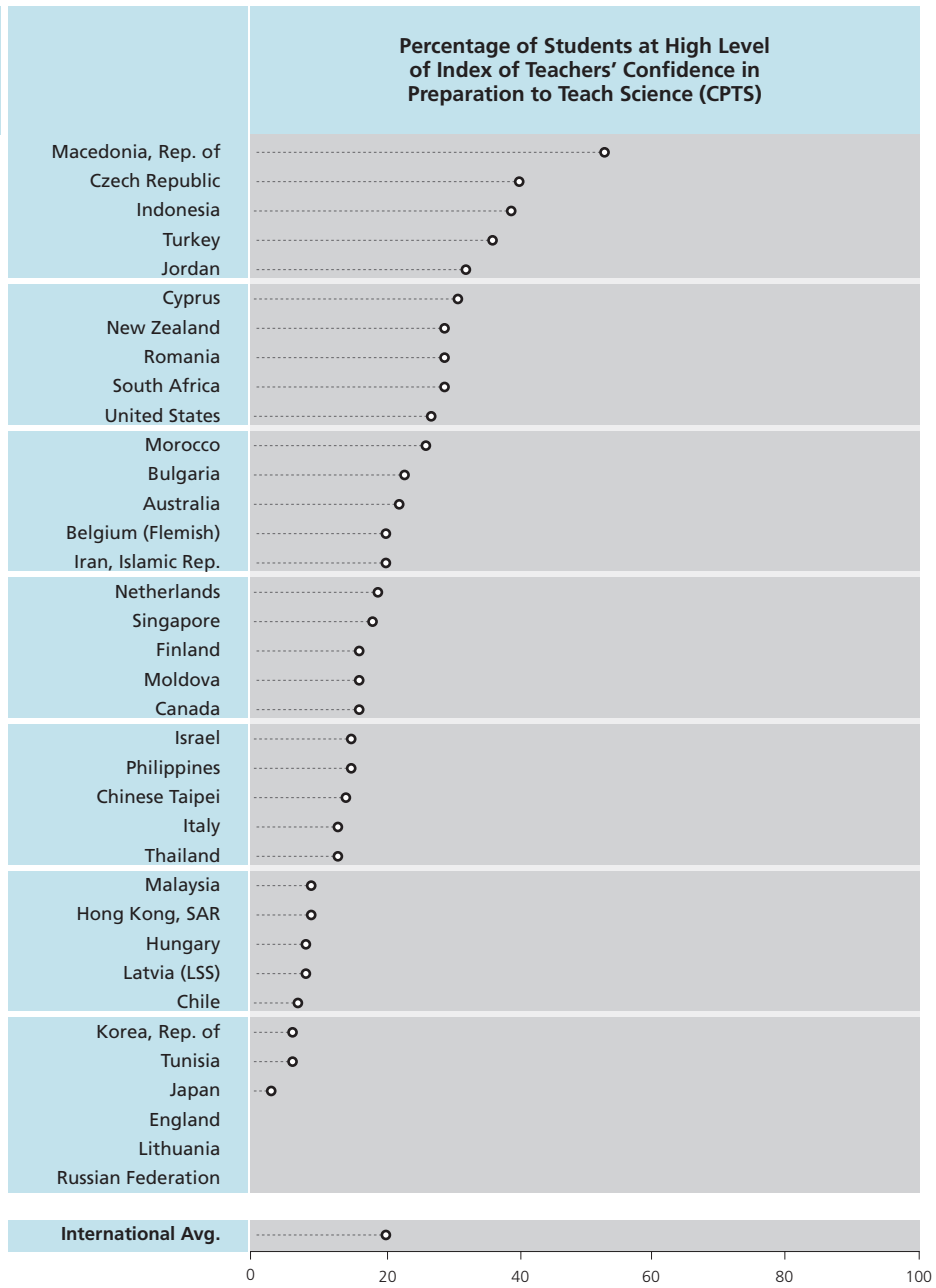
<sup>†</sup> Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

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

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

A dash (–) indicates data are not available.

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



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

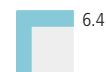


*continued from  
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used in the real world, and being able to provide reasons to support conclusions) are very important for students' success in science. The greatest variation in views was about whether science is primarily a formal way of representing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

## How Much School Time Is Devoted to Science Instruction?

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



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

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

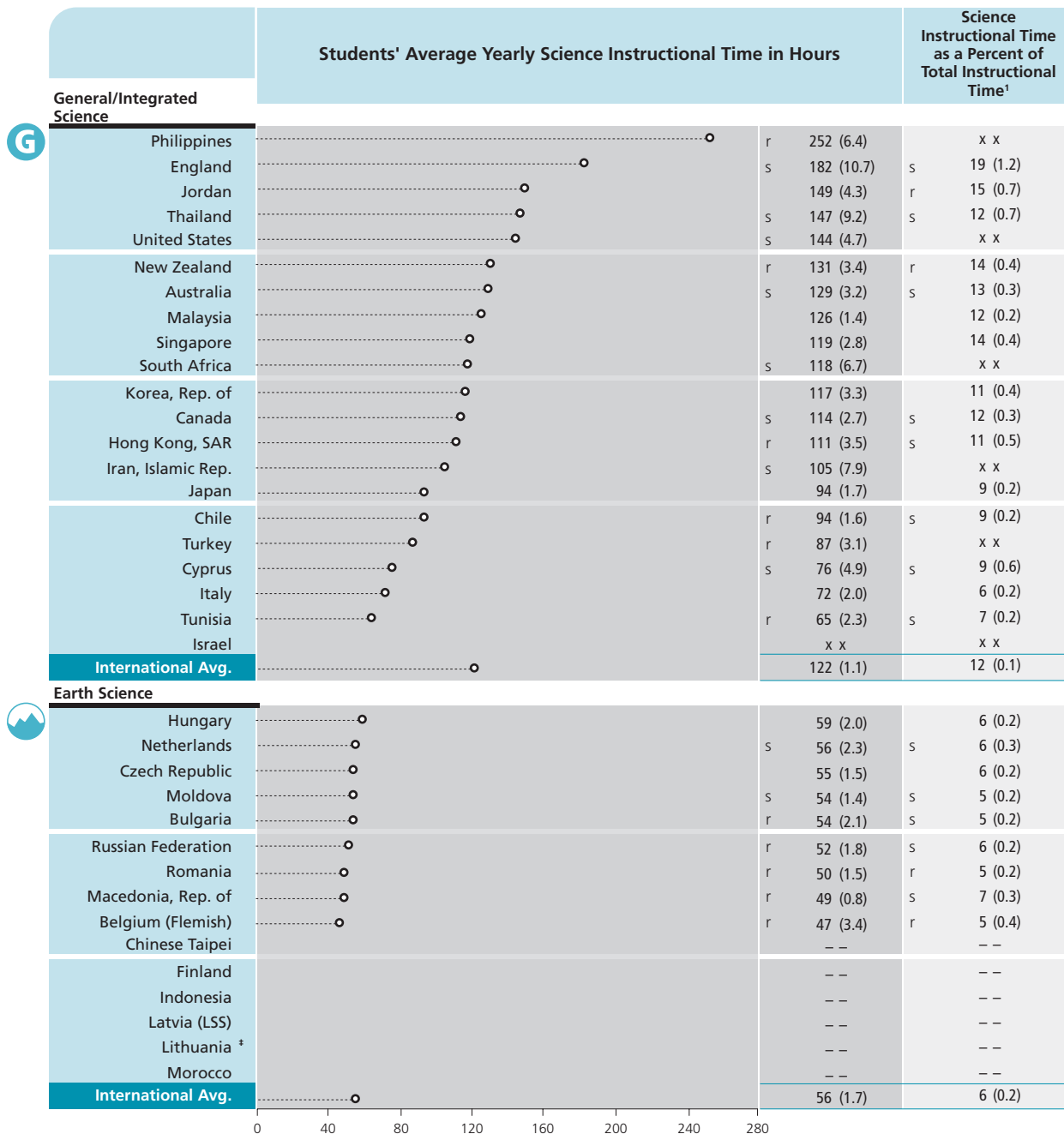
Among countries that teach general/integrated science, the percentage of instructional time at the eighth grade devoted to the sciences ranged from six percent in Italy to 19 percent in England (see reference Exhibit R3.7 for details on total instructional time in each country). For the separate-science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



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## Exhibit 6.4 Instructional Time in the Sciences at Grade 8\*



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

Science instructional time provided by teachers, and total instructional time provided by schools.

\* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

<sup>1</sup> Computed as the ratio of science instructional time to total instructional time averaged across students.

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

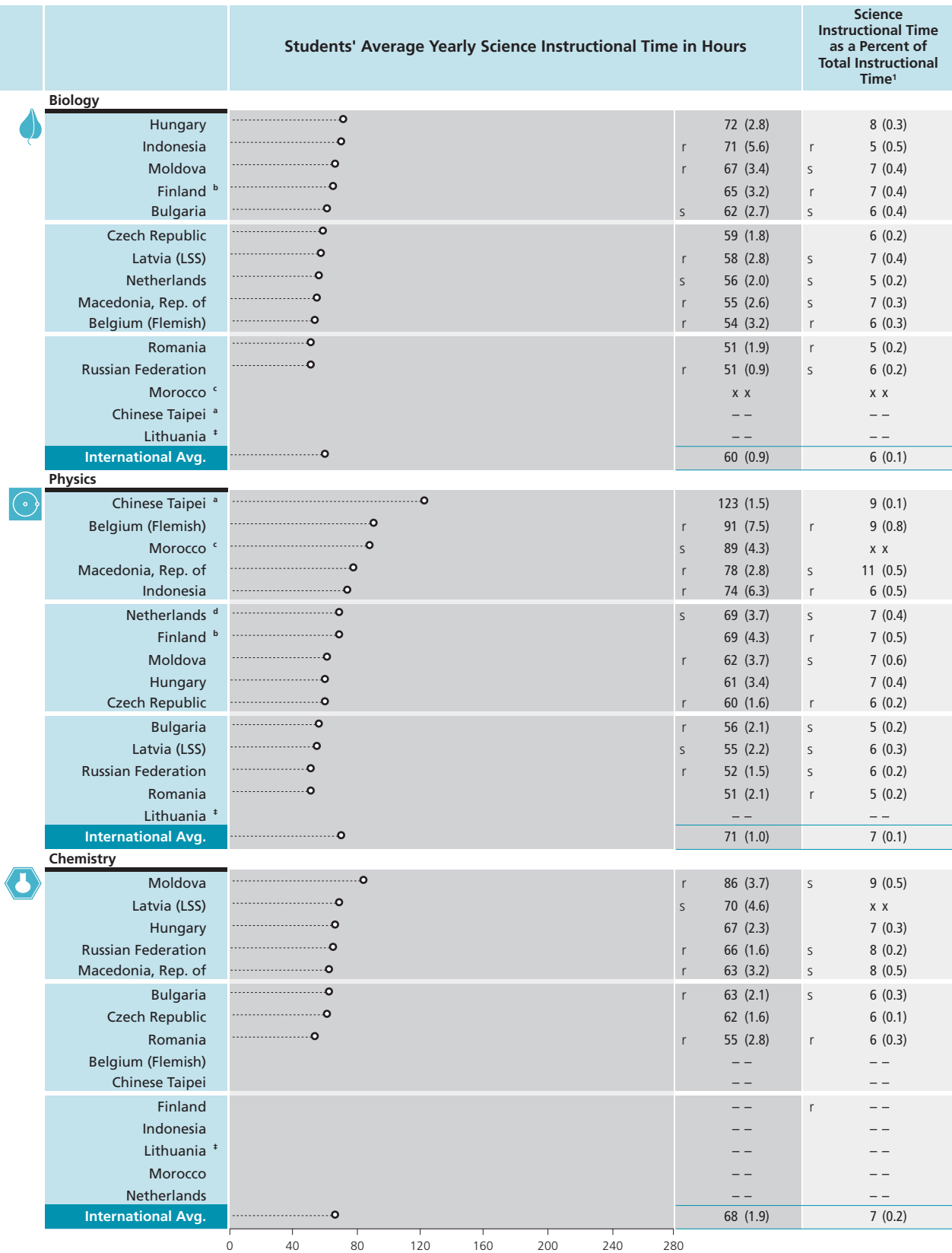
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

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

A dash (–) indicates data are not available.

An "r" indicates school and/or teacher response data available for 70-84% of students. An "s" indicates school and/or teacher response data available for 50-69% of students. An "x" indicates school and/or teacher response data available for <50% of students.






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

<sup>a</sup> Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.  
<sup>b</sup> Finland: Data for biology and biology/geography teachers are reported in biology panel; data for physics and physics/chemistry teachers are reported in physics panel. Small number of separate chemistry and geography teachers are not reported.


<sup>c</sup> Morocco: Data for biology/geology teachers are reported in biology panel; data for physics/chemistry teachers are reported in physics panel.  
<sup>d</sup> Netherlands: Data for physics/chemistry teachers are reported in physics panel.



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

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

Although in some countries the number of in-class instructional hours is related to science achievement, the data reveal no clear pattern either across or within countries. Common sense and research both support the idea that time on task is an important contributor to achievement, yet this time can be spent more or less efficiently. Time alone is not enough; it needs to be spent on high-quality science instruction. Devoting extensive class time to remedial activities can deprive students of this. Also, instructional time can be spent out of school in various tutoring programs; low-performing students may be receiving additional instruction.

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




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

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



## Exhibit 6.5 Number of Hours Science Is Taught Weekly\*

		5 Hours or More		3.5 Hours to < 5		2 Hours to < 3.5		Less Than 2 Hours		
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
<b>G</b>	<b>General/Integrated Science</b>									
	Australia <sup>r</sup>	3 (1.2)	526 (16.0)	28 (3.5)	555 (8.2)	64 (3.9)	535 (5.5)	6 (1.8)	523 (15.2)	
	Canada <sup>s</sup>	5 (1.5)	520 (8.7)	17 (3.2)	549 (6.6)	71 (3.5)	536 (3.3)	7 (1.6)	501 (9.0)	
	Chile	0 (0.0)	~ ~	2 (1.2)	~ ~	93 (1.9)	422 (4.2)	4 (1.5)	419 (9.9)	
	Cyprus <sup>s</sup>	0 (0.0)	~ ~	0 (0.0)	~ ~	28 (3.7)	463 (5.5)	72 (3.7)	462 (3.3)	
	England <sup>s</sup>	4 (1.6)	668 (21.8)	17 (4.0)	568 (16.9)	72 (4.3)	532 (6.2)	7 (2.1)	582 (19.4)	
	Hong Kong, SAR	10 (2.8)	514 (14.2)	7 (2.3)	551 (9.4)	79 (3.9)	532 (4.3)	4 (1.7)	525 (22.7)	
	Iran, Islamic Rep.	8 (2.3)	454 (9.9)	9 (2.5)	458 (11.5)	54 (4.6)	445 (6.4)	29 (4.3)	455 (6.8)	
	Israel <sup>r</sup>	0 (0.0)	~ ~	9 (2.5)	467 (23.8)	68 (3.7)	472 (6.9)	23 (3.2)	460 (11.6)	
	Italy	1 (0.8)	~ ~	1 (0.9)	~ ~	71 (3.7)	490 (5.0)	27 (3.5)	498 (5.8)	
	Japan	0 (0.0)	~ ~	0 (0.0)	~ ~	96 (1.3)	547 (2.4)	4 (1.3)	599 (14.2)	
	Jordan	11 (2.8)	441 (15.2)	63 (4.1)	449 (4.8)	25 (3.6)	458 (9.4)	1 (0.0)	~ ~	
	Korea, Rep. of	1 (0.8)	~ ~	4 (1.7)	531 (8.6)	84 (2.6)	550 (2.8)	10 (1.9)	546 (4.7)	
	Malaysia	0 (0.0)	~ ~	3 (1.5)	497 (26.7)	96 (1.8)	493 (4.6)	1 (0.9)	~ ~	
	New Zealand	2 (1.0)	~ ~	41 (4.0)	516 (8.9)	55 (4.1)	508 (6.5)	2 (1.0)	~ ~	
	Philippines	92 (2.4)	347 (7.8)	2 (1.3)	~ ~	2 (1.3)	~ ~	4 (1.4)	368 (35.3)	
	Singapore	4 (1.4)	608 (28.0)	50 (4.2)	586 (8.9)	42 (4.2)	550 (14.1)	5 (1.9)	497 (38.7)	
	South Africa	8 (2.4)	259 (31.6)	33 (4.2)	251 (18.9)	33 (4.3)	256 (17.4)	26 (3.9)	235 (15.5)	
	Thailand <sup>r</sup>	23 (4.1)	461 (10.8)	0 (0.0)	~ ~	76 (4.2)	491 (5.5)	1 (1.0)	~ ~	
	Tunisia	0 (0.0)	~ ~	1 (0.0)	~ ~	36 (4.1)	425 (4.3)	63 (4.1)	432 (4.2)	
Turkey	4 (1.4)	416 (17.8)	1 (0.7)	~ ~	82 (3.0)	432 (4.3)	12 (2.8)	439 (12.4)		
United States <sup>r</sup>	13 (2.0)	490 (8.0)	61 (3.0)	523 (5.0)	16 (2.3)	533 (11.4)	11 (2.3)	521 (18.3)		
<b>International Avg.</b>		9 (0.4)	475 (4.2)	17 (0.6)	500 (4.9)	59 (0.8)	484 (2.7)	15 (0.5)	474 (3.8)	
	<b>Earth Science</b>									
	Belgium (Flemish)	2 (1.1)	~ ~	0 (0.0)	~ ~	14 (4.2)	530 (13.0)	84 (4.4)	541 (5.4)	
	Bulgaria	1 (1.0)	~ ~	2 (1.1)	~ ~	4 (1.9)	519 (48.1)	93 (2.4)	512 (5.3)	
	Chinese Taipei	--	--	--	--	--	--	--	--	
	Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	3 (1.7)	561 (13.4)	97 (1.7)	539 (4.5)	
	Finland	--	--	--	--	--	--	--	--	
	Hungary	0 (0.0)	~ ~	2 (1.1)	~ ~	19 (3.6)	553 (11.6)	79 (3.6)	551 (4.5)	
	Indonesia	--	--	--	--	--	--	--	--	
	Latvia (LSS)	--	--	--	--	--	--	--	--	
	Lithuania <sup>†</sup>	--	--	--	--	--	--	--	--	
	Macedonia, Rep. of	0 (0.0)	~ ~	0 (0.0)	~ ~	3 (1.6)	376 (28.7)	96 (1.6)	461 (5.3)	
	Moldova	1 (0.9)	~ ~	1 (0.0)	~ ~	8 (2.6)	444 (13.9)	90 (2.8)	463 (4.7)	
	Morocco	--	--	--	--	--	--	--	--	
	Netherlands	0 (0.0)	~ ~	5 (0.4)	466 (7.8)	6 (3.3)	590 (33.0)	89 (5.7)	550 (6.4)	
	Romania	1 (0.7)	~ ~	1 (0.7)	~ ~	13 (2.9)	500 (14.9)	86 (3.0)	467 (6.5)	
	Russian Federation	0 (0.5)	~ ~	0 (0.0)	~ ~	8 (2.0)	558 (21.6)	91 (2.1)	526 (6.4)	
	<b>International Avg.</b>		1 (0.2)	~ ~	1 (0.2)	~ ~	9 (0.9)	514 (8.3)	90 (1.1)	512 (1.9)

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

Background data provided by teachers.

\* Countries are classified as having either general/integrated science or separate subject area classes at grade 8.

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

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

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

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

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

	5 Hours or More		3.5 Hours to < 5		2 Hours to < 3.5		Less Than 2 Hours	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
<b>Biology</b>								
Belgium (Flemish) <sup>r</sup>	3 (1.5)	528 (14.2)	1 (0.0)	~ ~	17 (3.0)	547 (6.8)	79 (3.1)	547 (5.3)
Bulgaria <sup>r</sup>	1 (1.0)	~ ~	2 (1.1)	~ ~	21 (3.8)	508 (10.8)	76 (4.4)	515 (7.4)
Chinese Taipei <sup>a</sup>	--	--	--	--	--	--	--	--
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	4 (2.1)	562 (16.7)	95 (2.1)	540 (4.6)
Finland <sup>b</sup>	1 (0.5)	~ ~	3 (1.5)	537 (9.3)	15 (2.9)	539 (8.4)	82 (3.2)	535 (3.5)
Hungary	1 (0.6)	~ ~	3 (1.4)	575 (23.6)	33 (4.1)	560 (7.1)	64 (4.3)	547 (4.9)
Indonesia	14 (3.2)	417 (14.4)	0 (0.3)	~ ~	8 (2.4)	434 (10.8)	78 (4.0)	440 (5.6)
Latvia (LSS)	0 (0.0)	~ ~	1 (1.4)	~ ~	17 (4.0)	498 (7.1)	82 (4.2)	513 (5.5)
Lithuania <sup>‡</sup>	--	--	--	--	--	--	--	--
Macedonia, Rep. of	1 (0.0)	~ ~	1 (0.8)	~ ~	11 (2.6)	426 (21.0)	87 (2.7)	465 (5.2)
Moldova	2 (1.0)	~ ~	6 (2.0)	468 (23.7)	19 (3.2)	445 (9.9)	74 (3.8)	461 (4.8)
Morocco <sup>c</sup>	0 (0.0)	~ ~	2 (1.0)	~ ~	81 (2.7)	320 (4.6)	17 (2.5)	335 (7.2)
Netherlands	0 (0.0)	~ ~	0 (0.0)	~ ~	1 (1.2)	~ ~	99 (1.2)	540 (8.9)
Romania	0 (0.3)	~ ~	1 (0.0)	~ ~	12 (3.0)	458 (15.0)	87 (3.1)	474 (6.2)
Russian Federation	0 (0.0)	~ ~	1 (0.5)	~ ~	9 (2.2)	548 (14.2)	90 (2.3)	526 (6.3)
<b>International Avg.</b>	2 (0.3)	~ ~	2 (0.3)	~ ~	19 (0.8)	487 (5.4)	78 (0.9)	495 (1.7)
<b>Physics</b>								
Belgium (Flemish)	3 (2.1)	553 (35.1)	0 (0.0)	~ ~	43 (6.7)	550 (5.6)	54 (7.0)	551 (6.6)
Bulgaria	1 (0.6)	~ ~	1 (0.7)	~ ~	11 (2.7)	499 (19.1)	88 (2.9)	507 (5.0)
Chinese Taipei <sup>a</sup>	1 (1.0)	~ ~	41 (4.4)	578 (6.8)	58 (4.5)	561 (4.9)	0 (0.0)	~ ~
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	7 (2.5)	596 (18.2)	93 (2.5)	537 (4.3)
Finland <sup>b</sup>	3 (1.7)	544 (12.9)	6 (2.1)	521 (11.9)	11 (2.4)	530 (9.8)	81 (3.6)	535 (3.7)
Hungary	3 (1.4)	528 (16.3)	2 (1.2)	~ ~	10 (2.3)	548 (10.0)	85 (2.8)	554 (4.0)
Indonesia	14 (3.3)	421 (14.1)	1 (0.7)	~ ~	8 (2.5)	418 (13.5)	76 (4.1)	440 (5.7)
Latvia (LSS)	1 (0.5)	~ ~	2 (1.3)	~ ~	16 (3.2)	502 (10.8)	82 (3.5)	503 (5.3)
Lithuania <sup>‡</sup>	--	--	--	--	--	--	--	--
Macedonia, Rep. of	3 (1.9)	424 (107.2)	0 (0.5)	~ ~	91 (2.7)	458 (5.6)	6 (1.9)	457 (13.2)
Moldova	3 (1.6)	437 (18.4)	3 (1.5)	422 (29.9)	8 (2.5)	478 (21.2)	86 (3.3)	460 (4.7)
Morocco <sup>c</sup>	0 (0.0)	~ ~	1 (0.6)	~ ~	82 (4.3)	323 (5.5)	17 (4.4)	335 (16.3)
Netherlands <sup>d</sup>	1 (0.9)	~ ~	0 (0.0)	~ ~	15 (3.9)	543 (6.3)	84 (4.0)	547 (8.7)
Romania	0 (0.4)	~ ~	2 (1.3)	~ ~	9 (2.7)	435 (12.8)	88 (3.1)	479 (7.1)
Russian Federation	1 (0.8)	~ ~	0 (0.0)	~ ~	6 (1.7)	554 (17.2)	92 (2.1)	527 (6.7)
<b>International Avg.</b>	2 (0.4)	~ ~	4 (0.4)	507 (6.6)	27 (0.9)	500 (3.4)	67 (1.0)	495 (2.3)
<b>Chemistry</b>								
Belgium (Flemish)	--	--	--	--	--	--	--	--
Bulgaria	1 (1.1)	~ ~	1 (0.8)	~ ~	22 (3.5)	505 (11.2)	75 (3.9)	520 (7.4)
Chinese Taipei	--	--	--	--	--	--	--	--
Czech Republic	0 (0.0)	~ ~	0 (0.0)	~ ~	8 (2.7)	585 (18.5)	92 (2.7)	536 (4.0)
Finland	--	--	--	--	--	--	--	--
Hungary	1 (0.6)	~ ~	3 (1.0)	587 (10.6)	18 (3.1)	554 (9.0)	78 (3.2)	549 (4.4)
Indonesia	--	--	--	--	--	--	--	--
Latvia (LSS) <sup>s</sup>	2 (1.1)	~ ~	4 (1.9)	489 (8.9)	17 (3.7)	479 (9.1)	78 (3.9)	510 (5.4)
Lithuania <sup>‡</sup>	--	--	--	--	--	--	--	--
Macedonia, Rep. of	1 (0.9)	~ ~	1 (0.7)	~ ~	20 (3.3)	435 (15.2)	77 (3.1)	472 (5.7)
Moldova	2 (1.2)	~ ~	7 (2.2)	465 (21.0)	78 (3.0)	460 (4.4)	14 (2.4)	442 (11.2)
Morocco	--	--	--	--	--	--	--	--
Netherlands	--	--	--	--	--	--	--	--
Romania	1 (0.7)	~ ~	1 (1.1)	~ ~	13 (3.7)	446 (13.9)	84 (3.3)	477 (7.1)
Russian Federation	0 (0.0)	~ ~	1 (0.6)	~ ~	63 (3.8)	526 (6.0)	36 (3.9)	532 (11.6)
<b>International Avg.</b>	1 (0.3)	~ ~	2 (0.4)	~ ~	30 (1.2)	499 (4.2)	67 (1.2)	505 (2.8)

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


<sup>a</sup> Chinese Taipei: Data for grade 8 physics/chemistry teachers are reported in the physics panel; data for grade 7 biology teachers are not available.

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

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

<sup>d</sup> Netherlands: Data for physics/chemistry teachers are reported in physics panel.

## Exhibit 6.6 Frequency of Outside Interruption During Science Lessons\*

		Never		Once in a While		Pretty Often		Almost Always	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
<b>G</b>	<b>General/Integrated Science</b>								
	Australia	16 (1.0)	537 (6.8)	63 (1.2)	553 (4.4)	16 (0.9)	526 (6.4)	6 (0.5)	487 (9.2)
	Canada	13 (0.7)	530 (4.9)	63 (0.9)	542 (2.4)	16 (0.7)	523 (3.3)	9 (0.5)	514 (7.9)
	Chile	21 (0.7)	431 (6.4)	47 (0.8)	435 (4.2)	16 (0.5)	408 (4.6)	15 (0.6)	387 (6.1)
	Chinese Taipei <sup>a</sup>	27 (1.1)	566 (4.7)	54 (1.0)	579 (5.4)	14 (0.8)	556 (7.3)	5 (0.6)	547 (11.4)
	Cyprus	27 (1.1)	465 (4.6)	50 (1.0)	471 (3.1)	17 (0.8)	448 (5.8)	6 (0.5)	414 (6.8)
	England	14 (1.1)	557 (9.1)	68 (1.1)	549 (5.1)	14 (0.9)	513 (6.4)	5 (0.5)	479 (13.2)
	Hong Kong, SAR	41 (1.1)	534 (4.1)	47 (0.9)	534 (3.7)	9 (0.7)	507 (9.3)	3 (0.4)	498 (10.3)
	Indonesia <sup>b</sup>	16 (1.0)	422 (6.4)	73 (1.1)	446 (4.0)	9 (0.6)	397 (8.7)	2 (0.2)	~ ~
	Iran, Islamic Rep.	34 (0.9)	451 (4.7)	38 (0.7)	458 (5.5)	15 (0.6)	435 (5.3)	13 (0.6)	443 (6.5)
	Israel	23 (0.9)	469 (7.4)	46 (1.0)	495 (4.3)	18 (0.7)	467 (6.0)	13 (0.7)	446 (8.5)
	Italy	19 (1.1)	493 (7.9)	53 (1.2)	503 (4.0)	16 (0.9)	486 (6.7)	12 (0.8)	470 (7.3)
	Japan	64 (1.3)	550 (3.4)	32 (1.2)	553 (3.7)	4 (0.3)	530 (11.7)	1 (0.2)	~ ~
	Jordan	28 (0.9)	469 (4.7)	38 (1.0)	478 (4.3)	18 (0.6)	431 (8.0)	17 (0.8)	427 (5.6)
	Korea, Rep. of	61 (0.9)	544 (2.8)	34 (0.8)	561 (3.3)	4 (0.3)	536 (9.3)	2 (0.2)	~ ~
	Malaysia	32 (0.9)	485 (5.4)	60 (0.9)	499 (4.3)	6 (0.4)	477 (8.6)	2 (0.2)	~ ~
	New Zealand	8 (0.6)	502 (9.7)	55 (1.6)	535 (4.9)	24 (1.1)	494 (5.2)	13 (0.9)	459 (6.6)
	Philippines	12 (0.6)	352 (8.6)	35 (1.1)	375 (9.5)	27 (0.6)	352 (10.0)	26 (1.0)	309 (6.8)
	Singapore	19 (0.7)	555 (11.1)	62 (1.2)	583 (7.0)	13 (0.8)	535 (10.6)	6 (0.5)	530 (11.4)
	South Africa	23 (0.9)	225 (9.5)	26 (1.2)	319 (13.8)	23 (0.8)	229 (10.3)	28 (1.2)	206 (8.2)
Thailand	24 (0.7)	480 (6.7)	63 (1.0)	490 (4.3)	11 (0.7)	459 (8.1)	3 (0.3)	459 (16.7)	
Tunisia	58 (1.1)	434 (3.1)	26 (0.9)	430 (6.4)	9 (0.5)	419 (4.5)	8 (0.5)	417 (6.9)	
Turkey	50 (1.3)	447 (5.8)	37 (0.9)	435 (4.2)	7 (0.5)	397 (9.7)	6 (0.4)	404 (9.5)	
United States	13 (0.7)	519 (7.3)	57 (1.2)	539 (4.7)	18 (0.7)	501 (5.3)	11 (0.8)	470 (7.5)	
<b>International Avg.</b>	<b>28 (0.2)</b>	<b>479 (1.3)</b>	<b>49 (0.2)</b>	<b>494 (1.1)</b>	<b>14 (0.1)</b>	<b>462 (1.6)</b>	<b>9 (0.1)</b>	<b>440 (2.8)</b>	
	<b>Earth Science</b>								
	Belgium (Flemish)	35 (1.3)	541 (4.2)	53 (1.2)	551 (3.6)	8 (0.6)	524 (9.4)	5 (0.5)	503 (10.8)
	Bulgaria	23 (1.2)	529 (9.0)	60 (1.3)	525 (5.4)	9 (0.8)	488 (12.6)	9 (0.7)	477 (10.9)
	Czech Republic	47 (1.7)	542 (4.1)	45 (1.5)	543 (5.9)	5 (0.5)	518 (9.3)	3 (0.7)	530 (16.1)
	Finland	39 (1.4)	538 (3.9)	50 (1.4)	542 (4.2)	7 (0.6)	509 (9.5)	4 (0.4)	472 (12.2)
	Hungary	58 (1.4)	559 (4.4)	33 (1.2)	550 (4.2)	5 (0.5)	529 (12.1)	3 (0.3)	526 (10.0)
	Latvia (LSS)	--	--	--	--	--	--	--	--
	Lithuania <sup>†</sup>	--	--	--	--	--	--	--	--
	Macedonia, Rep. of	43 (1.3)	486 (5.4)	36 (1.1)	476 (6.6)	10 (0.6)	425 (7.9)	11 (0.7)	407 (10.8)
	Moldova	35 (1.6)	476 (6.4)	46 (1.4)	466 (4.4)	10 (0.7)	432 (7.2)	9 (0.7)	426 (12.2)
	Morocco	x x	x x	x x	x x	x x	x x	x x	x x
	Netherlands	44 (1.5)	541 (8.3)	48 (1.7)	555 (6.8)	5 (0.6)	521 (15.8)	2 (0.5)	~ ~
	Romania	46 (1.7)	490 (6.2)	43 (1.5)	476 (6.2)	6 (0.6)	431 (15.3)	6 (0.5)	411 (12.8)
	Russian Federation	21 (1.5)	544 (11.4)	62 (1.3)	537 (6.1)	9 (0.7)	502 (10.2)	8 (0.7)	503 (8.9)
	Slovak Republic	52 (1.4)	540 (4.0)	42 (1.3)	535 (3.7)	4 (0.4)	518 (8.2)	2 (0.3)	~ ~
	Slovenia	--	--	--	--	--	--	--	--
	<b>International Avg.</b>	<b>40 (0.4)</b>	<b>526 (2.1)</b>	<b>47 (0.4)</b>	<b>523 (1.6)</b>	<b>7 (0.2)</b>	<b>491 (2.9)</b>	<b>6 (0.2)</b>	<b>473 (3.5)</b>

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

Background data provided by students.

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

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

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

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




<sup>c</sup> Netherlands: data in physics panel pertain to physics/chemistry course.

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

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

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

Exhibit 6.6: Frequency of Outside Interruption During Science Lessons\* (Continued)

	Never		Once in a While		Pretty Often		Almost Always		
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
<b>Biology</b>									
 Belgium (Flemish)	36 (1.3)	538 (5.2)	55 (1.4)	543 (3.1)	6 (0.5)	542 (10.0)	4 (0.7)	485 (10.3)	
Bulgaria	22 (1.2)	524 (8.0)	63 (1.6)	523 (5.5)	8 (0.9)	509 (11.3)	7 (0.6)	470 (10.4)	
Czech Republic	40 (1.7)	540 (4.3)	52 (1.6)	541 (5.6)	5 (0.6)	527 (14.0)	3 (0.4)	530 (20.0)	
Finland	37 (1.5)	538 (3.9)	53 (1.3)	540 (4.0)	7 (0.6)	508 (9.9)	3 (0.3)	490 (13.2)	
Hungary	54 (1.2)	558 (4.2)	37 (1.1)	550 (4.2)	5 (0.5)	537 (12.2)	3 (0.4)	527 (10.7)	
Latvia (LSS)	46 (1.5)	503 (6.0)	47 (1.5)	508 (6.6)	5 (0.5)	479 (11.6)	2 (0.4)	~ ~	
Lithuania †	--	--	--	--	--	--	--	--	
Macedonia, Rep. of	39 (1.3)	480 (5.8)	42 (1.1)	476 (5.8)	10 (0.6)	413 (12.2)	9 (0.6)	412 (12.1)	
Moldova	33 (1.5)	471 (5.8)	48 (1.4)	468 (4.8)	11 (0.7)	433 (8.2)	8 (0.7)	431 (9.0)	
Morocco	x x	x x	x x	x x	x x	x x	x x	x x	
Netherlands	41 (1.8)	537 (9.0)	53 (2.0)	551 (8.1)	4 (0.7)	520 (16.1)	2 (0.6)	~ ~	
Romania	44 (1.7)	487 (6.7)	45 (1.5)	476 (5.5)	6 (0.6)	436 (10.3)	4 (0.4)	408 (11.8)	
Russian Federation	19 (1.5)	545 (13.4)	64 (1.3)	535 (6.0)	10 (0.7)	506 (7.2)	8 (0.5)	507 (9.3)	
Slovak Republic	46 (1.6)	539 (4.2)	48 (1.5)	538 (4.0)	4 (0.5)	506 (9.2)	2 (0.3)	~ ~	
Slovenia	12 (0.9)	513 (5.6)	60 (1.2)	542 (3.4)	18 (0.9)	535 (5.6)	10 (0.6)	512 (7.7)	
<b>International Avg.</b>	36 (0.4)	521 (1.9)	51 (0.4)	522 (1.6)	8 (0.2)	496 (3.4)	5 (0.1)	477 (3.1)	
<b>Physics</b>									
 Belgium (Flemish)	32 (1.8)	548 (6.5)	58 (1.7)	545 (4.6)	7 (0.7)	539 (16.0)	4 (0.7)	529 (22.4)	
Bulgaria	22 (1.2)	523 (7.9)	59 (1.4)	525 (5.5)	11 (0.7)	503 (12.5)	9 (0.8)	478 (10.2)	
Czech Republic	48 (1.8)	541 (4.2)	44 (1.5)	544 (6.7)	5 (0.8)	520 (14.0)	3 (0.6)	532 (16.0)	
Finland	40 (1.3)	543 (4.8)	48 (1.3)	536 (4.3)	7 (0.7)	488 (11.2)	5 (0.5)	493 (8.8)	
Hungary	58 (1.3)	560 (4.1)	33 (1.1)	551 (4.8)	5 (0.5)	523 (9.9)	4 (0.3)	539 (9.6)	
Latvia (LSS)	50 (1.4)	504 (5.4)	41 (1.3)	509 (6.2)	6 (0.5)	476 (11.0)	3 (0.4)	463 (14.6)	
Lithuania †	--	--	--	--	--	--	--	--	
Macedonia, Rep. of	41 (1.3)	488 (5.9)	37 (1.0)	478 (6.4)	11 (0.6)	415 (8.9)	12 (0.7)	408 (8.7)	
Moldova	35 (1.5)	475 (6.2)	45 (1.5)	466 (4.4)	11 (0.7)	445 (8.2)	8 (0.6)	429 (8.1)	
Morocco	x x	x x	x x	x x	x x	x x	x x	x x	
Netherlands †	42 (1.7)	544 (8.3)	50 (1.6)	550 (6.6)	5 (0.8)	533 (14.5)	3 (0.5)	521 (16.9)	
Romania	45 (1.5)	488 (6.3)	42 (1.4)	477 (5.8)	7 (0.6)	446 (10.2)	6 (0.6)	432 (12.1)	
Russian Federation	22 (1.5)	545 (10.8)	62 (1.4)	537 (6.4)	8 (0.5)	505 (9.5)	8 (0.5)	498 (7.5)	
Slovak Republic	50 (1.4)	543 (4.0)	43 (1.3)	535 (3.6)	5 (0.5)	509 (10.1)	2 (0.4)	~ ~	
Slovenia	13 (1.0)	519 (5.8)	60 (1.2)	543 (3.7)	17 (0.9)	527 (6.2)	10 (0.7)	516 (6.7)	
<b>International Avg.</b>	38 (0.4)	525 (1.7)	48 (0.4)	523 (1.6)	8 (0.2)	495 (3.0)	6 (0.2)	486 (3.4)	
<b>Chemistry</b>									
 Belgium (Flemish)	--	--	--	--	--	--	--	--	
Bulgaria	22 (1.1)	527 (8.0)	60 (1.2)	523 (5.4)	10 (0.8)	501 (10.7)	9 (0.7)	482 (11.3)	
Czech Republic	45 (1.8)	538 (4.2)	46 (1.6)	546 (5.4)	5 (0.6)	532 (10.8)	3 (0.7)	503 (14.8)	
Finland	40 (1.4)	542 (5.1)	50 (1.3)	538 (3.9)	6 (0.7)	498 (9.7)	4 (0.5)	496 (10.8)	
Hungary	56 (1.6)	558 (4.1)	35 (1.3)	553 (4.9)	5 (0.5)	521 (10.2)	4 (0.5)	538 (11.0)	
Latvia (LSS)	48 (1.3)	506 (5.3)	44 (1.3)	508 (6.1)	4 (0.4)	476 (13.8)	3 (0.4)	459 (13.9)	
Lithuania †	--	--	--	--	--	--	--	--	
Macedonia, Rep. of	40 (1.3)	481 (5.7)	39 (1.0)	477 (6.2)	10 (0.7)	410 (9.0)	11 (0.6)	413 (12.6)	
Moldova	34 (1.4)	472 (6.2)	47 (1.5)	465 (4.6)	10 (0.6)	431 (8.9)	8 (0.5)	441 (10.5)	
Morocco	x x	x x	x x	x x	x x	x x	x x	x x	
Netherlands	--	--	--	--	--	--	--	--	
Romania	46 (1.5)	485 (6.3)	41 (1.4)	479 (6.1)	8 (0.6)	440 (10.6)	5 (0.5)	423 (14.6)	
Russian Federation	21 (1.6)	548 (10.5)	62 (1.3)	534 (6.0)	9 (0.6)	503 (9.9)	8 (0.6)	509 (8.6)	
Slovak Republic	51 (1.5)	541 (3.8)	42 (1.3)	535 (4.3)	5 (0.5)	513 (9.1)	2 (0.3)	~ ~	
Slovenia	12 (0.9)	514 (5.9)	60 (1.1)	542 (3.5)	18 (1.0)	534 (6.2)	10 (0.6)	515 (8.2)	
<b>International Avg.</b>	38 (0.4)	519 (2.0)	48 (0.4)	518 (2.0)	8 (0.2)	487 (3.3)	6 (0.2)	478 (3.3)	

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

## What Activities Do Students Do in Their Science Lessons?

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

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

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

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## Exhibit 6.7 Science Class Size

		Overall Average Class Size	1 - 20 Students		21 - 35 Students		36 or More Students	
			Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	r	26 (0.2)	11 (2.2)	485 (8.8)	88 (2.3)	546 (4.7)	1 (0.3)	~ ~
Belgium (Flemish)	r	20 (0.5)	61 (3.9)	527 (5.1)	38 (3.9)	540 (7.2)	1 (1.0)	~ ~
Bulgaria	r	22 (0.4)	40 (4.7)	493 (5.4)	59 (5.2)	525 (7.5)	1 (0.9)	~ ~
Canada	s	27 (0.3)	12 (2.1)	525 (7.8)	86 (2.2)	535 (3.1)	2 (0.8)	~ ~
Chile		34 (0.6)	6 (1.4)	376 (10.7)	47 (4.1)	415 (6.3)	48 (4.0)	428 (5.6)
Chinese Taipei		39 (0.5)	0 (0.0)	~ ~	14 (2.9)	564 (12.4)	86 (2.9)	569 (4.8)
Cyprus	s	29 (0.2)	1 (0.3)	~ ~	99 (0.3)	462 (3.4)	0 (0.0)	~ ~
Czech Republic		24 (0.4)	19 (3.8)	525 (7.6)	81 (3.8)	544 (5.3)	0 (0.0)	~ ~
England		x x	x x	x x	x x	x x	x x	x x
Finland		18 (0.3)	80 (2.6)	533 (4.2)	20 (2.6)	543 (4.6)	0 (0.3)	~ ~
Hong Kong, SAR		39 (0.3)	1 (0.0)	~ ~	13 (3.1)	487 (8.2)	86 (3.2)	537 (4.1)
Hungary	r	23 (0.4)	39 (3.6)	531 (6.7)	61 (3.6)	561 (4.2)	1 (0.5)	~ ~
Indonesia	r	44 (0.8)	1 (0.1)	~ ~	12 (2.8)	425 (13.3)	88 (2.8)	443 (5.6)
Iran, Islamic Rep.		33 (0.5)	4 (1.3)	446 (10.0)	63 (4.2)	456 (4.2)	34 (4.4)	439 (8.6)
Israel	r	28 (0.7)	17 (3.6)	489 (11.3)	62 (4.6)	470 (9.3)	21 (3.8)	472 (9.1)
Italy		20 (0.3)	55 (3.9)	486 (5.3)	44 (3.9)	502 (6.1)	1 (0.0)	~ ~
Japan		36 (0.3)	1 (0.0)	~ ~	41 (3.1)	547 (3.4)	58 (3.0)	550 (2.8)
Jordan		36 (0.6)	4 (1.3)	463 (45.9)	42 (3.8)	444 (7.0)	54 (3.6)	454 (4.3)
Korea, Rep. of		43 (0.7)	0 (0.0)	~ ~	10 (2.2)	537 (6.1)	90 (2.2)	550 (2.7)
Latvia (LSS)	s	23 (0.4)	36 (3.4)	495 (8.0)	64 (3.5)	510 (5.5)	0 (0.2)	~ ~
Lithuania <sup>†</sup>		23 (0.3)	30 (2.6)	476 (6.6)	70 (2.6)	494 (4.9)	0 (0.0)	~ ~
Macedonia, Rep. of		28 (0.4)	10 (2.3)	413 (16.9)	84 (3.0)	458 (5.5)	7 (2.3)	492 (13.8)
Malaysia		38 (0.4)	0 (0.0)	~ ~	25 (3.6)	496 (7.3)	75 (3.6)	491 (5.7)
Moldova	r	25 (0.4)	17 (2.3)	454 (13.2)	82 (2.4)	460 (4.6)	1 (0.5)	~ ~
Morocco		30 (0.7)	19 (3.4)	326 (10.7)	60 (3.1)	322 (4.9)	21 (2.9)	321 (6.1)
Netherlands	r	25 (0.4)	11 (3.3)	492 (20.1)	89 (3.3)	554 (8.1)	0 (0.0)	~ ~
New Zealand		26 (0.5)	14 (2.4)	468 (15.4)	84 (2.6)	520 (5.5)	2 (1.2)	~ ~
Philippines		50 (0.8)	0 (0.0)	~ ~	4 (1.5)	316 (28.5)	96 (1.5)	349 (7.9)
Romania		24 (0.4)	31 (2.8)	449 (9.7)	64 (2.9)	479 (7.8)	5 (1.4)	493 (11.3)
Russian Federation		24 (0.5)	19 (3.1)	501 (11.3)	81 (3.1)	536 (6.7)	0 (0.0)	~ ~
Singapore		37 (0.3)	1 (0.4)	~ ~	32 (3.8)	565 (16.0)	68 (3.8)	571 (8.0)
Slovenia		22 (0.3)	29 (3.2)	535 (7.0)	71 (3.2)	533 (3.3)	0 (0.0)	~ ~
South Africa	r	49 (1.3)	1 (0.6)	~ ~	14 (2.6)	284 (25.2)	85 (2.6)	248 (10.8)
Thailand	r	42 (0.9)	2 (0.8)	~ ~	25 (4.0)	473 (7.7)	73 (3.8)	486 (5.1)
Tunisia		34 (0.4)	3 (1.5)	431 (13.0)	53 (4.2)	426 (4.5)	44 (4.3)	431 (4.6)
Turkey	s	44 (1.2)	2 (1.2)	~ ~	22 (3.1)	436 (12.1)	76 (3.4)	429 (4.5)
United States	r	26 (0.5)	15 (2.1)	530 (9.4)	80 (2.4)	522 (5.4)	5 (1.4)	493 (14.9)
<b>International Avg.</b>		31 (0.1)	16 (0.4)	477 (2.8)	52 (0.5)	486 (1.5)	31 (0.4)	462 (4.8)

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

Background data provided by teachers.

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

Science teacher background data for Slovak Republic are unavailable.

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

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

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% of students.

## Exhibit 6.8 Trends in Science Class Size

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

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

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

Background data provided by teachers.

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

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

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

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

Science teacher background data for Slovak Republic are unavailable.

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

A dash (–) indicates data are not available.

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

## Exhibit 6.9 Time Spent on Various Activities in Science Class

	Average Percentage of Class Time Spent in a Typical Month of Lessons									
	Administrative Tasks	Homework Review	Lecture-Style Presentation by teacher	Teacher-Guided Student Practice	Re-teaching and Clarification of Content/Procedures	Student Independent Practice	Tests and Quizzes	Teacher Demonstrations of Experiments	Students Conducting Experiments	Other
Australia	5 (0.4)	7 (0.3)	18 (0.8)	16 (0.8)	9 (0.5)	11 (0.5)	7 (0.4)	6 (0.3)	23 (1.0)	r 3 (0.3)
Belgium (Flemish)	r 4 (0.3)	r 5 (0.5)	r 32 (1.9)	r 11 (0.7)	r 10 (0.6)	r 9 (0.5)	r 9 (0.4)	r 10 (0.7)	r 8 (0.8)	r 2 (0.4)
Bulgaria	r 2 (0.3)	r 4 (0.3)	r 43 (0.6)	r 9 (0.4)	r 8 (0.3)	r 9 (0.4)	r 16 (0.4)	r 6 (0.4)	r 3 (0.2)	r 1 (0.2)
Canada	r 4 (0.2)	r 9 (0.4)	r 19 (0.8)	r 12 (0.4)	r 8 (0.3)	r 11 (0.9)	r 8 (0.3)	r 8 (0.4)	r 22 (1.1)	s 3 (0.6)
Chile	5 (0.4)	12 (0.6)	21 (1.1)	12 (0.8)	15 (0.7)	7 (0.8)	11 (0.4)	7 (0.6)	13 (1.0)	r 3 (0.4)
Chinese Taipei	3 (0.6)	8 (0.4)	39 (1.4)	9 (0.6)	8 (0.4)	5 (0.3)	8 (0.4)	6 (0.3)	13 (0.7)	1 (0.3)
Cyprus	s 3 (0.3)	s 10 (0.5)	s 17 (1.1)	s 15 (0.7)	s 9 (0.5)	s 6 (0.6)	s 9 (0.4)	16 (0.7)	s 12 (1.1)	s 2 (0.4)
Czech Republic	2 (0.2)	4 (0.2)	32 (0.6)	18 (0.6)	9 (0.3)	12 (0.4)	8 (0.2)	7 (0.3)	5 (0.3)	3 (0.2)
England	s 3 (0.3)	s 3 (0.3)	s 13 (0.7)	s 19 (1.2)	s 8 (0.5)	s 13 (0.7)	s 7 (0.3)	10 (0.4)	s 24 (1.4)	x x
Finland	2 (0.2)	9 (0.3)	20 (0.8)	16 (0.7)	8 (0.3)	11 (0.5)	6 (0.2)	5 (0.2)	21 (0.8)	2 (0.2)
Hong Kong, SAR	4 (0.5)	7 (0.5)	20 (1.2)	8 (0.6)	7 (0.5)	6 (0.5)	6 (0.3)	13 (0.7)	29 (1.3)	2 (0.4)
Hungary	3 (0.1)	8 (0.3)	23 (0.8)	18 (0.5)	12 (0.3)	10 (0.3)	10 (0.3)	9 (0.3)	5 (0.2)	4 (0.3)
Indonesia	6 (0.5)	13 (1.3)	14 (1.1)	17 (1.0)	13 (0.9)	13 (0.9)	14 (1.1)	14 (1.0)	14 (1.1)	3 (0.3)
Iran, Islamic Rep.	6 (0.5)	12 (1.0)	29 (1.9)	13 (1.1)	13 (1.1)	9 (0.9)	16 (1.2)	15 (0.8)	9 (0.8)	6 (0.7)
Israel	r 4 (0.4)	r 11 (0.9)	r 23 (1.0)	r 16 (0.8)	r 11 (0.7)	r 14 (1.0)	r 8 (0.4)	r 12 (1.0)	r 12 (1.0)	s 3 (0.6)
Italy	2 (0.2)	10 (0.5)	29 (0.8)	15 (0.6)	13 (0.5)	7 (0.4)	12 (0.5)	7 (0.4)	5 (0.4)	r 1 (0.3)
Japan	2 (0.3)	3 (0.3)	31 (1.4)	11 (0.9)	11 (0.6)	5 (0.5)	5 (0.3)	9 (0.6)	24 (1.5)	2 (0.4)
Jordan	9 (1.1)	23 (2.2)	26 (1.7)	28 (2.3)	19 (1.7)	16 (1.7)	20 (2.1)	29 (2.5)	22 (2.1)	7 (1.3)
Korea, Rep. of	4 (0.7)	6 (0.4)	34 (1.4)	8 (0.5)	9 (0.5)	7 (0.6)	5 (0.3)	7 (0.4)	18 (1.0)	2 (0.3)
Latvia (LSS)	r 3 (0.3)	r 9 (0.4)	r 24 (0.8)	r 15 (0.5)	r 11 (0.5)	r 8 (0.4)	r 8 (0.3)	r 11 (0.4)	r 8 (0.4)	r 6 (0.5)
Lithuania <sup>†</sup>	2 (0.2)	8 (0.2)	31 (0.7)	22 (0.6)	11 (0.3)	12 (0.5)	12 (0.4)	--	--	2 (0.2)
Macedonia, Rep. of	5 (0.3)	6 (0.3)	42 (1.0)	12 (0.5)	6 (0.4)	7 (0.3)	6 (0.4)	9 (0.3)	7 (0.4)	3 (0.3)
Malaysia	5 (0.4)	9 (0.5)	15 (1.0)	12 (0.6)	9 (0.6)	6 (0.4)	8 (0.5)	10 (0.5)	23 (1.5)	r 4 (0.5)
Moldova	4 (0.4)	15 (0.5)	21 (0.8)	16 (0.6)	9 (0.4)	14 (0.4)	8 (0.2)	8 (0.3)	6 (0.3)	4 (0.2)
Morocco	2 (0.2)	12 (0.6)	17 (0.9)	18 (1.2)	10 (0.4)	6 (0.4)	12 (0.3)	18 (0.7)	14 (0.6)	5 (0.3)
Netherlands	4 (0.4)	13 (0.7)	13 (1.0)	7 (0.5)	14 (0.7)	23 (1.1)	r 10 (0.4)	5 (0.2)	5 (0.5)	6 (0.7)
New Zealand	5 (0.3)	6 (0.3)	16 (0.9)	16 (0.9)	9 (0.4)	11 (0.7)	7 (0.3)	7 (0.4)	23 (1.0)	1 (0.2)
Philippines	7 (0.9)	10 (1.1)	21 (1.2)	15 (1.5)	12 (1.2)	13 (1.3)	13 (0.9)	14 (1.1)	19 (1.1)	4 (0.9)
Romania	4 (0.2)	7 (0.3)	24 (0.7)	14 (0.4)	9 (0.3)	11 (0.4)	12 (0.4)	10 (0.7)	8 (0.4)	4 (0.5)
Russian Federation	2 (0.1)	13 (0.4)	29 (0.6)	12 (0.3)	9 (0.1)	11 (0.3)	9 (0.3)	6 (0.2)	6 (0.2)	5 (0.2)
Singapore	4 (0.4)	9 (0.5)	27 (1.3)	11 (1.0)	7 (0.5)	7 (0.5)	7 (0.4)	7 (0.6)	23 (1.1)	2 (0.2)
South Africa	10 (1.1)	18 (1.7)	22 (1.8)	17 (2.1)	19 (2.0)	16 (1.5)	21 (2.3)	17 (1.4)	14 (2.1)	r 6 (1.3)
Thailand	10 (1.1)	14 (1.4)	19 (1.4)	14 (1.4)	15 (1.4)	17 (1.6)	15 (1.5)	13 (1.4)	28 (1.8)	3 (0.8)
Tunisia	2 (0.2)	11 (0.7)	12 (0.9)	18 (1.0)	8 (0.7)	5 (0.5)	10 (0.7)	13 (0.8)	21 (1.3)	3 (0.5)
Turkey	5 (0.7)	7 (0.5)	41 (1.1)	11 (0.8)	11 (0.9)	7 (0.7)	8 (0.7)	12 (0.8)	7 (0.7)	3 (0.5)
United States	r 6 (0.5)	r 8 (0.4)	r 19 (0.8)	r 12 (0.5)	r 9 (0.3)	r 11 (0.4)	r 9 (0.3)	r 8 (0.4)	r 17 (0.9)	r 3 (0.5)
<b>International Avg.</b>	4 (0.1)	9 (0.1)	24 (0.2)	14 (0.2)	10 (0.1)	10 (0.1)	10 (0.1)	10 (0.1)	15 (0.2)	3 (0.1)

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

Background data provided by teachers.

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



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

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

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students. An "x" indicates teacher response data available for <50% students.

## Exhibit 6.10 Students Doing Various Activities in Science Class\*

		Percentage of Students Reporting Almost Always or Pretty Often				
		We Discuss Our Completed Homework	Teachers Shows Us How to Do Science Problems	We Work on Worksheets or Textbooks on Our own	We Work on Science Projects	We Begin Our Homework
 <b>General/Integrated Science</b>	Australia	48 (1.6)	73 (1.4)	75 (1.2)	51 (1.6)	40 (1.5)
	Canada	56 (1.4)	74 (1.2)	76 (1.1)	62 (1.5)	68 (1.8)
	Chile	50 (1.1)	84 (0.9)	51 (1.0)	72 (1.2)	57 (1.1)
	Chinese Taipei <sup>a</sup>	50 (1.4)	88 (0.7)	61 (1.3)	52 (1.3)	29 (0.9)
	Cyprus	76 (0.9)	86 (0.9)	66 (1.0)	52 (1.1)	47 (1.2)
	England	53 (1.6)	87 (0.9)	63 (2.1)	55 (1.6)	28 (1.3)
	Hong Kong, SAR	33 (1.0)	86 (0.8)	54 (1.1)	43 (1.1)	34 (1.1)
	Indonesia <sup>b</sup>	46 (1.1)	87 (0.8)	48 (1.7)	76 (1.1)	11 (0.8)
	Iran, Islamic Rep.	49 (1.0)	89 (0.7)	43 (1.1)	38 (1.3)	33 (1.1)
	Israel	63 (1.2)	62 (1.3)	67 (1.5)	49 (1.5)	55 (1.5)
	Italy	49 (1.4)	56 (1.5)	38 (1.3)	35 (1.7)	30 (1.6)
	Japan	10 (0.8)	74 (1.1)	29 (1.3)	21 (0.8)	7 (0.6)
	Jordan	71 (1.2)	91 (0.8)	50 (1.2)	55 (1.4)	57 (1.0)
	Korea, Rep. of	14 (0.8)	73 (1.1)	27 (0.8)	36 (1.0)	12 (0.6)
	Malaysia	51 (1.0)	89 (0.6)	56 (1.2)	41 (1.5)	45 (1.3)
	New Zealand	53 (1.4)	81 (1.0)	70 (1.6)	57 (1.6)	35 (1.8)
	Philippines	77 (0.7)	86 (0.8)	64 (0.8)	64 (1.1)	51 (1.0)
	Singapore	58 (0.9)	85 (0.9)	75 (0.9)	39 (1.5)	44 (1.6)
	South Africa	71 (0.7)	84 (1.1)	68 (0.9)	66 (1.4)	67 (1.1)
	Thailand	36 (1.2)	75 (1.2)	56 (1.1)	42 (1.7)	81 (0.8)
Tunisia	54 (1.2)	79 (0.8)	44 (1.2)	69 (0.9)	29 (1.0)	
Turkey	32 (1.0)	90 (0.7)	38 (1.0)	29 (1.0)	22 (1.2)	
United States	63 (1.9)	69 (1.4)	76 (1.5)	59 (1.3)	57 (2.0)	
<b>International Avg.</b>	51 (0.3)	80 (0.2)	56 (0.3)	51 (0.3)	41 (0.3)	
 <b>Earth Science</b>	Belgium (Flemish)	22 (1.4)	21 (1.0)	46 (1.3)	15 (0.9)	10 (0.8)
	Bulgaria	34 (1.9)	52 (2.3)	34 (1.4)	37 (1.9)	20 (1.4)
	Czech Republic	27 (1.8)	96 (0.7)	49 (2.6)	15 (1.3)	13 (1.2)
	Finland	37 (1.4)	59 (1.3)	63 (1.8)	39 (1.4)	41 (1.8)
	Hungary	45 (1.8)	60 (1.4)	60 (2.0)	66 (2.0)	20 (1.0)
	Latvia (LSS)	--	--	--	--	--
	Lithuania <sup>‡</sup>	--	--	--	--	--
	Macedonia, Rep. of	50 (1.8)	85 (1.1)	64 (2.0)	41 (1.4)	31 (1.5)
	Moldova	59 (1.4)	78 (1.4)	67 (1.2)	37 (1.5)	47 (1.5)
	Morocco	x x	x x	x x	x x	x x
	Netherlands	70 (2.3)	43 (2.4)	80 (1.9)	14 (1.6)	74 (2.1)
	Romania	39 (1.8)	66 (1.7)	43 (1.6)	36 (1.6)	25 (1.6)
	Russian Federation	39 (1.2)	44 (1.6)	62 (1.3)	29 (1.3)	21 (0.8)
	Slovak Republic	24 (1.2)	58 (1.5)	44 (1.8)	17 (1.3)	16 (1.2)
	Slovenia	--	--	--	--	--
	<b>International Avg.</b>	41 (0.5)	60 (0.5)	56 (0.5)	31 (0.5)	29 (0.4)

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

Background data provided by students.

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

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

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

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

<sup>c</sup> Netherlands: data in physics panel pertain to physics/chemistry course.

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

A dash (–) indicates data are not available.

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

	Percentage of Students Reporting Almost Always or Pretty Often				
	We Discuss Our Completed Homework	Teachers Shows Us How to Do Science Problems	We Work on Worksheets or Textbooks on Our own	We Work on Science Projects	We Begin Our Homework
<b>Biology</b>					
Belgium (Flemish)	22 (1.1)	21 (1.7)	42 (1.5)	24 (1.3)	7 (0.9)
Bulgaria	31 (1.9)	35 (1.7)	32 (1.6)	23 (1.4)	13 (1.3)
Czech Republic	25 (1.6)	98 (0.6)	41 (2.5)	15 (1.2)	15 (1.2)
Finland	37 (1.3)	45 (1.2)	58 (2.2)	37 (1.6)	39 (2.0)
Hungary	45 (1.9)	52 (1.7)	55 (2.4)	58 (2.1)	14 (0.9)
Latvia (LSS)	33 (1.4)	35 (1.6)	54 (1.6)	--	35 (1.6)
Lithuania †	--	--	--	--	--
Macedonia, Rep. of	52 (1.3)	85 (1.0)	60 (1.8)	48 (1.5)	26 (1.2)
Moldova	63 (1.2)	61 (1.5)	66 (1.3)	38 (1.5)	41 (1.6)
Morocco	s 67 (1.5)	s 79 (1.1)	s 57 (1.4)	s 48 (1.8)	s 51 (1.4)
Netherlands	57 (4.0)	45 (2.1)	79 (3.6)	17 (1.7)	70 (3.1)
Romania	39 (1.7)	62 (1.8)	40 (1.6)	34 (1.8)	23 (1.5)
Russian Federation	38 (1.2)	36 (1.5)	64 (1.5)	27 (1.4)	18 (1.1)
Slovak Republic	25 (1.5)	60 (1.7)	42 (1.9)	21 (1.3)	15 (1.2)
Slovenia	24 (1.6)	44 (1.6)	27 (1.2)	24 (1.1)	14 (1.0)
<b>International Avg.</b>	40 (0.5)	54 (0.4)	51 (0.5)	32 (0.4)	27 (0.4)
<b>Physics</b>					
Belgium (Flemish)	28 (2.1)	58 (2.6)	45 (2.0)	35 (1.8)	11 (1.3)
Bulgaria	39 (1.4)	87 (0.9)	37 (1.9)	35 (1.5)	22 (1.2)
Czech Republic	29 (1.7)	98 (0.4)	40 (1.6)	27 (1.4)	14 (1.4)
Finland	41 (1.7)	72 (1.2)	60 (1.8)	42 (1.4)	41 (2.0)
Hungary	57 (1.9)	88 (1.0)	46 (1.5)	87 (0.7)	23 (1.1)
Latvia (LSS)	37 (1.4)	86 (1.2)	54 (1.3)	--	29 (1.3)
Lithuania †	--	--	--	--	--
Macedonia, Rep. of	61 (1.7)	90 (0.8)	56 (1.6)	56 (1.6)	34 (1.2)
Moldova	60 (1.2)	94 (0.5)	72 (1.0)	39 (1.6)	46 (1.5)
Morocco	x x	s 92 (0.7)	x x	x x	x x
Netherlands †	64 (2.9)	55 (2.5)	81 (1.9)	17 (1.5)	73 (2.7)
Romania	50 (1.6)	84 (1.0)	42 (1.4)	47 (1.9)	32 (1.7)
Russian Federation	44 (1.2)	89 (0.9)	64 (1.3)	33 (1.1)	24 (1.0)
Slovak Republic	43 (1.5)	86 (0.9)	42 (1.6)	38 (1.8)	31 (1.7)
Slovenia	38 (1.5)	60 (1.3)	36 (1.3)	28 (1.1)	24 (1.3)
<b>International Avg.</b>	45 (0.5)	81 (0.3)	52 (0.4)	40 (0.4)	31 (0.4)
<b>Chemistry</b>					
Belgium (Flemish)	--	--	--	--	--
Bulgaria	41 (1.6)	90 (1.1)	40 (1.5)	42 (1.9)	24 (1.7)
Czech Republic	30 (1.9)	97 (0.9)	40 (2.1)	35 (1.4)	13 (1.2)
Finland	40 (1.5)	69 (1.2)	59 (1.9)	44 (1.5)	39 (1.9)
Hungary	56 (2.1)	86 (0.9)	57 (2.2)	84 (1.2)	21 (1.2)
Latvia (LSS)	45 (1.7)	93 (0.8)	56 (1.4)	--	38 (1.6)
Lithuania †	--	--	--	--	--
Macedonia, Rep. of	52 (1.4)	89 (0.9)	43 (1.2)	54 (1.5)	27 (1.1)
Moldova	62 (1.3)	92 (0.6)	75 (1.0)	40 (1.5)	44 (1.6)
Morocco	x x	s 89 (0.8)	x x	x x	x x
Netherlands	--	--	--	--	--
Romania	51 (1.7)	85 (1.0)	46 (1.6)	46 (1.9)	32 (1.8)
Russian Federation	48 (1.2)	89 (0.8)	64 (1.6)	30 (1.2)	21 (1.1)
Slovak Republic	39 (1.8)	87 (0.8)	39 (1.7)	42 (1.8)	24 (1.6)
Slovenia	33 (1.5)	60 (1.4)	35 (1.3)	28 (1.2)	20 (1.3)
<b>International Avg.</b>	45 (0.5)	85 (0.3)	50 (0.5)	44 (0.5)	28 (0.4)

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



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

6.11



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

6.12



Effective science instruction requires the teacher to guide, focus, challenge, and encourage student learning. Problem-solving activities typically call upon students to use higher-order thinking skills. To examine the emphasis on reasoning and problem-solving in science class, TIMSS created an index of teachers' emphasis on scientific reasoning and problem-solving (ESRPS). As shown in Exhibit 6.12, the index is based on teachers' reports about how often they asked students to explain the reasoning behind an idea, represent and analyze relationships using tables, charts, and graphs, work on problems for which there is no immediately obvious method of solution, write explanations about what was observed and why it happened, and put events or objects in order and give a reason for the organization. Students were placed in the high category if, on average, they were asked to do these activities in most of their lessons. The medium level represents students asked to do these activities in some to most lessons, and students in the low category did the activities only in some lessons or rarely.

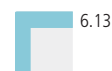
On average internationally, 16 percent of students had teachers who placed a high emphasis on scientific reasoning and problem-solving, with a range from four percent in Belgium (Flemish) and New Zealand to about one-third in Japan and the Philippines. While the level of emphasis on scientific reasoning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



Exhibit R3.9 in the reference section shows the percentages of students asked in most or every lesson to engage in each of the activities included in the problem-solving index. The most common problem-solving activity was for teachers to ask students to explain the reasoning behind an idea. Internationally, 68 percent of students had teachers who asked them to do this in most or every lesson. This activity was relatively infrequent in the top-performing Asian countries; between 42 and 69 percent of the students in Chinese Taipei, Hong Kong, Japan, Korea, and Singapore were asked to explain the reasoning behind an idea in most or every lesson. Across countries, a majority of students (52 percent) were asked to write explanations about what was observed and why it happened in most or every lesson, but only 15 percent were asked to work on problems for which there was no immediately obvious method of solution.



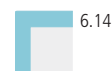
The trends in the index of teachers' emphasis on scientific reasoning and problem-solving are shown in Exhibit 6.13. Internationally, the trend is toward more emphasis on scientific reasoning and problem-solving, as the percentage of students in the high category rose from nine to 13 percent between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



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





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



text continued  
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## Exhibit 6.11 Presentational Modes Used in Science Class\*

		Percentage of Students Reporting Almost Always or Pretty Often				
		Teacher Uses the Board	Teacher Uses an Overhead Projector	Teacher Uses a Computer to Demonstrate Ideas in Science	Students Use the Board	Students Use an Overhead Projector
	<b>General/Integrated Science</b>					
	Australia	93 (0.7)	44 (2.1)	7 (0.8)	18 (1.0)	7 (0.7)
	Canada	81 (1.0)	55 (1.8)	10 (0.7)	19 (0.8)	11 (0.6)
	Chile	87 (1.1)	18 (1.7)	14 (1.1)	66 (1.2)	12 (1.0)
	Chinese Taipei <sup>a</sup>	92 (0.6)	7 (1.0)	5 (0.4)	39 (1.1)	3 (0.4)
	Cyprus	90 (0.7)	40 (2.3)	10 (0.6)	60 (1.6)	12 (0.8)
	England	93 (1.2)	36 (2.7)	8 (0.8)	16 (1.2)	6 (0.6)
	Hong Kong, SAR	88 (0.9)	25 (2.1)	9 (1.2)	32 (1.2)	6 (0.6)
	Indonesia <sup>b</sup>	80 (1.0)	12 (0.9)	3 (0.6)	42 (1.1)	5 (0.6)
	Iran, Islamic Rep.	86 (0.8)	13 (0.8)	0 (0.2)	71 (0.8)	8 (0.6)
	Israel	83 (1.2)	28 (1.4)	22 (1.2)	29 (1.1)	17 (0.9)
	Italy	73 (1.4)	9 (0.9)	9 (0.9)	59 (1.3)	7 (0.7)
	Japan	98 (0.3)	10 (1.5)	2 (0.8)	21 (1.5)	1 (0.2)
	Jordan	87 (0.9)	34 (1.6)	r 15 (1.4)	76 (1.0)	r 26 (1.3)
	Korea, Rep. of	86 (1.1)	26 (2.4)	13 (1.7)	23 (1.1)	7 (0.8)
	Malaysia	87 (0.9)	35 (2.4)	1 (0.2)	37 (1.0)	10 (0.8)
	New Zealand	94 (0.6)	53 (2.3)	12 (1.0)	22 (1.2)	13 (0.9)
	Philippines	85 (0.8)	39 (1.5)	r 24 (1.8)	63 (1.1)	33 (1.4)
	Singapore	92 (0.9)	81 (1.5)	19 (2.0)	40 (1.6)	22 (1.0)
	South Africa	83 (1.1)	48 (1.6)	--	55 (1.7)	38 (1.4)
Thailand	86 (1.0)	14 (1.5)	9 (0.8)	30 (1.0)	7 (0.7)	
Tunisia	78 (1.0)	44 (1.8)	2 (0.6)	52 (1.2)	16 (1.1)	
Turkey	77 (0.9)	15 (1.1)	4 (0.4)	75 (1.0)	12 (0.9)	
United States	75 (1.6)	59 (2.3)	20 (1.4)	29 (1.0)	19 (1.1)	
<b>International Avg.</b>	<b>86 (0.2)</b>	<b>32 (0.4)</b>	<b>10 (0.2)</b>	<b>42 (0.2)</b>	<b>13 (0.2)</b>	
	<b>Earth Science</b>					
	Belgium (Flemish)	68 (2.2)	57 (2.4)	3 (0.4)	12 (0.7)	6 (0.6)
	Bulgaria	61 (1.8)	13 (1.1)	6 (0.8)	49 (2.1)	10 (1.0)
	Czech Republic	65 (2.8)	12 (1.6)	3 (0.5)	40 (2.2)	5 (0.7)
	Finland	81 (1.5)	68 (2.0)	7 (0.7)	23 (1.5)	13 (0.9)
	Hungary	55 (2.1)	24 (2.3)	4 (0.4)	30 (1.4)	7 (0.7)
	Latvia (LSS)	--	--	--	--	--
	Lithuania <sup>‡</sup>	--	--	--	--	--
	Macedonia, Rep. of	58 (2.3)	22 (1.5)	r 8 (1.0)	47 (1.6)	15 (0.9)
	Moldova	62 (1.6)	31 (1.7)	15 (1.2)	61 (1.5)	27 (1.5)
	Morocco	x x	x x	x x	x x	x x
	Netherlands	71 (2.5)	19 (3.0)	6 (1.0)	8 (1.1)	5 (1.1)
	Romania	73 (1.4)	13 (0.9)	3 (0.6)	60 (1.6)	9 (0.8)
	Russian Federation	78 (1.1)	8 (0.7)	2 (0.4)	65 (1.3)	5 (0.5)
	Slovak Republic	41 (2.6)	8 (1.4)	1 (0.4)	30 (2.0)	3 (0.5)
	Slovenia	--	--	--	--	--
	<b>International Avg.</b>	<b>65 (0.6)</b>	<b>25 (0.6)</b>	<b>5 (0.2)</b>	<b>39 (0.5)</b>	<b>10 (0.3)</b>

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

Background data provided by students.

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

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

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

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




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

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

A dash (–) indicates data are not available.

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



	Percentage of Students Reporting Almost Always of Pretty Often				
	Teacher Uses the Board	Teacher Uses an Overhead Projector	Teacher Uses a Computer to Demonstrate Ideas in Science	Students Use the Board	Students Use an Overhead Projector
<b>Biology</b>					
 Belgium (Flemish)	75 (1.9)	50 (2.3)	3 (0.6)	13 (0.9)	4 (0.7)
Bulgaria	68 (2.2)	12 (1.2)	4 (0.7)	43 (1.9)	9 (0.8)
Czech Republic	79 (2.3)	17 (2.1)	3 (1.0)	40 (2.2)	4 (0.5)
Finland	83 (1.5)	75 (1.9)	7 (0.7)	20 (1.4)	11 (0.9)
Hungary	73 (1.9)	29 (2.4)	4 (0.7)	33 (1.5)	6 (0.6)
Latvia (LSS)	59 (2.1)	5 (0.6)	5 (0.7)	29 (1.6)	3 (0.5)
Lithuania <sup>†</sup>	--	--	--	--	--
Macedonia, Rep. of	73 (1.9)	32 (2.0)	6 (0.7)	49 (1.7)	18 (1.3)
Moldova	69 (1.2)	33 (1.6)	13 (1.0)	65 (1.4)	27 (1.5)
Morocco <sup>s</sup>	77 (1.5)	x x	x x	x x	x x
Netherlands	75 (2.4)	14 (2.7)	3 (0.7)	7 (0.9)	3 (0.6)
Romania	75 (1.6)	13 (0.9)	2 (0.4)	58 (1.7)	8 (0.8)
Russian Federation	80 (1.3)	10 (1.0)	2 (0.2)	61 (1.6)	5 (0.6)
Slovak Republic	64 (2.6)	12 (1.5)	1 (0.4)	32 (2.0)	3 (0.4)
Slovenia	71 (1.6)	68 (1.9)	9 (0.8)	32 (1.5)	14 (0.9)
<b>International Avg.</b>	73 (0.5)	28 (0.5)	5 (0.2)	37 (0.4)	9 (0.2)
<b>Physics</b>					
 Belgium (Flemish)	77 (2.2)	26 (2.9)	4 (0.8)	18 (1.5)	5 (0.7)
Bulgaria	83 (1.1)	16 (1.6)	7 (0.8)	71 (1.2)	12 (1.3)
Czech Republic	87 (1.1)	18 (1.8)	5 (0.7)	66 (2.1)	6 (0.6)
Finland	87 (1.1)	48 (1.8)	7 (0.7)	25 (1.3)	10 (0.8)
Hungary	85 (1.1)	19 (2.0)	5 (0.5)	53 (1.4)	7 (0.7)
Latvia (LSS)	81 (1.1)	11 (1.4)	7 (0.9)	57 (1.9)	4 (0.4)
Lithuania <sup>†</sup>	--	--	--	--	--
Macedonia, Rep. of	87 (0.8)	29 (1.8)	r 9 (1.1)	76 (1.1)	18 (1.0)
Moldova	79 (0.9)	35 (1.7)	16 (1.2)	79 (0.8)	29 (1.6)
Morocco	x x	x x	x x	x x	x x
Netherlands <sup>c</sup>	73 (2.0)	13 (2.1)	5 (1.0)	9 (1.3)	3 (0.5)
Romania	85 (0.8)	16 (1.0)	4 (0.7)	79 (1.1)	11 (0.9)
Russian Federation	91 (0.6)	10 (0.9)	3 (0.4)	82 (1.0)	6 (0.5)
Slovak Republic	79 (1.6)	14 (1.3)	3 (0.7)	60 (1.7)	4 (0.4)
Slovenia	80 (1.1)	42 (1.7)	17 (1.1)	48 (1.3)	14 (1.0)
<b>International Avg.</b>	83 (0.3)	23 (0.5)	7 (0.2)	56 (0.4)	10 (0.2)
<b>Chemistry</b>					
 Belgium (Flemish)	--	--	--	--	--
Bulgaria	89 (0.9)	14 (1.0)	6 (0.8)	80 (1.4)	11 (0.8)
Czech Republic	90 (1.3)	19 (2.3)	3 (0.8)	67 (2.2)	5 (0.8)
Finland	90 (1.0)	48 (1.7)	6 (0.6)	26 (1.3)	9 (0.7)
Hungary	90 (0.8)	16 (1.4)	3 (0.4)	54 (1.5)	6 (0.6)
Latvia (LSS)	86 (0.9)	7 (0.7)	5 (0.7)	69 (1.9)	4 (0.5)
Lithuania <sup>†</sup>	--	--	--	--	--
Macedonia, Rep. of	88 (1.0)	24 (1.6)	8 (0.9)	80 (1.2)	16 (1.0)
Moldova	80 (0.9)	34 (1.7)	13 (1.1)	81 (0.8)	28 (1.5)
Morocco	x x	x x	x x	x x	x x
Netherlands	--	--	--	--	--
Romania	87 (0.8)	16 (1.0)	4 (0.7)	84 (0.9)	11 (0.9)
Russian Federation	93 (0.6)	9 (0.7)	2 (0.3)	84 (1.2)	5 (0.5)
Slovak Republic	82 (1.7)	13 (1.8)	2 (0.4)	69 (1.8)	4 (0.4)
Slovenia	81 (1.1)	57 (2.3)	10 (0.9)	54 (1.3)	15 (0.9)
<b>International Avg.</b>	87 (0.3)	23 (0.5)	6 (0.2)	68 (0.4)	10 (0.3)

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

## Exhibit 6.12 Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving (ESRPS)

### Index of Teachers' Emphasis on Scientific Reasoning and Problem-Solving

Index based on teachers' responses to five questions about how often they ask students to: 1) explain the reasoning behind an idea; 2) represent and analyze relationships using tables, charts, graphs; 3) work on problems for which there is no immediately obvious method of solution; 4) write explanations about what was observed and why it happened; 5) put events or objects in order and give a reason for the organization (see reference exhibit R3.9). Average is computed across the five items based on a 4-point scale: 1 = never or almost never; 2 = some lessons; 3 = most lessons; 4 = every lesson. High level indicates average is greater than or equal to 3. Medium level indicates average is greater than or equal to 2.25 and less than 3. Low level indicates average is less than 2.25.

	High ESRPS		Medium ESRPS		Low ESRPS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Philippines	33 (3.8)	344 (10.9)	48 (3.9)	348 (11.4)	19 (3.2)	339 (15.2)
Japan	32 (4.0)	555 (3.1)	37 (4.4)	549 (3.5)	31 (3.9)	545 (3.7)
Tunisia	29 (3.6)	427 (4.5)	52 (4.2)	428 (4.1)	19 (3.5)	436 (6.6)
Turkey	28 (3.7)	445 (7.2)	45 (4.1)	430 (6.2)	27 (3.9)	427 (5.2)
Canada	26 (3.1)	551 (5.5)	48 (3.4)	530 (4.4)	26 (2.7)	528 (5.7)
Italy	26 (3.8)	490 (7.4)	46 (4.4)	490 (5.9)	28 (3.7)	502 (6.8)
Malaysia	25 (3.4)	490 (9.7)	54 (3.8)	498 (6.5)	21 (3.5)	482 (9.4)
Indonesia	24 (3.1)	446 (8.4)	39 (3.4)	438 (6.5)	37 (3.5)	432 (7.5)
Cyprus	22 (3.2)	458 (5.4)	44 (4.1)	469 (4.3)	34 (4.4)	458 (4.9)
Romania	21 (1.9)	480 (7.7)	51 (2.3)	471 (7.0)	27 (2.1)	469 (7.6)
South Africa	20 (3.1)	236 (19.4)	41 (3.5)	229 (14.5)	39 (3.9)	264 (12.0)
Thailand	18 (3.4)	495 (10.4)	44 (3.9)	485 (7.6)	38 (3.9)	473 (6.4)
Macedonia, Rep. of	18 (1.9)	465 (11.6)	48 (2.3)	456 (6.2)	34 (2.2)	458 (6.4)
Bulgaria	17 (1.8)	517 (8.4)	57 (2.2)	511 (4.7)	26 (2.2)	505 (9.5)
United States	16 (2.3)	519 (9.7)	51 (3.2)	524 (6.3)	33 (3.7)	514 (6.5)
Jordan	16 (2.8)	471 (7.7)	49 (4.2)	449 (6.0)	35 (4.1)	442 (6.9)
Morocco	15 (1.6)	317 (4.6)	41 (3.1)	323 (5.7)	44 (3.8)	324 (6.9)
Israel	15 (3.3)	426 (18.8)	55 (4.0)	475 (6.7)	30 (3.9)	479 (8.1)
Iran, Islamic Rep.	14 (4.0)	440 (15.8)	37 (3.6)	447 (5.0)	49 (4.4)	453 (4.8)
Lithuania <sup>†</sup>	14 (1.7)	508 (8.6)	50 (2.6)	489 (4.5)	36 (2.5)	479 (5.4)
Hungary	14 (1.6)	560 (5.6)	53 (2.0)	552 (5.0)	34 (1.9)	548 (3.9)
Chile	14 (2.3)	423 (11.4)	53 (3.5)	431 (5.8)	33 (3.3)	404 (5.4)
Moldova	13 (1.5)	463 (7.1)	51 (2.2)	462 (4.8)	35 (2.1)	456 (4.8)
Russian Federation	13 (1.5)	548 (13.0)	50 (2.6)	530 (7.1)	37 (2.5)	523 (5.7)
Finland	11 (2.1)	533 (6.4)	40 (3.1)	538 (4.4)	49 (2.9)	533 (4.5)
Chinese Taipei	11 (2.5)	589 (13.5)	34 (4.3)	576 (7.4)	54 (4.4)	559 (4.9)
Australia	11 (2.3)	524 (11.1)	38 (3.5)	541 (5.4)	51 (3.3)	541 (6.7)
Czech Republic	9 (1.7)	543 (8.2)	42 (3.1)	543 (6.1)	48 (3.4)	537 (4.5)
Hong Kong, SAR	8 (2.5)	554 (12.3)	29 (4.4)	538 (7.0)	63 (4.6)	524 (4.9)
Singapore	8 (2.4)	600 (20.7)	29 (3.8)	579 (15.8)	63 (4.2)	559 (10.0)
England	7 (2.3)	541 (28.3)	41 (4.6)	557 (7.5)	51 (4.7)	540 (8.0)
Korea, Rep. of	6 (1.9)	541 (10.4)	48 (4.1)	552 (3.3)	46 (3.9)	547 (3.2)
Netherlands	5 (1.4)	570 (13.1)	35 (4.3)	559 (6.9)	60 (4.6)	536 (10.1)
Latvia (LSS)	5 (1.3)	505 (9.9)	47 (2.9)	508 (5.2)	48 (2.9)	504 (5.6)
Belgium (Flemish)	4 (0.8)	550 (7.4)	20 (2.6)	537 (11.5)	77 (2.6)	533 (4.7)
New Zealand	4 (1.3)	521 (14.6)	46 (4.1)	516 (7.5)	51 (4.1)	504 (6.6)
<b>International Avg.</b>	<b>16 (0.4)</b>	<b>490 (1.9)</b>	<b>44 (0.6)</b>	<b>488 (1.2)</b>	<b>40 (0.6)</b>	<b>482 (1.1)</b>

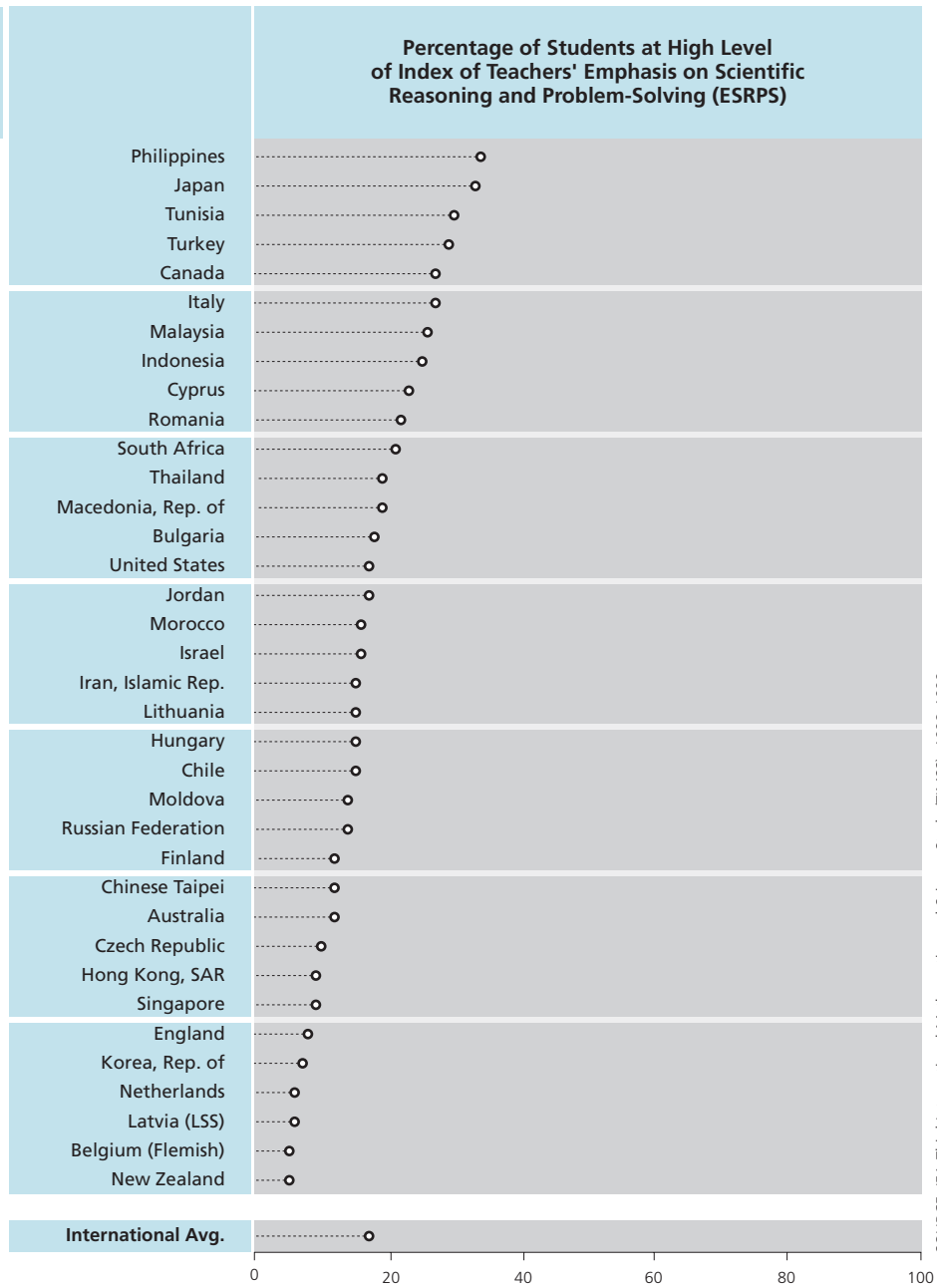
SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1998-1999.

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

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

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

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.



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

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

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

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

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

Background data provided by teachers.

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

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

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

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

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

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

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




ments and the students conducting experiments or practical investigations. A high level indicates that the teacher reported that at least 25 percent of class time is spent on the teacher demonstrating or students conducting experiments, and the student reported that teachers demonstrate experiments or students conduct experiments or practical investigations in class almost always or pretty often. A low level indicates that the teacher reported that 10 percent or less of class time is spent on the teacher demonstrating or students conducting experiments, and the student reported that experiments are demonstrated or conducted in class once in a while or never. The middle category includes all other possible combinations of responses.

Internationally on average, 38 percent of students in countries with general/integrated science had classes with high emphasis on experiments, with a range from two percent in Italy to 78 percent in Hong Kong. In general, lower percentages of students in the high category were found in the countries with separate sciences, but this varied across science subjects, with the greatest emphasis on experiments in the physical sciences. Earth science had the least emphasis on experiments. Across countries, 52 percent of earth science students were in the low category, but only 21 percent of students in biology, five percent in physics and chemistry, and three percent in general/integrated science had classes with low emphasis on experiments.

Exhibits R3.11 and R3.13 in the reference section summarize students' responses to the questions on the frequency of teachers demonstrating and students conducting experiments that were included in the index of emphasis on conducting experiments. On average internationally, 71 percent of students in general/integrated science reported that their teachers demonstrate experiments almost always or pretty often. Only 29 percent of Italian students reported that their teachers did so, compared with over 90 percent of the students in Cyprus and England. For the separate sciences, the percentages of students who reported that their teachers demonstrate experiments almost always or pretty often were, on average, 19 percent for earth science, 42 percent for biology, 61 percent for physics, and 68 percent for chemistry. Students' reports on the frequency with which they conduct experiments or practical investigations in class show a similar trend across science subjects but a lower frequency than those reported for teachers' demonstration of experiments. Internationally, 57 percent of students in countries with general/integrated science reported that they do an experiment or





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practical investigation almost always or pretty often. Across countries with separate sciences, only 15 percent of the students in earth science, 27 percent in biology, and 39 percent in physics and chemistry reported doing experiments this frequently.

R3.12, R3.14



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



**Exhibit 6.14 Overleaf**

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

### Index of Emphasis on Conducting Experiments in Science Classes

Index based on teachers' reports on the percentage of time they spend demonstrating experiments; teachers' reports on the percentage of time students spend conducting experiments; students' reports on how often the teacher gives a demonstration of an experiment in science lessons; students' reports on how often they conduct an experiment or practical investigation in class (see exhibits 6.9, R3.11, and R3.13). In countries where science is taught as separate subjects, students were asked about each subject area separately, and only teachers who teach a particular subject are represented in the figures shown for that subject. High level indicates teacher reported that at least 25 percent of class time is spent on the teacher demonstrating experiments or students conducting experiments, and the student reported that the teacher gives a demonstration of an experiment or the student conducts an experiment or practical investigation in class almost always or pretty often. Low level indicates the teacher reported that less than 10 percent of class time is spent on the teacher demonstrating experiments or students conducting experiments, and student reported that the teacher gives a demonstration of an experiment and the student conducts an experiment or practical investigation in class once in a while or never. Medium level includes all other possible combinations of responses.

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	High ECES		Medium ECES		Low ECES	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
<b>General/Integrated Science (ECES-G)</b>						
Hong Kong, SAR	78 (3.3)	536 (3.8)	22 (3.2)	516 (9.3)	1 (0.4)	~ ~
England s	59 (4.9)	556 (7.9)	40 (4.9)	539 (8.0)	0 (0.0)	~ ~
Singapore	55 (4.1)	580 (10.0)	44 (4.0)	556 (12.7)	1 (0.6)	~ ~
Japan	54 (4.0)	552 (3.2)	45 (3.8)	549 (2.6)	1 (0.6)	~ ~
Malaysia	53 (3.8)	509 (6.6)	46 (3.8)	470 (5.8)	1 (0.7)	~ ~
Thailand	52 (3.8)	485 (5.7)	47 (3.6)	481 (6.3)	1 (0.6)	~ ~
New Zealand	52 (4.1)	517 (5.9)	48 (4.1)	511 (7.9)	0 (0.2)	~ ~
Tunisia	51 (3.9)	432 (3.8)	49 (3.8)	429 (4.8)	0 (0.2)	~ ~
Jordan	47 (3.7)	451 (5.8)	52 (3.6)	463 (4.8)	1 (0.3)	~ ~
Canada r	47 (3.8)	539 (4.1)	52 (3.9)	533 (3.6)	1 (0.5)	~ ~
Cyprus s	46 (3.9)	469 (4.4)	54 (3.9)	462 (4.0)	0 (0.1)	~ ~
Australia	45 (3.9)	544 (6.1)	54 (3.9)	536 (5.3)	1 (0.3)	~ ~
Philippines	44 (3.9)	335 (11.4)	56 (3.9)	355 (8.8)	0 (0.0)	~ ~
United States r	31 (2.6)	531 (6.8)	64 (2.6)	523 (5.3)	4 (1.1)	529 (7.5)
Korea, Rep. of	27 (3.1)	558 (3.4)	71 (3.0)	546 (3.0)	2 (0.7)	~ ~
South Africa	26 (3.6)	214 (10.5)	72 (3.4)	257 (11.1)	2 (0.4)	~ ~
Israel r	26 (3.5)	490 (8.8)	71 (3.2)	471 (6.2)	3 (0.9)	443 (18.4)
Indonesia b	18 (1.6)	435 (8.7)	78 (2.0)	439 (4.6)	5 (1.5)	430 (22.7)
Iran, Islamic Rep.	16 (2.4)	447 (7.1)	79 (2.6)	449 (4.4)	4 (1.2)	473 (13.4)
Chinese Taipei a	14 (2.8)	574 (9.2)	84 (2.9)	570 (4.9)	2 (0.6)	~ ~
Turkey	14 (2.2)	434 (7.2)	79 (2.4)	436 (4.9)	8 (1.5)	431 (8.4)
Chile	12 (1.8)	435 (11.0)	81 (2.1)	422 (3.9)	7 (1.4)	410 (10.3)
Italy	2 (0.6)	~ ~	73 (3.0)	493 (4.3)	25 (2.9)	498 (6.7)
<b>International Avg.</b>	<b>38 (0.7)</b>	<b>483 (1.7)</b>	<b>59 (0.7)</b>	<b>478 (1.3)</b>	<b>3 (0.2)</b>	<b>459 (5.3)</b>
<b>Earth Science (ECES-E)</b>						
Romania	2 (0.9)	~ ~	67 (2.7)	465 (6.1)	31 (2.8)	495 (8.1)
Belgium (Flemish) r	2 (0.6)	~ ~	43 (3.6)	530 (5.3)	56 (3.8)	549 (5.9)
Macedonia, Rep. of	1 (0.5)	~ ~	74 (2.6)	459 (5.9)	25 (2.5)	487 (7.6)
Moldova r	1 (0.6)	~ ~	72 (2.9)	460 (4.7)	27 (2.9)	478 (7.4)
Bulgaria r	0 (0.0)	~ ~	50 (4.9)	508 (7.5)	50 (4.9)	522 (5.6)
Hungary	0 (0.1)	~ ~	43 (3.1)	547 (5.7)	57 (3.2)	557 (4.9)
Czech Republic	0 (0.0)	~ ~	24 (4.4)	526 (5.3)	76 (4.4)	544 (4.3)
Netherlands r	0 (0.0)	~ ~	12 (1.9)	526 (15.6)	88 (1.9)	551 (7.3)
Russian Federation	0 (0.0)	~ ~	45 (2.8)	521 (8.6)	55 (2.8)	538 (7.0)
Finland	--	--	--	--	--	--
Latvia (LSS)	--	--	--	--	--	--
Lithuania †	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
<b>International Avg.</b>	<b>1 (0.2)</b>	<b>~ ~</b>	<b>48 (1.1)</b>	<b>505 (2.7)</b>	<b>52 (1.1)</b>	<b>525 (2.2)</b>

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

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

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

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

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

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

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

An "r" indicates teacher and/or student response data available for 70-84% of students. An "s" indicates teacher and/or student response data available for 50-69% of students. An "x" indicates teacher and/or student response data available for <50% of students.



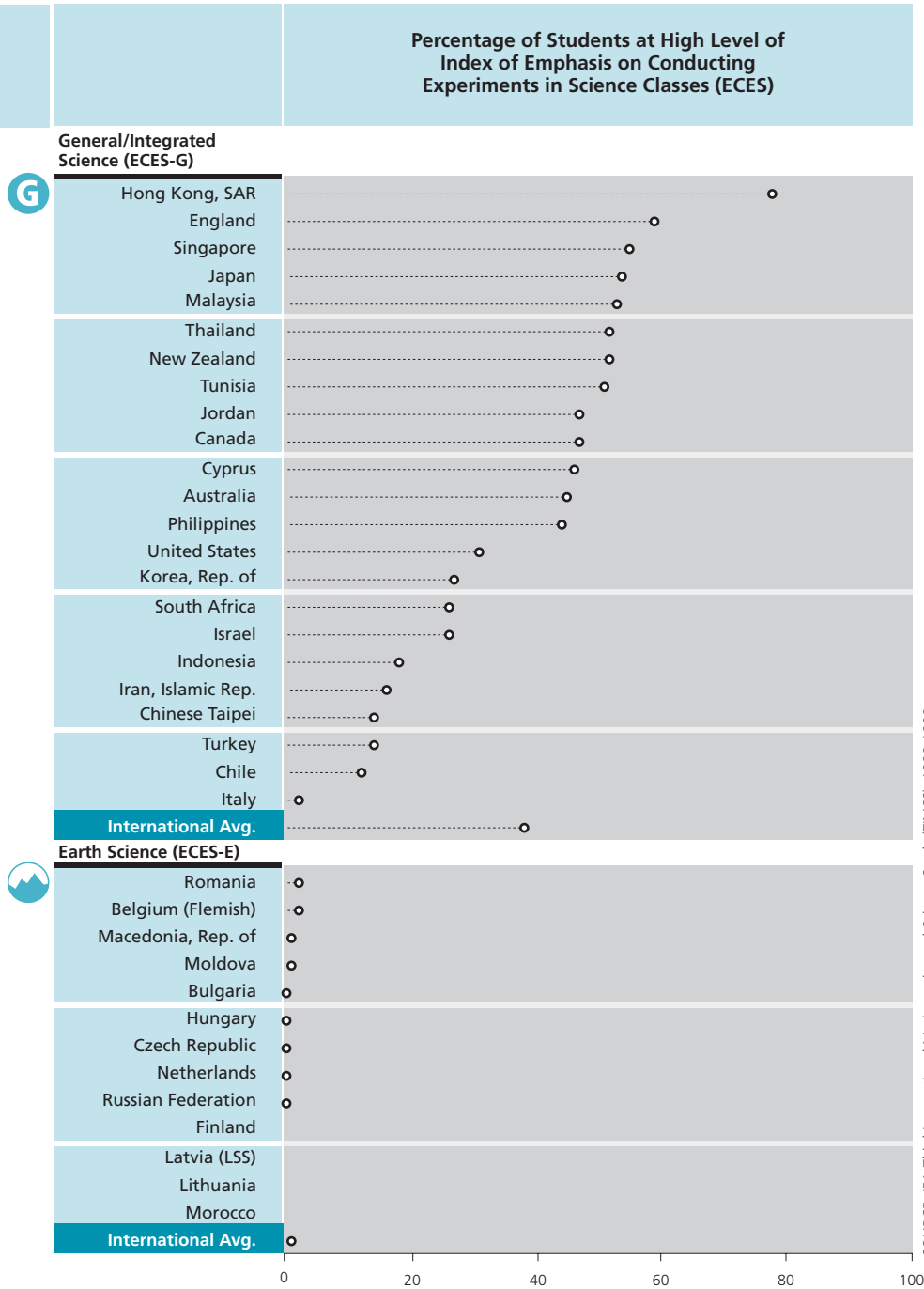





Exhibit 6.14: Index of Emphasis on Conducting Experiments in Science Classes (ECES) (Continued 2)

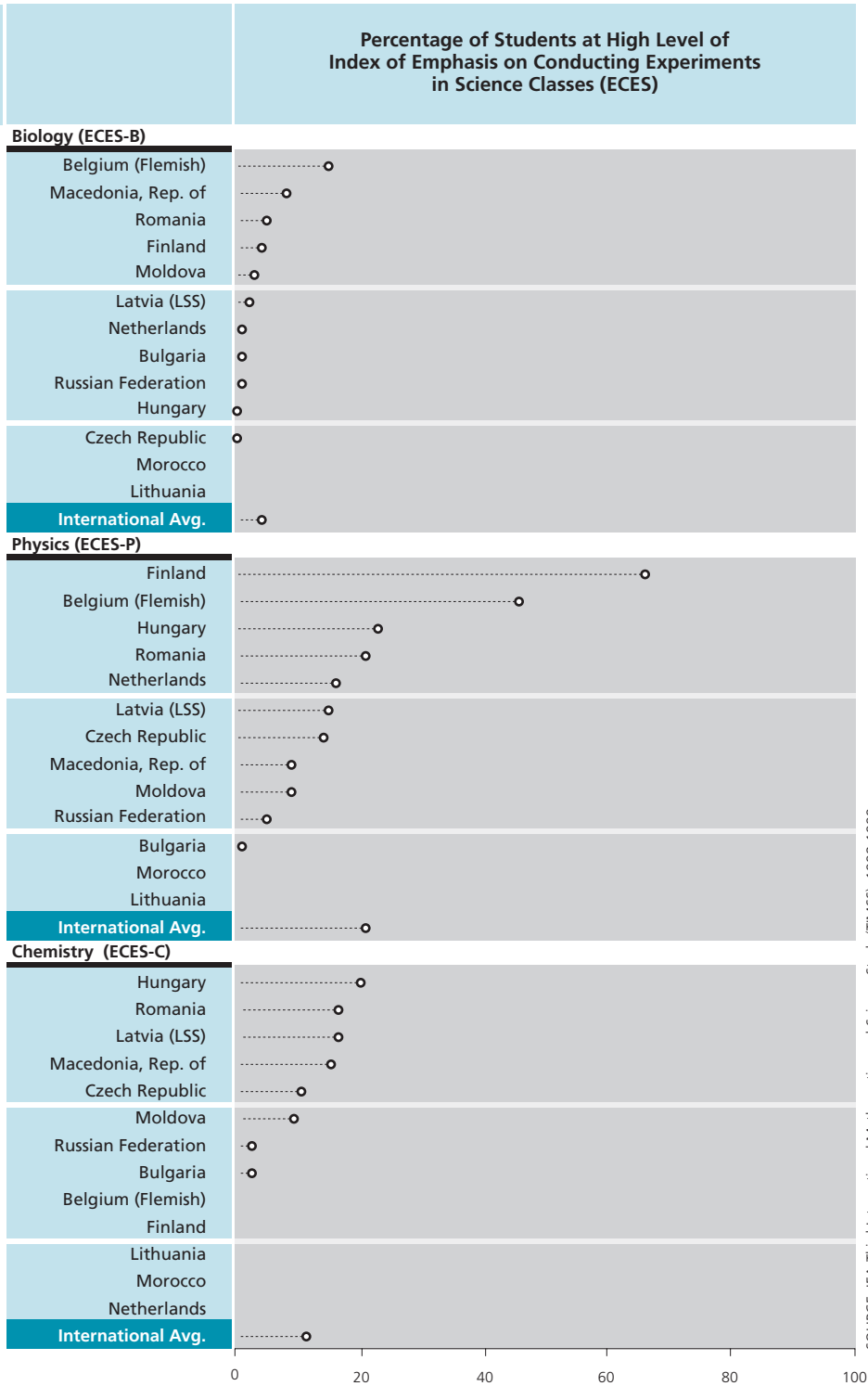
	High ECES		Medium ECES		Low ECES	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
<b>Biology (ECES-B)</b>						
 Belgium (Flemish) <sup>r</sup>	15 (2.7)	543 (5.6)	77 (3.1)	549 (4.6)	8 (1.7)	537 (11.7)
Macedonia, Rep. of	8 (1.9)	464 (15.1)	88 (2.0)	464 (5.2)	4 (0.7)	473 (14.1)
Romania	5 (1.2)	498 (20.2)	85 (2.0)	472 (5.9)	9 (2.1)	474 (13.8)
Finland <sup>c</sup>	4 (1.0)	526 (11.3)	70 (2.9)	534 (4.2)	26 (3.0)	543 (4.4)
Moldova	3 (1.4)	438 (30.5)	85 (2.1)	460 (4.6)	12 (1.6)	477 (8.1)
Latvia (LSS) <sup>r</sup>	2 (0.9)	~ ~	78 (3.8)	508 (5.0)	21 (3.8)	526 (11.4)
Netherlands <sup>r</sup>	1 (0.7)	~ ~	76 (5.1)	545 (12.1)	23 (5.1)	533 (10.3)
Bulgaria <sup>r</sup>	1 (0.5)	~ ~	58 (4.2)	511 (6.5)	41 (4.3)	520 (8.1)
Russian Federation	1 (0.4)	~ ~	79 (2.5)	530 (6.7)	20 (2.5)	540 (9.0)
Hungary	0 (0.2)	~ ~	65 (3.2)	554 (4.0)	34 (3.3)	551 (6.4)
Czech Republic	0 (0.0)	~ ~	72 (3.5)	538 (5.0)	28 (3.5)	547 (7.3)
Morocco <sup>d</sup>	x x	x x	x x	x x	x x	x x
Lithuania <sup>†</sup>	--	--	--	--	--	--
<b>International Avg.</b>	4 (0.4)	494 (10.9)	76 (1.0)	515 (1.9)	21 (0.9)	520 (2.9)
<b>Physics (ECES-P)</b>						
 Finland <sup>c</sup>	67 (2.4)	541 (4.7)	33 (2.4)	517 (4.1)	0 (0.2)	~ ~
Belgium (Flemish) <sup>r</sup>	46 (6.6)	557 (10.5)	52 (6.7)	549 (6.6)	2 (0.2)	~ ~
Hungary	23 (2.8)	557 (6.5)	73 (2.8)	552 (4.6)	4 (1.3)	568 (13.2)
Romania	21 (3.0)	482 (9.7)	75 (3.2)	479 (6.3)	4 (1.3)	450 (26.2)
Netherlands <sup>e</sup> <sup>r</sup>	16 (4.4)	550 (11.8)	78 (5.0)	551 (7.9)	6 (3.2)	497 (36.9)
Latvia (LSS) <sup>r</sup>	15 (2.6)	520 (10.6)	80 (2.9)	500 (5.2)	5 (1.7)	525 (11.9)
Czech Republic	14 (2.9)	536 (10.9)	82 (2.8)	544 (4.7)	5 (1.4)	555 (12.8)
Macedonia, Rep. of	9 (2.1)	482 (11.9)	86 (2.2)	462 (5.8)	5 (1.0)	467 (12.3)
Moldova	9 (2.2)	477 (14.6)	88 (2.3)	463 (4.3)	3 (0.7)	464 (16.5)
Russian Federation	5 (1.9)	538 (18.4)	90 (2.1)	533 (6.2)	5 (1.0)	516 (16.9)
Bulgaria	1 (0.4)	~ ~	84 (2.4)	508 (5.4)	15 (2.4)	520 (9.4)
Morocco <sup>d</sup>	x x	x x	x x	x x	x x	x x
Lithuania <sup>†</sup>	--	--	--	--	--	--
<b>International Avg.</b>	21 (1.0)	524 (3.3)	74 (1.0)	514 (1.7)	5 (0.5)	507 (5.3)
<b>Chemistry (ECES-C)</b>						
 Hungary	20 (3.1)	563 (6.2)	79 (3.2)	549 (3.8)	2 (1.0)	~ ~
Romania	16 (2.7)	486 (13.1)	81 (2.7)	473 (6.2)	3 (1.0)	444 (26.1)
Latvia (LSS) <sup>s</sup>	16 (3.0)	503 (7.5)	80 (3.1)	509 (6.1)	3 (1.2)	486 (22.7)
Macedonia, Rep. of	15 (2.6)	474 (11.6)	81 (2.7)	465 (6.0)	4 (0.8)	465 (13.9)
Czech Republic	10 (3.0)	556 (13.9)	87 (3.0)	538 (4.2)	3 (0.9)	545 (14.0)
Moldova	9 (2.2)	464 (15.7)	86 (2.4)	460 (4.3)	5 (1.1)	480 (13.6)
Russian Federation	2 (1.5)	~ ~	93 (1.5)	532 (6.3)	5 (0.9)	532 (17.4)
Bulgaria	2 (0.7)	~ ~	88 (1.9)	518 (6.5)	11 (1.8)	513 (7.6)
Belgium (Flemish)	--	--	--	--	--	--
Finland	--	--	--	--	--	--
Lithuania <sup>†</sup>	--	--	--	--	--	--
Morocco	--	--	--	--	--	--
Netherlands	--	--	--	--	--	--
<b>International Avg.</b>	11 (0.9)	508 (5.5)	84 (0.9)	506 (2.0)	5 (0.4)	495 (5.9)

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

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


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


<sup>e</sup> Netherlands: Data for physics/chemistry teachers are reported in physics panel.




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

## How Are Computers Used?

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

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

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



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

## Exhibit 6.15 Frequency of Computer Use in Science Classes\*

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

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

Background data provided by students.

\* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

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

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

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

A dash (–) indicates data are not available.

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

Percentage of Students Reporting Almost Always or Pretty Often

	Countries with Separate Science Subjects															
	Earth Science				Biology				Physics				Chemistry			
	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference	Percent of Students 1999	1995-1999 Difference				
Belgium (Flemish)	2 (0.4)	-2 (0.8)	2 (0.6)	-2 (1.1)	3 (0.5)	-4 (1.8)	--	--	2 (0.4)	-1 (1.9)	2 (0.8)	1 (0.9)	2 (0.6)	0 (1.0)	1 (0.5)	1 (0.5)
Czech Republic	2 (0.4)	-1 (1.9)	2 (0.8)	1 (0.9)	2 (0.6)	0 (0.5)	2 (0.4)	0 (0.5)	4 (0.5)	0 (0.7)	3 (0.4)	0 (0.5)	4 (0.5)	0 (0.7)	3 (0.4)	-1 (0.6)
Hungary	3 (0.4)	0 (0.6)	2 (0.4)	0 (0.5)	2 (0.3)	0 (0.4)	2 (0.3)	0 (0.4)	3 (0.5)	-1 (1.0)	--	--	--	--	3 (0.4)	-1 (0.6)
Latvia (LSS)	--	--	2 (0.3)	0 (0.4)	--	--	--	--	--	--	--	--	--	--	3 (0.4)	-1 (0.6)
Lithuania	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Netherlands <sup>c</sup>	5 (0.7)	1 (1.1)	2 (0.3)	0 (0.6)	3 (0.4)	-1 (1.3)	2 (0.3)	0 (0.6)	3 (0.4)	3 (0.4)	3 (0.4)	3 (0.6)	3 (0.5)	-1 (1.3)	3 (0.2)	--
Romania	2 (0.5)	-13 (0.9)	2 (0.4)	-13 (1.0)	3 (0.5)	-14 (1.2)	2 (0.4)	-13 (1.0)	3 (0.5)	-14 (1.2)	2 (0.5)	-13 (1.0)	3 (0.5)	-14 (1.2)	2 (0.5)	-13 (1.0)
Russian Federation	2 (0.3)	-1 (0.5)	1 (0.2)	-1 (0.5)	2 (0.3)	-2 (0.7)	1 (0.2)	-1 (0.5)	2 (0.3)	-2 (0.7)	2 (0.2)	-2 (0.7)	2 (0.3)	-2 (0.7)	2 (0.2)	-4 (0.6)
Slovak Republic	1 (0.2)	-1 (0.3)	1 (0.3)	0 (0.4)	2 (0.5)	-1 (0.8)	1 (0.3)	0 (0.4)	2 (0.5)	-1 (0.8)	1 (0.2)	-1 (0.8)	2 (0.5)	-1 (0.8)	1 (0.2)	-1 (0.3)
Slovenia	--	--	7 (0.9)	3 (1.0)	17 (1.3)	8 (1.5)	7 (0.9)	3 (1.0)	17 (1.3)	8 (1.5)	9 (0.8)	3 (1.0)	17 (1.3)	8 (1.5)	9 (0.8)	3 (1.0)
<b>International Avg.<sup>s</sup></b>	<b>2 (0.2)</b>	<b>-2 (0.3)</b>	<b>2 (0.2)</b>	<b>-1 (0.2)</b>	<b>5 (0.2)</b>	<b>-1 (0.4)</b>	<b>2 (0.2)</b>	<b>-1 (0.2)</b>	<b>5 (0.2)</b>	<b>-1 (0.4)</b>	<b>3 (0.2)</b>	<b>-2 (0.3)</b>	<b>5 (0.2)</b>	<b>-1 (0.4)</b>	<b>3 (0.2)</b>	<b>-2 (0.3)</b>

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

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

Significance tests adjusted for multiple comparisons

Countries with General/Integrated Science		
	Percent of Students 1999	1995-1999 Difference
Australia	10 (1.2)	4 (1.3)
Canada	14 (0.7)	4 (1.1)
Cyprus	8 (0.5)	-4 (0.9)
England	10 (1.1)	4 (1.3)
Hong Kong, SAR	6 (0.6)	1 (0.9)
Iran, Islamic Rep.	1 (0.2)	-5 (0.7)
Israel <sup>†</sup>	19 (2.0)	7 (3.7)
Italy	10 (1.5)	4 (1.7)
Japan	2 (0.8)	0 (1.1)
Korea, Rep. of	7 (0.9)	4 (1.0)
New Zealand	10 (1.0)	4 (1.3)
Singapore	15 (1.4)	13 (1.5)
Thailand <sup>†</sup>	5 (0.5)	0 (0.9)
United States	21 (1.4)	6 (1.9)
<b>International Avg.<sup>s</sup></b>	<b>9 (0.3)</b>	<b>3 (0.4)</b>

Background data provided by students.

\* Countries administered either a general/integrated science or separate subject area form of the questionnaire. In countries that administered the separate subject area form, students were asked about each subject area separately. Percentages for separate science subject areas are based only on those students taking each subject.

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

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

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

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

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

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

A dash (-) indicates data are not available.

An "s" indicates a 50-60% student response rate, based on the lower response rate in either 1995 or 1999.

## Exhibit 6.17 Access to the Internet and Use of the Internet for Science Projects

	Percentage of Students				
	Have Access to the Internet			Use the Internet for Science Projects at Least Once a Month	
	At Home	At School	Elsewhere	Use E-mail to Work with Students in Other Schools	Use the World Wide Web to Access Information
Australia	38 (1.4)	80 (2.3)	69 (0.9)	5 (0.5)	18 (1.0)
Belgium (Flemish)	27 (0.9)	44 (2.7)	64 (1.1)	3 (0.4)	10 (0.9)
Bulgaria	8 (1.1)	7 (1.5)	43 (1.8)	7 (0.6)	9 (0.6)
Canada	57 (1.3)	87 (1.5)	84 (0.8)	6 (0.4)	25 (0.9)
Chile	7 (0.8)	12 (1.8)	40 (1.2)	7 (0.5)	10 (0.6)
Chinese Taipei	32 (1.1)	61 (3.2)	41 (0.8)	9 (0.4)	15 (0.6)
Cyprus	27 (0.8)	3 (0.4)	50 (1.0)	10 (0.6)	15 (0.6)
Czech Republic	7 (0.7)	16 (2.6)	39 (1.6)	2 (0.3)	5 (0.5)
England	36 (1.1)	65 (3.1)	53 (1.3)	6 (0.5)	22 (1.1)
Finland	43 (1.6)	75 (2.3)	87 (0.8)	4 (0.5)	5 (0.6)
Hong Kong, SAR	34 (1.1)	26 (2.2)	34 (0.8)	8 (0.6)	13 (0.7)
Hungary	7 (0.6)	35 (3.2)	36 (1.2)	4 (0.4)	5 (0.4)
Indonesia	2 (0.3)	0 (0.3)	12 (0.9)	4 (0.5)	4 (0.5)
Iran, Islamic Rep.	--	--	--	--	--
Israel	42 (1.6)	47 (2.8)	54 (1.2)	9 (0.7)	18 (0.9)
Italy	13 (0.7)	20 (2.2)	27 (1.1)	5 (0.5)	8 (0.7)
Japan	r 13 (0.9)	6 (1.6)	2 (0.3)	7 (0.8)	7 (0.8)
Jordan	7 (0.5)	1 (0.5)	30 (1.2)	15 (1.0)	16 (0.9)
Korea, Rep. of	23 (0.7)	6 (1.2)	36 (1.0)	4 (0.3)	6 (0.4)
Latvia (LSS)	3 (0.4)	35 (3.4)	51 (1.4)	4 (0.4)	6 (0.6)
Lithuania <sup>‡</sup>	7 (0.8)	13 (1.6)	46 (1.5)	x x	x x
Macedonia, Rep. of	7 (0.5)	1 (0.4)	34 (1.4)	11 (0.7)	13 (0.7)
Malaysia	14 (0.9)	5 (1.3)	r 40 (1.5)	15 (0.8)	17 (0.8)
Moldova	3 (0.5)	2 (0.7)	22 (1.4)	6 (0.5)	7 (0.5)
Morocco	6 (0.4)	0 (0.2)	r 38 (0.9)	13 (0.6)	18 (0.8)
Netherlands	41 (1.8)	53 (5.4)	74 (1.8)	4 (0.7)	8 (0.8)
New Zealand	34 (1.1)	62 (2.7)	64 (1.1)	6 (0.6)	14 (0.8)
Philippines	--	--	--	--	--
Romania	3 (0.3)	1 (0.7)	21 (1.2)	4 (0.4)	5 (0.5)
Russian Federation	3 (0.3)	1 (0.4)	17 (0.9)	3 (0.3)	4 (0.4)
Singapore	47 (1.9)	48 (3.2)	39 (0.9)	9 (0.6)	19 (0.9)
Slovak Republic	5 (0.5)	5 (1.2)	36 (1.6)	2 (0.3)	4 (0.5)
Slovenia	23 (0.9)	49 (2.9)	61 (1.0)	8 (0.6)	14 (0.9)
South Africa	5 (0.5)	4 (1.1)	23 (1.5)	10 (0.8)	11 (0.7)
Thailand	3 (0.5)	8 (1.5)	22 (0.9)	8 (0.4)	8 (0.6)
Tunisia	8 (0.7)	1 (0.6)	46 (1.2)	13 (0.7)	14 (0.8)
Turkey	3 (0.3)	1 (0.6)	r 16 (1.0)	5 (0.4)	4 (0.4)
United States	59 (1.7)	76 (3.2)	81 (0.9)	9 (0.5)	29 (1.3)
<b>International Avg.</b>	19 (0.2)	27 (0.4)	43 (0.2)	7 (0.1)	12 (0.1)

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

Background data provided by students.

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

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

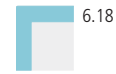
A dash (–) indicates data are not available.

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



## What Are the Roles of Homework and Assessment?

The amount of time students spend on homework assignments is an important consideration in examining their opportunity to learn science. Exhibit 6.18 presents the index of teachers' emphasis on science homework (ESH). Students in the high category had teachers who reported giving relatively long homework assignments (more than 30 minutes) on a relatively frequent basis (at least once or twice a week). Those in the low category had teachers who gave short assignments (less than 30 minutes) relatively infrequently (less than once a week or never). The medium level includes all other possible combinations of responses. The data reveal wide variation across countries in the emphasis placed on science homework. Internationally on average, 19 percent of students were in the high category, 62 percent the medium, and 18 percent the low. The percentage of students in the high category ranged from one percent in Belgium (Flemish) to 61 percent in Iran. Countries with more than half their students in the high category were Iran, Italy, Thailand, and Indonesia. Only in Belgium (Flemish) were more than half the students in the low category. Internationally and within countries, there is no apparent relationship between teachers' emphasis on science homework and student achievement.



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



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

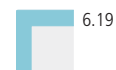


Exhibit R3.17 in the reference section shows teachers' reports of the frequency of assigning science homework based on projects and investigation. Internationally on average, about one-third of students were assigned this type of homework sometimes or always. While the percentage of students in this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



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

6.20



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

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

R3.18



As shown in Exhibit R3.18, eighth-grade students reported substantial variation in the frequency of testing in their science classes. On average internationally, 58 percent of students in general/integrated science classes and about 50 percent of students in separate science classes reported having a quiz or test almost always or pretty often. However, this level of testing was found for only a third or less of students in Finland, Hungary, Japan, Korea, and Turkey. Among the single-science countries, more than 70 percent of students reported this frequency of testing in Chile, Chinese Taipei, Cyprus, the Philippines, South Africa, and the United States. Countries where about 70 percent or more of students were tested this frequently in the separate sciences were Moldova, Morocco, Romania, and the Russian Federation.



**Exhibits 6.18–6.20 Overleaf**

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

### Index of Teachers' Emphasis on Science Homework

Index based on teachers' responses to two questions about how often they usually assign science homework and how many minutes of science homework they usually assign students (see reference exhibit R3.16). High level indicates the assignment of more than 30 minutes of homework at least once or twice a week. Low level indicates the assignment of less than 30 minutes of homework less than once a week or never assigning homework. Medium level includes all other possible combinations of responses.

	High ESH		Medium ESH		Low ESH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Iran, Islamic Rep.	61 (4.4)	449 (4.1)	32 (4.5)	447 (8.3)	7 (2.1)	449 (13.3)
Italy	58 (3.3)	493 (5.9)	34 (3.2)	495 (5.5)	8 (1.8)	486 (12.0)
Thailand	56 (4.0)	480 (5.0)	42 (3.9)	487 (6.7)	1 (1.0)	~ ~
Indonesia	53 (3.8)	436 (6.3)	42 (3.6)	438 (6.0)	5 (1.4)	405 (15.7)
Malaysia	46 (4.2)	486 (6.0)	51 (4.2)	497 (7.5)	3 (1.5)	497 (41.6)
Moldova	40 (2.6)	460 (5.0)	59 (2.7)	459 (4.9)	1 (0.5)	~ ~
Singapore	35 (4.3)	570 (12.3)	55 (4.1)	575 (11.2)	11 (2.4)	524 (19.3)
Russian Federation	32 (2.6)	527 (8.3)	66 (2.6)	530 (6.6)	3 (0.8)	542 (18.4)
Chile	26 (3.6)	424 (8.1)	47 (3.7)	421 (5.3)	26 (3.8)	418 (8.4)
Chinese Taipei	26 (3.8)	584 (7.8)	54 (4.4)	566 (5.5)	20 (3.3)	558 (7.9)
Turkey	24 (3.5)	430 (8.4)	64 (4.2)	434 (5.3)	11 (2.4)	432 (9.5)
South Africa	22 (3.6)	205 (14.0)	70 (4.0)	253 (10.5)	8 (2.6)	255 (31.8)
England	22 (2.9)	563 (11.3)	74 (3.1)	533 (5.2)	4 (1.3)	511 (12.4)
Morocco	16 (2.0)	319 (5.2)	54 (2.6)	324 (5.1)	30 (3.0)	324 (6.3)
Philippines	16 (3.0)	398 (15.5)	84 (3.0)	335 (8.0)	0 (0.0)	~ ~
United States	15 (1.8)	507 (9.5)	77 (2.4)	517 (5.2)	8 (1.7)	505 (15.6)
Israel	15 (2.7)	446 (13.3)	71 (3.6)	472 (6.3)	14 (2.5)	483 (9.0)
Cyprus	14 (2.4)	463 (4.9)	82 (2.7)	459 (2.6)	4 (1.7)	466 (15.3)
Hong Kong, SAR	14 (2.8)	527 (8.3)	68 (4.0)	533 (4.2)	19 (3.6)	521 (11.6)
Jordan	12 (2.8)	439 (12.7)	84 (2.9)	451 (4.1)	3 (1.5)	456 (38.5)
Macedonia, Rep. of	11 (1.6)	460 (8.9)	57 (3.1)	465 (6.9)	32 (2.7)	479 (6.5)
Canada	10 (2.3)	542 (8.9)	80 (2.8)	534 (2.6)	10 (1.9)	515 (6.4)
Lithuania <sup>†</sup>	9 (1.5)	497 (10.9)	81 (2.1)	487 (4.1)	9 (1.6)	484 (7.6)
Tunisia	9 (2.6)	436 (10.1)	54 (4.1)	429 (4.0)	37 (3.8)	427 (4.7)
Korea, Rep. of	8 (2.2)	559 (7.9)	55 (3.9)	549 (3.3)	37 (3.8)	547 (3.4)
New Zealand	7 (2.1)	513 (13.2)	78 (3.1)	512 (5.5)	14 (2.9)	497 (13.2)
Romania	7 (1.6)	479 (14.0)	58 (2.5)	469 (6.7)	35 (2.3)	475 (6.6)
Australia	7 (1.7)	528 (13.7)	75 (3.0)	545 (4.7)	18 (2.8)	522 (9.4)
Finland	6 (1.5)	531 (7.3)	83 (2.1)	537 (3.6)	11 (1.6)	526 (7.8)
Latvia (LSS)	5 (1.2)	508 (11.6)	81 (2.2)	501 (4.8)	14 (1.9)	513 (9.2)
Netherlands	5 (1.3)	573 (9.5)	82 (3.0)	548 (6.6)	13 (3.1)	514 (11.3)
Hungary	5 (0.9)	566 (7.9)	70 (1.9)	552 (4.1)	25 (1.9)	551 (5.8)
Japan	4 (1.7)	546 (11.0)	53 (4.1)	551 (3.0)	43 (4.2)	548 (2.9)
Bulgaria	3 (0.9)	521 (38.0)	54 (3.0)	526 (7.5)	43 (2.9)	507 (5.9)
Belgium (Flemish)	1 (0.5)	~ ~	39 (3.5)	528 (6.3)	60 (3.4)	537 (4.7)
Czech Republic	0 (0.3)	~ ~	29 (2.9)	541 (4.8)	70 (2.9)	539 (5.0)
<b>International Avg.</b>	<b>19 (0.4)</b>	<b>484 (2.6)</b>	<b>62 (0.6)</b>	<b>486 (1.0)</b>	<b>18 (0.4)</b>	<b>485 (2.6)</b>

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

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

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

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

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

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



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

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

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

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

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

Background data provided by teachers.

<sup>†</sup> Countries with unapproved sampling procedures at the classroom level in 1995.

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

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

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

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

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

An "†" indicates teacher response data available for 70-84% of students. An "§" indicates teacher response data available for 50-69% of students.

## Exhibit 6.20 Types of Assessment Teachers Give Quite A Lot or A Great Deal of Weight

	Percentage of Students by Type of Assessment						
	External Standardized Tests	Teacher-Made Tests Requiring Explanations	Teacher-Made Objective Tests	Homework Assignments	Projects or Practical Exercises	Observations of Students	Students' Responses in Class
Australia	16 (2.6)	71 (3.6)	67 (3.4)	37 (3.8)	66 (2.9)	38 (3.8)	30 (3.3)
Belgium (Flemish)	9 (2.1)	96 (1.6)	30 (2.7)	r 32 (2.9)	r 43 (3.6)	r 44 (3.3)	56 (3.3)
Bulgaria	r 67 (3.0)	r 90 (1.7)	r 38 (3.4)	r 69 (2.0)	r 66 (2.6)	r 84 (2.1)	r 96 (1.2)
Canada	r 13 (2.5)	r 66 (3.0)	r 59 (3.6)	r 60 (3.0)	r 84 (3.0)	r 50 (3.1)	r 44 (3.0)
Chile	27 (3.3)	78 (3.0)	87 (2.5)	56 (3.8)	68 (3.7)	77 (3.4)	80 (3.1)
Chinese Taipei	36 (4.1)	43 (4.5)	69 (4.1)	67 (3.6)	55 (4.1)	67 (3.8)	76 (3.4)
Cyprus	s 24 (4.3)	s 94 (2.1)	s 45 (4.6)	s 87 (2.6)	s 82 (3.9)	s 90 (2.5)	s 96 (1.6)
Czech Republic	45 (3.2)	96 (1.2)	40 (3.3)	23 (2.8)	56 (3.3)	78 (2.4)	97 (0.8)
England	s 57 (3.9)	s 68 (4.3)	s 25 (4.2)	s 77 (3.6)	s 80 (3.0)	s 74 (3.6)	s 71 (4.2)
Finland	9 (1.6)	47 (2.6)	37 (2.5)	70 (2.4)	83 (2.2)	85 (1.9)	94 (1.4)
Hong Kong, SAR	17 (3.1)	58 (4.2)	76 (3.5)	33 (3.8)	23 (3.8)	23 (3.6)	30 (4.1)
Hungary	52 (2.7)	80 (1.9)	31 (2.0)	29 (2.0)	47 (2.2)	72 (2.3)	92 (1.3)
Indonesia	53 (4.0)	83 (2.7)	48 (4.3)	64 (3.6)	61 (3.6)	71 (3.9)	72 (3.9)
Iran, Islamic Rep.	69 (3.9)	79 (3.9)	80 (3.5)	72 (3.8)	52 (3.9)	61 (4.2)	91 (2.3)
Israel	r 15 (3.5)	r 75 (3.7)	r 80 (3.4)	r 46 (3.9)	r 64 (3.3)	r 28 (3.7)	r 63 (3.6)
Italy	22 (2.8)	95 (1.7)	74 (3.2)	64 (4.0)	71 (3.4)	96 (1.6)	98 (1.2)
Japan	15 (2.6)	64 (4.3)	55 (4.3)	48 (4.3)	81 (3.6)	74 (3.9)	66 (3.5)
Jordan	28 (4.4)	84 (3.3)	41 (4.2)	59 (4.3)	49 (5.0)	72 (3.6)	84 (2.9)
Korea, Rep. of	51 (4.1)	84 (2.8)	76 (3.6)	89 (2.5)	99 (0.6)	92 (2.2)	81 (3.1)
Latvia (LSS)	r 81 (2.2)	r 92 (1.4)	r 59 (3.3)	r 59 (2.8)	r 93 (1.4)	r 78 (2.7)	r 97 (0.9)
Lithuania <sup>‡</sup>	34 (2.1)	68 (2.8)	26 (2.1)	30 (2.3)	55 (2.1)	32 (2.5)	78 (2.2)
Macedonia, Rep. of	36 (2.6)	62 (2.5)	68 (2.5)	83 (2.1)	52 (2.5)	96 (1.3)	98 (0.6)
Malaysia	18 (3.2)	42 (4.2)	78 (3.6)	74 (4.0)	69 (4.0)	78 (3.2)	81 (3.2)
Moldova	58 (2.3)	93 (1.0)	76 (2.0)	89 (1.4)	76 (1.9)	90 (1.4)	92 (1.4)
Morocco	33 (2.5)	86 (1.5)	77 (2.1)	67 (2.0)	62 (2.1)	72 (2.0)	85 (2.3)
Netherlands	24 (3.2)	97 (1.0)	73 (4.6)	17 (2.6)	32 (3.6)	24 (3.5)	23 (3.1)
New Zealand	9 (2.2)	65 (4.0)	46 (3.8)	31 (4.1)	71 (3.9)	57 (3.9)	45 (4.4)
Philippines	42 (4.0)	84 (3.3)	89 (2.4)	77 (3.6)	83 (3.3)	87 (2.8)	91 (2.5)
Romania	51 (2.7)	87 (1.6)	81 (2.1)	62 (2.8)	65 (2.8)	87 (1.7)	99 (0.6)
Russian Federation	--	97 (0.6)	64 (1.9)	77 (2.2)	83 (1.6)	97 (0.7)	96 (1.1)
Singapore	28 (3.9)	70 (4.2)	67 (3.5)	39 (4.5)	61 (4.2)	40 (4.2)	36 (4.5)
South Africa	39 (3.2)	65 (4.2)	61 (4.6)	66 (3.9)	50 (4.3)	62 (4.5)	70 (3.6)
Thailand	29 (4.1)	73 (4.1)	70 (3.9)	83 (3.2)	70 (4.2)	77 (3.6)	82 (3.4)
Tunisia	20 (3.7)	82 (3.0)	77 (3.3)	47 (4.2)	71 (3.8)	85 (3.1)	88 (2.5)
Turkey	20 (3.4)	64 (3.6)	43 (3.8)	44 (4.0)	46 (4.5)	61 (3.7)	93 (1.8)
United States	r 18 (2.5)	r 70 (2.8)	r 60 (3.2)	r 66 (2.8)	r 82 (2.7)	r 49 (3.6)	r 49 (2.6)
<b>International Avg.</b>	<b>33 (0.5)</b>	<b>76 (0.5)</b>	<b>60 (0.6)</b>	<b>58 (0.6)</b>	<b>65 (0.6)</b>	<b>68 (0.5)</b>	<b>75 (0.5)</b>

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

Background data provided by teachers.

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

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

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

A dash (–) indicates data are not available.

An "r" indicates teacher response data available for 70-84% of students. An "s" indicates teacher response data available for 50-69% of students.

