CHAPTER 5

5

The Science Curriculum

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

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

Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries and teachers' reports about the science content studied. Teacher's instructional programs for their classes are usually guided by an "official curriculum" that describes the science education that should be provided. The official curriculum can be communicated by means of documents or statements of various sorts (often called guides, guidelines, or frameworks) prepared by the education ministry or by national or regional education departments. These documents or statements, together with supporting material such as instructional guides or mandated textbooks, are referred to as the intended curriculum.

To collect information about the intended science curriculum at the eighth grade in each of the TIMSS 1999 countries, the National Research Coordinators responsible for implementing the study completed questionnaires and participated in interviews. As part of the process, information was gathered about factors related to supporting and monitoring the implementation of the official curriculum, including the availability of teacher training, instructional materials, assessments, and audits aligned with the curriculum.

In many cases, teachers need to interpret and modify the intended curriculum according to their perceptions of the needs and abilities of their classes, and this evolves into the implemented curriculum. Research has shown that the implemented curriculum, even in highly regulated educational systems, is not identical to the intended curriculum. To collect data about the implemented curriculum, the science teachers of the students tested in TIMSS 1999 completed questionnaires about whether students had been taught the various science topics covered in the test.

Science Subjects Offered Up To and Including Eighth Grade

5.1

The most striking difference among science curricula of the TIMSS 1999 countries in eighth and earlier grades is that the sciences are taught as separate subjects in some countries and integrated to form a general science course in others. Exhibit 5.1 shows how science instruction is organized in these grades in the TIMSS 1999 countries. By the eighth grade, Chinese Taipei, Indonesia, and most of the European countries were teaching some or all of earth science, biology, physics and chemistry as separate subjects, not necessarily contemporaneously. Elsewhere, the common practice was to integrate the sciences into a general science curriculum.

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

Exhibit 5.1 Science Subjects Offered Up to and Including Eighth Grade

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

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

Background data provided by National Research Coordinators.

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

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

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

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

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

5.2

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

In recent decades, it has become common for intended curricula to be updated regularly. At the time of the TIMSS 1999 testing, the official science curriculum in 31 countries had been in place for less than a decade, and more than three-quarters of them were in revision. Of the seven countries with a science curriculum of more than 10 years' standing, four were being revised. In Australia, Canada, and the United States, curriculum change is made at the state or provincial level, and some science curricula were in revision at the time of testing. The science curricula in these three countries were relatively recent, having been developed within ten years prior to the study.

Exhibit 5.2 Science Curriculum

	National or Regional Curriculum	Year Curriculum Introduced	Status of Curriculum
Australia	Regional & Local	1984-1999	In revision (in 4 states/territories); As introduced (in 4 states/territories)
Belgium (Flemish) [1]	National	1989-1999	As introduced
Bulgaria	National	1989 (biology and chemistry); 1996 (physics); 1995 (earth science)	In revision
Canada	Regional	1987-1998	In revision (5 provinces); As introduced (5 provinces)
Chile	National	1980	In revision
Chinese Taipei	National	1997	In revision
Cyprus	National	1978	As introduced
Czech Republic	National	1996	In revision
England	National	1995	In revision, same structure with minor revisions (to be implemented 2000/01)
Finland	National	1994	As introduced
Hong Kong, SAR	National	1986	In revision
Hungary	National	1995	As introduced
Indonesia	National	1994	In revision
Iran, Islamic Rep.	National	1996	In revision
Israel	National	1997-1998	In revision
Italy	National	1979	As introduced
Japan	National	1993	As introduced
Jordan	National	1993	Slight revisions annually
Korea, Rep. of	National	1995	As introduced
Latvia (LSS)	National	1992-1994	In revision
Lithuania	National	1997	In revision
Macedonia, Rep. of	National	1979 (adaptations in 1995)	As introduced
Malaysia	National	1990	In revision
Moldova	National	1991	In revision
Morocco	National	1991	In revision
Netherlands	National	1993 (slight adaptations in 1998)	As introduced
New Zealand	National	1995	As introduced
Philippines	National	1998	In revision
Romania	National	1993	In revision
Russian Federation	National	1998	In revision
Singapore	National	1993	In revision
Slovak Republic	National	–	–
Slovenia	National	1983	In revision
South Africa	National	1984	In revision
Thailand	National	1990	In revision
Tunisia	National	1997	In revision
Turkey	National	1992	In revision
United States	Regional & Local	1990-1999	As of 1999, 47 out of 50 states have completed content standards

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

Background data provided by National Research Coordinators.

A dash (–) indicates data are not available.

[1] Belgium (Flemish): Curricula were introduced as follows: 1997-98 (biology); 1997 (technological education), early 1990 (physics); 1997 (earth science); 1997-99 (applied sciences); 1989 (scientific work); 1989-97 (natural science).

How Do Countries Support and Monitor Curriculum Implementation?

Education systems use different ways to achieve the best match between the intended and the implemented curriculum. For example, teachers can be trained in the content and pedagogical approaches specified in the curriculum guides. Another way to help ensure alignment is to develop instructional materials, including textbooks, instructional guides, and ministry notes, that are tailored to the curriculum. Systems can also monitor implementation by means of school inspection or audit. The different methods used by the TIMSS 1999 countries are shown in Exhibit 5.3. It is assumed that monitoring implementation encourages teachers to use the official curriculum in planning their teaching programs. Testing and assessment of the intended curriculum are also widely used to support and monitor curriculum implementation; these are addressed in Exhibits 5.4 and 5.5

Of the methods for supporting and monitoring curriculum implementation shown in Exhibit 5.3, 10 countries reported using all six, and a further 13 countries used five. Support for the national/regional science curriculum as part of pre-service education was noted by 24 of the 38 countries, and nearly all reported using in-service teacher education for this purpose. A system of school inspection or audit was used by 31 countries.

Exhibit 5.3 Methods Used to Support or Monitor Curriculum Implementation*

TIMSS 1999 8th grade Science

	Pre-Service Teacher Education	In-Service Teacher Education	Mandated or Recommended Textbook(s)	Instructional or Pedagogical Guide	Ministry Notes and Directives	System of School Inspection or Audit
Australia [1]	●	●		●	●	
Belgium (Flemish)	●	●		●	●	●
Bulgaria	●	●	●		●	●
Canada [2]	●	●	●	●	●	
Chile			●		●	
Chinese Taipei	●	●	●	●		●
Cyprus		●	●		●	●
Czech Republic	●		●		●	●
England	●	●				●
Finland	●	●	●	●		
Hong Kong, SAR			●	●		●
Hungary	●	●	●	●	●	
Indonesia		●	●	●	●	●
Iran, Islamic Rep.	●	●	●	●	●	●
Israel	●	●	●	●	●	●
Italy		●		●	●	●
Japan		●	●	●	●	●
Jordan		●	●	●	●	●
Korea, Rep. of	●	●	●	●	●	●
Latvia (LSS)	●	●	●	●	●	●
Lithuania		●	●		●	
Macedonia, Rep. of	●	●	●	●		●
Malaysia	●	●	●	●	●	●
Moldova		●	●		●	●
Morocco	●	●	●	●	●	●
Netherlands	●	●		●	●	●
New Zealand	●	●				●
Philippines		●	●	●	●	●
Romania	●	●	●	●	●	●
Russian Federation	●	●	●	●	●	●
Singapore	●	●	●	●	●	●
Slovak Republic	●		●		●	●
Slovenia	●	●	●	●		●
South Africa		●	●			●
Thailand	●	●	●	●	●	●
Tunisia		●	●	●	●	●
Turkey		●	●		●	●
United States [3]	+	+	+	+	+	+

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

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

\+ Not applicable nationally

Background data provided by National Research Coordinators.

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

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

2 Canada: Results are for the majority of provinces.

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

What Countries Have Public Examinations in Science?

5.4

Using public examinations as a way to select students for university or academic tracks in secondary school can be an important motivating factor for student achievement. Exhibit 5.4 shows information on public examinations and their purpose. Thirty-six countries reported having public examinations or awards, at one or more grades, that include testing achievement in science. Most countries held their examinations in the final year of schooling for certification and selection to higher education (often, university education). Certification also provides students not going on to full-time post-secondary education with evidence of educational attainment for prospective employers. In about one-third of the countries, public examinations were also reported to be used to select students for entry to different types of secondary school, or to assign them to different tracks or courses within secondary schools. Providing feedback to policy makers in the educational system, schools, or both was also an important use of assessments in some countries.

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

Exhibit 5.4 Public Examinations in Science

	Public Exams/ Awards	Grade(s)	Purpose/Consequences
Australia	Yes	12	Certification and selection for tertiary education
Belgium (Flemish)	No		
Bulgaria	Yes	7/8, 12	Candidates for profile schools (grade 7 or 8); certification and entrance to university -- not taken by all students (grade 12)
Canada [1]	Yes	12 (2 provinces); 6, 9, 12 (1 province)	Certification (grade 12); feedback to system and schools
Chile	Yes	12	Entry to university
Chinese Taipei	No		
Cyprus	Yes	9, 12	Certification (grade 9); certification and entry to university (grade 12)
Czech Republic	Yes	13	Certification (science can be chosen as one of four subjects for leaving examination)
England	Yes	10, 12	Certification (grade 10); certification and entry to university (grade 12); feedback to system and schools
Finland	Yes	12	Certification and selection for tertiary education; in the matriculation exam, the General Studies Test section includes questions related to physics, chemistry, and biology in addition to seven other topic areas. Students can choose to take either the General Studies Test or the Mathematics Test
Hong Kong, SAR	Yes	6, 11, 13	School placement (grade 6); certification and placement for 12th grade (grade 11); placement in tertiary institutions (grade 13)
Hungary	Yes	12	Certification and entry to university (science is not a compulsory subject)
Indonesia	Yes	6, 9, 12	Leaving exam, selection for junior secondary school (grade 6); selection for senior secondary school (grade 9); leaving exam (grade 12); system-level feedback, in some cases school- and classroom-level feedback
Iran, Islamic Rep.	Yes	11, 12	Certification (grade 11); entry to tertiary education (grade 12); in addition, provincial exams are administered at grade 8
Israel	Yes	11 or 12	Matriculation certification for those choosing entry to specific areas in the university
Italy	Yes	13	Certification and entry to university
Japan	Yes	9, 12	Entry to prefectural and municipal upper secondary schools (grade 9); entry to national, prefectural and municipal universities (grade 12)
Jordan	Yes	12	Certification and entry to tertiary education
Korea, Rep. of	Yes	12	College entrance exam for selection of students
Latvia (LSS)	Yes	12	Certification
Lithuania	Yes	12	Leaving examination
Macedonia, Rep. of	Yes	12	Certification and entry to university; the exam constitutes 40% of the required points for entry to university with the remaining points based on university entry exams
Malaysia	Yes	6, 9, 11, 13	Feedback to system and schools, achievement test (grade 6); entry to course tracks (grade 9); certification and end of secondary (grade 11); certification and entry to university (grade 13)
Moldova	Yes	9, 11/12	Certification, selection for high school (grade 9); graduation (grade 11 or 12 depending on school)
Morocco	Yes	6, 9, 10, 11, 12	Remedial test for retention purposes (grade 6); certification, selection to secondary, and selection to courses (grade 9); certification and entry to tertiary (grade 12); feedback to system and schools
Netherlands	Yes	10, 11, 12	End-of-track examinations; exams recommended at grades 6 and 8
New Zealand	Yes	10, 12	Certification, course selection (grade 10); entry to tertiary education (grade 12); feedback to system and schools; informal between-school comparisons
Philippines	Yes	6, 10	Feedback to system and schools; entry to university set by each institution
Romania	Yes	12	Certification (science can be chosen as one of 7 subjects)
Russian Federation	Yes	9, 11	Certification (not state compulsory, may be administered at the regional or school level)
Singapore	Yes	6, 10, 12	Feedback to system and schools; selection into courses; certification and entry to university
Slovak Republic	Yes	12	Certification (science can be chosen as one of four subjects for leaving exam)
Slovenia	Yes	12	Certification and entry to tertiary education
South Africa	Yes	12	Certification and selection for tertiary education
Thailand	Yes	12	Entry to university
Tunisia	Yes	6, 9, 13	Feedback to system and schools; regional exam for promotion (grade 6); selection for schools/courses; promotion (grade 9)
Turkey	Yes	8, 11	Placement in specialized schools for some students (grade 8); entry to university (grade 11)
United States [2]	Yes	varies	Primarily feedback to system and schools; in 8 states grade promotion is dependent on results; in 18 states graduation is dependent on results of grade 12 exams

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

Background data provided by National Research Coordinators.

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

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

What Countries Have System-Wide Assessments in Science?

Although national public examinations can provide information of interest to national and regional policy makers, their main purpose is to make decisions about individual students. In comparison, system-wide assessments are designed primarily to inform policy makers about matters such as national standards of achievement of the intended curriculum objectives, strengths and weaknesses in the curriculum or how it is being implemented, and whether educational achievement is improving or deteriorating.

5.5

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

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

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

R2.1

Exhibit 5.5 System-Wide Assessments in Science

TIMSS 1999 8th grade Science

	System-Wide Assessments[1]	Grades		Purpose/Consequences
		Entire Grade Level	Sample from Grade Level	
Australia [2]	Yes	10 (1 state)	3, 7, 10 (1 state) 10 (1 state)	System-level feedback
Belgium (Flemish)	No			
Bulgaria	No			
Canada [3]	Yes	4, 7, 10 (1 province)	ages 13 and 16 nationally (most provinces)	System- and school-level feedback
Chile	Yes	4, 8, 10		System- and school-level feedback, usually one grade level assessed each year
Chinese Taipei	No			
Cyprus	No			
Czech Republic	No			
England	Yes	5, 8		System-, school- and student-level feedback
Finland	Yes		4, 8, 9	System-level feedback
Hong Kong, SAR	No			
Hungary	Yes		4, 6, 8, 10, 12	System-level, school-level, and individual-level feedback
Indonesia	Yes		various grades	System-level feedback, assessments given irregularly at different primary grades
Iran, Islamic Rep.	No			
Israel	Yes		6	System-level feedback
Italy	Yes		6, 8, 10, 13	System-level feedback; first administered in 1999 with a grade 4 assessment instituted in 2000.
Japan	Yes		5, 6, 7, 8, 9	System-level feedback
Jordan	Yes		4, 5, 8, 10	System-level feedback; monitoring reform impact; curricular revisions
Korea, Rep. of	Yes	4, 5, 6, 7, 8, 10		System-level feedback
Latvia (LSS)	No			
Lithuania	No			
Macedonia, Rep. of	Yes		5, 6, 7, 8	System-level feedback and research purposes (projects and curriculum development)
Malaysia	Yes	6, 9, 11, 13		System- and school-level feedback; "good schools" publicized
Moldova	No			
Morocco	Yes	6, 9, 10, 11, 12		System- and school-level feedback
Netherlands	Yes	10, 11, 12	6	System-level feedback
New Zealand	Yes		3, 7	System-level feedback
Philippines	Yes	6, 10		System- and school-level feedback (the assessment was sample-based up until 1999)
Romania	No			
Russian Federation	Yes		various grades	Irregularly for research purposes
Singapore	Yes	6, 10, 12		System- and school-level feedback; selection into courses, certification and entry to university
Slovak Republic	No			
Slovenia	No			
South Africa	No			
Thailand	No			
Tunisia	Yes	4, 6, 9, 13		System- and school-level feedback; may lead to redistribution of teachers in the regions; assessments at grades 4 and 6 developed regionally
Turkey	Yes		5, 8, 11	System- and school- level feedback
United States	Yes		4, 8, 12	National and state-level feedback

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

Background data provided by National Research Coordinators.

1 Public examinations are also used for system-wide assessment purposes in these countries: Malaysia, Morocco, Netherlands, Philippines, Singapore, Tunisia, and Turkey.

2 Australia: System-wide assessments are administered in 3 of 8 states/territories.

3 Canada: System-wide assessments are administered in 5 of 10 provinces.

How Much Instructional Time Is Recommended for Science?

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

5.6

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

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

Exhibit 5.6 Overleaf

Exhibit 5.6 Instructional Time for Science

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

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

Background data provided by National Research Coordinators.

All data rounded to the nearest whole number.

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

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

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

A dash (–) indicates data are not available.

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

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

How Do Countries Deal with Individual Differences?

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

5.7

Some countries indicated using more than one method of dealing with individual differences among students, and in these cases the category describing the main method was reported. The most common approach, found in 25 countries, was to have the same intended curriculum for all students, but to recommend that teachers adapt the level and scope of their teaching to the abilities and needs of their students. Adaptations for individuals and classes were also recommended in the intended curricula of some countries with different levels of curricula or different curricula for different groups.

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

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

R2.2

Exhibit 5.7 Differentiation of Instruction for Students with Different Abilities or Interests

TIMSS 1999 8th grade Science

	Curriculum Addresses Differentiation	Approaches to Addressing Students with Different Abilities or Interests at Grade 8			
		Same Curriculum for All Students, and Teachers Adapt to Students' Needs	Same Curriculum with Different Levels for Different Groups	Different Curricula for Different Groups	Number of Curriculum Levels
Australia	Yes	Yes	No	No	1
Belgium (Flemish)	Yes	No	No	Yes	2
Bulgaria	Yes	Yes	No	No	1
Canada	Yes	Yes	No	No	1
Chile	No				
Chinese Taipei	Yes	Yes	No	No	1
Cyprus	Yes	Yes	No	No	1
Czech Republic [1]	Yes	Yes	Yes	No	2
England [2]	Yes	No	Yes	No	9
Finland	Yes	Yes	No	No	1
Hong Kong, SAR	Yes	Yes	No	No	1
Hungary	Yes	Yes	No	No	1
Indonesia	No				
Iran, Islamic Rep.	Yes	Yes	No	No	1
Israel	Yes	Yes	No	No	1
Italy	No				
Japan	No				
Jordan	Yes	Yes	No	No	1
Korea, Rep. of	No				
Latvia (LSS)	No				
Lithuania	No				
Macedonia, Rep. of	Yes	Yes	No	No	1
Malaysia	Yes	Yes	No	No	1
Moldova	No				
Morocco	Yes	Yes	No	No	1
Netherlands	Yes	No	No	Yes	4
New Zealand	Yes	Yes	No	No	1
Philippines	Yes	Yes	No	No	1
Romania	Yes	Yes	No	No	1
Russian Federation	Yes	Yes	No	No	1
Singapore	Yes	No	No	Yes	3
Slovak Republic	Yes	Yes	No	No	1
Slovenia	Yes	Yes	No	No	1
South Africa	No				
Thailand	Yes	Yes	No	No	1
Tunisia	Yes	Yes	No	No	1
Turkey	Yes	Yes	No	No	1
United States [3]	Yes	Yes	No	No	1

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

Background data provided by National Research Coordinators.

1 Czech Republic: There is the same curriculum with different levels for different groups in physics and chemistry (2 levels); there is one curriculum for all students, and teachers adapt to students' needs, in life science and earth science.

2 England: While there is one "programme of study" for grades 6-8, the document identifies nine performance-levels describing the types and range of performance that pupils working at a particular level should demonstrate.

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

What Are the Major Characteristics of the Intended Curriculum?

5.8

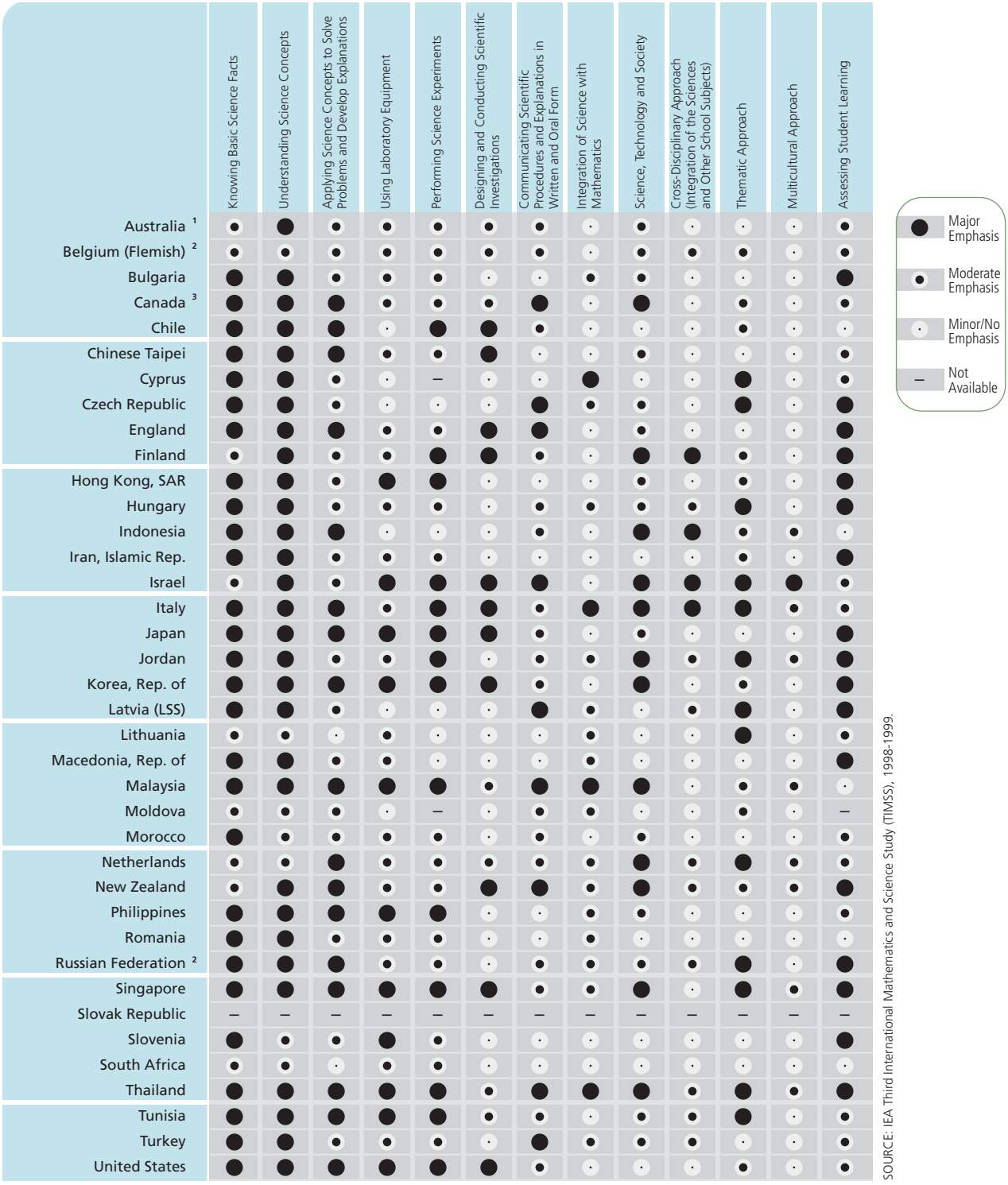
Exhibit 5.8 indicates the relative emphasis given to various aspects of science instruction in the intended curriculum. Knowing basic science facts and understanding science concepts received major emphasis in the curriculum of most participating countries, and at least moderate emphasis was placed on application of science concepts in almost all national curricula. Few countries gave major emphasis to using laboratory equipment and performing science experiments, but there were some notable exceptions. Top-performing Singapore, Korea, and Japan were among the 10 countries that reported major emphasis for both. The Czech Republic's intended curriculum had minor or no emphasis on any aspect of practical work, and several other countries' curricula had minor or no emphasis on performing experiments.

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

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

Exhibit 5.8 Emphasis on Approaches and Processes

TIMSS 1999 8th grade Science



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

Background data provided by National Research Coordinators.

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

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

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

What Science Content Do Teachers Emphasize at the Eighth Grade?

5.9

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

Exhibit 5.9 Subject Matter Emphasized Most in General/Integrated Science Class

TIMSS 1999 8th grade Science

	Percentage of Students Whose Teachers Report the Subject Matter Emphasized Most in Their Grade 8 Science Class						
	General/ Integrated Science	Earth Science	Biology	Physics	Chemistry	Physical Science (chemistry/ physics)	Other
Australia r	83 (2.6)	0 (0.3)	5 (1.6)	1 (0.4)	4 (1.3)	2 (0.7)	4 (1.2)
Canada r	55 (3.5)	14 (2.3)	6 (1.7)	1 (0.7)	1 (0.6)	19 (2.7)	3 (1.2)
Chile	71 (4.0)	1 (0.9)	22 (3.4)	1 (0.9)	0 (0.0)	2 (1.1)	2 (1.2)
Cyprus s	17 (3.6)	1 (1.3)	17 (3.2)	39 (4.5)	13 (2.6)	6 (2.3)	6 (2.8)
England	– –	– –	– –	– –	– –	– –	– –
Hong Kong, SAR	92 (2.6)	0 (0.0)	3 (1.5)	0 (0.0)	1 (0.0)	4 (1.9)	0 (0.0)
Iran, Islamic Rep.	53 (4.6)	0 (0.0)	13 (2.7)	14 (3.1)	3 (1.4)	16 (2.9)	1 (0.8)
Israel s	34 (4.4)	1 (0.0)	21 (3.9)	3 (1.3)	7 (2.5)	28 (4.5)	6 (2.1)
Italy	0 (0.0)	20 (3.2)	49 (3.9)	13 (2.6)	3 (1.2)	11 (2.6)	3 (1.4)
Japan	64 (4.6)	1 (1.0)	7 (2.4)	6 (2.1)	11 (2.7)	6 (2.1)	5 (1.9)
Jordan	30 (4.1)	3 (1.4)	12 (3.0)	19 (3.5)	14 (3.2)	21 (3.6)	1 (0.8)
Korea, Rep. of	49 (4.0)	2 (1.0)	10 (2.0)	5 (1.6)	5 (1.7)	26 (3.2)	4 (1.6)
Malaysia	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
New Zealand	94 (1.7)	1 (0.5)	2 (0.9)	1 (0.6)	0 (0.0)	2 (1.6)	1 (0.6)
Philippines	88 (2.7)	6 (2.1)	3 (1.2)	0 (0.0)	1 (0.8)	2 (1.2)	1 (0.0)
Singapore	69 (4.1)	0 (0.0)	5 (2.0)	4 (1.8)	7 (2.3)	11 (2.5)	4 (1.6)
South Africa r	48 (5.0)	1 (0.8)	7 (2.5)	8 (2.8)	5 (2.3)	31 (4.0)	1 (0.9)
Thailand	81 (3.2)	7 (2.0)	4 (1.6)	1 (0.8)	3 (1.3)	3 (1.4)	1 (1.0)
Tunisia	8 (2.4)	8 (2.1)	81 (3.4)	1 (0.0)	0 (0.0)	0 (0.0)	3 (1.5)
Turkey	74 (3.1)	0 (0.3)	3 (1.3)	8 (2.1)	2 (1.0)	11 (2.7)	2 (0.9)
United States r	41 (4.7)	28 (4.8)	5 (1.5)	2 (0.8)	3 (1.0)	21 (3.1)	1 (0.4)
International Avg.	58 (0.8)	5 (0.4)	14 (0.5)	6 (0.4)	4 (0.4)	11 (0.6)	2 (0.3)

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

Background data provided by teachers.

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

A dash (–) indicates data are not available.

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

What Science Topics Are Included in the Intended Curriculum?

In the course of their meetings on planning and implementation of TIMSS 1999, the National Research Coordinators developed a list of science topics that they agreed covered most of the content in the intended science curriculum in their respective countries. This list of topics, presented in Exhibit 5.10, built on the topics covered in the TIMSS 1995 science test and included in the teacher questionnaire. It represents a comprehensive list of the topics likely to have been included in the curricula of the participating countries up to and including eighth grade. From the following choices, the National Research Coordinators indicated the percentage of students in their own countries expected to have been taught each topic:

5.10

- All or almost all students (at least 90 percent)
- About half of the students
- Only the more able students (top track – about 25 percent)
- Only the most advanced students (10 percent or less)

Exhibit 5.11 summarizes the data according to the percentage of topics intended to be taught to all or almost all students (at least 90 percent) in each country, across the entire list of topics and for each content area. There was marked variation between content areas and between countries. In 21 countries it was intended that all, or nearly all, students be taught all of the earth science topics. All environmental and resource issues topics were intended to be taught to practically all students in 20 countries, while in six countries none of these topics were intended for all or almost all students. On average, biology topics were most likely, and chemistry topics least likely, to have been included in the intended curricula up to and including eighth grade.

5.11

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

R2.3-R2.8

It should be noted that some countries reported having different curricula or different levels of curriculum for different groups of students, as detailed in Exhibit 5.7. Not surprisingly, then, these countries often reported that about half, only the more able (25 percent), or the top 10

percent of students were expected to have been taught substantial percentages of the topics. In addition, if content within a topic area required different responses, National Research Coordinators chose the response that best represented the entire topic area and noted the discrepancy (see Exhibit A.11 in the appendix for details).

Exhibit 5.10 Science Topics Included in the TIMSS Questionnaires

Earth Science

- ■ Earth's physical features (layers, landforms, bodies of water, rocks, soil)
- ■ Earth's atmosphere (layers, composition, temperature, pressure)
- ■ Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)
- ■ Earth in the solar system and the universe (interactions between Earth, sun, and moon; relationship to planets and stars)

Biology

- ■ Human body - structure and function of organs and systems
- ■ Human bodily processes (metabolism, respiration, digestion)
- ■ Human nutrition, health, and disease
- ■ Biology of plant and animal life (diversity, structure, life processes, life cycles)
- ◆ Photosynthesis
- ■ Interactions of living things (biomes and ecosystems, interdependence)
- ■ Reproduction, genetics, evolution, and speciation

Physics

- ■ Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)
- ■ Subatomic particles (protons, electrons, neutrons)
- ■ Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)
- ■ Heat and temperature
- ◆ Gas laws (relationship between temperature/pressure/volume)
- ■ Wave phenomena, sound, and vibration
- ■ Light (reflection, refraction, light and color)
- ■ Electricity and magnetism (circuits, conductivity, magnets)
- ■ Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)
- ◆ Buoyancy

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

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Chemistry

- ■ Classification of matter (elements, compounds, solutions, mixtures)
- ■ Structure of matter (atoms, ions, molecules, crystals)
- ◆ Formation of solutions (solvents, solutes, soluble/insoluble substances)
- ◆ Acids, bases, and salts
- ■ Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)
- ■ Energy and chemical change (exothermic and endothermic reactions, reaction rates)
- ◆ Chemical bonding and compound formation (ionic, covalent)
- ◆ Chemical equations
- ◆ Atomic structure
- ◆ Atomic number and atomic mass
- ◆ Periodic table
- ◆ Valency

Environmental and Resource Issues

- ■ Pollution (acid rain, global warming, ozone layer, water pollution)
- ■ Conservation of natural resources (land, water, forests, energy resources)
- ■ Food supply and production, population, and environmental effects of natural and man-made events

Scientific Inquiry and the Nature of Science

- ■ Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)
- ■ Experimental design (experimental control, materials, and procedures)
- ■ Scientific measurements (reliability, replication, experimental error, accuracy, scales)
- ■ Using scientific apparatus and conducting routine experimental operations
- ■ Gathering, organizing, and representing data (units, tables, charts, graphs)
- ■ Describing and interpreting data

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

■ Topics included in the curriculum and teacher questionnaires (intended and implemented curriculum).

◆ Topics also included in the curriculum questionnaire (intended curriculum).

Exhibit 5.11 Science Topics in the Intended Curriculum for At Least 90% of Students, Up to and Including Eighth Grade

TIMSS 1999 8th grade Science

	Percentage of Topics Intended to Be Taught to All or Almost All (at least 90%) Students						
	Overall	Earth Science	Biology	Physics	Chemistry	Environmental and Resource Issues	Scientific Inquiry and the Nature of Science
Australia	79	100	71	80	58	100	100
Belgium (Flemish)	38	0	71	40	0	67	83
Bulgaria	90	100	57	100	100	100	83
Canada	48	75	86	20	17	100	67
Chile	60	100	100	30	25	100	83
Chinese Taipei	69	25	86	80	58	67	83
Cyprus	62	75	86	40	50	100	67
Czech Republic	79	100	86	90	83	33	50
England	71	75	71	80	42	100	100
Finland	55	25	100	30	50	33	83
Hong Kong, SAR	50	25	100	60	42	0	33
Hungary	83	100	100	100	100	0	33
Indonesia	55	100	86	90	8	100	0
Iran, Islamic Rep.	57	100	100	60	50	33	0
Israel	57	0	43	40	75	67	100
Italy	67	75	100	70	25	100	83
Japan	62	100	57	70	50	0	83
Jordan	88	100	86	100	67	100	100
Korea, Rep. of	60	100	71	70	50	0	50
Latvia (LSS)	36	100	14	30	33	100	0
Lithuania	76	100	86	90	83	33	33
Macedonia, Rep. of	69	25	86	90	92	67	0
Malaysia	57	50	86	50	33	33	100
Moldova	95	100	100	100	83	100	100
Morocco	5	0	0	20	0	0	0
Netherlands	24	0	43	20	0	100	33
New Zealand	52	100	43	60	25	100	50
Philippines	55	100	71	50	42	67	33
Romania	81	100	100	70	92	100	33
Russian Federation	71	100	29	70	100	100	33
Singapore	79	100	100	70	58	100	83
Slovak Republic	–	–	–	–	–	–	–
Slovenia	95	100	100	80	100	100	100
South Africa	21	25	29	30	25	0	0
Thailand	64	50	100	40	42	100	100
Tunisia	45	25	100	40	0	67	83
Turkey	95	100	100	100	100	100	67
United States	86	100	100	100	50	100	100
International Avg.	63	72	77	64	52	69	60

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

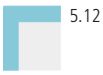
Background data provided by National Research Coordinators according to the national curriculum. NRCs indicated the percentage of students who should have been taught each of the topics listed in exhibit 5.10. The response categories were: all or almost all of the students (at least 90%); about half of the students; only the more able students (top track - about 25%); only the most advanced students (10% or less); not included in curriculum through grade 8. (See reference exhibits R2.3-R2.8 for detail by topic.)

A dash (–) indicates data are not available.

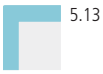
Have Students Been Taught the Topics Tested by TIMSS?

In interpreting the achievement results, it is important to consider how extensively the topics tested are taught in the participating countries. As shown in Exhibits 5.12 through 5.17, the six major science content areas assessed in TIMSS 1999 were represented by 31 topic areas. For each area, teachers indicated whether their students had been taught the topics before this year, one to five periods this year, more than five periods this year; whether the topics had not yet been taught; or whether the teacher did not know. Exhibits 5.12 through 5.17 show the percentages of students in each country reported to have been taught each topic before or during the year of the testing.

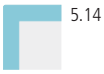
Although the international average percentage of students whose teachers reported that earth science topics (see Exhibit 5.12) were taught before or during the year of testing was greater than 70 percent for each topic, countries varied greatly in topic coverage. For example, in 19 countries at least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



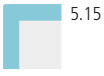
With the exception of "reproduction, genetics, evolution, and speciation," biology topics (see Exhibit 5.13) had been taught to the great majority of students in most countries. Teachers in nine countries reported that 80 percent or more of their students were taught all of the biology topics. In comparison,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



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



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



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

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

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

Exhibit 5.12 Percentages of Students Taught Earth Science Topics*

TIMSS 1999 8th grade Science

	Earth's physical features (layers, landforms, bodies of water, rocks, soil)	Earth's atmosphere (layers, composition, temperature, pressure)	Earth processes and history (weather and climate, physical cycle, plate tectonics, fossils)	Earth in the solar system and the universe (interactions between earth, sun, and moon; relationship to planets and stars)
Australia	r 73 (3.4)	r 65 (3.5)	r 67 (3.4)	r 80 (3.3)
Belgium (Flemish)	r 93 (3.0)	r 45 (4.3)	r 64 (5.2)	r 16 (3.4)
Bulgaria	99 (0.6)	r 99 (0.6)	r 99 (0.6)	r 99 (0.8)
Canada	s 91 (1.9)	s 83 (2.1)	s 86 (2.3)	s 80 (3.1)
Chile	95 (1.5)	95 (1.8)	r 81 (2.9)	94 (1.9)
Chinese Taipei [1]	– –	– –	– –	– –
Cyprus	s 45 (6.6)	s 38 (6.0)	s 39 (5.6)	s 88 (3.6)
Czech Republic	99 (0.4)	98 (1.2)	97 (1.7)	98 (1.2)
England	s 86 (4.0)	s 64 (3.9)	s 71 (3.5)	s 90 (3.6)
Finland	65 (4.0)	r 38 (4.0)	62 (3.5)	r 45 (4.1)
Hong Kong, SAR	s 17 (3.2)	r 61 (5.0)	s 17 (4.0)	s 15 (3.8)
Hungary	83 (3.1)	72 (3.9)	88 (2.8)	79 (3.8)
Indonesia	98 (1.2)	97 (1.5)	88 (3.1)	97 (1.5)
Iran, Islamic Rep.	95 (2.4)	72 (4.4)	69 (3.7)	68 (3.9)
Israel	x x	x x	x x	x x
Italy	82 (2.9)	95 (1.5)	81 (3.2)	70 (3.6)
Japan	6 (2.2)	74 (3.7)	39 (4.1)	99 (0.7)
Jordan	98 (1.1)	84 (3.4)	88 (3.1)	82 (3.7)
Korea, Rep. of	91 (2.4)	98 (1.2)	95 (1.5)	52 (4.0)
Latvia (LSS)	s 92 (3.1)	r 83 (4.0)	s 78 (4.6)	r 86 (3.4)
Lithuania [‡]	– –	– –	– –	– –
Macedonia, Rep. of	88 (2.9)	88 (2.2)	r 86 (2.6)	85 (2.4)
Malaysia	32 (4.1)	32 (3.9)	14 (3.0)	16 (3.2)
Moldova	– –	– –	– –	– –
Morocco	– –	– –	– –	– –
Netherlands	76 (5.6)	91 (2.7)	92 (4.1)	r 82 (4.8)
New Zealand	40 (3.9)	45 (3.9)	r 40 (3.9)	63 (3.5)
Philippines	99 (0.6)	98 (1.1)	98 (1.0)	74 (3.8)
Romania	100 (0.0)	100 (0.0)	99 (1.0)	99 (0.8)
Russian Federation	– –	– –	– –	– –
Singapore	x x	x x	x x	x x
South Africa	s 72 (5.2)	s 68 (5.9)	x x	s 62 (6.0)
Thailand	99 (0.7)	63 (3.8)	95 (1.8)	88 (2.6)
Tunisia	82 (3.5)	r 12 (3.0)	16 (3.4)	r 4 (1.9)
Turkey	42 (3.7)	60 (4.0)	37 (4.2)	73 (3.4)
United States	r 87 (2.5)	r 84 (2.7)	r 92 (2.0)	r 84 (2.3)
International Avg.	77 (0.6)	73 (0.6)	71 (0.6)	71 (0.6)

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

Background data provided by teachers.

* Taught before or during this school year.

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

1 Data for grade 9 earth science teachers not available.

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

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

A dash (–) indicates data are not available.

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

Exhibit 5.13 Percentages of Students Taught Biology Topics*

	Human body - structure and function of organs and systems	Human bodily processes (metabolism, respiration, digestion)	Human nutrition, health, and disease	Biology of plant and animal life (diversity, structure, life processes, life cycles)	Interactions of living things (biomes, ecosystems, and interdependence)	Reproduction, genetics, evolution, and speciation
Australia	r 80 (3.3)	r 75 (3.1)	r 75 (3.3)	r 84 (2.7)	r 67 (3.9)	r 39 (3.8)
Belgium (Flemish)	98 (1.0)	100 (0.0)	100 (0.0)	r 91 (2.6)	r 85 (3.7)	94 (2.2)
Bulgaria	94 (3.4)	94 (3.4)	95 (3.3)	r 96 (2.2)	r 65 (6.8)	r 36 (5.2)
Canada	s 54 (3.0)	s 49 (3.6)	s 54 (3.8)	s 70 (3.2)	s 77 (2.7)	s 45 (3.7)
Chile	95 (1.8)	93 (2.1)	94 (1.7)	96 (1.2)	99 (1.0)	92 (2.2)
Chinese Taipei [1]	– –	– –	– –	– –	– –	– –
Cyprus	r 100(0.0)	r 100 (0.0)	r 100 (0.0)	s 82 (4.1)	r 40 (4.5)	r 30 (4.1)
Czech Republic	99 (0.4)	99 (0.5)	98 (1.1)	96 (2.1)	73 (4.4)	57 (5.4)
England	s 96 (1.9)	s 99 (0.8)	s 95 (2.5)	s 91 (3.2)	s 84 (4.2)	s 80 (3.6)
Finland	30 (4.0)	28 (3.5)	28 (3.5)	90 (2.6)	92 (2.4)	21 (3.4)
Hong Kong, SAR	79 (3.8)	76 (3.6)	r 30 (4.7)	r 69 (4.6)	r 57 (4.9)	r 61 (4.6)
Hungary	93 (2.2)	94 (2.1)	90 (2.6)	99 (1.0)	89 (2.3)	87 (2.8)
Indonesia	100(0.0)	99 (1.1)	58 (4.5)	100 (0.3)	98 (1.2)	50 (4.4)
Iran, Islamic Rep.	99 (0.7)	99 (0.8)	98 (1.0)	91 (2.5)	78 (3.5)	95 (1.8)
Israel	r 77 (3.6)	r 57 (3.9)	r 36 (4.4)	r 66 (3.9)	r 40 (4.3)	r 76 (3.3)
Italy	99 (0.9)	99 (0.9)	97 (0.9)	100 (0.0)	89 (2.4)	87 (2.9)
Japan	97 (1.7)	96 (1.8)	82 (3.3)	86 (3.0)	15 (3.2)	8 (2.5)
Jordan	96 (2.0)	98 (1.1)	90 (2.9)	87 (3.3)	r 82 (3.8)	61 (5.1)
Korea, Rep. of	91 (2.2)	92 (2.2)	87 (2.8)	76 (3.7)	57 (4.3)	54 (4.3)
Latvia (LSS)	49 (4.4)	46 (4.3)	67 (4.2)	98 (1.3)	90 (2.9)	49 (4.8)
Lithuania [‡]	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	99 (0.8)	99 (1.0)	98 (1.1)	96 (1.6)	90 (2.7)	90 (2.7)
Malaysia	96 (1.8)	93 (2.1)	96 (1.7)	75 (4.0)	88 (2.8)	15 (2.9)
Moldova	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –
Netherlands	r 100(0.0)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	r 99 (0.9)
New Zealand	58 (4.1)	55 (4.4)	55 (4.2)	85 (3.0)	65 (4.2)	28 (3.3)
Philippines	46 (4.0)	61 (4.1)	65 (4.4)	63 (3.9)	83 (2.7)	44 (4.4)
Romania	99 (0.6)	99 (0.6)	98 (1.3)	99 (1.2)	96 (1.9)	96 (1.6)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	97 (1.5)	97 (1.6)	97 (1.8)	r 86 (3.8)	r 69 (4.4)	92 (2.7)
South Africa	r 43 (5.4)	s 44 (5.6)	s 49 (5.3)	r 80 (4.1)	r 85 (3.0)	r 49 (5.6)
Thailand	93 (2.3)	94 (2.0)	87 (2.7)	79 (3.2)	83 (3.5)	91 (2.8)
Tunisia	53 (4.1)	49 (4.6)	51 (4.3)	92 (2.4)	58 (4.1)	24 (3.4)
Turkey	93 (2.9)	93 (2.6)	86 (3.4)	92 (2.0)	96 (1.4)	63 (3.9)
United States	r 90 (2.6)	r 90 (2.1)	r 91 (2.2)	r 92 (1.9)	r 90 (2.0)	r 83 (2.8)
International Avg.	84 (0.5)	83 (0.5)	79 (0.6)	87 (0.5)	77 (0.6)	61 (0.7)

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

Background data provided by teachers.

* Taught before or during this school year.

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

1 Data for grade 7 biology teachers not available.

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

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

A dash (–) indicates data are not available.

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

Exhibit 5.14 Percentages of Students Taught Physics Topics*

TIMSS 1999 8th grade Science

	Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)	Subatomic particles (protons, electrons, neutrons)	Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	Heat and temperature	Wave phenomena, sound, and vibration	Light	Electricity and magnetism	Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)
Australia	r 91 (2.4)	r 80 (3.2)	r 71 (3.2)	r 76 (3.3)	r 39 (4.1)	r 48 (4.4)	r 72 (3.2)	r 45 (4.0)
Belgium (Flemish)	s 58 (5.3)	s 8 (2.9)	s 35 (4.7)	s 54 (5.4)	s 5 (2.1)	s 31 (4.0)	s 38 (4.3)	s 33 (4.5)
Bulgaria	r 97 (1.7)	r 89 (2.9)	r 98 (1.0)	r 97 (1.3)	r 87 (3.3)	r 84 (6.9)	r 97 (1.4)	r 96 (1.9)
Canada	r 97 (1.3)	s 44 (3.4)	r 82 (2.6)	r 91 (2.1)	s 35 (3.8)	s 50 (4.0)	s 48 (3.3)	s 56 (3.1)
Chile	96 (1.7)	85 (3.0)	92 (2.2)	96 (1.4)	r 52 (4.3)	r 61 (4.8)	r 57 (4.1)	52 (3.7)
Chinese Taipei	98 (1.0)	98 (1.0)	47 (4.3)	93 (2.3)	79 (3.1)	89 (2.6)	20 (3.2)	29 (3.5)
Cyprus	r 100 (0.0)	r 28 (5.4)	r 96 (2.5)	r 100 (0.0)	s 11 (3.9)	s 88 (3.4)	s 20 (4.5)	s 12 (3.9)
Czech Republic	96 (2.1)	96 (2.0)	94 (2.4)	98 (1.3)	10 (3.1)	81 (4.1)	71 (4.8)	100 (0.2)
England	s 97 (1.4)	s 66 (4.1)	s 96 (1.7)	s 92 (2.8)	s 82 (3.6)	s 98 (1.1)	s 97 (1.8)	s 98 (1.1)
Finland	80 (3.4)	83 (3.0)	14 (2.8)	49 (4.0)	44 (3.7)	17 (3.2)	35 (4.1)	51 (3.6)
Hong Kong, SAR	r 87 (3.4)	r 34 (4.9)	87 (3.4)	84 (3.2)	r 58 (4.6)	r 50 (5.2)	83 (3.5)	r 41 (4.9)
Hungary	98 (1.2)	92 (2.3)	100 (0.2)	97 (1.5)	87 (3.1)	58 (4.0)	97 (1.5)	98 (1.2)
Indonesia	93 (2.2)	79 (3.7)	85 (3.4)	91 (2.5)	90 (2.4)	90 (2.4)	60 (4.5)	85 (3.6)
Iran, Islamic Rep.	100 (0.0)	99 (0.9)	100 (0.0)	96 (1.2)	r 48 (4.8)	97 (1.5)	97 (1.2)	69 (3.8)
Israel	94 (1.9)	89 (2.6)	r 40 (4.7)	r 35 (4.0)	r 7 (2.6)	r 11 (3.2)	r 76 (4.1)	r 19 (3.8)
Italy	98 (1.2)	89 (2.6)	77 (3.1)	95 (1.5)	44 (4.0)	38 (4.0)	55 (3.9)	85 (2.9)
Japan	100 (0.0)	43 (4.1)	15 (3.5)	99 (0.9)	99 (1.3)	99 (1.3)	90 (2.6)	20 (3.1)
Jordan	99 (0.8)	99 (0.8)	92 (2.2)	94 (2.4)	97 (1.4)	98 (1.1)	88 (2.9)	99 (0.8)
Korea, Rep. of	95 (1.9)	66 (4.1)	63 (4.3)	85 (3.1)	33 (3.9)	41 (4.0)	96 (1.7)	87 (2.6)
Latvia (LSS)	98 (1.2)	55 (4.4)	71 (4.1)	77 (3.9)	83 (3.4)	90 (2.2)	8 (2.5)	71 (4.5)
Lithuania ‡	– –	– –	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	r 98 (1.2)	r 95 (2.1)	r 98 (1.3)	97 (1.5)	r 19 (3.8)	92 (2.3)	98 (1.1)	97 (0.9)
Malaysia	83 (3.4)	29 (4.1)	81 (3.6)	80 (3.4)	87 (2.6)	89 (2.6)	36 (4.3)	76 (3.5)
Moldova	– –	– –	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –	– –	– –
Netherlands	100 (0.0)	r 100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)	100 (0.0)
New Zealand	94 (1.9)	74 (3.6)	78 (3.4)	78 (3.3)	24 (3.3)	69 (4.0)	34 (4.0)	51 (4.2)
Philippines	95 (1.8)	77 (3.5)	94 (2.0)	89 (2.6)	58 (4.7)	70 (4.4)	63 (4.6)	85 (2.8)
Romania	100 (0.0)	91 (2.5)	96 (1.8)	99 (0.7)	16 (3.5)	98 (1.2)	98 (1.5)	98 (1.1)
Russian Federation	– –	– –	– –	– –	– –	– –	– –	– –
Singapore	96 (1.8)	s 80 (4.5)	97 (1.6)	99 (0.9)	85 (3.4)	99 (0.8)	92 (2.6)	r 82 (4.2)
South Africa	88 (2.8)	r 48 (4.5)	75 (3.7)	r 56 (4.9)	r 27 (4.3)	r 35 (4.4)	89 (2.5)	r 39 (5.2)
Thailand	r 76 (4.2)	r 76 (4.1)	r 53 (4.9)	r 60 (4.6)	r 34 (4.2)	r 27 (4.4)	r 49 (5.0)	r 26 (4.4)
Tunisia	s 9 (3.1)	s 3 (1.8)	s 7 (2.6)	s 15 (4.0)	s 6 (2.5)	s 9 (3.1)	s 12 (3.6)	s 13 (3.4)
Turkey	99 (0.5)	96 (1.9)	98 (1.4)	100 (0.0)	r 46 (4.5)	93 (2.4)	96 (1.8)	99 (0.6)
United States	r 93 (1.7)	r 86 (2.6)	r 76 (3.4)	r 82 (3.0)	r 65 (3.8)	r 67 (3.3)	r 70 (3.2)	r 75 (3.4)
International Avg.	91 (0.4)	71 (0.6)	75 (0.5)	83 (0.5)	52 (0.6)	68 (0.6)	67 (0.6)	65 (0.6)

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

Background data provided by teachers.

* Taught before or during this school year.

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

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

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

A dash (–) indicates data are not available.

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

Exhibit 5.15 Percentages of Students Taught Chemistry Topics*

	Classification of matter (elements, compounds, solutions, mixtures)	Structure of matter (atoms, ions, molecules, crystals)	Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	Energy and chemical change (exothermic and endothermic reactions, reaction rates)
Australia	98 (1.1)	r 89 (2.6)	r 65 (4.1)	r 42 (3.8)
Belgium (Flemish)	s 13 (2.9)	s 8 (2.6)	s 8 (3.0)	s 4 (1.9)
Bulgaria	99 (0.8)	99 (1.1)	99 (0.5)	r 87 (2.8)
Canada	r 80 (2.3)	s 63 (3.1)	s 54 (4.2)	s 36 (3.6)
Chile	95 (1.8)	90 (2.1)	86 (3.0)	r 83 (3.2)
Chinese Taipei	100 (0.0)	97 (1.4)	100 (0.0)	84 (2.9)
Cyprus	r 95 (1.7)	r 80 (4.2)	r 68 (4.4)	r 53 (4.9)
Czech Republic	100 (0.0)	100 (0.0)	92 (3.0)	53 (5.3)
England	s 98 (1.7)	s 84 (4.1)	s 94 (2.1)	s 73 (4.7)
Finland	95 (1.7)	89 (2.6)	79 (2.7)	51 (3.6)
Hong Kong, SAR	90 (2.7)	r 66 (4.6)	r 57 (5.0)	r 71 (4.8)
Hungary	100 (0.0)	100 (0.0)	97 (1.4)	99 (1.0)
Indonesia	x x	x x	x x	x x
Iran, Islamic Rep.	100 (0.0)	97 (1.6)	97 (1.1)	66 (4.8)
Israel	95 (2.1)	94 (2.2)	62 (4.1)	r 29 (4.0)
Italy	95 (1.8)	91 (2.0)	78 (3.6)	58 (4.0)
Japan	99 (1.2)	75 (3.6)	96 (1.7)	46 (4.2)
Jordan	99 (0.6)	99 (0.9)	98 (1.1)	62 (4.5)
Korea, Rep. of	99 (0.8)	97 (1.4)	91 (2.3)	51 (3.8)
Latvia (LSS)	99 (0.9)	99 (0.9)	89 (2.6)	54 (4.8)
Lithuania ‡	– –	– –	– –	– –
Macedonia, Rep. of	98 (1.0)	99 (0.9)	99 (0.7)	87 (3.0)
Malaysia	82 (3.2)	71 (3.7)	57 (4.4)	39 (4.3)
Moldova	– –	– –	– –	– –
Morocco	– –	– –	– –	– –
Netherlands	r 99 (1.0)	r 99 (0.9)	r 99 (0.9)	r 99 (0.8)
New Zealand	96 (1.5)	89 (2.6)	61 (4.1)	35 (3.6)
Philippines	92 (2.2)	87 (2.7)	83 (3.2)	72 (3.8)
Romania	100 (0.0)	99 (0.7)	84 (4.0)	36 (4.9)
Russian Federation	– –	– –	– –	– –
Singapore	98 (1.3)	93 (2.5)	r 89 (2.9)	x x
South Africa	96 (1.8)	72 (3.5)	65 (4.0)	r 43 (4.5)
Thailand	86 (3.6)	86 (3.5)	r 51 (4.8)	r 52 (4.3)
Tunisia	s 9 (3.1)	s 1 (0.9)	s 3 (1.8)	s 1 (1.1)
Turkey	97 (1.5)	96 (1.9)	94 (2.1)	95 (1.8)
United States	r 88 (2.2)	r 88 (2.6)	r 76 (3.4)	r 66 (3.9)
International Avg.	90 (0.3)	84 (0.4)	76 (0.6)	58 (0.7)

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

Background data provided by teachers.

* Taught before or during this school year.

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

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

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

A dash (–) indicates data are not available.

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

Exhibit 5.16 Percentages of Students Taught Environmental and Resource Issues Topics*

TIMSS 1999 8th grade Science

	Pollution (acid rain, global warming, ozone layer, water pollution)		Conservation of natural resources (land, water forests, energy sources)		Food supply and production, population, and environmental effects of natural and man-made events	
Australia	r	62 (3.6)	r	45 (3.9)	r	40 (3.6)
Belgium (Flemish)	r	89 (3.3)	r	82 (3.7)	r	63 (4.3)
Bulgaria	s	92 (2.9)	s	89 (3.3)	s	84 (4.0)
Canada	s	92 (1.4)	s	90 (2.2)	s	83 (2.9)
Chile		97 (1.3)		97 (1.3)		90 (2.3)
Chinese Taipei	r	73 (3.5)	r	48 (4.4)	r	41 (4.7)
Cyprus	s	93 (3.2)	s	89 (3.7)	s	50 (5.0)
Czech Republic		92 (2.6)		92 (2.5)		82 (4.1)
England	s	79 (4.5)	s	71 (5.1)	s	71 (4.6)
Finland		78 (3.2)		77 (4.0)		55 (4.2)
Hong Kong, SAR		74 (4.3)	r	54 (5.3)	r	30 (4.7)
Hungary		99 (1.0)		99 (1.0)		89 (2.8)
Indonesia		79 (4.0)		85 (3.0)		79 (3.8)
Iran, Islamic Rep.		39 (4.3)		88 (2.9)		69 (3.8)
Israel	r	44 (4.8)	s	37 (4.5)	r	35 (4.4)
Italy		84 (2.6)		80 (2.8)		70 (3.4)
Japan		26 (3.4)		7 (2.4)		7 (2.4)
Jordan		87 (2.9)		81 (3.6)	r	72 (4.4)
Korea, Rep. of		75 (3.8)		58 (4.5)		49 (4.4)
Latvia (LSS)	r	88 (3.4)	r	87 (3.3)	r	75 (4.4)
Lithuania ‡		– –		– –		– –
Macedonia, Rep. of	r	86 (3.1)	r	89 (2.7)	r	84 (3.5)
Malaysia		82 (3.5)		75 (3.7)		77 (3.9)
Moldova		– –		– –		– –
Morocco		– –		– –		– –
Netherlands		99 (1.0)		98 (1.0)	r	98 (1.1)
New Zealand		60 (3.9)		61 (4.0)	r	40 (4.1)
Philippines		95 (1.9)		97 (1.4)		90 (2.3)
Romania		94 (2.5)		94 (2.3)		96 (2.2)
Russian Federation		– –		– –		– –
Singapore		93 (2.4)	r	86 (3.5)	s	64 (5.0)
South Africa	s	60 (4.2)	s	66 (4.6)	s	59 (4.9)
Thailand		83 (3.4)		92 (2.3)		89 (2.3)
Tunisia	r	37 (4.2)	r	52 (4.7)	r	42 (4.8)
Turkey		87 (3.3)		84 (3.4)		74 (3.5)
United States	r	83 (2.4)	r	79 (2.5)	s	81 (2.9)
International Avg.		78 (0.6)		76 (0.6)		66 (0.7)

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

Background data provided by teachers.

* Taught before or during this school year.

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

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

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

A dash (–) indicates data are not available.

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

Exhibit 5.17 Percentages of Students Taught Scientific Inquiry and the Nature of Science Topics*

TIMSS 1999 8th grade Science

	Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	Experimental design (experimental control, materials, and procedures)	Scientific measurements (reliability, replication, experimental error, accuracy, scales)	Using scientific apparatus and conducting routine experimental operations	Gathering, organizing, and representing data (units, tables, charts, graphs)	Describing and interpreting data
Australia	98 (0.7)	r 95 (1.2)	r 78 (3.5)	98 (1.2)	99 (0.5)	96 (2.0)
Belgium (Flemish)	r 86 (3.8)	r 46 (4.6)	r 64 (4.6)	r 66 (4.9)	r 91 (2.8)	r 90 (3.2)
Bulgaria	x x	x x	x x	x x	x x	x x
Canada	r 99 (0.5)	r 97 (1.7)	s 84 (2.8)	r 99 (0.8)	r 100 (0.2)	r 99 (0.7)
Chile	98 (1.2)	86 (3.1)	r 71 (3.6)	78 (3.2)	93 (2.0)	91 (1.9)
Chinese Taipei	85 (3.2)	71 (4.0)	83 (3.3)	90 (2.7)	68 (4.0)	69 (3.9)
Cyprus	r 100 (0.0)	r 93 (3.0)	r 85 (3.5)	r 93 (2.5)	s 88 (3.0)	r 92 (2.3)
Czech Republic	r 79 (4.4)	r 73 (4.9)	r 81 (4.4)	r 80 (4.8)	r 86 (3.7)	r 81 (4.8)
England	s 96 (1.6)	s 95 (1.9)	s 92 (2.2)	s 98 (0.9)	s 98 (0.8)	s 98 (0.9)
Finland	89 (2.8)	89 (2.5)	82 (2.9)	84 (2.7)	90 (2.6)	92 (2.2)
Hong Kong, SAR	85 (3.4)	68 (4.5)	63 (4.8)	88 (3.1)	81 (3.4)	r 80 (3.3)
Hungary	96 (1.7)	93 (1.9)	80 (3.5)	77 (3.7)	97 (1.7)	99 (0.7)
Indonesia	90 (2.8)	63 (4.1)	67 (4.6)	78 (4.2)	80 (3.8)	71 (4.0)
Iran, Islamic Rep.	r 64 (4.3)	77 (3.5)	r 54 (4.5)	83 (3.3)	r 57 (4.4)	r 60 (4.1)
Israel	r 91 (2.6)	91 (2.7)	r 55 (4.6)	r 84 (3.5)	82 (3.7)	88 (3.0)
Italy	100 (0.0)	94 (1.8)	84 (3.1)	84 (3.2)	95 (1.7)	94 (1.8)
Japan	90 (2.6)	96 (1.8)	77 (3.4)	99 (1.0)	97 (1.6)	95 (1.9)
Jordan	r 58 (4.7)	r 55 (4.8)	r 53 (5.0)	83 (3.2)	r 78 (4.0)	75 (4.2)
Korea, Rep. of	93 (2.1)	89 (2.6)	84 (3.1)	99 (0.7)	92 (2.1)	86 (2.9)
Latvia (LSS)	r 82 (3.8)	r 95 (2.1)	r 61 (5.3)	r 82 (3.9)	r 92 (2.9)	r 91 (2.8)
Lithuania ‡	– –	– –	– –	– –	– –	– –
Macedonia, Rep. of	s 87 (3.9)	x x	x x	x x	s 84 (4.8)	s 85 (4.7)
Malaysia	87 (3.2)	76 (4.2)	68 (4.0)	95 (2.3)	83 (3.3)	83 (3.4)
Moldova	– –	– –	– –	– –	– –	– –
Morocco	– –	– –	– –	– –	– –	– –
Netherlands	92 (3.7)	96 (3.0)	99 (0.7)	100 (0.0)	100 (0.0)	100 (0.0)
New Zealand	99 (0.8)	96 (1.7)	85 (3.3)	97 (1.8)	99 (0.6)	99 (1.0)
Philippines	100 (0.4)	96 (1.7)	87 (2.9)	90 (2.7)	97 (1.4)	98 (1.1)
Romania	r 94 (2.5)	r 92 (3.0)	r 90 (3.0)	r 94 (2.3)	r 95 (2.2)	r 96 (2.1)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	94 (2.2)	r 93 (2.6)	r 91 (3.0)	97 (1.7)	95 (2.1)	96 (1.9)
South Africa	r 66 (4.1)	r 65 (4.1)	r 53 (4.8)	r 73 (4.2)	r 68 (4.8)	r 69 (3.9)
Thailand	90 (2.2)	89 (2.4)	76 (4.0)	93 (2.0)	87 (3.1)	82 (3.2)
Tunisia	r 85 (3.4)	r 84 (3.5)	r 47 (5.2)	r 73 (4.1)	r 70 (3.8)	79 (3.7)
Turkey	r 58 (4.3)	r 76 (3.4)	r 55 (4.0)	r 65 (4.4)	r 67 (4.6)	r 59 (4.7)
United States	r 99 (0.6)	r 97 (1.2)	r 89 (2.5)	r 95 (1.4)	r 97 (1.4)	r 98 (1.1)
International Avg.	88 (0.5)	84 (0.6)	75 (0.7)	87 (0.5)	87 (0.5)	87 (0.5)

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

Background data provided by teachers.

* Taught before or during this school year.

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

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

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

A dash (–) indicates data are not available.

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

Can Meaningful Comparisons Between Intended and Implemented Curricula Be Made?

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

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