CHAPTER 5

The Science Curriculum

The first part of Chapter 5 presents information about the curricular goals in the TIMSS 1999 countries and Benchmarking states, districts, and consortia. The ways in which the curriculum is supported and monitored within each entity, and the relationship between the curriculum and system-wide testing, are examined. The second part of the chapter contains teachers' reports about the science topics actually studied in their classrooms.

Science Subjects Offered Up To and Including Eighth Grade

The most striking difference among science curricula of the

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

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 Lithuania and Slovenia: 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.

	Separate Science Courses Offered	Science Subjects and Grades Taught
States		
Connecticut	Yes	Varies throughout the state
Idaho	No	General/integrated science course
Illinois	No	General/integrated science course
Indiana	No	General/integrated science course
Maryland	No	General/integrated science course
Massachusetts	No	General/integrated science course
Michigan	–	–
Missouri	Yes	Different schools teach earth science, life science, and physical science in middle school
North Carolina	No	There are not separate courses but each grade level has specific science areas that are emphasized
Oregon	Yes	Many districts offer science as separate subjects (e.g. life science, physical science, and earth science)
Pennsylvania	Varies	Districts have the ability to decide the structure of their science instruction
South Carolina	No	Integrated science course (K-8); science content in life science, earth science, and physical science will be integrated in grades 6-8 beginning 2000
Texas	No	General/integrated science course (K-8)
Districts and Consortia		
Academy School Dist. #20, CO	Yes	General/integrated science course (K-5), earth science or integrated science (6), life science (7), physical science (8)
Chicago Public Schools, IL	Varies	Schools have the ability to decide the structure of their science instruction as long as it meets the achievement standards set by the school district
Delaware Science Coalition, DE	Varies	Currently in grades K-5, curriculum units are available to cover required topics in physical science, earth science, life science, and ecology each year; at grades 6-8, a similar set of units is being piloted for eventual adoption
First in the World Consort., IL	No	General/integrated science course (K-8)
Fremont/Lincoln/WestSide PS, NE	No	General/integrated science course (K-8)
Guilford County, NC	No	There are not separate courses but each grade level has specific science areas that are emphasized
Jersey City Public Schools, NJ	Yes	Different science courses are offered in middle school: earth science (6); physical science (7); life science (8)
Miami-Dade County PS, FL	Yes	Comprehensive science, regular and advanced (6-8); earth/space science and biology honors courses (accelerator courses for 7-8)
Michigan Invitational Group, MI	No	General/integrated science course (K-8)
Montgomery County, MD	No	General/integrated science course (K-8)
Naperville Sch. Dist. #203, IL	No	General science course (K-8) with emphasis on earth science, life science, and physical science
Project SMART Consortium, OH	No	General/integrated science course (K-8)
Rochester City Sch. Dist., NY	Yes	Integrated physical science, life science, and earth science (K-6), life science (7), physical science (8)
SW Math/Sci. Collaborative, PA	Varies	Districts have the ability to decide the structure of their science instruction

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

Background data provided by coordinators from participating jurisdictions.

A dash (–) indicates data are not available.

Standards (NSES), both of which define standards for the teaching and learning of science that many state and local educational systems have used to fashion their own curricula.[3] All but four states now have standards in science.[4]

In all 13 states that participated in TIMSS 1999 Benchmarking, curriculum frameworks or content standards in science were published between 1996 and 2000 (see Exhibit 5.3). Four states detailed the standards for every grade including the eighth grade, seven states detailed them by a cluster or pair of grades that included the eighth grade, and two states reported the eighth grade as a benchmark grade at which certain standards should be met. Most states provided standards documents to guide districts and schools in developing their own curriculum, while some states, such as North Carolina, developed a statewide curriculum for all schools to use.

Exhibit 5.4 presents information about the curriculum of participating districts and consortia. Of the eight districts that participated, one reported that it used the statewide curriculum in all schools (Guilford County); five had a district-wide curriculum that supported the state-developed frameworks or standards (the Jersey City Public Schools, the Miami-Dade County Public Schools, Montgomery County, the Naperville School District, and the Rochester City School District); and two had a curriculum developed at the school level (the Academy School District and the Chicago Public Schools), with Chicago also offering an optional structured curriculum district-wide. Each participating consortium indicated that all or most of its districts developed their own curriculum at the district level.

3 Smith, T.A., Martin, M.O., Mullis, I.V.S., and Kelly, D.L. (2000), *Profiles of Student Achievement in Science at the TIMSS International Benchmarks: U.S. Performance and Standards in an International Context*, Chestnut Hill, MA: Boston College.

4 *Key State Education Policies on K-12 Education: 2000* (2000), Washington, DC: Council of Chief State School Officers.

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

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).

Exhibit 5.3 States' Curriculum Frameworks/Content Standards

8th Grade Science

	Curriculum Framework/Content Standards and Year[1]	Grades Detailed in Framework/Standards
Connecticut	Connecticut's K-12 Science Curriculum Framework (1998)	Grade clusters: K-4, 5-8, 9-12
Idaho	Skills-Based Scope and Sequence Guides K-6 (1996); Achievement Standards K-8 (In draft); Achievement Standards 9-12 (1999)	Every grade: K-6 Grade clusters: 7-8, 9-12
Illinois	Illinois Learning Standards for Science (1997)	Grade clusters: Early Elementary School, Late Elementary School, Middle/Junior High School, Early High School, Late High School
Indiana	Indiana Science Proficiency Guide (1997); revised Indiana's Academic Standards for Science (2000)	Grade clusters: K-2, 3-5, 6-8, 9-12 (1997 version); Every grade: K-8, individual courses in high school (2000 version)
Maryland	Learning Outcomes (1990); Content Standards for Science (2000)	Grade clusters: K-3, 4-5, 6-8, 9-12
Massachusetts	Massachusetts Science & Technology Curriculum Frameworks (1996; under revision)	Grade clusters: pK-4, 5-8, 9-10, 11-12
Michigan	Michigan Essential Goals and Objectives for Science Education (1991); Michigan Curriculum Frameworks: Content Standards and Benchmarks (1996)	Grade clusters: Elementary School, Middle School, High School
Missouri	Frameworks for Curriculum Development in Science (1996)	Grade clusters: K-2, 3-4, 5-8, 9-12
North Carolina	North Carolina Standard Course of Study (1994; revised 2000-01)	Every grade: K-8, individual courses in high school
Oregon	Oregon Science Content Standards (1996, 1998)	Benchmark grades: 3, 5, 8, 10, 12
Pennsylvania	Academic Standards for Science and Technology (2000)	Benchmark grades: 4, 7, 10, 12
South Carolina	South Carolina Science Curriculum Standards (2000)	Every grade: K-8; Grade clusters: 9-12
Texas	Texas Essential Knowledge and Skills (1998)	Every grade: K-8, individual courses in high school

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

Background data provided by coordinators from participating jurisdictions.

[1] Indicates year(s) in which curriculum frameworks/content standards were instituted.

	Level of Curriculum Development
Academy School Dist. #20, CO	Curriculum is developed at the school level. Curriculum is currently in revision to reflect state standards.
Chicago Public Schools, IL	Curriculum is developed at the school level. The district writes standards statements which are aligned with state standards; schools translate these into a curriculum. The district also offers an optional structured curriculum.
Delaware Science Coalition, DE	Districts share a common curriculum in grades K-5 based on NSF-funded modules. In middle school, schools use NSF-funded units (FOSS, BCSC, STC, etc.) or units developed through the local systemic change program. The high school curriculum is mainly textbook driven with some NSF-funded modules and units developed by teachers with university faculty.
First in the World Consort., IL	Most districts within the Consortium have district-wide objectives and/or a curriculum based on state standards.
Fremont/Lincoln/ WestSide PS, NE	Each district has locally-developed standards and a curriculum based on state standards.
Guilford County, NC	The district uses the state-developed curriculum, the North Carolina Standard Course of Study.
Jersey City Public Schools, NJ	The science curriculum (pK-12) is developed by the district and is aligned with the New Jersey Core Curriculum Content Standards.
Miami-Dade County PS, FL	The district has developed a science curriculum, Competency-Based Curriculum (CBC), which is correlated to the Florida Sunshine State Standards for Science and the National Science Education Standards. Most recently, the state has developed Grade Level Expectations (GLEs) that further define what a student should know and be able to do at specific grade levels. The district is currently making revisions to the CBC to reflect the GLEs.
Michigan Invitational Group, MI	Most districts have district-wide curriculum guides aligned to the state standards.
Montgomery County, MD	The district develops curriculum based on state standards.
Naperville Sch. Dist. #203, IL	The district develops curriculum based on state standards.
Project SMART Consortium, OH	Each district in the consortium has a separate curriculum.
Rochester City Sch. Dist., NY	The district develops curriculum based on state standards.
SW Math/Sci. Collaborative, PA	Each district in the collaborative has a separate curriculum. District-level curriculum is not necessarily based on the state standards.

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

Background data provided by coordinators from participating jurisdictions.

How Do Education Systems Support and Monitor Curriculum Implementation?

During the past decade, content-driven systemic school reform has emerged as a promising model for school improvement.[5] That is, curriculum frameworks establishing what students should know and be able to do provide a coherent direction for improving the quality of instruction. Teacher preparation, instructional materials, and other aspects of the system are then aligned to reflect the content of the frameworks in an integrated way to reinforce and sustain high-quality teaching and learning in schools and classrooms.

Education systems use different ways to achieve this desired connection between the intended and the implemented curriculum. The methods used by the TIMSS 1999 countries to monitor curriculum implementation are shown in Exhibit 5.5, and by states, districts, and consortia in Exhibits 5.6 through 5.8. 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 of the intended curriculum by means of school inspection or audit.

Of the methods for supporting and monitoring curriculum implementation shown in Exhibit 5.5, 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 reported by 24 of the 38 countries. Nearly all countries (33) used in-service teacher education, and most countries (31) used mandated or recommended textbooks. Ministry notes and directives were used in 29 countries, and a system of school inspection or audit was used in 31 countries.

States, districts, and consortia provided data on policies related to textbook selection, pedagogical guides, and accreditation. As shown in Exhibit 5.6, seven of the Benchmarking states reported that they do not select textbooks for use at the local level. The other six states issue a list of books from which districts can choose. Almost all districts and consortia reported that their state does not select textbooks, while three reported state involvement in textbook selection. Ten jurisdictions indicated that textbooks were chosen or recommended at the

	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
United States [1]	+	+	+	+	+	+
Australia [2]	●	●		●	●	
Belgium (Flemish)	●	●		●	●	●
Bulgaria	●	●	●		●	●
Canada [3]	●	●	●	●	●	
Chile			●		●	
Chinese Taipei	●	●	●	●		●
Cyprus		●	●		●	●
Czech Republic	●		●		●	●
England	●	●				●
Finland	●	●	●	●		
Hong Kong, SAR			●	●		●
Hungary	●	●	●	●	●	
Indonesia		●	●	●	●	●
Iran, Islamic Rep.	●	●	●	●	●	●
Israel	●	●	●	●	●	●
Italy		●		●	●	●
Japan		●	●	●	●	●
Jordan		●	●	●	●	●
Korea, Rep. of	●	●	●	●	●	●
Latvia (LSS)	●	●	●	●	●	●
Lithuania		●	●		●	
Macedonia, Rep. of	●	●	●	●		●
Malaysia	●	●	●	●	●	●
Moldova		●	●		●	●
Morocco	●	●	●	●	●	●
Netherlands	●	●		●	●	●
New Zealand	●	●				●
Philippines		●	●	●	●	●
Romania	●	●	●	●	●	●
Russian Federation	●	●	●	●	●	●
Singapore	●	●	●	●	●	●
Slovak Republic	●		●		●	●
Slovenia	●	●	●	●		●
South Africa		●	●			●
Thailand	●	●	●	●	●	●
Tunisia		●	●	●	●	●
Turkey		●	●		●	●

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

Background data provided by National Research Coordinators.

* Other than system-wide assessments and public examinations described in Exhibits 5.9 and 5.10, respectively.

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

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

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

	Policy on Textbooks and Instructional Materials
States	
Connecticut	The state does not select textbooks.
Idaho	The state approves a list of textbooks and materials from which districts/schools must choose. The textbooks selection criteria include alignment with Idaho Skills-Based Scope and Sequence Guide and Achievement Standards, which specify skills that all students should know at different levels. Schools are required to select all their basic instructional materials from the Idaho Adoption Guide produced by the adoption committee. Schools not choosing from the adoption list can lose accreditation points.
Illinois	The state does not select textbooks.
Indiana	The state recommends a list of textbooks from which districts/schools must choose; however, waivers are granted. The state texts are not necessarily based on the state standards. The state intends to align textbook selections with Indiana's new Academic Standards (2000).
Maryland	The state does not select textbooks.
Massachusetts	The state does not select textbooks.
Michigan	The state does not select textbooks.
Missouri	The state does not select textbooks.
North Carolina	The state recommends textbooks and instructional materials; there is a fee arrangement between the state and the vendor that the districts are able to use.
Oregon	The state selects a list of textbooks and materials from which districts can choose. Districts may submit a waiver for an independent adoption to select textbooks and instructional materials of their own choice. These district-level adoptions must meet the state selection criteria.
Pennsylvania	The state does not select textbooks.
South Carolina	The state selects a list of textbooks and materials from which districts can choose. The state funds the instructional materials that are selected from the state approved list.
Texas	State Textbook Review Committee selects textbooks and instructional materials according to the state curriculum framework. Districts choose textbooks and/or instructional materials using local criteria. The state funds the purchase of textbooks and/or instructional materials that are on the selected list. Districts may waiver, at own expense, from selected textbooks or instructional materials.

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

Background data provided by coordinators from participating jurisdictions.

	Policy on Textbooks and Instructional Materials
Districts and Consortia	
Academy School Dist. #20, CO	STATE: The state does not select textbooks. LOCAL: Schools can select materials based on guidelines with acceptance by the Board of Education.
Chicago Public Schools, IL	STATE: The state does not select textbooks. LOCAL: Schools in districts choose instructional materials.
Delaware Science Coalition, DE	STATE: The state does not select textbooks. LOCAL: Textbook selection is usually made at the school level.
First in the World Consort., IL	STATE: The state does not select textbooks. LOCAL: Textbooks and materials are selected and recommended at the district level. Consortium is reviewing materials to recommend as well. As of 1999/2000, the Consortium is looking to Project 2061/AAAS and NSF for guidance in textbook selection. Selection includes a committee reviewing materials against AAAS benchmarks, choosing materials, and submitting their recommendation for approval by the school board.
Fremont/Lincoln/ WestSide PS, NE	STATE: The state does not select textbooks. LOCAL: Districts select textbooks/textbook series and schools select supplemental materials.
Guilford County, NC	STATE: The state selects a list of textbooks and materials based on the state content standards from which districts can choose. LOCAL: One textbook used throughout county. A system-wide committee reviews the state selected list and one textbook per grade level is selected to be used system-wide.
Jersey City Public Schools, NJ	STATE: The state does not select textbooks. LOCAL: A committee is formed at the district level to facilitate the selection of science textbooks and materials. There is a "standard operating procedure" for the formulation of the committee so as to include all constituent groups. All selected textbooks and materials are aligned with the district's science curriculum and the NJ Core Curriculum Content Standards in Science.
Miami-Dade County PS, FL	STATE: The state recommends the texts and instructional materials. LOCAL: The district selection committee narrows the selection to two or three texts. The schools pick one of the selected textbooks. The new legislation makes waivers for using non-adopted texts more difficult, but schools are allotted some money to spend on non-state adopted materials with review at the district level.
Michigan Invitational Group, MI	STATE: The state does not select textbooks. LOCAL: Textbook selection is made at the school level. Selection of textbooks is based on curriculum.
Montgomery County, MD	STATE: The state does not select textbooks. LOCAL: The district recommends a few textbooks. Evaluation and approval of texts to support specific courses is done by a committee headed by the science supervisor.
Naperville Sch. Dist. #203, IL	STATE: The state does not select textbooks. LOCAL: District uses criteria based on the learning outcomes to select instructional materials. No one textbook selected.
Project SMART Consortium, OH	STATE: The state does not select textbooks, but approves a liberal textbook list from which districts can choose. LOCAL: A teacher review committee selects several texts and the teacher community involved usually votes or is given an opportunity to express their choice.
Rochester City Sch. Dist., NY	STATE: The state does not select textbooks. LOCAL: A committee conformed by parents, teachers, building administrators and staff from central office selects textbooks.
SW Math/Sci. Collaborative, PA	STATE: The state does not select textbooks. LOCAL: Each district selects instructional materials. Over forty districts are part of a local initiative which supports use of exemplary modules at the elementary level. At the middle school level, the Collaborative has engaged over 14 districts in selecting materials through a showcase-pilot adoption process.

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

	Pedagogical Guides
States	
Connecticut	Some pedagogical information is included with the state science framework.
Idaho	Pedagogical guides are not available at the state level.
Illinois	Performance descriptors have been completed (in draft form) to guide educators in implementing the standards. Classroom assessment tasks and student work exemplars will be available Summer 2001.
Indiana	The "Indiana Science Proficiency Guide" (1997) contains grade cluster ideas for activities. New Curriculum Frameworks are being written to support Indiana's new grade-specific Academic Standards (2000).
Maryland	Pedagogical guidance is not available at the state level.
Massachusetts	The curriculum frameworks provide appropriate teaching activities for each learning standard.
Michigan	Toolkits are designed to support the implementation of the curriculum frameworks including kits on planning subject area instructional units, curriculum integration, designing classroom assessments, and connecting with the learner. "The Science Education Guidebook" was developed specifically to assist in teaching the science frameworks.
Missouri	The Curriculum Frameworks provide appropriate teaching activities by discipline providing examples of how "Show-Me Standards" may be taught and assessed.
North Carolina	The development of a curriculum enhancement guide is in process.
Oregon	"Teaching and Learning to Standards" supports the Oregon content standards and provides best practices, example lessons, vignettes, scored student work, teaching resources, and common curriculum goals. A curriculum framework will be complete in January 2001.
Pennsylvania	Pedagogical guides are not available at the state level.
South Carolina	An implementation guide (2000) contains sample lesson plans, sample assessments, resources for teachers, and information for administrators on what to look for in exemplary science instruction. Content briefs are being developed to help teachers with implementation of the standards.
Texas	Under the direction of the Texas Education Agency, the Texas Science Center for Educator Development has produced different pedagogical guides: "TEXTEAMS" (modules for curriculum and instructional reform), "TEKSplorations Guides" for each grade and high school courses, "TEKS for Leaders" (materials and training for science reform), "Safety Handbook" (supports implementation of TEKS hands-on science in laboratory and field curriculum), "Curriculum Charts: K-12"; as well as a website and CD ROM: the "Science Teacher Toolkit" that includes support on many aspects of science teaching.

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

Background data provided by coordinators from participating jurisdictions.

	Pedagogical Guides
Districts and Consortia	
Academy School Dist. #20, CO	No specific "how-to" instructional manuals are provided. The state has provided grade-appropriate sample assessments as well as released items and samples of scored student work which the district has expanded upon.
Chicago Public Schools, IL	The optional structured curriculum provides daily lesson plans at all grade levels. For high schools, test blueprints of the "Chicago Academic Standards Exam" (CASE) are provided to teachers for instructional purposes.
Delaware Science Coalition, DE	The "Delaware Performance Indicators for Curriculum Planning and Development" is a pedagogical guide for teachers. It defines expected performance in science but does not specify performance levels. All Performance Indicators are specifically limited to content standards and are included in the guide. Some districts have developed their own Performance Indicators, but most have adopted state Performance Indicators.
First in the World Consort., IL	There is no specific guide developed by the consortium. AAAS/Project 2061 provides professional development on content and instruction and evaluating materials for alignment to the Project 2061 benchmarks of science literacy.
Fremont/Lincoln/ WestSide PS, NE	Districts have curriculum-based instructional activities and commercially-developed materials.
Guilford County, NC	There is a locally-written book, Strategies for Instruction, detailing best practices, lessons, assessments, and teaching methods based on the North Carolina Course of Study.
Jersey City Public Schools, NJ	The "New Jersey Framework for Teaching in Science" published in May 1996, discusses essential components of a quality K-12 science program. The framework is not a curriculum, but a comprehensive digest of activities, curriculum connections, and instructional strategies related to the NJ Core Curriculum Content Standards in Science. In addition to the state standards and the state frameworks, the district's curriculum guides provide content guidelines based on grade-level competencies. In the district curriculum materials, hands-on learning kits, resources, and learning activities are provided at each grade level.
Miami-Dade County PS, FL	The Florida Curriculum Frameworks include the content knowledge and process skills for science that students should acquire, strategies to address various learning needs and styles, guidelines for effective assessment, professional development information, and sample evaluation criteria for school and district programs. The state recently has developed a CD-ROM entitled "Science Best Practices". The district produced a "Middle School Science Guide for Teachers" and "Elementary Science Guide for Teachers" that give specific information about the content and effective strategies that should be implemented. Most recently, the "Science Department Chairperson Handbook" was distributed that includes important information about curriculum, science inquiry, and technology use in the classroom.
Michigan Invitational Group, MI	Toolkits are designed by the state to support the implementation of the curriculum frameworks including kits on planning subject area instructional units, curriculum integration, designing classroom assessments, and connecting with the learner. The "Science Education Guidebook" was developed specifically to assist in teaching the science frameworks.
Montgomery County, MD	"Better Science" (1991), produced at the state level, provides pedagogical information and the "Outcomes Clarification Document" (1996) provides concept and process information. A website has been developed to provide the latest in best practices and exemplars. Local-level guides are adopted from commercial vendors. In addition, high school guides are developed locally.
Naperville Sch. Dist. #203, IL	The state provides goals, standards, and sample test items. Locally, the district develops K-5 detailed lessons and outcomes; grades 6-8 outcomes are connected to resources.
Project SMART Consortium, OH	There are not pedagogical guides at the state level. As soon as the state "Draft Content Science Standards" are approved by the Ohio State Board of Education (early 2001) plans are underway to provide pedagogical guides to locals. Ohio is a local-control state and thus many locals have developed various types of science guides.
Rochester City Sch. Dist., NY	New York State provides core curriculum guides based on the standards at all grade levels. Locally, the district develops K-12 curriculum guides based on standards.
SW Math/Sci. Collaborative, PA	Informal support is available connecting districts to exemplary materials, research findings, and best practices.

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

	Use of Accreditation
States	
Connecticut	No accreditation system.
Idaho	Accreditation requires that curriculum developed at the local level be aligned with state standards. Schools must establish educational standards for all grade levels and develop high school exiting standards for graduation; these standards must be aligned with exiting standards established by the State Board of Education. It also requires that schools participate in state testing and adhere to text adoption policies.
Illinois	Quality Review Teams of the State Board of Education conduct periodic quality-assurance site visits to schools.
Indiana	The accreditation system requires K-8 schools to self-report alignment of curriculum with state standards (proficiencies); grade 9-12 schools submit a master schedule and course descriptions to verify compliance with state standards. Performance on the ISTEP+ is also considered in accreditation. Technical assistance is available to schools that do not meet the accreditation standards.
Maryland	No accreditation system.
Massachusetts	No accreditation system.
Michigan	Accreditation is based in part on student performance on state assessments. The system is being revised to include successful achievement as well as continuous improvement.
Missouri	The Missouri School Improvement Program, designed to accredit districts, assesses districts progress on the Show-Me Standards as measured by the Missouri Assessment Program. There are "success teams" that help districts improve student achievement in all subject areas.
North Carolina	No accreditation system.
Oregon	All schools are state accredited through a system of "standard" assurances, Consolidated District and School Improvement Plans, Annual Performance Reports and Schools Reviews. State accreditation is based on the Oregon Performance Accountability System (OPAS), that assesses school science performance. Any school falling in the low or unacceptable category receives targeted assistance including alignment with standards, instructional improvement and professional development.
Pennsylvania	No accreditation system.
South Carolina	The accreditation system is in revision. Schools must meet a battery of standards in the current accreditation system, but student academic performance is not included. The new accreditation system will include student academic performance and will go into effect in 2001.
Texas	Although not considered an accreditation system, there is an accountability system in place. The state's accountability system includes a variety of on-site evaluations designed to provide feedback for improvement.

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

Background data provided by coordinators from participating jurisdictions.

	Use of Accreditation
Districts and Consortia	
Academy School Dist. #20, CO	The state will be implementing an accreditation system beginning in Fall 2001 based primarily on the success and/or progress on the standards-referenced state assessment (CSAP).
Chicago Public Schools, IL	No accreditation system.
Delaware Science Coalition, DE	No accreditation system.
First in the World Consort., IL	No accreditation system.
Fremont/Lincoln/ WestSide PS, NE	No accreditation system.
Guilford County, NC	No accreditation system.
Jersey City Public Schools, NJ	No accreditation system.
Miami-Dade County PS, FL	No accreditation system.
Michigan Invitational Group, MI	State-level accreditation is based in part on student performance on state assessments. The system is being revised to include successful achievement as well as continuous improvement.
Montgomery County, MD	No accreditation system.
Naperville Sch. Dist. #203, IL	No accreditation system.
Project SMART Consortium, OH	No accreditation system.
Rochester City Sch. Dist., NY	No accreditation system.
SW Math/Sci. Collaborative, PA	No accreditation system.

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

Exhibit 5.9 Countries' System-Wide Assessments in Science

8th Grade Science

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

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.

Exhibit 5.10 Countries' Public Examinations in Science

8th Grade Science

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

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

Background data provided by National Research Coordinators.

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

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

Benchmarking states also reported a range of consequences at the district or school level. For example, Massachusetts reported that additional funding was made available to low-performing schools and districts to support remediation. In Oregon and South Carolina, districts were required to provide remediation to students with low scores on the state assessments. States had the right to take over schools or districts in Maryland and Massachusetts. While consequences of assessments for schools or districts usually involved remediation activities or sanctions, Maryland also provided monetary rewards to schools that showed improvement. In Massachusetts, schools receiving recognition were eligible for an Exemplary Schools Program.

As shown in Exhibit 5.14, 10 of the 14 Benchmarking districts and consortia participated in the science assessments administered by their state. Of these, the Michigan Invitational Group and Montgomery County were in states that were revising their science assessments to align more closely with their current standards. Ohio's Project SMART Consortium was in a state administering proficiency tests that were not standards-based assessments. Miami-Dade, Rochester, and the Southwest Pennsylvania Math and Science Collaborative were developing science assessments for 2003, 2001, and 2001, respectively. The Fremont/Lincoln/Westside Public Schools and Guilford County reported having no statewide science assessments at the eighth grade.

			1996	2000
Connecticut	Connecticut Academic Performance Test (CAPT): In revision - Grade 10	None	Yes	Yes
Idaho	In discussion	ITBS: Grades 3-8 TAP: Grades 9-11	No	Yes
Illinois	Illinois Goal Assessment Program (IGAP): Grades 4, 7, 11 (1988-99)			

	Status of State-Developed Science Assessment
Connecticut	The Connecticut Academic Performance Test (CAPT), first administered in 1995, was developed to be aligned with the 1987 Common Core of Learning. It is now being revised for 2000-01 based on Connecticut's 1998 K-12 Science Curriculum Framework.
Idaho	The development of state-wide science assessments is in discussion.
Illinois	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the 1997 Illinois Learning Standards.
Indiana	A state science assessment is in development for implementation in 2002. Currently, there is no mandatory state science assessment. Voluntary state science assessments of high schools courses (Core 40 assessments) are available.
Maryland	The Maryland School Performance Assessment Program (MSPAP) assesses students at grades 3, 5, and 8. Currently, the MSPAP is based on the 1990 Learning Outcomes. By 2003, the MSPAP will be revised to assess the 2000 standards. The High School Assessment, in development, is proposed as an end-of-course test which will be part of the graduation requirement. Unlike the Maryland Functional Assessment that is currently required for high school graduation, the new High School Assessment will have a science component.
Massachusetts	Massachusetts Comprehensive Assessment System (MCAS) was first administered in 1998 to grades 4, 8, and 10. Integrated science assessments for grades 5 and 8 and discipline-specific assessments for secondary grades are in development and will be included from 2002. The Science & Technology MCAS was developed to assess the 1996 Curriculum Frameworks which are currently in revision.
Michigan	The Michigan Educational Assessment Program (MEAP) will introduce revised science tests at grades 5, 8, and 11 in 2002. Each of these tests are based on the Michigan Curriculum Frameworks science standards.
Missouri	The Missouri Assessment Program (MAP) has been developed for science in grades 3, 7, and 10. This assessment is currently in revision. Each test includes multiple-choice, short constructed-response, and performance-event items. The test consist of three sessions. The first two sessions include items designed to assess the Show-Me Standards (1996) which are directly related to the curriculum frameworks. Items that match the Show-Me Standards from the norm-referenced Terra Nova are administered in the third session.
North Carolina	There are no state-level science assessments in grades K-8. The four end-of-course science assessments (physical science, biology, chemistry and physics) are being revised in accordance with the new curriculum for the 2001-2002 administration.
Oregon	The Oregon Statewide Assessment System includes a multiple-choice state test in science at grades 5, 8, and 10. Classroom work samples are required as local assessment in science for grades 3-12. All assessments are based on the content standards and are revised annually.
Pennsylvania	Science assessments are in development with field testing scheduled for Spring 2001.
South Carolina	The Palmetto Achievement Challenge Test (PACT) is being developed to be aligned with the 2000 science standards. The grades 3-8 assessments will be implemented in 2002 and the grade 10 exit-level assessment will be implemented in 2004. The PACT will replace the Basic Skills Assessment Program (BSAP) given at grades 3, 6, and 8. Additionally, a biology end-of-course assessment will be implemented in 2004.
Texas	The Texas Assessment of Academic Skills (TAAS) was recently revised to more specifically assess the current standards for the 2000 administration. TAAS is administered in science at grade 8 and the TAAS end-of-course biology exam is administered in high school. As a prerequisite to receiving a high school diploma, students must demonstrate satisfactory performance on either the biology or the U.S. History end-of-course examination. Beginning in 2003, science will be tested at grades 5, 10, and 11. Students will be required to pass the grade 11 examination for graduation.

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

Background data provided by coordinators from participating jurisdictions.

	Assessment	Graduation Requirement	Other Consequences
North Carolina	NC Testing Program	No	STUDENT: For biology, the student's score on the biology test must be included as 25% of student's final grade for the course.
Oregon	Oregon State-wide Assessment System	No	STUDENT: Students who meet the performance standard on the state-level and local standards-based assessments receive Certificates of Initial Mastery in each area in which the standard is met. Students who do not meet the 10th grade science performance standard have an opportunity to take the test again. Low-performing students receive additional support and individual instruction to help them meet the standards. These students can change schools if instruction at one school is not meeting their needs. Districts may use the results of the tests to determine student promotion. DISTRICT/SCHOOL: Test results are part of the accountability system. Districts must meet set goals for the assessments to avoid possible sanctions.
Pennsylvania	In development	–	–
South Carolina	Palmetto Achievement Challenge Tests (PACT)	Beginning in 2004, students will have to pass a standards-based exam to graduate.	STUDENT: Promotion policy considers students' performances on the state assessments as of 2002. DISTRICT/SCHOOL: Schools will be rated based on student performance and improvement. Accreditation of schools will take into account student performance. Districts are required to provide remediation to low-performing students.
Texas	Texas Assessment of Academic Skills (TAAS)	No	STUDENT: No consequences. DISTRICT/SCHOOL: No consequences.

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

		Local
Academy School Dist. #20, CO	Colorado State Assessment Program (CSAP) administered in science at grade 8.	In addition to the CSAP, students take ITBS (grade 7), and ITED (grade 10). District-developed performance assessment units are optional.
Chicago Public Schools, IL	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the Illinois Learning Standards.	Chicago Academic Standards Exam was developed to assess the district framework and is being piloted 1999-2000. Students are assessed in science in grades 9 and 10 with end-of-course exams (Biology, Physics, Chemistry, Earth and Space Science, Environmental Science). Chicago uses the norm-referenced TAP (9-11). Also, ACT's PLAN nationally-normed tests are administered at grade 11.
Delaware Science Coalition, DE	The Delaware Student Testing Program (DSTP) first administered in science at grades 8 and 11 (Spring 2000) and at grades 4 and 6 (Fall 2000).	There are no district-wide assessments based on the standards.

	Science Assessments	
	State	**Local**
Miami-Dade County PS, FL	The state criterion-referenced science assessment is in development (2003 administration).	The SAT-9 Science test is administered to students in grades 5, 7, and 9. The EXPLORE, which has mathematics and science assessments, is administered to all grade 8 students. District-level curriculum-based science assessments will be developed and implemented by 2001-02.
Michigan Invitational Group, MI	The Michigan Educational Assessment Program (MEAP) will introduce revised science tests at grades 5, 8, and 11 in 2002. Each of these tests are based on the Michigan Curriculum Frameworks science standards.	A variety of tests are used by local districts.
Montgomery County, MD	The Maryland School Performance Assessment Program (MSPAP) assesses students at grades 3, 5, and 8. Currently, the MSPAP is based on the 1990 Learning Outcomes. By 2003, the MSPAP will be revised to assess the 2000 standards. The High School Assessment is in development. It is proposed as an end-of-course test which will be part of the graduation requirement.	No formal local-level assessments for elementary or middle school in science. There are county-wide high school exams required for each high school science course.
Naperville Sch. Dist. #203, IL	Starting in 2000, the Illinois Standard Achievement Test (ISAT), administered at grades 4 and 7, replaced the Illinois Goal Assessment Program (IGAP) which was administered from 1988-1999 at grades 4, 7, and 11. Beginning in 2001, the state will give new high school tests, the Prairie State Achievement Examination (PSAE), based on the Illinois Learning Standards. Schools could be placed on academic warning based on state test results. State NAEP is also administered at the 4th grade.	There are force choice and performance local science assessments at grades 2, 5, 6, 7, and 8. The science assessments are currently under revision.
Project SMART Consortium, OH	Proficiency assessments in science are administered at grades 4, 6, 9, and 12. As of 2000/01, students must pass the 9th grade assessment to graduate. A high school graduation exam is in development and will be required for the Class of 2005.	Districts have their own assessments in addition to state assessments. District assessments are given at grades 1-3, 5, and 7 to assess student progress. These are both standardized and district-developed assessments.
Rochester City Sch. Dist., NY	The state science test for grade 4 has been in place since 1989. The state science test for grade 8 starts in Spring 2001. The class entering grade 9 in 2001 will be the first class required to pass Regents exams (with a grade of 65% or higher) in all subject areas, including science. Beginning in June 2001, New York will assess students using new state-developed final exams for biology and earth science. Chemistry and physics will follow in later years. Exams are based on new state standards. New York is currently phasing out high school competency exams; instead, students will be required to pass at least one Regents exam. New York State has developed a school accountability system that will be phased in by 2003. School districts must provide academic intervention services to students who score below the state designated performance level on state assessments and/or students at risk of not achieving the state learning standards.	There are district-wide mid-terms and final exams for courses not ending in a Regents exam for grades 6 through 12.
SW Math/Sci. Collaborative, PA	The science assessment is in development with field testing scheduled for Spring 2001.	Each of the 118 districts has its own assessment system in addition to the state assessments. Forty of the districts have worked together to develop classroom-based assessment tools for the STC modules at the elementary level.

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

	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
Countries					
United States [1]	Yes	Yes	No	No	1
Belgium (Flemish)	Yes	No	No	Yes	2
Canada	Yes	Yes	No	No	1
Chinese Taipei	Yes	Yes	No	No	1
Czech Republic [2]	Yes	Yes	Yes	No	2
England [3]	Yes	No	Yes	No	9
Hong Kong, SAR	Yes	Yes	No	No	1
Italy	No				
Japan	No				
Korea, Rep. of	No				
Netherlands	Yes	No	No	Yes	4
Russian Federation	Yes	Yes	No	No	1
Singapore	Yes	No	No	Yes	3
States					
Connecticut	Yes	Yes	No	No	1
Idaho	Yes	Yes	No	No	1
Illinois	Yes	Yes	No	No	1
Indiana	Yes	Yes	No	No	1
Maryland	Yes	Yes	No	No	1
Massachusetts	Yes	Yes	No	No	1
Michigan	Yes	Yes	No	No	1
Missouri	Yes	Yes	No	No	1
North Carolina	Yes	Yes	No	No	1
Oregon	Yes	Yes	No	No	1
Pennsylvania [4]	–	–	–	–	–
South Carolina	Yes	Yes	No	No	1
Texas	Yes	Yes	No	No	1
Districts and Consortia					
Academy School Dist. #20, CO	Yes	Yes	No	No	1
Chicago Public Schools, IL	Yes	Yes	No	No	1
Delaware Science Coalition, DE	Yes	Yes	No	No	1
First in the World Consort., IL	Yes	No	Yes	No	3
Fremont/Lincoln/WestSide PS, NE	Yes	Yes	No	No	1
Guilford County, NC	Yes	Yes	No	No	1
Jersey City Public Schools, NJ	Yes	Yes	No	No	1
Miami-Dade County PS, FL	Yes	No	Yes	No	2
Michigan Invitational Group, MI	Yes	Yes	No	No	1
Montgomery County, MD	Yes	No	Yes	No	2
Naperville Sch. Dist. #203, IL	Yes	Yes	No	No	1
Project SMART Consortium, OH	Yes	Yes	No	No	1
Rochester City Sch. Dist., NY	Yes	Yes	No	No	1
SW Math/Sci. Collaborative, PA [4]	–	–	–	–	–

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

Background data provided by coordinators from participating jurisdictions.

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

2 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.

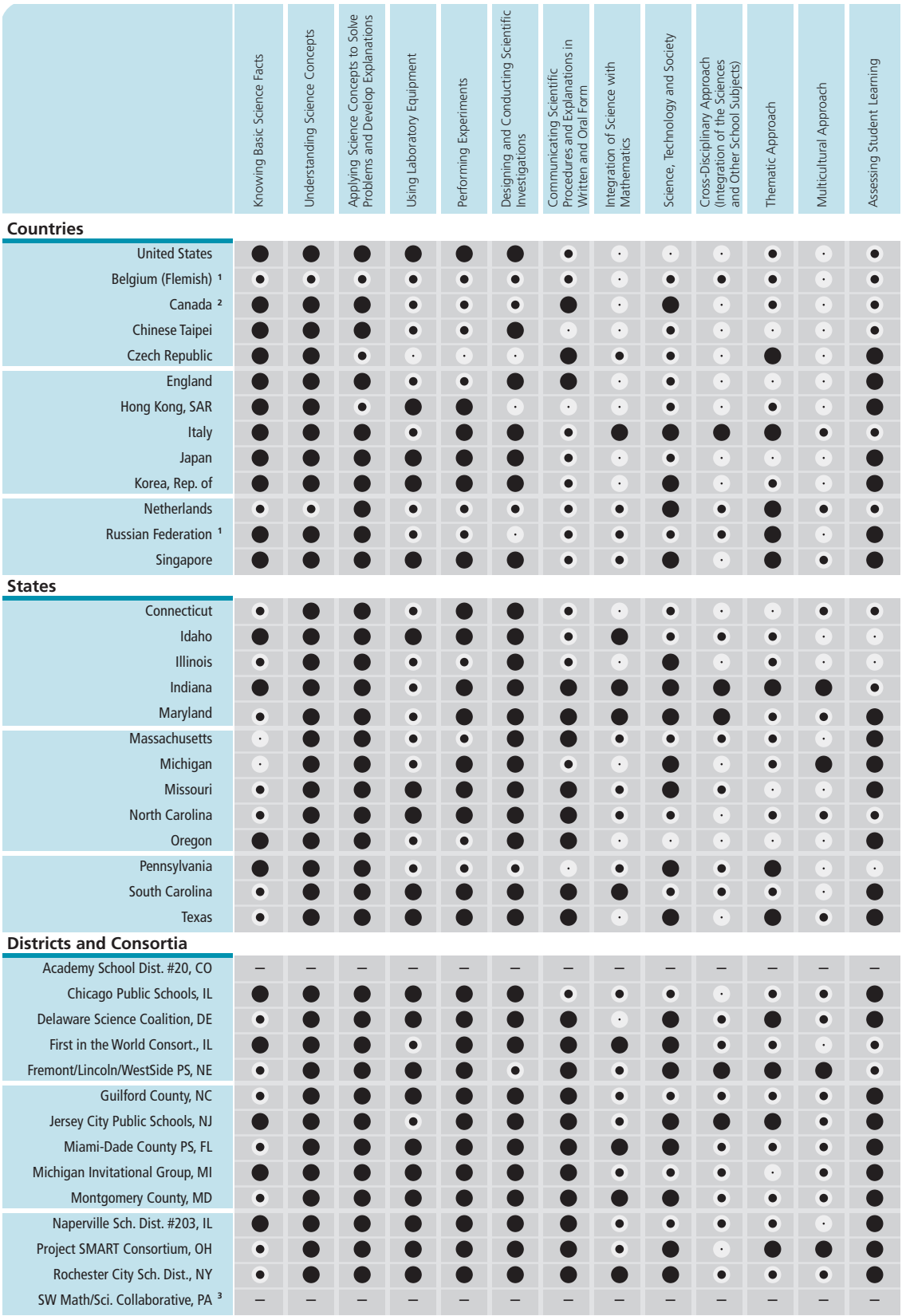
3 England: While there is one "programme of study" for grades 6-8, the document identifies nine performance-levels describing the types and range of performance that pupils working at a particular level should demonstrate.

4 Due to the variation across the state/collaborative, a representative response cannot be provided for these questions.

A dash (–) indicates data are not available.

Exhibit 5.16 Emphasis on Approaches and Processes

8th Grade Science



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

Background data provided by coordinators from participating jurisdictions.

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

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

3 SW Math/Sci. Collaborative: Covering a workforce region of 118 autonomous districts, the Collaborative cannot provide a representative response for these questions.

What Science Content Do Teachers Emphasize at the Eighth Grade?

Teachers from the Benchmarking jurisdictions and the countries where eighth-grade science was taught as a general or integrated course were asked what subject matter they emphasized most in their classes (general science, earth science, biology, etc.). Their responses, shown in Exhibit 5.17, reveal that on average across all the TIMSS 1999 single-science countries, more than half the eighth-grade students (58 percent) were in classes where the emphasis was on general or integrated science. Next most common was biology with 14 percent, and physical science (physics and chemistry combined) with 11 percent.

In the United States, 41 percent of students were in classes emphasizing general science, 28 percent earth science, and 21 percent physical science. Just five percent of U.S. students were in science classes emphasizing biology, three percent chemistry, and two percent physics. The United States was unusual in its emphasis on earth science. Among the 21 single-science countries in TIMSS, only Canada, Italy, and the U.S. had more than 10 percent of their students in classes emphasizing earth science. It was more common for single-science countries to place emphasis on physical science.

There was considerable variation across the Benchmarking jurisdictions in the reported subject matter emphasis in science classes. Among states, the percentage of students in classes emphasizing general science ranged from four percent in Idaho to 72 percent in North Carolina. The only Benchmarking states besides Idaho with percentages lower than the U.S. average were Connecticut, Missouri, Oregon, Pennsylvania, and Texas. Earth science received least emphasis in Michigan (nine percent of students) and greatest in Texas (52 percent). Benchmarking states with more than one-fifth of the students in classes emphasizing earth science, in addition to Texas, were Connecticut, Idaho, Missouri, Oregon, Pennsylvania, and South Carolina. Physical science received least emphasis in Texas and North Carolina (five and six percent, respectively), and most in Idaho (50 percent). Eight of the states had more than one-fifth of their students in classes emphasizing physical science.

Among the districts and consortia, the greatest emphasis on general science was reported in Chicago, the Fremont/Lincoln/Westside Public Schools, Guilford County, Miami-Dade, and Naperville, all of which had two-thirds or more of their students in classes emphasizing general science. In contrast, the First in the World Consortium, Jersey City, the

	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
Countries							
United States r	41 (4.7)	28 (4.8)	5 (1.5)	2 (0.8)	3 (1.0)	21 (3.1)	1 (0.4)
Canada r	55 (3.5)	14 (2.3)	6 (1.7)	1 (0.7)	1 (0.6)	19 (2.7)	3 (1.2)
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)
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)
Korea, Rep. of	49 (4.0)	2 (1.0)	10 (2.0)	5 (1.6)	5 (1.7)	26 (3.2)	4 (1.6)
Singapore	69 (4.1)	0 (0.0)	5 (2.0)	4 (1.8)	7 (2.3)	11 (2.5)	4 (1.6)
States							
Connecticut s	30 (7.8)	22 (6.2)	5 (4.1)	4 (2.4)	5 (2.4)	32 (7.7)	3 (2.1)
Idaho r	4 (2.8)	32 (6.6)	8 (4.6)	3 (1.2)	0 (0.0)	50 (7.3)	3 (2.7)
Illinois r	46 (7.1)	14 (4.7)	8 (3.4)	0 (0.0)	6 (2.0)	24 (6.7)	1 (0.6)
Indiana r	52 (8.1)	16 (4.8)	3 (1.5)	0 (0.0)	3 (2.2)	23 (8.0)	4 (1.7)
Maryland s	41 (6.9)	18 (4.7)	1 (1.4)	0 (0.0)	5 (2.3)	32 (6.7)	2 (2.0)
Massachusetts r	42 (5.9)	17 (5.3)	0 (0.1)	0 (0.0)	0 (0.0)	41 (7.0)	1 (0.0)
Michigan r	54 (5.7)	9 (3.9)	3 (2.5)	2 (2.1)	0 (0.3)	32 (5.0)	0 (0.4)
Missouri r	38 (7.2)	37 (7.2)	6 (3.8)	0 (0.0)	0 (0.1)	16 (4.6)	2 (0.2)
North Carolina	72 (5.7)	10 (3.4)	1 (1.3)	1 (0.1)	8 (4.0)	6 (2.7)	2 (0.1)
Oregon r	36 (6.2)	41 (7.7)	5 (2.6)	0 (0.0)	4 (2.7)	12 (5.1)	2 (1.0)
Pennsylvania r	16 (3.2)	40 (5.5)	6 (2.5)	0 (0.0)	2 (0.9)	35 (6.1)	1 (0.9)
South Carolina	41 (6.6)	48 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	11 (4.1)	1 (0.3)
Texas s	40 (5.6)	52 (6.7)	1 (0.7)	0 (0.0)	1 (1.0)	5 (3.2)	0 (0.0)
Districts and Consortia							
Academy School Dist. #20, CO	28 (0.4)	0 (0.0)	0 (0.0)	15 (0.4)	0 (0.0)	57 (0.6)	0 (0.0)
Chicago Public Schools, IL r	66 (8.5)	6 (4.0)	7 (4.7)	0 (0.0)	0 (0.0)	19 (8.1)	3 (0.3)
Delaware Science Coalition, DE r	31 (4.1)	68 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)
First in the World Consort., IL	20 (9.3)	0 (0.0)	15 (1.5)	0 (0.0)	7 (1.0)	47 (8.1)	11 (4.7)
Fremont/Lincoln/WestSide PS, NE	87 (3.9)	0 (0.3)	1 (0.1)	4 (2.6)	0 (0.0)	8 (2.9)	1 (0.5)
Guilford County, NC	86 (4.5)	8 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	6 (3.9)	0 (0.0)
Jersey City Public Schools, NJ r	0 (0.0)	0 (0.0)	8 (4.1)	14 (1.4)	0 (0.0)	68 (4.1)	9 (0.9)
Miami-Dade County PS, FL s	70 (5.9)	1 (0.8)	1 (0.5)	0 (0.0)	6 (3.5)	20 (6.2)	3 (2.7)
Michigan Invitational Group, MI	47 (4.3)	32 (3.3)	4 (0.2)	0 (0.0)	3 (0.7)	14 (2.6)	0 (0.0)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	68 (3.4)	0 (0.0)	0 (0.0)	13 (0.7)	0 (0.0)	18 (3.5)	0 (0.0)
Project SMART Consortium, OH r	22 (4.2)	33 (3.3)	11 (3.0)	0 (0.0)	7 (3.1)	22 (3.4)	4 (1.7)
Rochester City Sch. Dist., NY	17 (5.3)	0 (0.0)	22 (6.2)	0 (0.0)	0 (0.0)	61 (6.5)	0 (0.0)
SW Math/Sci. Collaborative, PA	31 (7.8)	18 (6.6)	10 (5.8)	2 (2.1)	7 (3.8)	31 (5.9)	0 (0.0)
International Average (All General Science Countries)	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.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) 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.

In the United States overall, 86 percent of the science topics – compared with the international average of 63 percent – were intended to be taught to 90 percent or more of the students. This relatively high level of coverage resulted from the inclusion of 100 percent of the topics in each of the content areas except chemistry.

Benchmarking participants generally resembled the United States in topic coverage in the intended curriculum, although there were differences, particularly among the districts and consortia. Earth science, biology, environmental and resource issues, and scientific inquiry and the nature of science were included in the curriculum for almost all students in almost all Benchmarking jurisdictions, but the coverage of physics and particularly chemistry was more variable. Among states the percentage of physics topics intended for almost all students ranged from 60 percent in Idaho and Oregon to 100 percent in Illinois, Massachusetts, and North Carolina, and among districts and consortia from 50 percent in the Delaware Science Coalition to 100 percent in the First in the World Consortium, Guilford County, Jersey City, and Montgomery County. The percentage of chemistry topics ranged from just eight percent in Oregon to 100 percent in Texas, and from zero in the Michigan Invitational Group to 100 percent in First in the World, Jersey City, and Montgomery County.

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 5.15. 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. Surprisingly, the Benchmarking jurisdictions that reported having different levels of curriculum for different groups, First in the World, Miami-Dade, and Montgomery County, indicated that at least 90 percent of the topics in each content area were intended to be taught to 90 percent or more of the students. It should also be noted that if content within a topic area required different responses, coordinators from participating entities chose the response that best represented the entire topic area and noted the discrepancy (see Exhibits A.8 and A.9 in the appendix for details).

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).

	Overall	Earth Science	Biology	Physics	Chemistry	Environmental and Resource Issues	Scientific Inquiry and the Nature of Science
Countries							
United States							
Belgium (Flemish)							
Canada							
Chinese Taipei							
Czech Republic							
England							
Hong Kong, SAR							
Italy							
Japan							
Korea, Rep. of							
Netherlands							
Russian Federation							
Singapore							
States							
Connecticut							
Idaho							
Illinois							
Indiana							
Maryland							
Massachusetts							
Michigan							
Missouri							
North Carolina							
Oregon							
Pennsylvania [1]							

However, as indicated by Exhibit R2.10 in the reference section, physics topics received very little emphasis before the eighth grade in the United States and in the Benchmarking jurisdictions. This was true internationally as well. Only 12 percent of the students in the U.S., and nine percent on average across countries, were taught more than half the physics topics before the eighth grade and not again during the eighth grade. Fifty-eight percent of U.S. students, compared with 44 percent internationally, were taught more than half these topics during the eighth grade. More than half the topics were taught before or during the eighth grade to three-fourths or more of the students in Michigan, South Carolina, Texas, the Academy School District, Jersey City, and Miami-Dade. However, half or more of the topics had not yet been taught to one-third or more of the students in Connecticut, Idaho, Pennsylvania, and Rochester.

Instructional coverage was high for three of the four chemistry topics, "classification of matter" (90 percent of students taught), "structure of matter" (84 percent), and "chemical reactivity and transformations" (76 percent), but less for "energy and chemical change," which just 58 percent of students, internationally on average, had been taught (see Exhibit 5.23). As with physics, nearly all students (99 percent) in the Netherlands were taught each of the chemistry topics. The United States as a whole and the Benchmarking participants had similar or even higher percentages of students taught these topics than internationally. Highest percentages across all topics were reported in Naperville and the First in the World Consortium.

Exhibit R2.11 in the reference section shows that, like physics, topics in chemistry received very little emphasis before the eighth grade internationally, in the United States, and in the Benchmarking jurisdictions. Only 13 percent of the students on average across countries, and 10 percent in the U.S., had been taught the chemistry topics before the eighth grade only. Sixty-three percent of U.S. students, compared with 54 percent of students internationally, were taught more than half these topics during the eighth grade. Results for the Benchmarking jurisdictions generally resembled those of the United States.

Most students in most countries, with the notable exception of Japan among the comparison countries, were taught the topics in environmental and resource issues (see Exhibit 5.24), especially those dealing with "pollution" and "conservation of natural resources." Four-fifths or more of the students in the United States had been taught each of the topics in this content area, which was above the international average in each case. Among Benchmarking entities the lowest percentages were in

Exhibit 5.20 Percentages of Students Taught Earth Science Topics*

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 cycles, plate tectonics, fossils)	Earth in the solar system and the universe (interactions between earth, sun, and moon; relationship to planets and stars)
Countries				
United States	r 87 (2.5)	r 84 (2.7)	r 92 (2.0)	r 84 (2.3)
Belgium (Flemish)	r 93 (3.0)	r 45 (4.3)	r 64 (5.2)	r 16 (3.4)
Canada	s 91 (1.9)	s 83 (2.1)	s 86 (2.3)	s 80 (3.1)
Chinese Taipei [1]	– –	– –	– –	– –
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)
Hong Kong, SAR	s 17 (3.2)	r 61 (5.0)	s 17 (4.0)	s 15 (3.8)
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)
Korea, Rep. of	91 (2.4)	98 (1.2)	95 (1.5)	52 (4.0)
Netherlands	76 (5.6)	91 (2.7)	92 (4.1)	r 82 (4.8)
Russian Federation	– –	– –	– –	– –
Singapore	x x	x x	x x	x x
States				
Connecticut	s 84 (6.0)	s 83 (5.9)	s 81 (5.7)	s 85 (5.8)
Idaho	s 53 (6.8)	s 50 (7.3)	s 52 (7.2)	s 48 (6.6)
Illinois	r 84 (6.6)	r 83 (7.0)	r 81 (6.9)	r 75 (7.3)
Indiana	r 93 (3.0)	r 92 (3.7)	r 89 (3.8)	r 91 (4.0)
Maryland	s 83 (4.3)	s 81 (5.1)	s 82 (4.1)	s 79 (6.4)
Massachusetts	r 83 (4.6)	r 80 (4.5)	r 84 (4.6)	r 79 (4.5)
Michigan	r 89 (4.3)	r 86 (4.9)	r 93 (3.0)	r 88 (4.1)
Missouri	r 93 (3.1)	r 95 (1.6)	r 93 (3.8)	r 77 (4.4)
North Carolina	93 (1.5)	91 (2.2)	r 90 (3.0)	88 (3.6)
Oregon	94 (3.2)	83 (4.6)	90 (4.0)	85 (5.0)
Pennsylvania	r 83 (4.2)	r 80 (4.8)	r 83 (4.0)	r 75 (4.4)
South Carolina	r 98 (1.5)	r 91 (3.6)	98 (1.0)	90 (3.6)
Texas	r 94 (3.3)	r 89 (3.8)	r 93 (3.6)	r 85 (4.2)
Districts and Consortia				
Academy School Dist. #20, CO	91 (0.2)	90 (0.2)	90 (0.2)	90 (0.2)
Chicago Public Schools, IL	r 92 (4.9)	r 94 (4.2)	r 82 (4.9)	r 80 (7.9)
Delaware Science Coalition, DE	s 85 (5.4)	s 83 (4.6)	s 84 (5.4)	s 83 (4.8)
First in the World Consort., IL	86 (7.8)	86 (7.8)	100 (0.0)	82 (7.5)
Fremont/Lincoln/WestSide PS, NE	r 97 (2.4)	r 96 (2.5)	r 97 (2.4)	68 (6.6)
Guilford County, NC	95 (2.8)	96 (2.5)	92 (2.7)	88 (3.6)
Jersey City Public Schools, NJ	r 100 (0.0)	r 100 (0.0)	r 100 (0.0)	s 100 (0.0)
Miami-Dade County PS, FL	s 98 (1.2)	s 93 (5.1)	s 97 (2.6)	s 82 (6.6)
Michigan Invitational Group, MI	r 83 (2.3)	r 94 (1.8)	r 90 (1.4)	r 96 (1.5)
Montgomery County, MD	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	90 (2.9)	100 (0.0)	100 (0.0)
Project SMART Consortium, OH	r 84 (1.8)	r 81 (3.7)	r 94 (0.9)	r 85 (3.3)
Rochester City Sch. Dist., NY	s 22 (3.5)	s 25 (4.0)	s 22 (3.5)	s 35 (5.9)
SW Math/Sci. Collaborative, PA	79 (5.0)	79 (4.9)	80 (6.4)	r 72 (7.4)
International Avg. (All Countries)	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.

1 Chinese Taipei: Data for grade 9 earth science teachers not available.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) 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.

	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
Countries						
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)
Belgium (Flemish)	98 (1.0)	100 (0.0)	100 (0.0)	r 91 (2.6)	r 85 (3.7)	94 (2.2)
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)
Chinese Taipei [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)
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)
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)
Korea, Rep. of	91 (2.2)	92 (2.2)	87 (2.8)	76 (3.7)	57 (4.3)	54 (4.3)
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)
Russian Federation	– –	– –	– –	– –	– –	– –
Singapore	97 (1.5)	97 (1.6)	97 (1.8)	r 86 (3.8)	r 69 (4.4)	92 (2.7)
States						
Connecticut	s 91 (4.7)	s 95 (2.2)	s 97 (1.2)	s 93 (2.8)	s 96 (2.6)	s 78 (5.9)
Idaho	s 76 (7.7)	s 77 (7.7)	s 80 (7.0)	s 87 (4.4)	s 83 (5.6)	s 76 (5.8)
Illinois	r 84 (5.3)	r 89 (4.6)	r 88 (3.6)	r 95 (2.5)	r 91 (3.3)	r 84 (4.0)
Indiana	r 91 (3.5)	r 91 (3.6)	r 94 (2.7)	r 93 (3.1)	r 93 (2.9)	r 84 (5.5)
Maryland	s 99 (1.0)	s 99 (1.0)	s 97 (1.9)	s 96 (2.5)	s 89 (4.3)	s 83 (5.8)
Massachusetts	r 96 (2.8)	r 93 (3.3)	s 97 (2.2)	r 96 (1.9)	r 92 (1.8)	r 91 (3.3)
Michigan	r 87 (4.1)	r 85 (4.7)	r 86 (4.5)	r 98 (1.2)	r 97 (1.4)	r 81 (5.1)
Missouri	r 83 (4.1)	r 86 (4.9)	r 83 (5.6)	r 89 (4.4)	r 89 (4.1)	r 83 (5.7)
North Carolina	r 92 (3.4)	r 89 (4.1)	r 91 (3.6)	r 90 (3.0)	r 84 (3.9)	r 85 (4.5)
Oregon	r 92 (3.6)	r 92 (3.2)	r 93 (3.4)	r 93 (3.2)	r 94 (3.4)	r 92 (3.7)
Pennsylvania	r 78 (3.5)	r 77 (3.7)	r 86 (3.2)	r 91 (3.3)	r 90 (3.6)	r 74 (3.6)
South Carolina	96 (2.6)	r 97 (2.0)	r 96 (2.2)	r 89 (4.3)	r 90 (3.6)	r 95 (2.8)
Texas	r 94 (2.8)	r 91 (4.1)	r 91 (3.5)	r 94 (3.0)	r 95 (2.8)	s 89 (4.6)
Districts and Consortia						
Academy School Dist. #20, CO	100 (0.0)	100 (0.0)	100 (0.0)	r 100 (0.0)	r 100 (0.0)	100 (0.0)
Chicago Public Schools, IL	r 75 (12.5)	r 75 (12.5)	r 86 (8.3)	r 89 (7.7)	r 79 (8.0)	r 77 (10.6)
Delaware Science Coalition, DE	s 81 (6.9)	s 82 (6.3)	s 86 (5.7)	s 89 (5.3)	s 85 (6.3)	s 86 (6.0)
First in the World Consort., IL	95 (1.7)	95 (1.7)	100 (0.0)	96 (1.5)	96 (1.5)	96 (1.5)
Fremont/Lincoln/WestSide PS, NE	s 96 (1.4)	x x	s 96 (3.2)	r 87 (0.8)	90 (3.3)	r 82 (7.5)
Guilford County, NC	r 94 (2.8)	r 94 (2.9)	r 94 (2.9)	94 (2.7)	r 79 (4.5)	r 87 (3.0)
Jersey City Public Schools, NJ	r 93 (4.2)	r 91 (4.3)	r 92 (4.0)	r 98 (0.2)	r 96 (0.4)	r 96 (0.4)
Miami-Dade County PS, FL	s 98 (0.8)	s 94 (4.0)	s 86 (5.0)	s 96 (2.9)	s 91 (5.5)	s 83 (4.6)
Michigan Invitational Group, MI	r 76 (2.8)	r 74 (3.5)	r 79 (4.0)	r 73 (2.4)	r 85 (3.5)	r 65 (1.5)
Montgomery County, MD	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	86 (4.2)	100 (0.0)	r 100 (0.0)	100 (0.0)	100 (0.0)	83 (1.7)
Project SMART Consortium, OH	r 87 (3.5)	r 84 (3.8)	r 97 (1.5)	r 94 (2.9)	r 87 (3.9)	r 86 (3.2)
Rochester City Sch. Dist., NY	r 86 (3.0)	r 90 (3.4)	r 88 (3.9)	r 90 (3.4)	r 81 (4.9)	r 83 (3.7)
SW Math/Sci. Collaborative, PA	r 76 (8.4)	r 74 (7.0)	r 82 (7.3)	82 (5.0)	r 85 (3.8)	r 64 (8.2)
International Avg. (All Countries)	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.

1 Chinese Taipei: Data for grade 7 biology teachers not available.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) 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 5.22 Percentages of Students Taught Physics Topics*

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)
Countries								
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)	75 (3.4)
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)	33 (4.5)
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)	56 (3.1)
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)
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)	98 (1.1)
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)	41 (4.9)
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)
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)
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)
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)	82 (4.2)
States								
Connecticut	s 92 (4.2)	s 79 (7.4)	s 74 (6.2)	s 87 (5.3)	s 58 (7.7)	s 67 (7.6)	s 68 (7.6)	65 (7.5)
Idaho	s 87 (6.4)	s 87 (6.6)	s 67 (6.6)	s 69 (7.1)	s 56 (7.9)	s 53 (7.3)	s 46 (7.6)	65 (7.1)
Illinois	91 (2.4)	89 (4.7)	r 79 (6.7)	r 70 (6.9)	s 50 (6.2)	r 54 (6.9)	r 70 (5.8)	87 (4.9)
Indiana	r 97 (1.7)	r 94 (3.0)	r 77 (7.8)	r 78 (8.0)	s 56 (9.1)	r 62 (9.2)	r 69 (9.0)	91 (3.6)
Maryland	s 98 (1.4)	s 88 (3.3)	s 85 (4.0)	s 79 (5.3)	s 69 (4.7)	s 71 (4.6)	s 80 (5.6)	89 (4.4)
Massachusetts	r 97 (2.0)	r 91 (3.8)	r 78 (5.6)	r 82 (5.7)	s 58 (7.5)	r 62 (7.6)	r 70 (7.1)	81 (5.5)
Michigan	r 97 (2.6)	r 91 (4.1)	r 95 (2.8)	r 94 (3.1)	r 79 (5.1)	r 77 (5.2)	r 74 (5.5)	87 (4.7)
Missouri	r 97 (1.6)	r 94 (3.3)	r 81 (5.6)	r 85 (5.5)	r 69 (5.1)	r 70 (6.7)	r 78 (4.9)	83 (4.4)
North Carolina	r 97 (3.2)	97 (3.1)	r 82 (6.1)	r 88 (5.5)	r 77 (6.8)	r 76 (6.7)	73 (6.1)	78 (6.4)
Oregon	98 (1.3)	96 (2.7)	r 81 (5.1)	r 86 (4.9)	r 57 (5.9)	r 63 (6.0)	r 74 (6.2)	80 (5.9)
Pennsylvania	r 85 (3.4)	r 85 (3.9)	r 74 (6.4)	r 73 (6.4)	s 49 (8.1)	s 56 (7.8)	s 67 (6.6)	61 (5.9)
South Carolina	97 (1.8)	98 (1.1)	r 87 (3.4)	r 93 (2.7)	r 79 (4.6)	r 82 (4.6)	r 85 (4.5)	76 (6.0)
Texas	r 96 (2.4)	r 98 (1.3)	s 82 (4.8)	s 87 (5.5)	s 78 (7.1)	s 77 (5.5)	s 77 (4.8)	79 (5.5)
Districts and Consortia								
Academy School Dist. #20, CO	100 (0.0)	86 (0.2)	100 (0.0)	91 (0.1)	41 (0.4)	38 (0.4)	r 47 (0.4)	69 (0.4)
Chicago Public Schools, IL	r 86 (7.3)	r 86 (7.3)	r 87 (7.4)	r 83 (8.5)	r 66 (10.8)	r 69 (10.4)	r 73 (10.0)	84 (8.1)
Delaware Science Coalition, DE	s 99 (0.4)	s 91 (4.8)	s 77 (7.3)	s 94 (3.2)	s 55 (7.2)	s 89 (5.0)	s 68 (6.7)	83 (2.6)
First in the World Consort., IL	100 (0.0)	98 (2.2)	94 (1.9)	86 (7.8)	69 (3.1)	69 (3.1)	92 (0.8)	87 (1.5)
Fremont/Lincoln/WestSide PS, NE	r 99 (0.6)	r 100 (0.3)	r 73 (3.2)	r 78 (8.1)	s 65 (10.1)	r 61 (6.0)	r 86 (3.7)	91 (1.4)
Guilford County, NC	r 97 (1.1)	95 (2.3)	r 94 (2.2)	r 97 (2.2)	s 89 (4.9)	r 95 (3.6)	95 (2.3)	87 (4.6)
Jersey City Public Schools, NJ	r 98 (0.3)	r 93 (0.7)	r 100 (0.0)	r 100 (0.0)	s 48 (5.0)	r 55 (4.5)	r 69 (4.2)	100 (0.0)
Miami-Dade County PS, FL	s 99 (1.2)	s 96 (2.5)	s 92 (2.6)	s 90 (4.0)	s 76 (6.4)	s 67 (7.9)	s 78 (6.7)	82 (4.3)
Michigan Invitational Group, MI	r 97 (0.4)	r 96 (0.4)	r 79 (1.6)	r 86 (3.4)	r 69 (2.4)	r 56 (6.6)	r 80 (2.6)	89 (1.9)
Montgomery County, MD	x x	x x	x x	x x	x x	x x	x x	x x
Naperville Sch. Dist. #203, IL	100 (0.0)	100 (0.0)	100 (0.0)	89 (0.4)	36 (4.3)	19 (3.5)	44 (3.3)	90 (2.9)
Project SMART Consortium, OH	r 95 (2.6)	r 82 (3.7)	r 93 (1.5)	r 84 (2.3)	r 75 (3.5)	r 78 (3.1)	r 76 (3.0)	81 (2.8)
Rochester City Sch. Dist., NY	r 86 (4.7)	r 100 (0.4)	r 83 (5.4)	r 60 (4.8)	r 22 (3.8)	r 28 (5.6)	r 57 (6.8)	74 (7.4)
SW Math/Sci. Collaborative, PA	96 (2.6)	93 (3.0)	r 79 (7.3)	80 (6.9)	r 44 (8.7)	r 53 (6.9)	r 62 (6.3)	72 (9.0)
International Avg. (All Countries)	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.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

( ) 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.

Countries					
	United States	r 88 (2.2)	r 88 (2.6)	r 76 (3.4)	r 66 (3.9)
76 1)	r				

Exhibit 5.24 Percentages of Students Taught Environmental and Resource Issues Topics*

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	
Countries						
United States	r	83 (2.4)	r	79 (2.5)	s	81 (2.9)
Belgium (Flemish)	r	89 (3.3)	r	82 (3.7)	r	63 (4.3)
Canada	s	92 (1.4)	s	90 (2.2)	s	83 (2.9)
Chinese Taipei	r	73 (3.5)	r	48 (4.4)	r	41 (4.7)
Czech Republic		92 (2.6)		92 (2.5)		82 (4.1)
England	s	79 (4.5)	s	71 (5.1)	s	71 (4.6)
Hong Kong, SAR		74 (4.3)	r	54 (5.3)	r	30 (4.7)
Italy		84 (2.6)		80 (2.8)		70 (3.4)
Japan		26 (3.4)		7 (2.4)		7 (2.4)
Korea, Rep. of		75 (3.8)		58 (4.5)		49 (4.4)
Netherlands		99 (1.0)		98 (1.0)	r	98 (1.1)
Russian Federation		– –		– –		– –
Singapore		93 (2.4)	r	86 (3.5)	s	64 (5.0)
States						
Connecticut	s	91 (4.4)	s	87 (5.5)		x x
Idaho	s	65 (7.5)	s	64 (6.6)	s	55 (8.3)
Illinois	r	86 (3.7)	r	81 (4.7)	r	88 (3.6)
Indiana	s	87 (4.3)	s	82 (5.1)	s	76 (5.5)
Maryland	s	84 (5.7)	s	82 (4.8)	s	82 (5.4)
Massachusetts	r	93 (2.2)	r	88 (3.2)	s	87 (3.9)
Michigan	r	92 (3.2)	r	84 (4.8)	s	90 (4.2)
Missouri	r	90 (3.3)	r	91 (3.0)	r	90 (3.6)
North Carolina	r	76 (5.8)	r	78 (5.8)	r	77 (5.2)
Oregon	r	84 (5.7)	r	84 (5.3)	r	84 (5.9)
Pennsylvania	r	77 (5.9)	r	74 (6.3)	r	75 (6.1)
South Carolina	r	93 (2.7)	r	94 (2.1)	r	90 (3.4)
Texas	r	90 (2.9)	r	88 (3.2)	s	85 (4.7)
Districts and Consortia						
Academy School Dist. #20, CO	s	100 (0.0)	s	100 (0.0)	s	100 (0.0)
Chicago Public Schools, IL	r	65 (11.2)	r	53 (12.5)	r	63 (11.7)
Delaware Science Coalition, DE	s	79 (6.0)	s	66 (5.2)	s	56 (5.6)
First in the World Consort., IL		95 (2.5)		100 (0.0)		100 (0.0)
Fremont/Lincoln/WestSide PS, NE	s	81 (6.5)	s	76 (6.2)	r	73 (5.4)
Guilford County, NC	r	66 (4.1)	r	90 (2.7)	r	74 (4.5)
Jersey City Public Schools, NJ	r	100 (0.0)	r	98 (0.2)	r	90 (0.9)
Miami-Dade County PS, FL	s	82 (6.7)	s	83 (7.0)	s	81 (6.6)
Michigan Invitational Group, MI	s	80 (4.0)	s	84 (3.9)	r	83 (3.5)
Montgomery County, MD		x x		x x		x x
Naperville Sch. Dist. #203, IL		100 (0.0)		89 (3.9)	r	77 (3.4)
Project SMART Consortium, OH	r	89 (2.1)	r	90 (1.7)	r	91 (1.6)
Rochester City Sch. Dist., NY	r	46 (4.5)	s	33 (6.3)	s	36 (7.1)
SW Math/Sci. Collaborative, PA	r	85 (6.8)	r	93 (4.3)	s	87 (5.4)
International Avg. (All Countries)		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.

States in *italics* did not fully satisfy guidelines for sample participation rates (see Appendix A for details).

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What Can Be Learned About the Science Curriculum?

In contrast to the United States, most countries around the world have well-established, centrally-mandated national curricula. Recently, however, states and districts in the U.S. have been making great strides in establishing content standards and curriculum frameworks to guide curriculum implementation in schools. Furthermore, many education systems in the U.S. have begun to assess whether the intended curriculum in science is being attained or learned by their students. Thoroughly examining the Benchmarking jurisdictions' results in an international context can provide insights into what students are expected to learn in science, what is taught in classrooms, and what policies and practices provide the best match between the intended and the implemented curriculum to improve student achievement.