



UNITED STATES NATIONAL RESEARCH CENTER

THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY (TIMSS)
SURVEY OF MATHEMATICS AND SCIENCE OPPORTUNITY (SMSO)

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Michigan State University
East Lansing, MI 48824-1034
FAX NUMBER: (517) 432-1727
TELEPHONE: (517) 353-7755

National Science Foundation - Washington, D.C.

October 27, 1998

To: Larry Suter
Pat Forgione
Mike Smith
Maggie McNeely

From: William Schmidt 

Subject: First In the World Report

Enclosed, please find the First in the World report we prepared. They encouraged me to share it with you. I think the results are interesting.

FIRST IN THE WORLD CONSORTIUM:

CURRICULUM ANALYSIS FINAL REPORT

Prepared by:

United States National Research Center for the Third
International Mathematics and Science Study

Michigan State University

William H. Schmidt, Director

East Lansing

1998

INTRODUCTION

As a component of the participation of the First in the World Consortium (henceforward "Consortium" or FIW) in the Third International Mathematics and Science Study (TIMSS), the Consortium conducted a study of the Intended Curriculum, following the same format and procedures of the other educational systems participating in the TIMSS. These procedures, fully reported elsewhere (Schmidt et al. 1996; Schmidt and McKnight 1995; Schmidt et al. 1997a; Schmidt et al. 1997b; Schmidt et al. 1997c; Survey of Mathematics and Science Opportunities 1992a; Survey of Mathematics and Science Opportunities 1992b; Survey of Mathematics and Science Opportunities 1993a; Survey of Mathematics and Science Opportunities 1993b), are intended to provide critical information for the interpretation of the results of the Teacher Survey and Achievement components of the TIMSS, and as an important benchmarking study in themselves. The United States Center for the TIMSS (henceforth: "Center") undertook the data collection, analysis, and reporting for the Curriculum Analysis.

This document, in accordance with the agreement between the Consortium and the Center, presents the principal analytical graphs and tables benchmarking the Consortium results against those for the rest of the educational systems participating in the TIMSS, those educational systems demonstrating the highest levels of achievement in the TIMSS, and the United States. Additionally, it presents in the form of bulleted text, key conclusions to be drawn from these materials. All analyses are to be found at the end of this report, and the data for the Consortium is on a separate, accompanying diskette. This report and the data set represent the fulfillment of the contractual obligation of the Center to the Consortium.

TIMSS AND THE STUDY OF CURRICULUM

TIMSS is a study of educational systems as they exist to deliver educational experiences to students. To do so it is designed as a complex array of interrelated data collections within which the achievement data are but one important component. These data collections are interrelated through a theoretical model of potential educational experiences. We think of these potential educational experiences as the formulation of education-system intentions and their classroom implementation. They are policy instruments and teaching techniques intended to guide realized experiences. The model recognizes that actual learning or realized educational experiences are subjective processes in students.

This model, developed at the US TIMSS Center through a separate grant known as the Survey of Mathematics and Science Opportunities (SMSO) and presented in our first reports from this study (Schmidt et al. 1996; Schmidt and McKnight 1995) centers on the notion that one purpose of an educational system and a primary focus of its pedagogical role, is to enable educators and policy makers to provide opportunities to learn the sciences and mathematics. In this schema it is recognized that curricula, schools, and teachers are elements that both define and delimit the potential learning experiences afforded to students for learning mathematics and the sciences. The opportunities to reach a standard (e.g.,

reach a criterion of knowledge and skill centered around specific topics) have a direct impact on the actual fulfillment of that standard by students.

The term "standard" is used to refer to content goals, performance expectations and attitudes as defined by international curriculum frameworks (Survey of Mathematics and Science Opportunities 1992a; Survey of Mathematics and Science Opportunities 1992b). These frameworks are the core measurement strategy for TIMSS benchmarking. They were developed by an international team of curriculum specialists and educational researchers, and all countries participating in TIMSS were consulted during their development. This is indeed crucial as it makes it possible to both retain sensitivity to cultural differences between the nations studied while at the same time producing measures that can be meaningfully compared. This represents a considerable departure from other cross-national benchmarking studies that explicitly eschew the use of a common metric for the description of standards, favoring a qualitative, case-study approach intended to depict each set of standards in its 'own terms' (Resnick, Nolan, and Resnick 1995; Seashore Louis and Versloot 1996). Teams conducting the TIMSS in each participating educational system did so with the express purpose of measuring themselves against each other and thus a common metric, grounded in extensive qualitative work and international consultation – capable of producing comparable quantitative measures – was required.

The TIMSS collected data on expectations for mathematics and science education from all participating countries. These data include detailed reports of topics intended for instruction at each pre-University grade level. Survey methods including some documentary support were used to collect this information. In addition, trained coders conducted a detailed line-by-line, page-by-page content analysis of nationally representative samples of curriculum guides and textbooks at three focal grade levels. These grades correspond to grades four, eight, and advanced placement calculus and physics (grade 12) in the United States. Data collection techniques and characteristics of the data have been reported elsewhere (Peak et al. 1996; Survey of Mathematics and Science Opportunities 1993b; U.S. Department of Education. National Center for Education Statistics 1997; U.S. Department of Education. National Center for Education Statistics 1998). These data are used to characterize the expectations of high-achieving countries in this article.

BENCHMARKING AGAINST HIGH-ACHIEVING COUNTRIES

A total of 27 countries, out of 41, achieved higher average scores on the eighth-grade mathematics assessment than did students in the United States, 16 achieved higher average scores in science. However, not all of these differences were statistically significant. Twenty countries significantly outperformed students in the United States in terms of average scores in mathematics, nine in science. Thus, as a standard for anchoring a first comparison, two groups of higher-achieving countries can be identified, the 20 countries in mathematics and the 9 in science that significantly outperformed the United States. Anchoring comparisons against average achievement in the United States is one way to identify high-achieving countries. However, given average achievement in the United States, it may be setting the standard too low. In order to identify the 'highest-achieving countries' the decision was made to compare average achievement to all TIMSS countries. Examining achievement data

it was noted that a smaller number of countries significantly outperformed all but less than ten of the TIMSS countries. That is, in both mathematics and science a small set of highest-achieving countries can be identified that significantly outperform thirty seven countries or more, these are six countries in the case of mathematics and four countries in the case of science. Display 1 shows these two groups of countries for both mathematics and science — these are the groups of countries that will be used for comparison with the Consortium in this report. For convenience, these benchmarking groups are referred to in this article as groups A and A+. (see: Valverde and Schmidt *in preparation*) for further details regarding this benchmarking strategy)

THE RESULTS

Following, is a series of bulleted text, providing guidance to major points derived from the analytical tables and graphs prepared. All analytical material are presented under "Displays".

CURRICULAR FLOW ACROSS GRADES

When compared to the United States composite national pattern, the number of topics intended for instruction in the Consortium (FIW) is

- ◆ in the case of Mathematics:
 - ◆ FIW intends (as defined by curriculum guides) about the same number of mathematics topics as the US which places it on the high side especially in population 2. However, for population 3 specialists FIW intends far fewer topics looking more like Japan than the US.
 - ◆ The pattern would seem to indicate that High-school non-specialist instruction in mathematics for the Consortium is intended to be broader (like the US as a whole) than is the case for the FIW specialists.
 - ◆ In terms of the intended curriculum across elementary and middle grades, the Consortium shows an intended curriculum characterized by breadth, as was the case for the US composite.
- ◆ in the case of Science:
 - ◆ A pattern different from that of mathematics emerges in science where FIW is more focused – below the international median at population 2, intends fewer topics at population 1 and many more topics for population 3 specialists.
 - ◆ The Consortium's intended curriculum for Grades 1 through 4 is similar to the US as a whole which is relatively focused; for Grades 5 through 9 it is substantially less broad than the case for the US Composite, and in grades 7 and 8, it is also substantially less broad than the intended curriculum for most educational systems participating in TIMSS.
 - ◆ As was the case for specialists, the science non-specialist curriculum in High-School appears to be broad in its coverage.

TEXTBOOKS IN GRADES 4, 8 AND 12

Regarding disciplinary *content* in the most commonly used textbooks across the Consortium the following important points emerge:

- ◆ Mathematics:

- ◆ The number of topics in Consortium textbooks is similar to that in textbooks of the US composite at all populations.
- ◆ In population 1 the consortium's textbooks are essentially no different in their content profiles from the US as a whole and have a great deal of overlap in content with Japan except for the prominent presence of decimals in the Japanese textbooks which is not the case in US or FIW textbooks.
- ◆ However, there are notable differences in the topics emphasized in the Consortium at population 2, with the topic of 'Equations and Formulas' for example, more emphasized in the Consortium than is the case for the most commonly used textbooks in the US.
- ◆ The emphasis of Consortium textbooks on 'Equations and Formulas' in Grade 8 is similar to that of TIMSS countries in which mean student achievement on TIMSS was significantly higher than mean student achievement in the US.
- ◆ The FIW non-algebra textbooks do not have any of the standard arithmetic topics among the top 5 topics as the US non-algebra textbooks do such as percentages.
- ◆ The FIW algebra book is essentially identical in profile to the US algebra book. The difference in the content profiles between the US and FIW found in display 12 reflect the content profile of the FIW non-algebra books. They have a content profile more consistent with top achieving countries than does the US.
- ◆ The key difference between FIW and the top achieving countries in content profiles has to do with the absence in FIW books of such topics as congruence and similarity, 2D & 3D-geometry basics among the five most emphasized.
- ◆ In mathematics FIW curriculum guides and textbooks are broad based and lack serious focus as defined internationally (except for population 3 specialists – calculus courses – where there is more focus) but the big difference is in terms of the content profile for eighth graders which is based more heavily in algebra and geometry rather than arithmetic as is the case for the US as a whole. This characterizes FIW as unfocused in their intended coverage but what emphasis there is in the textbooks is consistent with international standards, i.e., concentrating more on algebra than arithmetic.

◆ Science

- ◆ The significant difference between the Consortium and the US composite is both the number of topics present, and which topics are present, especially at eighth grade.
- ◆ In population 1 the consortium's textbooks are similar in content profile to the US as a whole but the books are more focused in their coverage of the same topics. The five topics in FIW books cover essentially one-half the book compared to only one-fourth of the US books.
- ◆ Consortium textbooks at population 2 place greater emphasis on the Physical Sciences than is the case for the United States composite.
- ◆ The 5 most emphasized topics encompass 75% of the book compared to the US composite where the 5 most emphasized topics only encompass 50% of the book.
- ◆ The FIW textbook profile is most consistent with the US - Physical Science book but notable differences still emerge. The most emphasized topic in the FIW textbooks is the classification of matter which takes up over one-fourth of the book. This is very different from the US as a whole where the most emphasized topic is applications of science in mathematics and technology.
- ◆ The FIW profile is a composite and therefore when compared to the US composite it suggests major differences in the content profile the typical US student is exposed to compared to the typical FIW student.
- ◆ However, when compared to the top achieving countries not included among the top 5 in FIW books are such topics as electricity, chemical changes and energy, types sources and conversions.
- ◆ In Science, FIW curriculum guides and textbooks reflect intentions that are relatively focused (except for high school) by international standards and have content profiles that emphasize physics and chemistry which is different from the US as a whole but more consistent with top achieving countries.

Regarding *performance expectations* in most commonly used textbooks across the Consortium the following important points emerge:

- ◆ Mathematics:
 - ◆ The pattern of performance expectations in Consortium textbooks for Grade 8 is similar than that for the US Composite.
 - ◆ However, it is notable that Consortium textbooks intended for non-algebra mathematics at Grade 8 are more similar in their emphasis on 'performing routine procedures' with textbooks in A and A+ countries , than to the US

composite which emphasizes more the recalling of mathematical objects and properties.

- ◆ One example of performance expectation differences is illustrated for congruence and similarity in Display 16. FIW textbooks at population 2 emphasize complex procedures, knowing and communication but little emphasis is given to problem solving and mathematical reasoning while much emphasis is given to these expectations in German and Japanese textbooks.
- ◆ Science
 - ◆ Consortium Grade 8 textbooks are similar to textbooks of the US composite, except in the emphasis on 'Applying scientific principals to develop explanations' and 'making decisions'. Japan, Slovenia and Hungary, among countries that significantly outperform the US, share an emphasis on the former.
 - ◆ Emphasis on 'making decisions' in Grade 8 textbooks is not common among the countries outperforming the US significantly, and represents what appears to be a unique feature of the intended curriculum for this grade in the Consortium

A MORE DETAILED LOOK AT CURRICULAR INTENTIONS AND TEXTBOOKS

- ◆ A large percentage of districts within the FIW consortium have basic arithmetic both in their curriculum guides and textbooks at population 2. This would be in contrast to top achieving countries. The emphasis in textbooks as cited earlier, however, seems to relegate the arithmetic to lesser importance. Yet the arithmetic topics are present.
- ◆ There are serious problems of alignment between curriculum guides and textbooks for the consortium as a whole. For some topics such as complex numbers few district guides intend them (31% for complex numbers) but most of the textbooks cover them (67% for complex numbers). For other topics such as properties of common and decimal fractions most districts intend them (81%) and few textbooks cover them (17%). Such a lack of alignment makes implementation difficult. A similar lack of alignment exists in science.
- ◆ The fact that the percentage of districts intending coverage of a topic varies considerably from 100% indicates the consortium is more a collection of individual districts rather than a group with common content goals.
- ◆ Consistent with the physical science emphasis cited earlier is the fact that most districts intend physics and chemistry topics to be covered and the textbooks also contain them as well.

- ◆ In mathematics, the pattern of how many and which topics are introduced in the middle grades in the FIW is more consistent with the TIMSS world and in particular the top achieving countries than with the US as a whole. Grades 7 and 8, however, suggest some differences. For example, certain topics such as 2-D and 3-D geometry are introduced in grades 4-6 in FIW as is done by most countries worldwide and not in grades 1-3 as is done in the US. Perhaps this later introduction permits a more vigorous and focused coverage of these topics than trying to introduce them earlier with so many other topics. On the other hand, congruence and similarity is introduced in grades 4-6 both in the US and FIW but is not introduced worldwide until grades 7-8. This raises questions both about the nature of the spiral curriculum and about the appropriate sequencing of topics. Similar examples exist for science.
- ◆ Displays 22 and 23 indicate the topics intended for coverage at each grade and the percentage of districts who intend them. The repetitive nature of the FIW curriculum both in science and mathematics is remarkable.
- ◆ Displays 24-31 contrast the FIW, US and International core for topics and performance expectations at populations 1 and 2. In mathematics the US and FIW look very similar but different from the international core especially by its inclusion of arithmetic at population 2. In science, FIW is very different from the US and even the TIMSS world by having a very clear focus on physics and chemistry.

THE IMPLEMENTED CURRICULUM

Patterns in the data concerning the intended curriculum in the Consortium, come to fruition in the analyses of teaching practices. Here we note that:

- ◆ In Mathematics at eighth grade
 - ◆ The Consortium teachers clearly emphasize algebra (linear equations) and geometry (2D geometry basics) more than is common for their US peers, an emphasis that appears to be aided by the fact that the textbooks themselves provide more material in these areas. This is in spite of district guides that are unfocused and continue to call for coverage of most arithmetic topics – a call apparently unheeded by most teachers at least in terms of emphasis.
 - ◆ It is interesting that FIW teachers still spend a sizable amount of their instructional time on fractions and decimals, but it is less time spent by US teachers as a whole. This is not consistent with most of the A+ countries.
 - ◆ FIW teachers do heed the call of district curriculum guides by teaching many topics including most of the arithmetic topics. In this regard, they are like other US

teachers.

- ◆ FIW teachers, however, spend less time on whole number arithmetic, fractions, decimals and percentages than their counterparts in the US as a whole.
- ◆ Included among topics taught by at least 90% of FIW teachers are congruence and similarity, and equations (consistent with Japan) which are topics not among those taught by 90% of other US teachers. Functions, another part of algebra is taught by at least 75% of FIW teachers.
- ◆ Measurement units and processes is also a topic taught by 90% or more of FIW teachers (only 75-89% for other US teachers). Measurement and Geometry were the two worst areas of achievement for US students as a whole.
- ◆ What seems to be missing among the five most emphasized topics in FIW classes when contrasted to Japan and other top achieving countries are the topics of functions and other parts of geometry such as congruence and similarity.
- ◆ The profile of emphasis across topics by FIW teachers is more consistent with US algebra classes and the top achieving countries (except for the absence of some geometry topics) than it is with US regular or pre-algebra classes. Perhaps this is in part because of the high percentage of FIW students in the algebra track (almost half by consortium estimates). But it also reflects that classes not in the algebra track are emphasizing more algebra and less arithmetic.
- ◆ FIW mathematics teachers use fewer different instructional activities such as review, lecture or seatwork in teaching their classes on a given day than US teachers in general.
- ◆ In Science at eighth grade
 - ◆ Consortium teachers emphasize physical sciences more in their instruction, and they appear to have textbooks that aid them in this choice as well as district level intentions that point them in that direction and are very focused on a few topics.
 - ◆ FIW teachers spend less time on average on all earth science topics and on environmental topics and more on types and properties of matter and chemical changes than do US teachers as a whole.
 - ◆ FIW teachers also teach fewer topics over the year than do other US teachers. This is consistent with the district curriculum guides.
 - ◆ Included among the topics taught by at least 90% of FIW teachers are types and properties of matter, energy (types, sources and conversions) and chemical changes – none of which are taught by at least 90% of US teachers as a whole.

GENERAL OBSERVATIONS AND HUNCHES

◆ In Mathematics at eighth grade

- ◆ FIW district curriculum guides are similar to the rest of the US – unfocused and repetitive. At eighth grade the textbooks are similarly broad based in the number of topics covered. FIW teachers also teach nearly as many topics as other US teachers do.
- ◆ However, the textbooks used have a content profile in terms of emphasis that is more consistent with the top achieving countries (focused on algebra and geometry and not arithmetic). Not surprisingly the FIW teachers teach with a similar emphasis (either in terms of more teachers teaching a topic or a greater percentage of time spent on the topic). They teach more on equations, functions, slope, 2D geometry basics, transformations and congruence and similarity than other US teachers.
- ◆ A hunch: Here the story may be that with the type of student attending school in these districts and the subject matter background of the teachers involved that the unfocused and repetitive nature of the intended curriculum is overcome in the classroom by teachers and textbooks (although teaching or containing all of the topics) whose emphasis is on the rigorous content found in the top achieving countries. Perhaps the laundry list of topics including most of the standard arithmetic topics is only for review and, therefore, dealt with briefly or is embedded in the algebra and geometry being taught.

◆ In Science at eighth grade

- ◆ The story in science is simpler. The district curriculum guides are focused and less repetitive and so are the textbooks and the teachers. Less is more seems to be a curricular principle underlying science for the consortium.
- ◆ The focus in eighth grade is chemistry and physics. This is true in guides, textbooks and in terms of what teachers teach. What is intended, found in textbooks and implemented is consistent with many of the top achieving countries.
- ◆ The alignment in science is strong.

DISPLAYS

Display 1. Countries with mean TIMSS student achievement scores for 13-year-olds significantly higher than the US by order of achievement, with average scores in parentheses. The higher(A)- and highest(A+)-achieving countries are bracketed.

	MATHEMATICS		SCIENCE	
Group A+	Singapore (643)		Singapore (607)	Group A+
	Korea (607)		Czech Republic (574)	
	Japan (605)		Japan (571)	
	Hong Kong (588)		Korea (565)	
	Belgium Fl (565)		Bulgaria (565)	
Group A	Czech Republic (564)		Netherlands (560)	Group A
	Slovak Republic (547)		Slovenia (560)	
	Switzerland (545)		Austria (558)	
	Netherlands (541)		Hungary (554)	
	Slovenia (541)		US (534)	
	Bulgaria (540)			
	Austria (539)			
	France (538)			
	Hungary (537)			
	Russian Federation (535)			
	Australia (530)			
	Ireland (527)			
	Canada (527)			
	Belgium Fr (526)			
	Sweden (519)			
	US (500)			

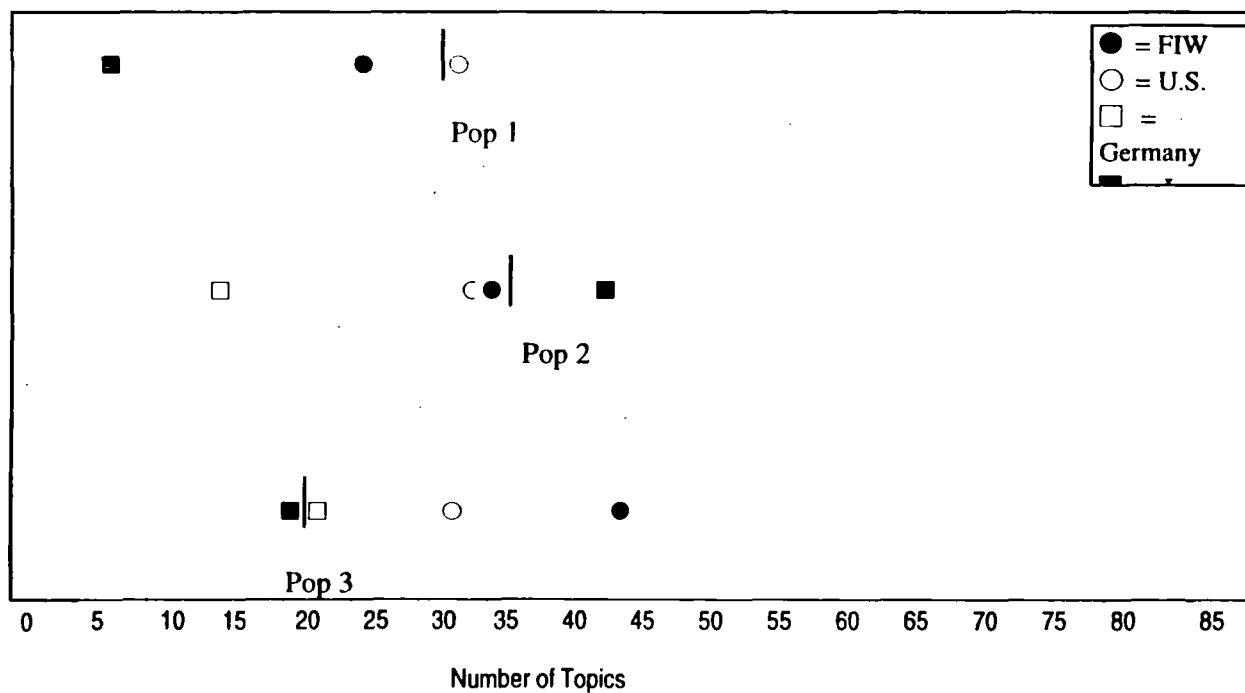
Display 2: Number of Curriculum Guides and Textbooks in the First in the World Analyses.

	<i>Mathematics</i>			<i>Science</i>		
	Population			Population		
	1	2	3	1	2	3
<i>Curriculum Guides</i>	15	16	2	16	15	2
<i>Textbooks</i>	5	6	0	3	6	1

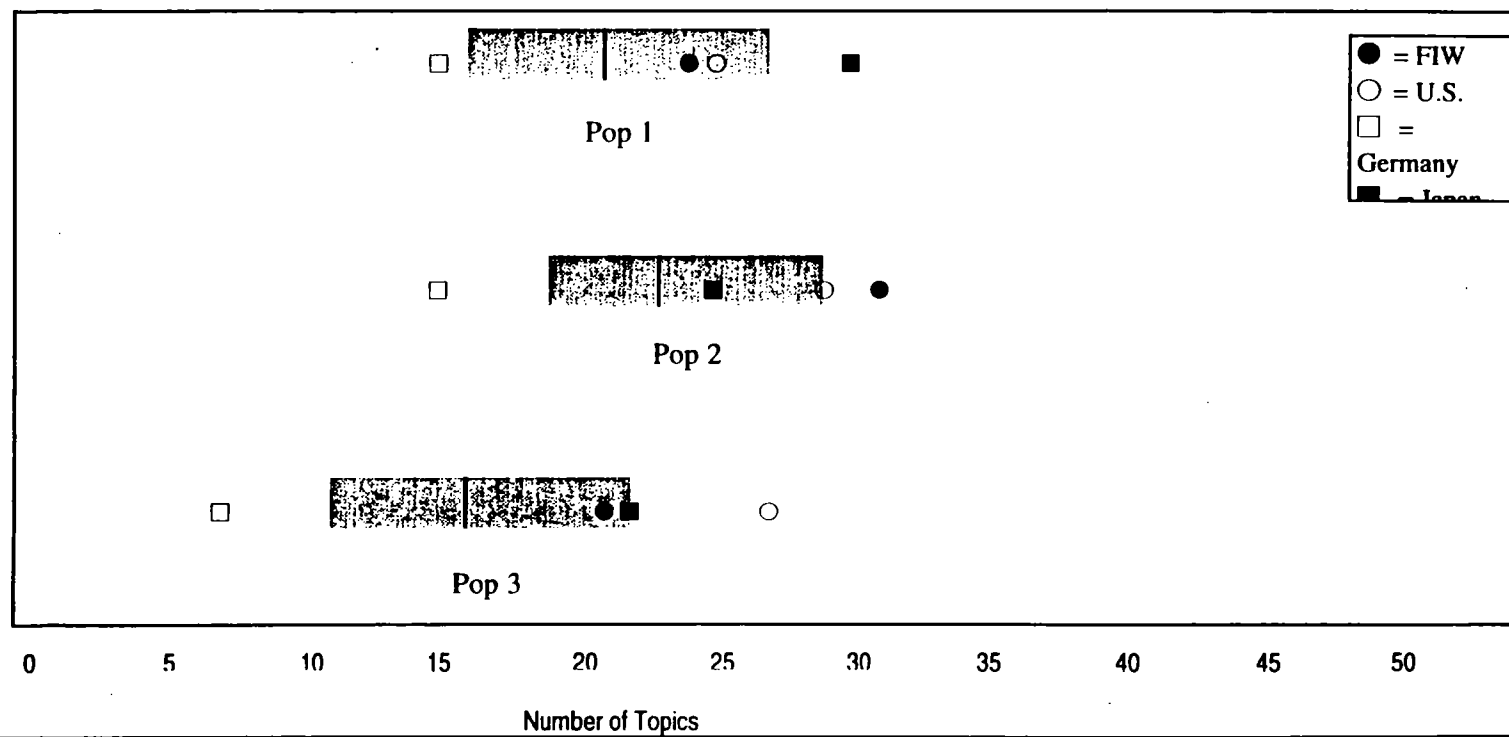
Display 3: Number of GTTM forms covering each grade.

Grade	1	2	3	4	6	7	8	10	11	12
<i>Mathematics</i>	#	12	12	11	11	10	10	5	5	5
<i>Science</i>	#	12	12	12	11	10	13	6	6	5

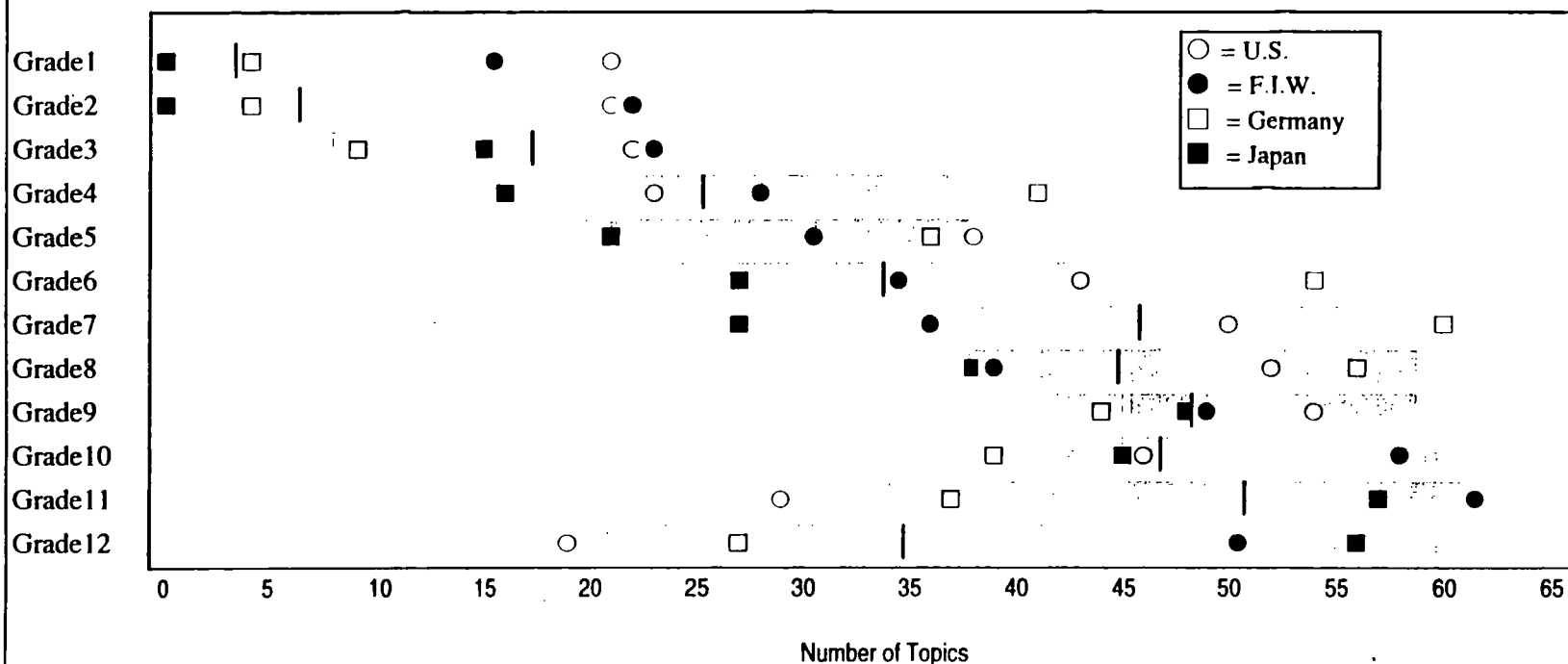
Display 4. Number of science topics intended at the TIMSS tested populations.



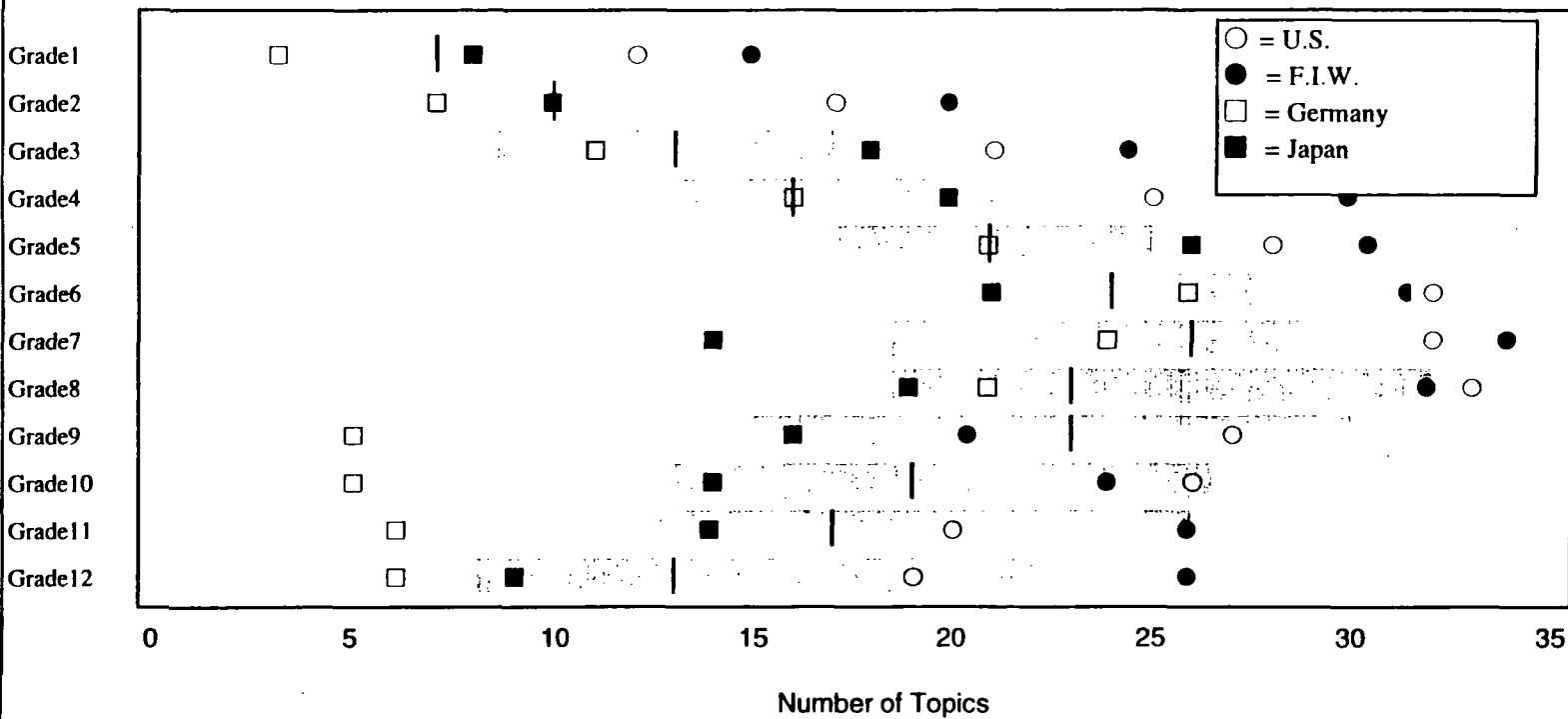
Display 5. Number of mathematics topics intended at the TIMSS tested populations.



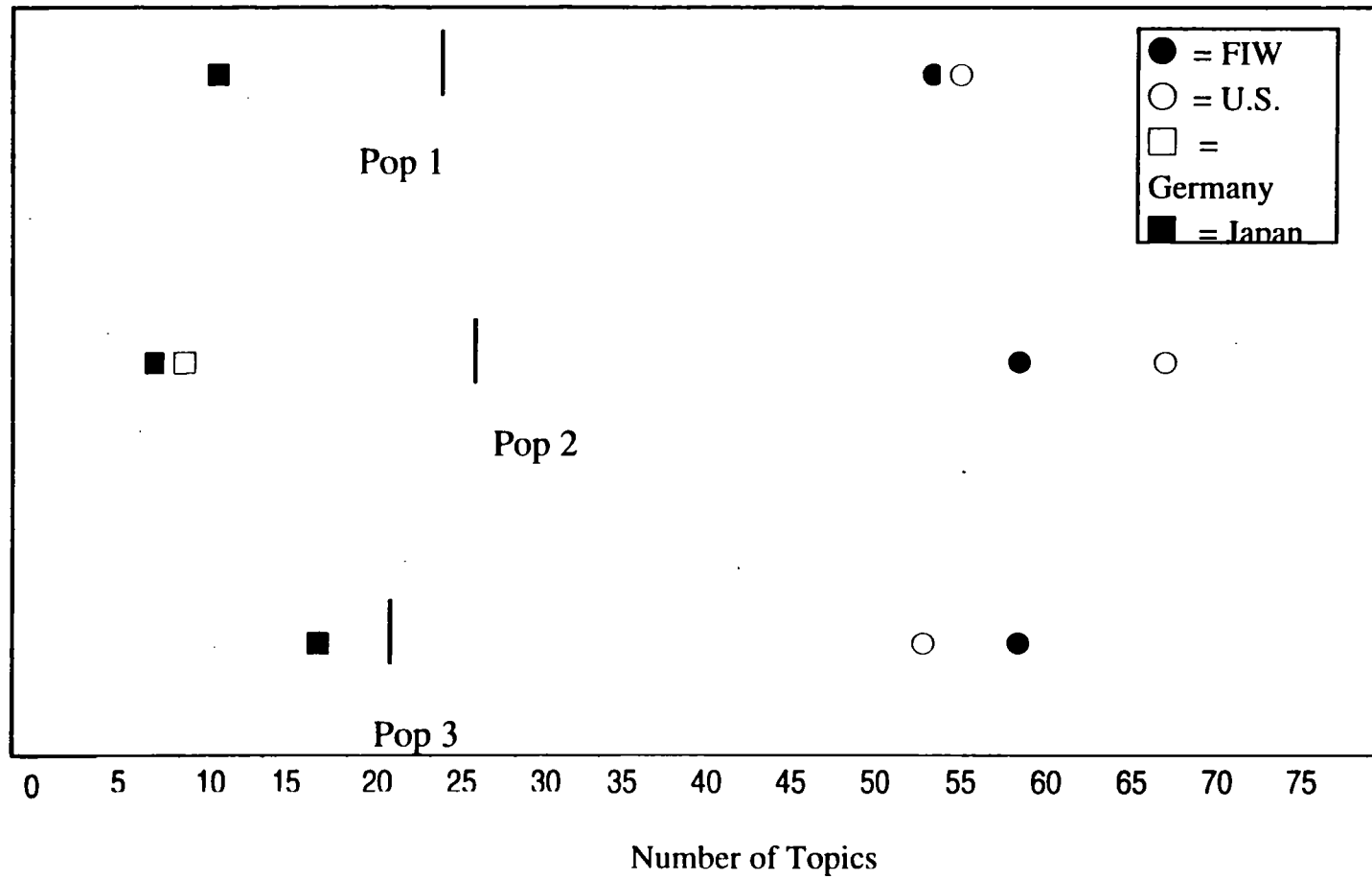
Display 6. Number of science topics intended. On average, the states indicated plans to cover so many topics that the U.S. composite shows more science topics generally covered than the median for other countries. The number of topics to be covered dropped significantly only in grades 10, 11, and 12 (below the 25th percentile in grades 11 and 12). We appear, in these later grades, to have abandoned more general sciences approaches for specific courses — chemistry, physics, etc. [The gray bars show how many mathematics topics we intended to cover at each grade in the TIMSS countries. The bars extend from the 25th percentile to the 75th percentile among countries. The black line indicates the median number of topics at each grade. We marked the U.S., Germany, and Japan individually.]



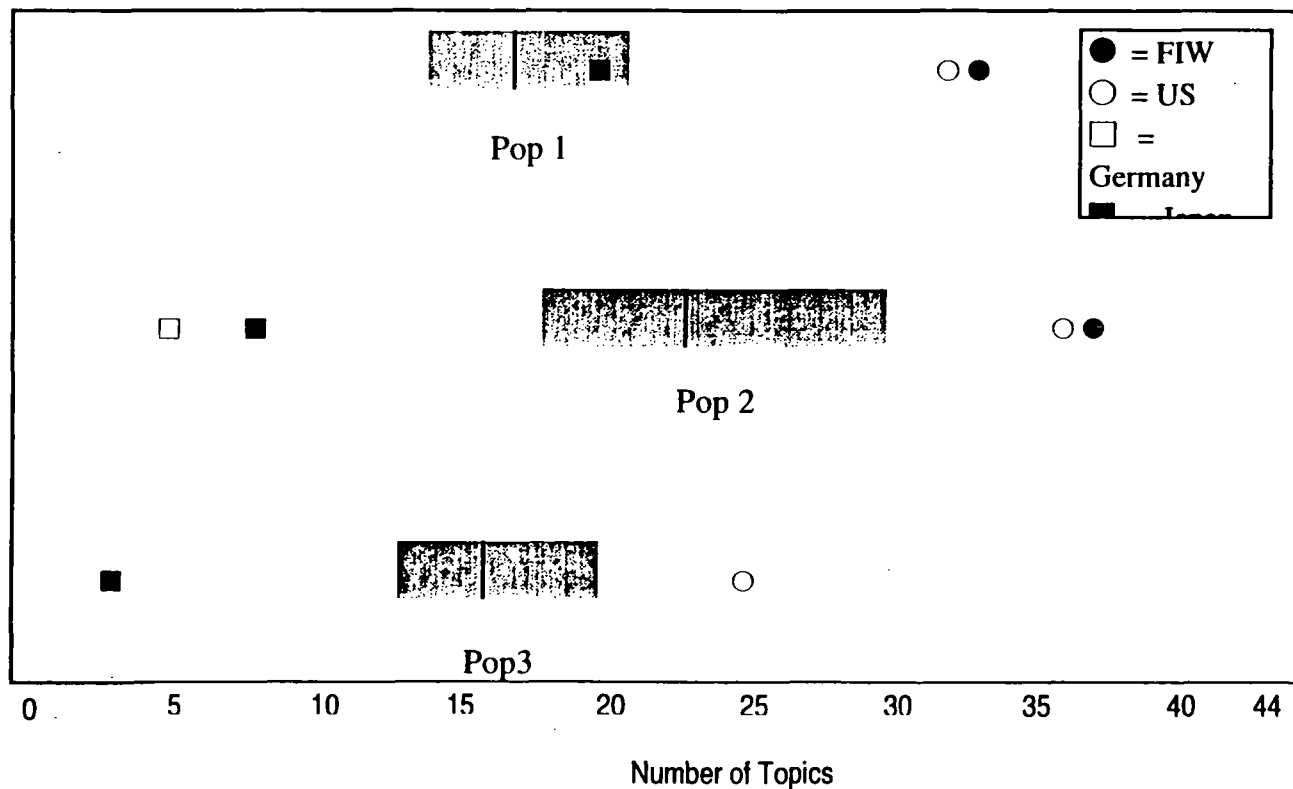
Display 7. Number of mathematics topics intended. On average, the states indicated plans to cover so many topics that the U.S. composite shows an intention to cover more mathematics topics than the majority of other countries. The number of topics to be covered dropped below the 75th percentile internationally only in grades 9, 10, 11 and 12 when we typically teach mathematics in specific courses — algebra, geometry, etc. [The gray bars show how many mathematics topics we intended to cover at each grade in the TIMSS countries. The bars extend from the 25th percentile to the 75th percentile among countries. The black line indicates the median number of topics at each grade. We marked the U.S., Germany, and Japan individually.]



Display 8. Number of science textbook topics.

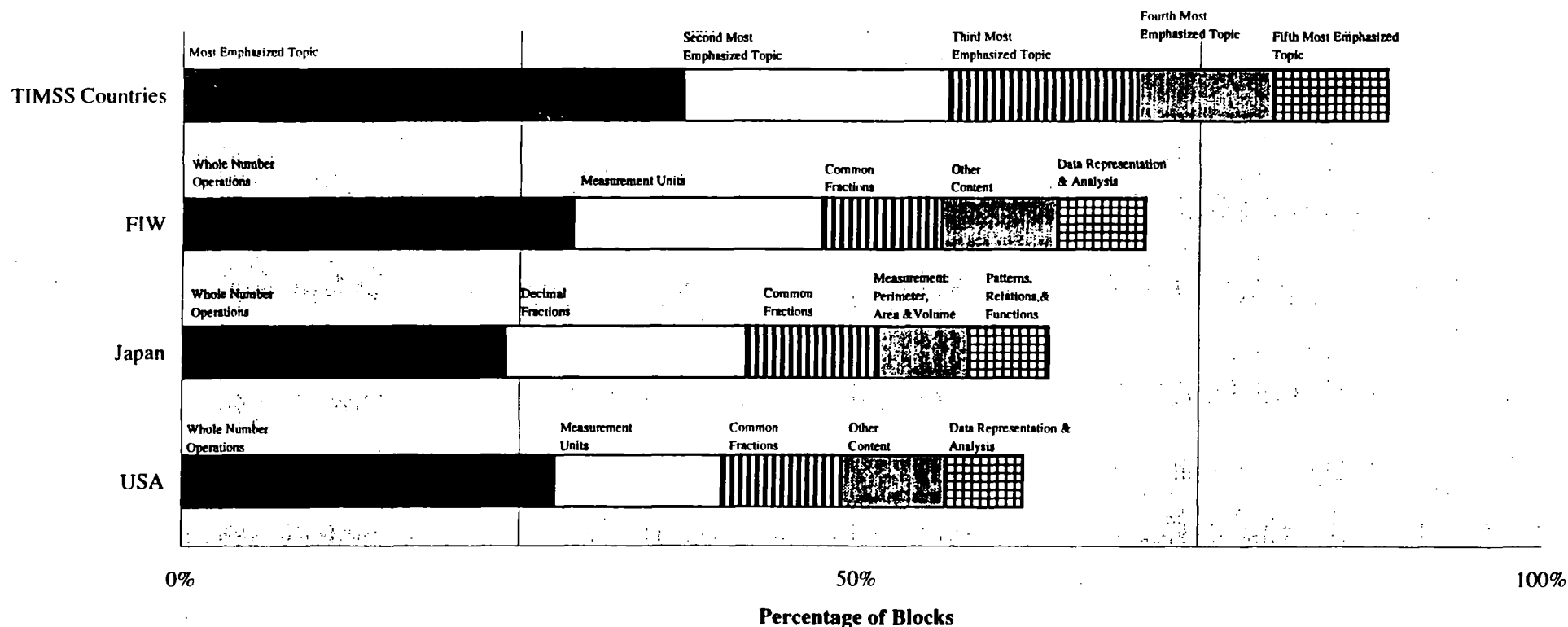


Display 9. Number of mathematics textbook topics.

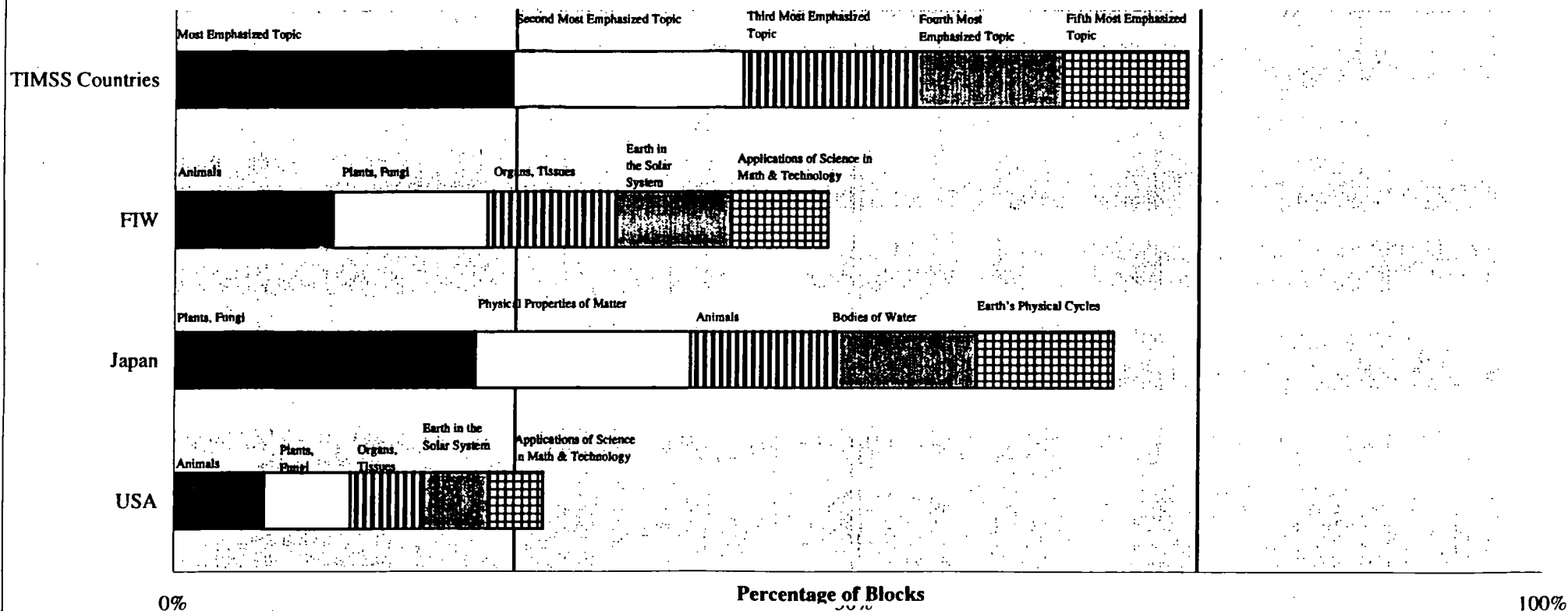


Note: The United States and FIW are very close in their values for population 1 and 2

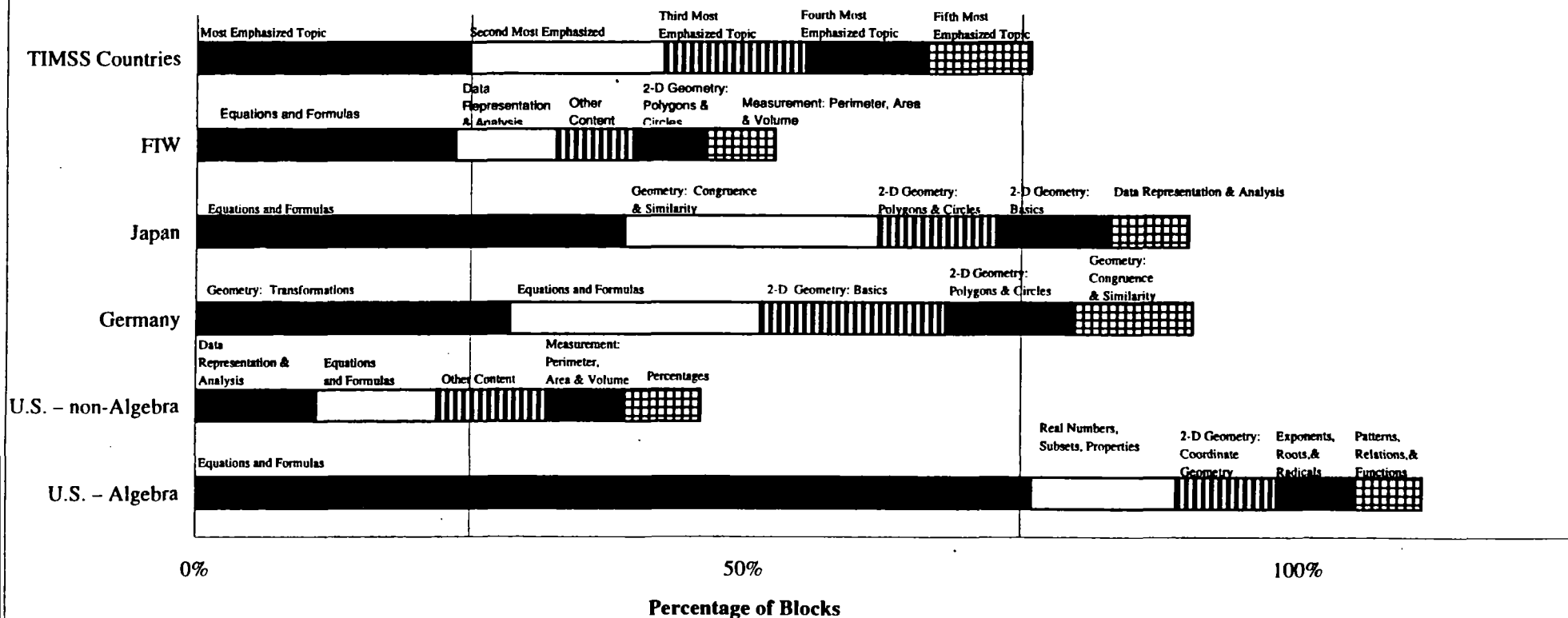
Display 10. The five topics emphasized most in Population 1 mathematics textbooks. At Population 1, U.S. mathematics books were somewhat focused but not as much so as was true internationally. For the upper grade of Population 1, the five most emphasized topics accounted for about 60 percent of U.S. and Japanese mathematics textbooks on average. This was far lower than the international average of over 85 percent. In the U.S., one of the emphasized "topics" was 'other content,' a combination of an unknown number of topics not in the TIMSS mathematics framework. [Data collection partitioned each textbook into "blocks" — small segments used as units of analysis. Each bar shows the cumulative percentage of textbook "blocks" for the five topics with the largest percentages of blocks devoted to them. These data are country or multi-country averages for mathematics textbooks at the upper grade of Population 1 (U.S. grade 4). Bars are for the average over all TIMSS countries, for Japan, and for the U.S. German textbook data were not available at this level. For the U.S. and Japan, each segment's specific TIMSS framework topic (e.g., 'whole number operations') could be determined and is shown. Internationally, the five topics varied among countries. We show them only as most emphasized (highest percentage of blocks), second most emphasized, etc.]



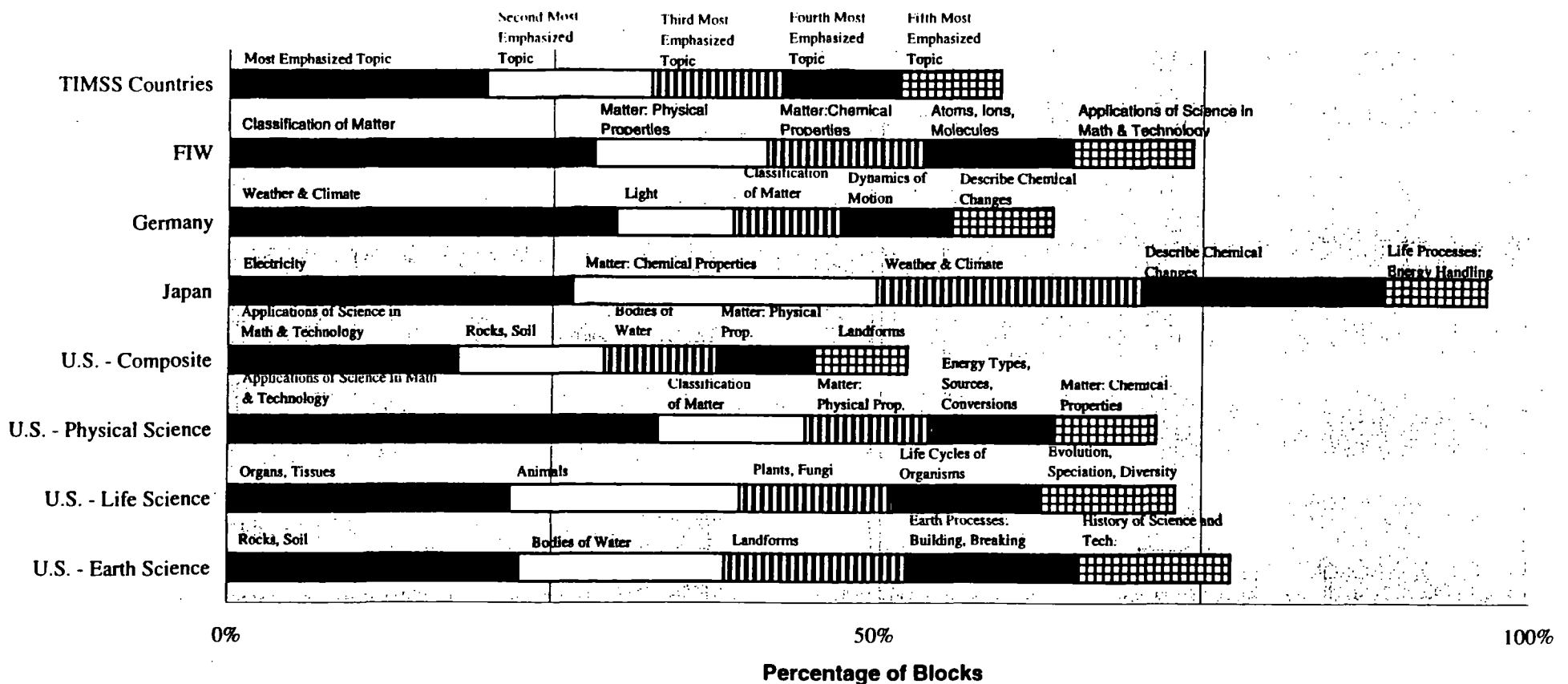
Display 11. The five topics emphasized most in Population 1 science textbooks. At Population 1, U.S. science books were comparatively unfocused. On average the five most emphasized topics accounted for just over 25 percent of U.S. science textbooks compared to 70 to 75 percent internationally and for Japan. [Data collection partitioned each textbook into "blocks" — small segments used as units of analysis. Each bar shows the cumulative percentage of textbook "blocks" for the five topics with the largest percentages of blocks devoted to them. These data are country or multi-country averages for science textbooks at the upper grade of Population 1 (U.S. grade 4). Bars are for the average over all TIMSS countries, for Japan, and for the U.S. German textbook data were not available at this level. For the U.S. and Japan, each segment's specific TIMSS framework topic (e.g., 'whole number operations') could be determined and is shown. Internationally, the five topics varied among countries. We show them only as most emphasized (highest percentage of blocks), second most emphasized, etc.]



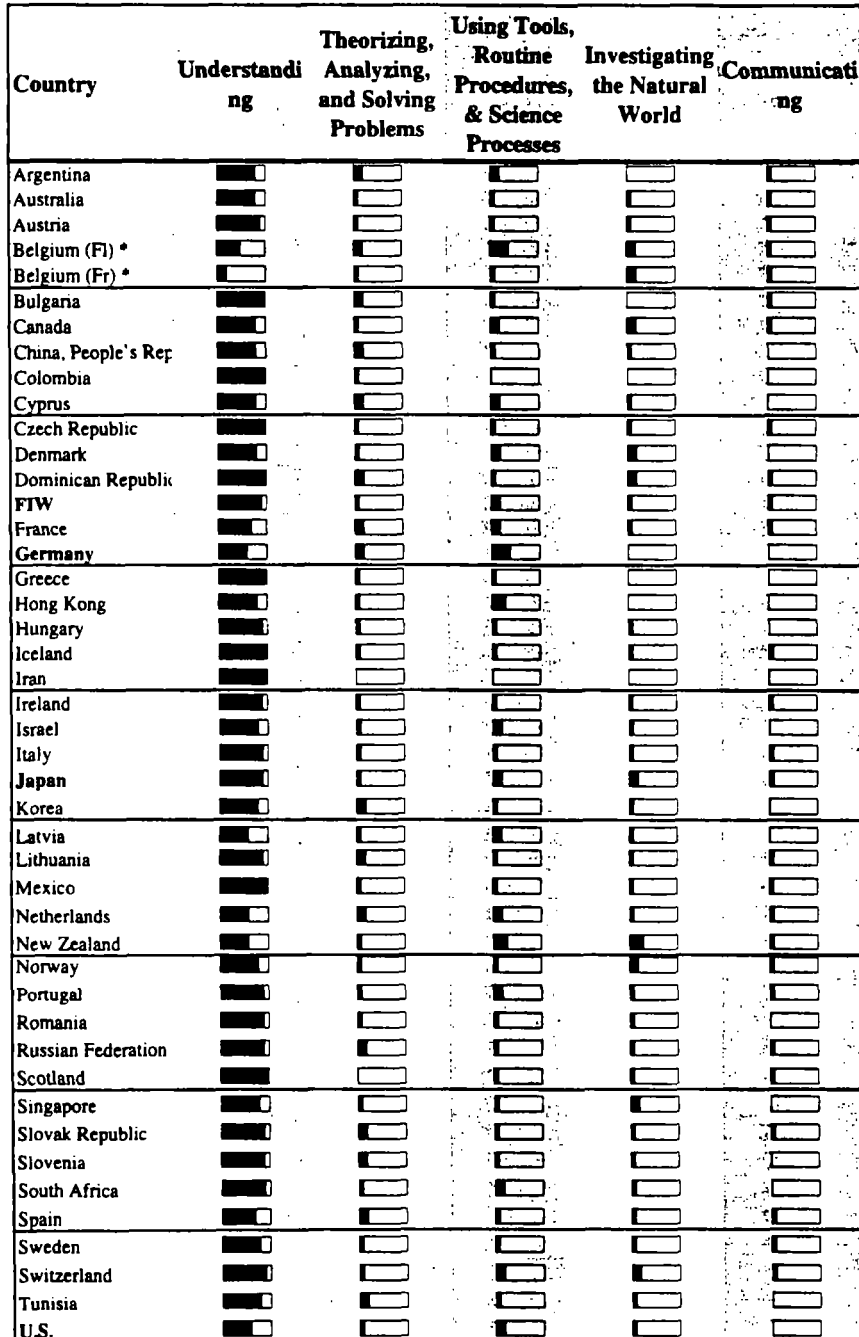
Display 12. The five topics emphasized most in Population 2 mathematics textbooks. At Population 2, U.S. mathematics books, other than Algebra I textbooks, were much less focused than their international counterparts, or even than Population 1 mathematics textbooks. Only about half their content was accounted for by the five most emphasized topics in comparison to an international average of about 75 percent. One of the emphasized U.S. "topics" was again the catch-all 'other content' category which makes the degree of focus portrayed misleadingly high. U.S. Algebra I textbooks were highly focused with all content accounted for by the five most emphasized topics. [Data collection partitioned each textbook into "blocks" — small segments used as units of analysis. Each bar shows the cumulative percentage of textbook "blocks" for the five topics with the largest percentages of blocks devoted to them. These data are country or multi-country averages for mathematics textbooks at the upper grade of Population 2 (US grade 8). Bars are for the average over all TIMSS countries, for Japan, Germany, and for the U.S. For the U.S., Germany, and Japan, each segment's specific TIMSS framework topic (e.g., 'equations and formulas') could be determined and is shown. Internationally, the five topics varied among countries. We show them only as most emphasized (highest percentage of blocks), second most emphasized, etc.]



Display 13. The five topics emphasized most in Population 2 science textbooks. At Population 2, U.S. science books, other than single-area textbooks, were much less focused than their international counterparts. About 50 percent of their content was accounted for by the five most emphasized topics compared to an international average of about 60 percent. US single-area textbooks in physical science, life science, or earth science —were highly focused with the five most emphasized topics accounting for more of the books together than was true internationally. [Data collection partitioned each textbook into "blocks" — small segments used as units of analysis. Each bar shows the cumulative percentage of textbook "blocks" for the five topics with the largest percentages of blocks devoted to them. These data are country or multi-country averages for science textbooks at the upper grade of Population 2 (U.S. grade 8). Bars are for the average over all TIMSS countries, for Japan, Germany, and for the U.S. For the U.S., Germany, and Japan, each segment's specific TIMSS framework topic (e.g., 'rocks and soil') could be determined and is shown. Internationally, the five topics varied among countries. We show them only as most emphasized (highest percentage of blocks), second most emphasized, etc.]



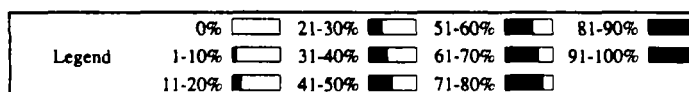
Display 14. Textbook space devoted to major Population 2 science performance expectations. U.S. textbook performance expectations in grade 8 science emphasized 'understanding' almost to the exclusion of all other expectations except 'using tools, routine procedures, and science processes.' This emphasis on 'understanding' was typical internationally. [The bars represent the percentage of blocks devoted to each of the five most inclusive performance expectation categories in science textbooks for the upper grade of Population 2 (grade 8). Bars represent the average over all TIMSS countries and the U.S., Germany, and Japan specifically.]



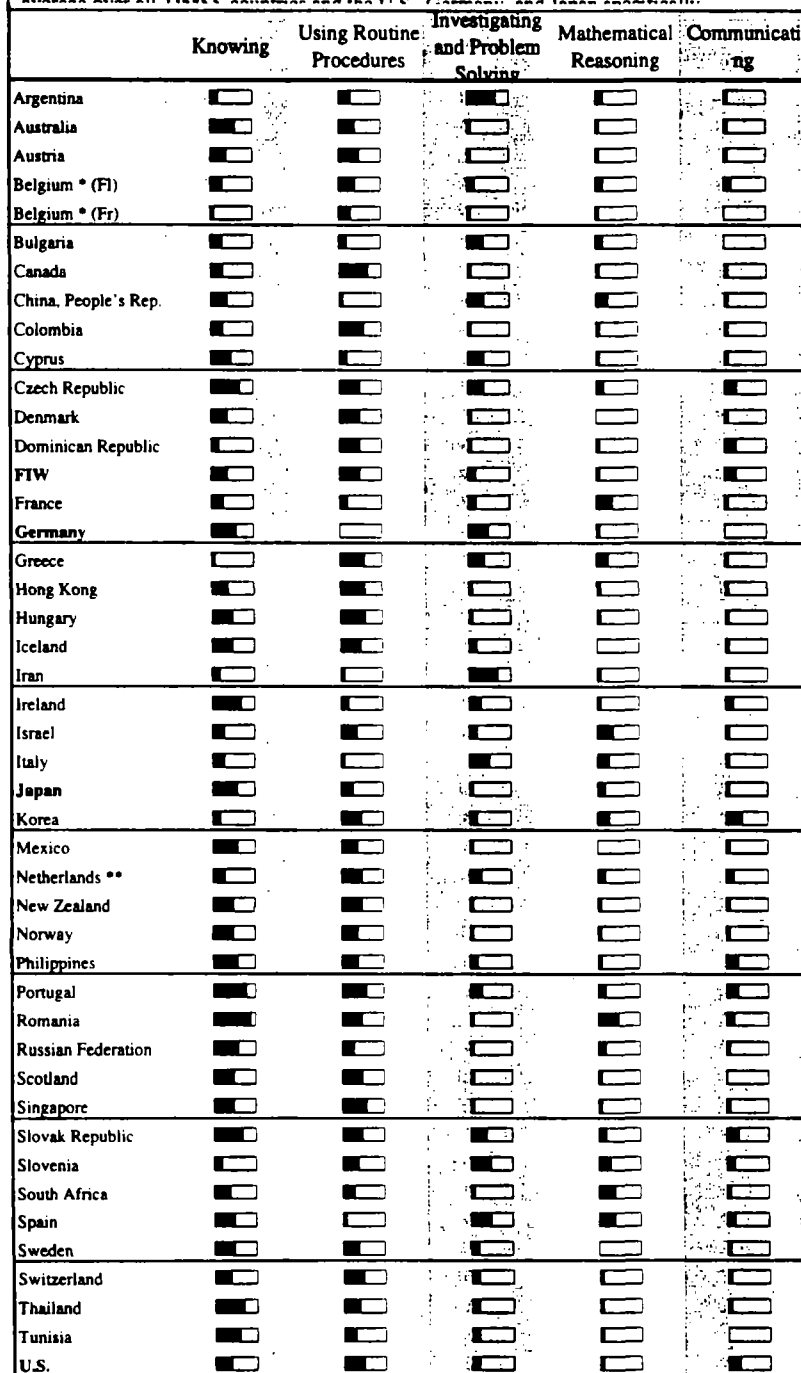
* The national Research Coordinators of Belgium have collected data only from curriculum guides. Due to the great level of detail in these guides, and their extensive use, data from these are compared in this display with the textbook data supplied from all other countries.

Note: Percentages across all categories do not sum to 100% because of the multiple codings associated with some blocks.

Missing data: Philippines, Thailand; Germany did not code Biology text.



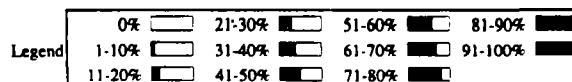
Display 15. Textbook space devoted to major Population 2 mathematics performance expectations. U.S. textbook performance expectations in grade 8 mathematics emphasized 'knowing' and 'using routine procedures' (including more complex procedures such as estimating and graphing) with some additional emphasis on communication. This pattern was more balanced than its international counterpart and may reflect more depth of attention to reform concerns to make more and more complex demands of students. Germany showed even more emphasis on 'knowing' but also more on 'investigating and problem solving.' [The bars represent the percentage of blocks devoted to each of the five most inclusive performance expectation categories in mathematics textbooks for the upper grade of Population 2 (grade 8). Bars represent the average over all TIMSS countries and the U.S. Germany and Japan specifically.]



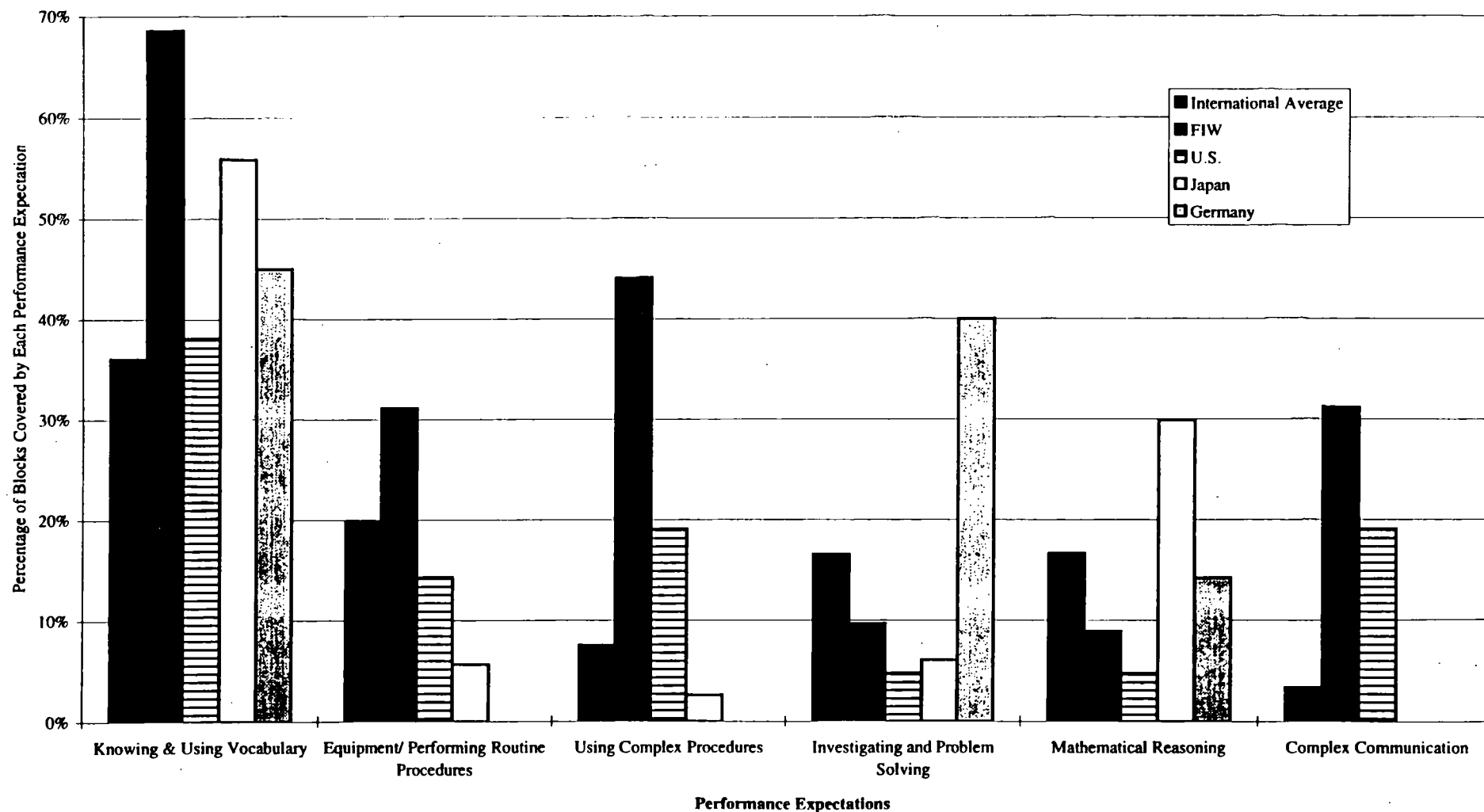
- * The national Research Coordinators of Belgium have collected data only from curriculum guides. Due to the great level of detail of the guides, and their extensive use, data from these are compared in this display with the textbook data supplied from all other countries.
- ** Netherlands' sample did not meet the 50% market coverage criterion for Populations 1 and 2.

Note: Percentages across all categories do not sum to 100% because of the multiple codings associated with

Missing data: Latvia, Lithuania

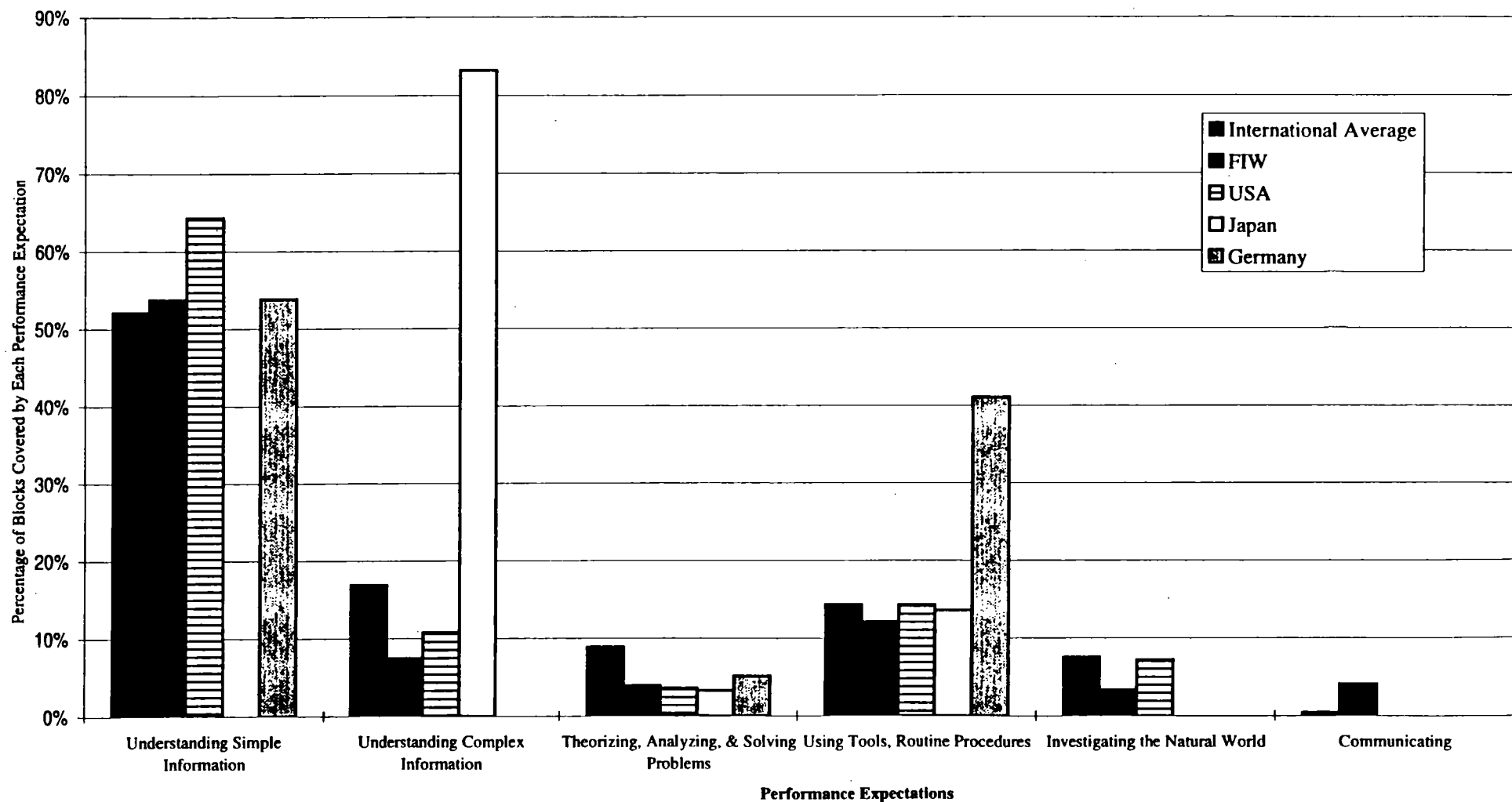


Display 16. Grade 8 mathematics textbook performance expectations for 'Congruence and Similarity.' All textbooks tend to use the least demanding expectation the most, except for Germany's use of 'investigating and problem solving' and Japan's use of 'mathematical reasoning.' U.S. textbooks make some use (more than the international average) of complex procedures and communication. [The columns represent the average percentage of grade 8 mathematics textbook blocks indicating 'congruence and similarity' that also indicate the column's performance expectation. We give data for the international average, the U.S., Germany, and Japan.]



* Missing bars indicate that the performance expectation was not included for this topic.

Display 17. Grade 8 science textbook performance expectations for 'Chemical Changes.' All textbooks tend to use the least demanding expectation almost exclusively, except that Japan used only 'understanding complex information' rather than 'understanding simple information.' Germany made more use of routine procedures. In all cases the emphasis was almost entirely on understanding and on using routine procedures. [The columns represent the average percentage of grade 8 science textbook blocks indicating 'chemical changes' that also indicate the column's performance expectation. We give data for the international average, the U.S., Germany, and Japan.]



* Missing bars indicate that the performance expectation was not included for this topic

Display 18. The Percentage of Mathematics Guides and Textbooks from 'First in the World' Covering the Content Areas

	Curriculum Guides		Textbooks	
	pop1	pop2	pop1	pop2
Numbers				
Whole Number				
Meaning	93%	88%	100%	100%
Operations	100%	88%	100%	100%
Properties of Operations	87%	94%	100%	100%
Fractions & Decimals				
Common Fractions	93%	94%	100%	100%
Decimal Fractions	93%	94%	100%	100%
Relation. of Common & Decimal Fractions	87%	94%	100%	100%
Percentages	93%	100%	60%	100%
Properties of Common & Decimal Fractions	87%	81%	60%	17%
Integer, Rational & Real Numbers				
Integers & Their Properties	47%	94%	100%	100%
Rational Numbers & Their Properties	20%	100%	60%	100%
Real Num., Their Subsets & Properties	20%	88%	40%	83%
Other Numbers & Number Concepts				
Binary arith. and/or Other Num. Bases	20%	25%	20%	67%
Exponents, Roots & Radicals	40%	100%	40%	100%
Complex Numbers & Their Properties	13%	31%	0%	67%
Number Theory	60%	94%	100%	100%
Systematic Counting	13%	50%	100%	83%
Estimation & Number Sense Concepts				
Estimating Quantity & Size	73%	63%	100%	67%
Rounding & Significant Figures	73%	69%	100%	83%
Estimating Computations	87%	69%	100%	83%
Exponents & Orders of Magnitude	60%	88%	60%	17%
Measurement				
Units	93%	69%	100%	83%
Perimeter, Area & Volume	87%	94%	100%	100%
Estimation & errors	73%	63%	100%	83%
Geometry: Position, Visualizat. & Shape				
1-D & 2-D Coordinate Geometry	73%	88%	100%	100%
2-D Geometry: Basics	93%	94%	100%	100%
2-D Geometry: Polygons & Circles	80%	100%	100%	100%
3-D Geometry	67%	81%	100%	83%
Vectors	0%	31%	20%	17%
Geometry: Symm., Congruence & Similarity				
Transformations	67%	81%	100%	100%
Congruence & Similarity	60%	75%	80%	100%
Constructions w. Straightedge & Compass	13%	38%	40%	83%
Proportionality				
Concepts	47%	88%	80%	100%
Problems	33%	88%	60%	100%
Slope & Trigonometry	0%	63%	20%	100%
Linear Interpolation & Extrapolation	0%	13%	0%	0%
Functions, Relations, & Equations				
Patterns, Relations & Functions	67%	94%	100%	100%
Equations & Inequalit., Graphs & Solut.	87%	100%	80%	100%
Data Representat., Probabil., & Statist.				
Data Representation & Analysis	87%	88%	100%	100%
Uncertainty & Probability	47%	81%	100%	100%
Elementary Analysis				
Infinite Processes	13%	19%	20%	67%
Change	0%	6%	20%	0%
Validation & Structure				
Logic & Proof	40%	69%	60%	100%
Set Theory & Axiomatic Systems	27%	63%	60%	100%
Other Content*	27%	6%	80%	83%

Display 19. The Percentage of Science Curriculum Guides and Textbooks from 'First in the World' Covering the Content Areas

	Curriculum Guide		Textbook	
	pop1	pop2	pop1	pop2
Earth Sciences				
Earth Features				
Composition	21%	23%	33%	67%
Land forms	43%	8%	100%	100%
Bodies of water	43%	23%	100%	83%
Atmosphere	36%	31%	67%	83%
Rocks, soil	21%	0%	67%	83%
Ice forms	7%	0%	33%	67%
Earth Processes				
Weather & climate	57%	38%	100%	83%
Physical cycles	50%	8%	100%	50%
Building, breaking	7%	15%	67%	50%
History	21%	23%	67%	67%
Earth in the Universe				
Earth in the solar system	57%	31%	100%	100%
Planets other than earth	29%	8%	100%	100%
Beyond the solar system	29%	8%	67%	83%
Evolution of the universe	21%	8%	33%	67%
Life Sciences				
Diversity, Organ., Str. of Living Things				
Plant, fungi types	64%	54%	100%	100%
Animal types	71%	62%	100%	100%
Microorganism types	50%	23%	100%	67%
Organs, tissues	64%	46%	100%	83%
Cells	21%	31%	100%	67%
Life Proc. & Sys. Enabling Life Functions				
Organism energy handling	36%	46%	100%	100%
Organism sensing, responding	21%	38%	100%	50%
Biochemical processes in cells	0%	23%	67%	33%
Life Spirals, Genetic Continu/Diversity				
Life cycles of organisms	50%	38%	100%	67%
Reproduction of organisms	43%	31%	100%	33%
Variation, inheritance in organisms	14%	38%	33%	33%
Evolution, speciation, diversity	29%	23%	100%	50%
Biochemistry of genetics	7%	31%	33%	67%
Interactions of Living Things				
Biomes, ecosystems	36%	38%	67%	50%
Habitats & niches	29%	69%	100%	33%
Interdependence of living things	64%	54%	100%	67%
Animal & plant behavior	50%	54%	100%	50%
Human Biology & Health				
Human nutrition	14%	23%	100%	83%
Human diseases	21%	38%	67%	83%
Physical Sciences				
Matter				
Classification of matter	50%	77%	100%	100%
Physical properties of matter	64%	69%	100%	100%
Chemical properties of matter	43%	85%	100%	100%
Structure of Matter				
Atoms, molecules, ions	7%	62%	100%	100%
Macromolecules, crystals	7%	46%	33%	67%
Subatomic particles	0%	54%	33%	100%

Display 19. The Percentage of Science Curriculum Guides and Textbooks from 'First in the World' Covering the Content Areas

	Curriculum Guide		Textbook	
	pop1	pop2	pop1	pop2
Energy & Physical Processes				
Energy types, sources, conversions	21%	69%	100%	100%
Heat & temperature	36%	54%	67%	100%
Wave phenomena	7%	23%	67%	67%
Sound & vibration	21%	23%	100%	67%
Light	43%	31%	100%	83%
Electricity	21%	69%	100%	83%
Magnetism	21%	46%	33%	83%
Physical Transformations				
Describe physical changes of matter	29%	31%	67%	100%
Explain physical changes of matter	21%	15%	67%	83%
Kinetic-molecular theory	0%	15%	67%	67%
Quantum theory, fundamental particles	0%	0%	0%	50%
Chemical Transformations				
Describe chemical changes of matter	7%	69%	67%	100%
Explain chemical changes of matter	0%	46%	0%	67%
Rate of chemical change & equilibrium	0%	31%	33%	67%
Energy & chemical change	0%	15%	33%	67%
Organic & biochemical changes	0%	31%	0%	67%
Nuclear chemistry	0%	38%	0%	83%
Electrochemistry	0%	8%	0%	33%
Forces & Motion				
Types of forces	36%	62%	100%	100%
Time, space, motion	57%	62%	0%	67%
Dynamics of motion	21%	38%	0%	50%
Relativity theory	7%	23%	0%	17%
Fluid behavior	21%	15%	33%	33%
Science, Technology, & Mathematics				
Nature or Conceptions of Technol.	43%	62%	67%	100%
Interactions of Sci, Math, & Technol.				
Mathe, Sci influence on Sci	21%	23%	33%	67%
Science applications in Math, Technol.	21%	38%	100%	83%
Interactions of Sci, Technol. & Society				
Influence of Sci, Technol. on Society	50%	46%	100%	100%
Influence of Society on Sci, Technol.	21%	38%	67%	83%
History of Sci & Technol.	29%	38%	100%	100%
En' tal & Resource Issues Related to Sci				
Pollution	57%	77%	67%	100%
Land, water, sea resource conservation	43%	62%	100%	83%
Material & energy resource conservation	36%	69%	100%	83%
World human population	36%	23%	0%	33%
Food production, storage	29%	23%	100%	67%
Effects of natural disasters	29%	23%	33%	67%
Nature of Science				
Nature of scientific knowledge, methods	86%	85%	100%	100%
The scientific enterprise	29%	31%	100%	100%
Science & Other Disciplines				
Science & Mathematics	21%	23%	100%	100%
Science & other disciplines	21%	23%	100%	67%

1 / 20. **Mathematics Topics Intended for Introduction in Various Stages.** Certain framework topics were typically introduced at various stages of schooling: grades 1-3, 4-6, 7-8, 9-12. This table presents a broad picture of the typical sequence of mathematics topics introduction (representing the aggregate and not individual countries) in the following countries: Singapore, Korea, Japan, Hong Kong, Belgium (Fl), Czech Republic, Slovak Republic, Switzerland, Netherlands, Slovenia, Bulgaria, France, Hungary, the Russian Federation, Australia, Ireland, Canada, Belgium (Fr), and Sweden. US data are shown next to the composite data.

G Group	Topics Which Half the Comparison Countries Intended for Introduction in or before Grade Group	Topics Which the US Intended for Introduction in Grade Group	Topics Which the FIW Intended for Introduction in Grade Group
Grades 1-3	Whole Number: Meaning Whole Number: Operations Whole Numbers: Properties of Operations Common Fractions Estimating Quantity & Size Estimating Computations Measurement Units Measurement: Perimeter, Area & Volume 2-D Geometry: Basics 2-D Geometry: Polygons & Circles Equations & Formulas	Whole Number: Meaning Whole Number: Operations Whole Numbers: Properties of Operations Common Fractions Decimal Fractions Relation of Common & Decimal Fractions Estimating Quantity & Size Rounding & Significant Figures Estimating Computations Measurement Units Measurement: Perimeter, Area & Volume Measurement: Estimation & Errors 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Transformations Patterns, Relations & Functions Equations & Formulas Data Representation & Analysis	Whole Number: Meaning Whole Number: Operations Whole Numbers: Properties of Operations Common Fractions Decimal Fractions Relation of Common & Decimal Fractions Systematic Counting Estimating Quantity & Size Rounding & Significant Figures Estimating Computations Measurement Units Measurement: Perimeter, Area & Volume Measurement: Estimation & Errors 2-D Geometry: Basics 2-D Geometry: Polygons & Circles Equations & Formulas Data Representation & Analysis
Grades 4-6	Decimal Fractions Relation of Common & Decimal Fractions Percentages Properties of Common & Decimal Fractions Negative Numbers, Integers, & Their Properties Number Theory Rounding & Significant Figures Measurement: Estimation & Errors 2-D Geometry: Coordinate Geometry 3-D Geometry Geometry: Transformations Constructions using Straightedge & Compass Proportionality Concepts Proportionality Problems Patterns, Relations & Functions Data Representation & Analysis	Percentages Properties of Common & Decimal Fractions Negative Numbers, Integers, & Their Properties Exponents, Roots & Radicals Number Theory Counting Exponents & Orders of Magnitude Geometry: Congruence & Similarity Constructions using Straightedge & Compass Proportionality Concepts Proportionality Problems Uncertainty & Probability	Percentages Properties of Common & Decimal Fractions Integers & Their Properties Exponents, Roots & Radicals Number Theory Exponents & Orders of Magnitude 2-D Geometry: Coordinate Geometry 3-D Geometry Geometry: Transformations Geometry: Congruence & Similarity Constructions using Straightedge & Compass Proportionality Concepts Proportionality Problems Patterns, Relations & Functions
Grades 7-8	Rational Numbers & Their Properties Real Numbers, Subsets & Properties Exponents, Roots & Radicals Exponents & Orders of Magnitude Geometry: Congruence & Similarity Proportionality: Slope & Trigonometry Validation & Justification	Rational Numbers & Their Properties Real Numbers, Subsets & Properties Proportionality: Slope & Trigonometry Linear Interpolation & Extrapolation Validation & Justification Structuring and Abstracting	Rational Numbers & Their Properties Real Num., Their Subsets & Properties Slope & Trigonometry Uncertainty & Probability
Grades 9-12	Complex Numbers & Their Properties Counting Vectors Uncertainty & Probability Infinite Processes Change Structuring and Abstracting Other Content	Complex Numbers & Their Properties Vectors Infinite Processes Change	Complex Numbers & Their Properties Linear Interpolation & Extrapolation Infinite Processes Change

* These two grades are important as typically representing TIMSS testing in Population 2

Display 21. Science Topics Intended for Introduction in Various Stages. Certain framework topics were typically introduced at various stages of schooling: grades 1-3, 4-6, 7-8, 9-12. This table presents a broad picture of the typical sequence of science topics introduction (representing the aggregate and not individual countries) in the following countries: Singapore, Czech Republic, Japan, Korea, Bulgaria, Netherlands, Slovenia, and Hungary. Data from the US are presented next to the composite data.

Grade Groups	Topics which half the comparison countries intended for introduction in or before grade group	Topics which the US intended for introduction in grade group	Topics which the FTW intended for introduction in grade group
1 to 3	Bodies of Water Atmosphere Rocks, Soil Weather and Climate Plant, Fungi Animals Organs, Tissues Classification of Matter Physical Properties Light	Bodies of Water Atmosphere Rocks, Soil Weather and Climate Physical Cycles Building and Breaking Plant, Fungi Animals Microorganisms Organs, Tissues Energy Handling Life Cycles Reproduction Interdependence of Life Nutrition Disease Physical Properties Electricity Physical Changes Types of Forces Time, Space, Motion Nature of Scientific Knowledge	Plant, Fungi Animals Life Cycles Habitats and niches Interdependence of Life Electricity
4 to 6	Composition Landforms Physical Cycles Earth in the Solar System Planets in the Solar System Microorganisms Cells Energy Handling Sensing and Responding Life Cycles Reproduction Biomes and Ecosystems Habitats and Niches Interdependence of Life Animal Behavior Nutrition Chemical Properties Heat and Temperature Electricity Magnetism Physical Changes Time, Space, Motion Applications of Science in Mathematics, Technology Pollution Conservation of Land, Water, and Sea Resources Conservation of Material and Energy Resources Science and Mathematics	Earth's History Earth in the Solar System Planets in the Solar System Beyond the Solar System Cells Variation and Inheritance Biomes and Ecosystems Habitats and Niches Classification of Matter Chemical Properties Atoms, Ions, Molecules Subatomic Particles Energy types, Sources, Conversions Heat and Temperature Wave Phenomena Sound and Vibration Explanations of Physical Changes Pollution Conservation of Land, Water, and Sea Resources Conservation of Material and Energy Resources Effects of Natural Disasters	Landforms Weather and Climate Physical Cycles Earth in the Solar System Planets in the Solar System Organs, Tissues Energy Handling Biomes and Ecosystems Nutrition Physical Properties Influence of Science, Technology on Society Influence of Society on Science, Technology Pollution Conservation of Land, Water, and Sea Resources

Display 21. (continued).

Grade Groups	Topics which half the comparison countries intended for introduction in or before grade group	Topics which the US intended for introduction in grade group	Topics which the FIW intended for introduction in grade group
7 to 8	Ice Forms Building and Breaking Earth's History Evolution, Speciation, Diversity Disease Atoms, Ions, Molecules Macromolecules, Crystals Subatomic Particles Energy types, Sources, Conversions Wave Phenomena Sound and Vibration Explanations of Physical Changes Chemical Changes Explanations of Chemical Changes Electrochemistry Types of Forces Dynamics of Motion Nature or Conceptions of Technology Influence of Mathematics, Technology in Science World Population	Chemical Changes Explanations of Chemical Changes Rate of Change and Equilibrium Energy and Chemical Change Organic and Biochemical Changes Nuclear Chemistry Electrochemistry Dynamics of Motion Fluid Behavior	Microorganism Cells Sensing and Responding Reproduction Disease Classification of matter Chemical properties of matter Atoms, Ions, Molecules Subatomic Particles Energy types, Sources, Conversions Explanations of Physical Changes Material & energy resource conservation Nature of scientific knowledge, methods
9 to 12	Beyond the Solar System Evolution of the Universe Biochemical Processes in Cells Variation and Inheritance Biochemistry of Genetics Kinetic Theory Quantum Theory and Fundamental Particles Rate of Change and Equilibrium Energy and Chemical Change Organic and Biochemical Changes Nuclear Chemistry Relativity Theory Influence of Science, Technology on Society Influence of Society on Science, Technology History of Science and Technology Food Production, Storage Effects of Natural Disasters Nature of Scientific Knowledge	Composition Landforms Biochemistry of Genetics Light Magnetism	Bodies of water Atmosphere Rocks, soil Ice forms Building and Breaking Earth's History Biochemical Processes in Cells Variation and Inheritance Evolution, speciation, diversity Biochemistry of Genetics Animal & plant behavior Macromolecules, crystals Heat & temperature Wave phenomena Sound & vibration Light Magnetism Describe physical changes of matter Kinetic Theory Quantum Theory and Fundamental Particles Describe chemical changes of matter Explain chemical changes of matter Rate of Change and Equilibrium Energy and Chemical Change Organic and Biochemical Changes Nuclear Chemistry Electrochemistry Types of forces Time, space, motion Dynamics of motion Relativity Theory Fluid behavior Nature or Conceptions of Technol. Influence of Science, Technology on Society Influence of Society on Science, Technology History of Science and Technology World human population Food Production, Storage Effects of Natural Disasters The Scientific Enterprise Science and Mathematics

Display 22. Content expectations in First in the World Schools as calculated by grade.

Grade 1		Grade 2		Grade 3		Grade 4	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Whole Number: Meaning	100	Whole Number: Meaning	100	Whole Number: Meaning	100	Whole Number: Operations	100
Whole Number: Operations	100	Whole Number: Operations	100	Whole Number: Operations	100	Properties of Operations	100
Measurement Units	100	Common Fractions	100	Common Fractions	100	Common Fractions	100
Estimating Quantity & Size	92	Estimating Quantity & Size	100	Estimating Quantity & Size	100	Estimating Quantity & Size	100
Data Representation & Analysis	92	Estimating Computations	100	Estimating Computations	100	Reasoning & Significant Figures	100
Common Fractions	75	Measurement Units	100	Measurement Units	100	Estimating Computations	100
Systematic Counting	67	Data Representation & Analysis	92	Perimeter, Area & Volume	100	Measurement Units	100
Estimating Computations	67	2-D Geometry: Polygons & Circles	83	Data Representation & Analysis	100	Perimeter, Area & Volume	100
2-D Geometry: Polygons & Circles	58	Properties of Operations	75	Properties of Operations	75	Estimation & errors	100
Patterns, Relations & Functions	58	Systematic Counting	75	Decimal Fractions	100	2-D Geometry: Basics	100
Properties of Operations	50	Perimeter, Area & Volume	67	Reasoning & Significant Figures	83	2-D Geometry: Polygons & Circles	100
Equations & Inequalities, Graphs & Solids	50	Reasoning & Significant Figures	58	Estimation & errors	83	Data Representation & Analysis	100
		Estimation & errors	58	2-D Geometry: Polygons & Circles	83	Whole Number: Meaning	91
		2-D Geometry: Basics	58	Relations of Common & Decimal Fractions	75	Decimal Fractions	91
		Patterns, Relations & Functions	58	Systematic Counting	75	1-D & 2-D Coordinate Geometry	91
		Decimal Fractions	50	2-D Geometry: Basics	75	Relations of Common & Decimal Fractions	82
		3-D Geometry	50	Equations & Inequalities, Graphs & Solids	75	Systematic Counting	82
		Equations & Inequalities, Graphs & Solids	50	Patterns, Relations & Functions	64	Transformations	82
				3-D Geometry	58	Congruence & Similarity	82
				Transformations	58	Equations & Inequalities, Graphs & Solids	82
				Congruence & Similarity	58	Perimeters	73
				Properties of Common & Decimal Fractions	50	Properties of Common & Decimal Fractions	73
				Number Theory	50	3-D Geometry	73
						Constructions w/ Straightedge & Compass	73
						Patterns, Relations & Functions	73
						Integers & Their Properties	64
						Number Theory	64
						Real Num. Their Subsets & Properties	55
						Exponents, Roots & Radicals	55
						Exponents & Orders of Magnitude	55
						Concepts	55
						Uncertainty & Probability	55
Grade 5		Grade 6		Grade 7		Grade 8	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Whole Number: Meaning	100	Properties of Operations	100	Properties of Operations	100	Properties of Operations	100
Whole Number: Operations	100	Common Fractions	100	Common Fractions	100	Common Fractions	100
Properties of Operations	100	Decimal Fractions	100	Decimal Fractions	100	Decimal Fractions	100
Common Fractions	100	Relations of Common & Decimal Fractions	100	Relations of Common & Decimal Fractions	100	Relations of Common & Decimal Fractions	100
Decimal Fractions	100	Percentages	100	Percentages	100	Percentages	100
Relations of Common & Decimal Fractions	100	Properties of Common & Decimal Fractions	100	Properties of Common & Decimal Fractions	100	Properties of Common & Decimal Fractions	100
Estimating Quantity & Size	100	Estimating Computations	100	Integers & Their Properties	100	Integers & Their Properties	100
Estimating Computations	100	Measurement Units	100	Reasoning & Significant Figures	100	Whole Number: Meaning	90
Measurement Units	100	Perimeter, Area & Volume	100	Estimating Computations	100	Whole Number: Operations	90
Perimeter, Area & Volume	100	2-D Geometry: Basics	100	Exponents & Orders of Magnitude	100	Rational Numbers & Their Properties	90
2-D Geometry: Basics	100	2-D Geometry: Polygons & Circles	100	Measurement Units	100	Real Num. Their Subsets & Properties	90
2-D Geometry: Polygons & Circles	100	Concepts	100	3-D Geometry: Basics	100	Exponents, Roots & Radicals	90
Data Representation & Analysis	100	Problems	100	2-D Geometry: Polygons & Circles	100	Estimating Computations	90
Percentages	91	Data Representation & Analysis	91	Concepts	100	Measurement Units	90
Properties of Common & Decimal Fractions	91	Whole Number: Operations	91	Problems	91	1-D & 2-D Coordinate Geometry	90
Number Theory	91	Integers & Their Properties	91	Data Representation & Analysis	91	Concepts	90
Reasoning & Significant Figures	91	Estimation & errors	91	Whole Number: Meaning	90	Problems	90
Estimation & errors	91	1-D & 2-D Coordinate Geometry	91	Whole Number: Operations	90	Patterns, Relations & Functions	90
1-D & 2-D Coordinate Geometry	91	Whole Number: Meaning	91	Exponents, Roots & Radicals	90	Equations & Inequalities, Graphs & Solids	90
Transformations	82	Number Theory	82	Systematic Counting	90	Data Representation & Analysis	90
Integers & Their Properties	73	Estimating Quantity & Size	73	Perimeter, Area & Volume	90	Number Theory	90
Systematic Counting	73	Reasoning & Significant Figures	73	Estimation & errors	90	Reasoning & Significant Figures	80
Exponents & Orders of Magnitude	73	Exponents & Orders of Magnitude	73	1-D & 2-D Coordinate Geometry	90	Exponents & Orders of Magnitude	80
Congruence & Similarity	73	Transformations	73	Transformations	82	Perimeter, Area & Volume	80
Constructions w/ Straightedge & Compass	73	Equations & Inequalities, Graphs & Solids	82	Equations & Inequalities, Graphs & Solids	82	Estimation & errors	80
Concepts	73	Exponents, Roots & Radicals	73	Rational Numbers & Their Properties	73	2-D Geometry: Basics	80
Problems	73	Congruence & Similarity	73	Real Num. Their Subsets & Properties	73	2-D Geometry: Polygons & Circles	80
Exponents, Roots & Radicals	64	Equations & Inequalities, Graphs & Solids	64	Number Theory	73	Transformations	80
Equations & Inequalities, Graphs & Solids	64	Rational Numbers & Their Properties	64	Estimating Quantity & Size	64	Congruence & Similarity	80
3-D Geometry	55	3-D Geometry	55	Constructions w/ Straightedge & Compass	64	Slope & Trigonometry	80
Patterns, Relations & Functions	55	Patterns, Relations & Functions	55	Patterns, Relations & Functions	64	Systematic Counting	70
Uncertainty & Probability	55	Real Num. Their Subsets & Properties	55	Congruence & Similarity	55	3-D Geometry	70
		Uncertainty & Probability	55	Uncertainty & Probability	55	Estimating Quantity & Size	60
				Slope & Trigonometry	50	Uncertainty & Probability	60
						Constructions w/ Straightedge & Compass	50
Grade 9		Grade 10		Grade 11		Grade 12	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Exponents, Roots & Radicals	100	2-D Geometry: Basics	100	Exponents, Roots & Radicals	100	Real Num. Their Subsets & Properties	100
Concepts	100	2-D Geometry: Polygons & Circles	100	1-D & 2-D Coordinate Geometry	100	1-D & 2-D Coordinate Geometry	100
Patterns, Relations & Functions	100	3-D Geometry	100	Problems	100	Slope & Trigonometry	100
Equations & Inequalities, Graphs & Solids	100	Problems	100	Patterns, Relations & Functions	100	Patterns, Relations & Functions	100
Data Representation & Analysis	100	Slope & Trigonometry	100	Equations & Inequalities, Graphs & Solids	100	Equations & Inequalities, Graphs & Solids	100
Integers & Their Properties	75	Patterns, Relations & Functions	100	Rational Numbers & Their Properties	100	Infinite Processes	100
Rational Numbers & Their Properties	75	Equations & Inequalities, Graphs & Solids	100	Real Num. Their Subsets & Properties	100	Exponents, Roots & Radicals	80
Real Num. Their Subsets & Properties	75	Data Representation & Analysis	100	Complex Numbers & Their Properties	100	Complex Numbers & Their Properties	80
Number Theory	75	Real Num. Their Subsets & Properties	80	Systematic Counting	80	Systematic Counting	80
Estimating Quantity & Size	75	Perimeter, Area & Volume	80	Perimeter, Area & Volume	80	Estimating Quantity & Size	80
Reasoning & Significant Figures	75	1-D & 2-D Coordinate Geometry	80	2-D Geometry: Polygons & Circles	80	Exponents & Orders of Magnitude	80
Estimating Computations	75	Transformations	80	3-D Geometry	80	3-D Geometry	80
1-D & 2-D Coordinate Geometry	75	Congruence & Similarity	80	Transformations	80	Problems	80
2-D Geometry: Polygons & Circles	75	Rational Numbers & Their Properties	80	Concepts	80	Data Representation & Analysis	80
Problems	75	Exponents, Roots & Radicals	80	Slope & Trigonometry	80	Change	80
Whole Number: Meaning	50	Complex Numbers & Their Properties	80	Linear Interpretations & Extrapolations	80	Properties of Operations	80
Whole Number: Operations	50	Systematic Counting	80	Data Representation & Analysis	80	Properties of Common & Decimal Fractions	80
Properties of Operations	50	Estimating Quantity & Size	80	Properties of Operations	80	Rational Numbers & Their Properties	80
Common Fractions	50	Measurement Units	80	Properties of Common & Decimal Fractions	80	Number Theory	80
Decimal Fractions	50	Constructions w/ Straightedge & Compass	80	Estimating Quantity & Size	80	Estimating Computations	80
Relations of Common & Decimal Fractions	50	Concepts	80	Reasoning & Significant Figures	80	Measurement Units	80
Percentages	50	Percentages	80	Exponents & Orders of Magnitude	80	Perimeter, Area & Volume	80
Properties of Common & Decimal Fractions	50	Properties of Common & Decimal Fractions	80	Measurement Units	80	2-D Geometry: Basics	80
Complex Numbers & Their Properties	50	Complex Numbers & Their Properties	80	2-D Geometry: Basics	80	2-D Geometry: Polygons & Circles	80
Systematic Counting	50	Systematic Counting	80	Vectors	80	Vectors	80
Exponents & Orders of Magnitude	50	Exponents & Orders of Magnitude	80	Infinite Processes	80	Transformations	80
Measurement Units	50	Measurement Units	80	Logic & Proof	80	Concepts	80
Transformations	80	Perimeter, Area & Volume	80			Linear Interpretations & Extrapolations	80
Congruence & Similarity	80					Uncertainty & Probability	80
Slope & Trigonometry	80						
Systematic Counting	70						
3-D Geometry	70						
Estimating Quantity & Size	60						
Uncertainty & Probability	60						
Constructions w/ Straightedge & Compass	50						

calcula by grade.

Grade 1		Grade 2		Grade 3		Grade 4	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Plant, fungi types	83	Plant, fungi types	100	Plant, fungi types	75	Plant, fungi types	91
Animal types	75	Animal types	92	Animal types	75	Interdependence of living things	91
Weather & climate	58	Life cycles of organisms	75	Interdependence of living things	75	Human nutrition	91
Life cycles of organisms	58	Habitats & niches	75	Electricity	75	Pollution	82
Nature of scientific knowledge, methods	50	Land, water, sea resource conservation	67	Earth in the solar system	67	Biomes, ecosystems	82
Bodies of water	50	Land forms	67	Planets other than earth	67	Habitats & niches	82
Interdependence of living things	50	Classification of matter	67	Life cycles of organisms	67	Electricity	82
Human nutrition	50	Describe physical changes of matter	67	Human nutrition	67	Land, water, sea resource conservation	73
Magnetism	50	Pollution	58	Magnetism	67	Land forms	73
		Bodies of water	58	Pollution	58	Weather & climate	73
		Physical properties of matter	58	Nature of scientific knowledge, methods	58	Earth in the solar system	73
		Nature of scientific knowledge, methods	50	Land forms	58	Animal types	73
		Science & other disciplines	50	Habitats & niches	58	Physical properties of matter	73
		Weather & climate	50	Human diseases	58	Nature of scientific knowledge, methods	64
		Earth in the solar system	50	Classification of matter	58	Bodies of water	64
		Biomes, ecosystems	50	Land, water, sea resource conservation	50	Organism energy handling	64
		Interdependence of living things	50	Science & other disciplines	50	Life cycles of organisms	64
		Human nutrition	50	Bodies of water	50	Human diseases	64
		Magnetism	50	Weather & climate	50	History of Sci & Technol.	55
		Explain physical changes of matter	50	Organs, tissues	50	Material & energy resource conservation	55
			Biomes, ecosystems	50	Science & Mathematics	55	
			Energy types, sources, conversions	50	Science & other disciplines	55	
			Heat & temperature	50	Physical cycles	55	
				Planets other than earth	55		
				Animal & plant behavior	55		
				Classification of matter	55		
				Heat & temperature	55		
				Magnetism	55		

Display 23. First in the World Schools content expectation
calculated by grade.

Grade 5		Grade 6		Grade 7		Grade 8	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Life cycles of organisms	100	Physical cycles		82 Human diseases		91 Atoms, molecules, ions	92
Weather & climate	91	Earth in the solar system		Nature of scientific knowledge, methods		82 Nature of scientific knowledge, methods	85
Organs, tissues	91	conservation		73 Organism energy handling		82 Chemical properties of matter	85
Interdependence of living things	82	Weather & climate		73 Organism sensing, responding		82 Subatomic particles	85
Physical cycles	73	Planets other than earth		73 Life cycles of organisms		82 Energy types, sources, conversions	85
Animal types	73	Plant, fungi types		73 Reproduction of organisms		82 Material & energy resource conservation	77
Organism energy handling	73	Life cycles of organisms		73 Influence of Sci. Technol. on Society		82 Classification of matter	77
Biomes, ecosystems	73	Biomes, ecosystems		73 Microorganism types		73 Physical properties of matter	77
Habitats & niches	73	Influence of Sci. Technol. on Society		73 Cells		73 Explain physical changes of matter	77
Nature of scientific knowledge, methods	64	Technol.		73 Human nutrition		73 Influence of Sci. Technol. on Society	77
Earth in the solar system	64	History of Sci & Technol.		64 Influence of Society on Sci. Technol.		73 Influence of Society on Sci. Technol.	77
Planets other than earth	64	Pollution		64 History of Sci & Technol.		64 Nature or Conceptions of Technol.	69
Plant, fungi types	64	Effects of natural disasters		64 Nature or Conceptions of Technol.		64 Pollution	69
Organism sensing, responding	64	Nature of scientific knowledge, methods		64 Pollution		64 Land, water, sea resource conservation	69
Reproduction of organisms	64	Science & Mathematics		64 Land, water, sea resource conservation		64 World human population	69
Human nutrition	64	Science & other disciplines		Material & energy resource conservation		64 Human diseases	69
Physical properties of matter	64	Bodies of water		64 Science & Mathematics		64 Heat & temperature	69
Pollution	55	Microorganism types		64 Organs, tissues		64 Describe physical changes of matter	69
Science & Mathematics	55	Organs, tissues		64 Variation, inheritance in organisms		64 Describe chemical changes of matter	69
Land forms	55	Organism energy handling		64 Biomes, ecosystems		64 Energy & chemical change	69
Beyond the solar system	55	Interdependence of living things		64 Energy types, sources, conversions		64 Nuclear chemistry	69
Microorganism types	55	Physical properties of matter		64 Dynamics of motion		64 History of Sci & Technol.	62
Human diseases	55	Nature or Conceptions of Technol.		55 Effects of natural disasters		55 Bodies of water	62
Energy types, sources, conversions	55	Material & energy resource conservation		55 Biochemical processes in cells		55 Reproduction of organisms	62
Heat & temperature	55	conservation		55 Evolution, speciation, diversity		55 Interdependence of living things	62
Mathe, Sci influence on Sci	55	Composition		55 Biochemistry of genetics		55 Macromolecules, crystals	62
Beyond the Solar System	50%	Beyond the solar system		55 Interdependence of living things		55 Explain chemical changes of matter	62
Conservation of Land, Water, and Sea Resources	50%	Animal types		55 Classification of matter		55 Mathe, Sci influence on Sci	62
		Cells		55 Physical properties of matter		55 Science & Mathematics	54
		Reproduction of organisms					
		Habitats & niches		55 Heat & temperature		55 Composition	54
		Human nutrition		55 Types of forces		55 Atmosphere	54
		Classification of matter		55 Time, space, motion		55 Earth in the solar system	54
		Energy types, sources, conversions		55 Mathe, Sci influence on Sci		55 Organs, tissues	54
		Light		55		Cells	54
		Electricity		55		Evolution, speciation, diversity	54
		Magnetism		55		Habitats & niches	54
		Mathe, Sci influence on Sci		55			

Display 23. First in the World School content expectations as calculated by grade.

Grade 9		Grade 10		Grade 11		Grade 12	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
Pollution	100	Nature or Conceptions of Technol.	100	Nature or Conceptions of Technol.	100	Nature of scientific knowledge, methods	100
Land, water, sea resource conservation	100	Pollution	100	Pollution	100	Atoms, molecules, ions	100
Material & energy resource conservation	100	Land, water, sea resource conservation	100	Land, water, sea resource conservation	100	Subatomic particles	100
World human population	100	Material & energy resource conservation	100	Material & energy resource conservation	100	Energy types, sources, conversions	100
Food production, storage	100	World human population	100	Nature of scientific knowledge, methods	100	Energy & chemical change	100
History	100	Food production, storage	100	Organism energy handling	100	Organic & biochemical changes	100
Life cycles of organisms	100	Effects of natural disasters	100	Biochemical processes in cells	100	Nuclear chemistry	100
Reproduction of organisms	100	Nature of scientific knowledge, methods	100	Life cycles of organisms	100	Mathe. Sci influence on Sci	100
Evolution, speciation, diversity	100	History	100	Reproduction of organisms	100	Influence of Sci, Technol. on Society	100
Biomes, ecosystems	100	Earth in the solar system	100	Variation, inheritance in organisms	100	Influence of Society on Sci, Technol.	100
Habitats & niches	100	Planets other than earth	100	Evolution, speciation, diversity	100	History of Sci & Technol.	80
Interdependence of living things	100	Organs, tissues	100	Biochemistry of genetics	100	Nature or Conceptions of Technol.	80
Subatomic particles	100	Cells	100	Interdependence of living things	100	The scientific enterprise	80
History of Sci & Technol.	80	Organism energy handling	100	Human diseases	100	Science & Mathematics	80
Nature or Conceptions of Technol.	80	Organism sensing, responding	100	Atoms, molecules, ions	100	Classification of matter	80
Effects of natural disasters	80	Biochemical processes in cells	100	Subatomic particles	100	Physical properties of matter	80
of scientific knowledge, methods	80	Life cycles of organisms	100	Energy types, sources, conversions	100	Chemical properties of matter	80
The scientific enterprise	80	Reproduction of organisms	100	Energy & chemical change	100	Macromolecules, crystals	80
Science & Mathematics	80	Variation, inheritance in organisms	100	Organic & biochemical changes	100	Heat & temperature	80
Composition	80	Evolution, speciation, diversity	100	Nuclear chemistry	100	Wave phenomena	80
Bodies of water	80	Biochemistry of genetics	100	Mathe. Sci influence on Sci	100	Sound & vibration	80
Atmosphere	80	Biomes, ecosystems	100	Influence of Sci, Technol. on Society	100	Light	80
Rocks, soil	80	Habitats & niches	100	Influence of Society on Sci, Technol.	100	Electricity	80
Ice forms	80	Interdependence of living things	100	History of Sci & Technol.	80	Magnetism	80
Physical cycles	80	Human nutrition	100	World human population	80	Describe physical changes of matter	80
Building, breaking	80	Human diseases	100	Food production, storage	80	Explain physical changes of matter	80
Organs, tissues	80	Atoms, molecules, ions	100	Effects of natural disasters	80	Kinetic-molecular theory	80
Organism energy handling	80	Subatomic particles	100	The scientific enterprise	80	Quantum theory, fundamental particles	80
Organism sensing, responding	80	Energy types, sources, conversions	100	Science & Mathematics	80	Describe chemical changes of matter	80
Biochemical processes in cells	80	Energy & chemical change	100	History	80	Explain chemical changes of matter	80
Variation, inheritance in organisms	80	Organic & biochemical changes	100	Organs, tissues	80	Rate of chemical change & equilibrium	80
Biochemistry of genetics	80	Mathe. Sci influence on Sci	100	Cells	80	Electrochemistry	80
Human nutrition	80	Influence of Sci, Technol. on Society	100	Organism sensing, responding	80	Types of forces	80
Human diseases	80	Influence of Society on Sci, Technol.	100	Biomes, ecosystems	80	Time, space, motion	80
Classification of matter	80	History of Sci & Technol.	80	Habitats & niches	80	Dynamics of motion	80
Physical properties of matter	80	The scientific enterprise	80	Human nutrition	80	Relativity theory	80
Atoms, molecules, ions	80	Science & Mathematics	80	Classification of matter	80	Fluid behavior	80
Energy types, sources, conversions	80	Composition	80	Physical properties of matter	80	Science applications in Math, Technol.	80
Sci influence on Sci	80	Bodies of water	80	Chemical properties of matter	80	Pollution	60
Influence of Sci, Technol. on Society	80	Building, breaking	80	Macromolecules, crystals	80	Land, water, sea resource conservation	60
Influence of Society on Sci, Technol.	80	Plant, fungi types	80	Heat & temperature	80	Material & energy resource conservation	60
Science & other disciplines	60	Animal types	80	Wave phenomena	80	World human population	60
Land forms	60	Microorganism types	80	Sound & vibration	80	Science & other disciplines	60
Weather & climate	60	Animal & plant behavior	80	Light	80	Composition	60
Earth in the solar system	60	Classification of matter	80	Electricity	80	Ice forms	60
Planets other than earth	60	Physical properties of matter	80	Magnetism	80	Weather & climate	60
Animal types	60	Chemical properties of matter	80	Describe physical changes of matter	80	History	60
Microorganism types	60	Macromolecules, crystals	80	Explain physical changes of matter	80	Earth in the solar system	60
Cells	60	Heat & temperature	80	Kinetic-molecular theory	80	Planets other than earth	60
Animal & plant behavior	60	Describe physical changes of matter	80	Describe chemical changes of matter	80	Evolution of the universe	60

Display 23. First in the World Schools content expectation

ulated by grade.

Grade 9		Grade 10		Grade 11		Grade 12	
Topic	% Cover	Topic	% Cover	Topic	% Cover	Topic	% Cover
60 properties of matter		60 Explain physical changes of matter		80 Explain chemical changes of matter		80 Organism energy handling	60
Heat & temperature		60 Kinetic-molecular theory		80 Rate of chemical change & equilibrium		80 Organism sensing, responding	60
Explain physical changes of matter		60 Describe chemical changes of matter		80 Electrochemistry		80 Biochemical processes in cells	60
Describe chemical changes of matter		60 Explain chemical changes of matter		80 Science applications in Math, Technol.		80 Human diseases	60
Explain chemical changes of matter		60 Rate of chemical change & equilibrium		80 Science & other disciplines	60		
60 y & chemical change		60 Nuclear chemistry		80 Bodies of water	60		
Organic & biochemical changes		60 Science applications in Math, Technol.		80 Rocks, soil	60		
Nuclear chemistry		60 Science & other disciplines		60 Earth in the solar system	60		
! : applications in Math, Technol.		60 Land forms		60 Planets other than earth	60		
		Atmosphere		60 Plant, fungi types	60		
		Rocks, soil		60 Animal types	60		
		Ice forms		60 Microorganism types	60		
		Weather & climate		60 Animal & plant behavior	60		
		Physical cycles		60 Quantum theory, fundamental particles	60		
		Beyond the solar system	60				
		Evolution of the universe	60				
		Wave phenomena	60				
		Electricity	60				
		Magnetism	60				
		Quantum theory, fundamental particles	60				
		Electrochemistry	60				
		Types of forces	60				
		Time, space, motion	60				
		Dynamics of motion	60				

Display 24. Common U.S. and international topics for Population 1 mathematics. The U.S. composite mathematics curriculum as represented in state curriculum guides includes far more topics at this grade level than does the international composite. The same is true for the U.S. textbook composite. U.S. textbooks include several topics not commonly included in state curriculum guides for the U.S. [This exhibit lists topics from the TIMSS mathematics framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 1 (U.S. grade 4). Bold-face labels are more general categories which subsume more specific (non-bold-face) topics. We arranged both lists (U.S. and international) in three categories — topics listed only in 70 percent of curriculum guides, topics listed in 70 percent of both curriculum guides and textbooks, and topics listed only in 70 percent of the textbooks. Asterisks mark topics receiving more extensive textbook attention.]

FIW	International	U.S.
CURRICULUM GUIDES (Not In Textbooks)		
Numbers Fractions and Decimals Percentages Properties of Common & Decimal Fractions	Numbers Fractions and Decimals Decimal Fractions Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry Geometry: Symmetry, Congruence & Similarity Transformations	
CURRICULUM GUIDES (Included in Textbooks)		
Numbers Whole Numbers Meaning* Operations* Properties of Operations Fractions and Decimals Common Fractions Decimal Fractions Relation of Common & Decimal Fractions Estimation & Number Sense Concepts Estimating Quantity & Size Rounding & Significant Figures Estimating Computations Measurement Units* Perimeter, Area & Volume Estimation & Errors Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles Functions, Relations, & Equations Equations & Formulas Data Representation, Probability, & Statistics Data Representation & Analysis	Numbers Whole Numbers Meaning* Operations* Properties of Operations Fractions and Decimals Common Fractions Measurement Units* Perimeter, Area & Volume Geometry: Position, Visualization & Shape 2-D Geometry: Basics 2-D Geometry: Polygons & Circles	Numbers Whole Numbers Meaning* Operations* Fractions and Decimals Common Fractions Decimal Fractions Estimation & Number Sense Concepts Estimating Computations Measurement Units* Perimeter, Area & Volume Estimation & Errors Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Congruence & Similarity Functions, Relations, & Equations Patterns, Relations & Functions Equations & Formulas Data Representation, Probability, & Statistics Data Representation & Analysis Uncertainty & Probability
EXCLUSIVELY IN TEXTBOOKS		
Numbers Integer, Rational & Real Numbers Negative Numbers, Integers & Their Properties Other Numbers & Number Concepts Number Theory Counting Geometry: Position, Visualization & Shape 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Congruence & Similarity Proportionality Proportionality Concepts Functions, Relations & Equations Patterns, Relations & Functions Data Representation, Probability, & Statistics Uncertainty & Probability Other Content	Data Representation, Probability, & Statistics Data Representation & Analysis	Numbers Whole Numbers Properties of Operations Fractions and Decimals Relation of Common & Decimal Fractions Integer, Rational & Real Numbers Negative Numbers, Integers & Their Properties Other Numbers & Number Concepts Number Theory Counting Estimation & Number Sense Estimating Quantity & Size Rounding & Significant Figures Proportionality Proportionality Concepts Validation & Structure Validation and Justification Structuring and Abstracting Other Content

Display 25. Common U.S. and international Population 1 mathematics performance expectations. U.S. state curriculum guides and textbooks had a larger number of common performance expectations than their international counterparts. State curriculum guides included performance expectations from all major categories. U.S. textbooks included even more. [This exhibit lists topics from the TIMSS' mathematics framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 1 (U.S. grade 4). Bold-face labels are more general categories that subsume more specific (non-bold-face) performance expectations. Both lists (U.S. and international) are arranged in three categories — specific expectations listed only in 70 percent of curriculum guides, those listed in 70 percent of both curriculum guides and textbooks, and those listed only in 70 percent of the textbooks. Asterisks mark performance expectations receiving more extensive textbook attention.]

FIW Intentions	Intentions in TIMSS Countries	U.S. Intentions
	CURRICULUM GUIDES (Not in Textbooks)	
	Investigating Problem Solving Predicting Verifying	
	Mathematical Reasoning Developing notation & vocabulary Developing algorithms	
	CURRICULUM GUIDES (Included in Textbooks)	
Knowing Representing Recognizing equivalents Recalling mathematical objects & properties	Knowing Representing Recognizing equivalents Recalling mathematical objects and properties	Knowing Representing Recalling mathematical objects and properties*
Using Procedures Using equipment Performing routine procedures Using more complex procedures	Using Routines Procedures Using equipment Performing routine procedures* Using more complex procedures	Using Routines Procedures Using equipment Performing routine procedures* Using more complex procedures*
Investigating & Problem Solving Formulating & clarifying problems & situations Solving	Investigating & Problem Solving Formulating and clarifying problems and solutions Developing strategy Solving	Investigating & Problem Solving Formulating and clarifying problems and solutions Developing strategy Solving Predicting Verifying
		Mathematical Reasoning Generalizing Conjecturing Justifying and proving
		Communicating Using vocabulary and notation Relating representations Describing/discussing
	EXCLUSIVELY IN TEXTBOOKS	
Investigating and Problem Solving Developing strategy Predicting Verifying		Knowing Recognizing equivalents
Mathematical Reasoning Developing notation and vocabulary Developing algorithms Generalizing Conjecturing Justifying and proving		Mathematical Reasoning Developing notation and vocabulary Developing algorithms
Communicating Using vocabulary and notation Relating representations Describing/discussing Critiquing		Communicating Critiquing

Display 26. Common U.S. and international topics for Population 2 mathematics. The U.S. composite mathematics curriculum as represented in state curriculum guides includes more topics at this grade level than does the international composite. The same is true for U.S. textbooks. This is true both for algebra course textbooks and those for more general mathematics courses. These latter may include some but not an entire course of algebra (although here called "nonalgebra textbooks"). U.S. textbooks include several topics not commonly included in state curriculum guides for the US. (This exhibit lists topics from the TIMSS' mathematics framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 2 (U.S. grade 8). Bold-face labels are more general categories that subsume more specific (non-bold-face) topics. Both lists (U.S. and international) are arranged in three categories. These three are topics listed only in 70 percent of curriculum guides, topics listed in 70 percent of both curriculum guides and textbooks, and topics listed only in 70 percent of the textbooks. Asterisks mark topics receiving more extensive textbook attention.)

FIW	International	U.S.-Nonalgebra Textbooks	U.S.-Algebra Textbooks
CURRICULUM GUIDES (Not in Textbooks)			
Number Fractions and Decimals Properties of Common & Decimal Fractions Estimation & Number Sense Concepts Exponents & Orders of Magnitude	Number Integer, Rational & Real Numbers Real Numbers, Their Subsets & Properties Geometry: Symmetry, Congruence & Similarity Congruence & Similarity Constructions Using Straightedge & Compass Proportionality Proportionality Concepts	Number Estimation & Number Sense Concepts Exponents & Orders of Magnitude Measurement Units Estimation & Errors Geometry: Position, Visualization & Shape Vectors	Number Estimation & Number Sense Concepts Estimating Quantity & Size Rounding & Significant Figures Estimating Computations Exponents & Orders of Magnitude Measurement Units Estimation & Errors Geometry: Position, Visualization & Shape 3-D Geometry Vectors
CURRICULUM GUIDES (Included in Textbooks)			
Number Whole Numbers Meaning Operations Properties of Operations Fractions & Decimals Common Fractions Decimal Fractions Relationship of Common & Decimal Fractions Percentages Integer, Rational & Real Numbers Integers & Their Properties Rational Numbers & Their Properties Real Numbers, Their Subsets & Properties Other Numbers & Number Concepts Exponents, Roots & Radicals Number Theory Measurement Perimeter, Area & Volume Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Congruence & Similarity Proportionality Proportionality Concepts Proportionality Problems Functions, Relations & Equations Patterns, Relations & Functions Equations & Formulas Data Representation, Probability & Statistics Data Representation & Analysis Uncertainty & Probability	Number Integer, Rational & Real Numbers Integers & Their Properties Rational Numbers & Their Properties Other Numbers & Number Concepts Exponents, Roots & Radicals Measurement Perimeter, Area & Volume Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Proportionality Proportionality Problems Functions, Relations & Equations Patterns, Relations & Functions Equations & Formulas	Number Whole Numbers Operations Fractions & Decimals Common Fractions Relationship of Common & Decimal Fractions Percentages Integer, Rational & Real Numbers Integers & Their Properties Estimation & Number Sense Concepts Estimating Quantity & Size Rounding & Significant Figures Estimating Computations Measurement Units Perimeter, Area & Volume Estimation & Errors Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Congruence & Similarity Proportionality Proportionality Concepts Functions, Relations & Equations Patterns, Relations & Functions Equations & Formulas Data Representation, Probability & Statistics Data Representation & Analysis Uncertainty & Probability	Number Whole Numbers Operations Fractions & Decimals Common Fractions Relationship of Common & Decimal Fractions Percentages Integer, Rational & Real Numbers Integers & Their Properties Measurement Units Perimeter, Area & Volume Geometry: Position, Visualization & Shape 2-D Geometry: Coordinate Geometry 2-D Geometry: Basics 2-D Geometry: Polygons & Circles 3-D Geometry Geometry: Symmetry, Congruence & Similarity Transformations Congruence & Similarity Proportionality Proportionality Concepts Functions, Relations & Equations Patterns, Relations & Functions Equations & Formulas Data Representation, Probability & Statistics Data Representation & Analysis Uncertainty & Probability
EXCLUSIVELY IN TEXTBOOKS			
Number Other Numbers & Number Concepts Counting Estimation & Number Sense Concepts Rounding & Significant Figures Estimating Computations Measurement Units Estimation & Errors Geometry: Symmetry, Congruence & Similarity Constructions Using Straightedge & Compass Proportionality Slope & Trigonometry Validation & Structure Validation & Justification Structuring and Abstracting Other Content	Number Whole Numbers Properties of Operations Fractions & Decimals Common Fractions Decimal Fractions Relationships of Common & Decimal Fractions Percentages Measurement Units	Number Whole Numbers Meaning Properties of Operations Fractions & Decimals Decimal Fractions Integer, Rational & Real Numbers Rational Numbers & Their Properties Real Numbers, Their Subsets & Properties Other Numbers & Number Concepts Binary arithmetic and/or Other Number Bases Exponents, Roots & Radicals Number Theory Counting Geometry: Symmetry, Congruence & Similarity Constructions Using Straightedge & Compass Proportionality Proportionality Problems Slope & Trigonometry Validation & Structure Validation & Justification Structuring and Abstracting Other Content	Number Whole Numbers Meaning Properties of Operations Fractions & Decimals Decimal Fractions Integer, Rational & Real Numbers Rational Numbers & Their Properties Real Numbers, Their Subsets & Properties Other Numbers & Number Concepts Exponents, Roots & Radicals Complex Numbers & Their Properties Number Theory Proportionality Proportionality Problems Slope & Trigonometry Validation & Structure Validation & Justification Structuring and Abstracting Other Content

Display 27. Common U.S. and International Population 2 mathematics performance expectations. U.S. and international curriculum guides and textbooks have comparable numbers of common performance expectations. State curriculum guides include performance expectations from all major categories. There are even more in textbooks. [This exhibit lists topics from the TIMSS' mathematics framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 2 (U.S. grade 8). Bold-face labels are more general categories that subsume more specific (non-bold-face) performance expectations. Both lists (U.S. and international) are arranged in three categories — specific expectations listed only in 70 percent of curriculum guides, those listed in 70 percent of both curriculum guides and textbooks, and those listed only in 70 percent of the textbooks. Asterisks mark performance expectations receiving more extensive textbook attention.]

FTW Intentions	Intentions in TIMSS Countries	U.S.-non-Algebra Textbooks	U.S.-Algebra Textbook
CURRICULUM GUIDES (Not in Textbooks)			
	Mathematical Reasoning Developing notation and vocabulary		Mathematical Reasoning Developing notation and vocabulary
CURRICULUM GUIDES (Included in Textbooks)			
Knowing Representing Recalling mathematical objects & properties	Knowing Representing Recognizing equivalents Recalling mathematical objects and properties*	Knowing Representing	Knowing Representing
Using Routines, Procedures Using equipment Performing routine procedures Using more complex procedures	Using Routines, Procedures Using equipment Performing routine procedures* Using more complex procedures	Using Routines, Procedures Using equipment Performing routine procedures* Using more complex procedures*	Using Routines Procedures Using equipment Performing routine procedures* Using more complex procedures*
Investigating and Problem Solving Formulating & clarifying problems & situations Developing strategy Solving	Investigating and Problem Solving Formulating and clarifying problems and situations Developing strategy Solving Predicting Verifying	Investigating and Problem Solving Formulating and clarifying problems and situations Developing strategy Solving* Predicting Verifying	Investigating and Problem Solving Formulating and clarifying problems and situations Developing strategy Solving* Predicting Verifying
	Mathematical Reasoning Generalizing Conjecturing Justifying and proving	Mathematical Reasoning Developing notation and vocabulary Generalizing Conjecturing Justifying and proving	Mathematical Reasoning Generalizing Conjecturing Justifying and proving
Communicating Relating representations	Communicating Using vocabulary and notation Relating representations Describing/discussing	Communicating Using vocabulary and notation Relating representations Describing/discussing*	Communicating Using vocabulary and notation Relating representations Describing/discussing*
EXCLUSIVELY IN TEXTBOOKS			
Knowing Recognizing equivalents		Knowing Recognizing equivalents Recalling mathematical objects and properties*	Knowing Recognizing equivalents Recalling mathematical objects and properties*
Investigating and Problem Solving Predicting Verifying	Mathematical Reasoning Generalizing	Mathematical Reasoning Developing algorithms	Mathematical Reasoning Developing algorithms
Mathematical Reasoning Developing algorithms Generalizing Conjecturing Justifying and proving	Communicating Relating representations	Communicating Critiquing	Communicating Critiquing
Communicating Using vocabulary and notation Describing/discussing Critiquing			

Display 28. Common U.S. and International topics for Population 1 science. Looking only at the common topics in state curriculum guides (not those in textbooks) the U.S. composite science curriculum in state curriculum guides includes fewer topics at this grade level than the international composite. While state curriculum guides commonly plan for around 30 science topics, they are not the same science topics in each state so the list of specific common topics is smaller. Since each state still plans for a comparatively large number of topics, the state science curricula at this level still remain unfocused. [This exhibit lists topics from the TIMMS' science framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 1 (U.S. grade 4). Bold-face labels are more general categories that subsume more specific (non-bold-face) topics. Both lists (U.S. and international) are arranged in three categories. These are topics listed only in 70 percent of curriculum guides, topics listed in 70 percent of both curriculum guides and textbooks, and topics listed only in 70 percent of the textbooks. Asterisks mark topics receiving more extensive textbook attention.]

FIW	International	U.S.
	CURRICULUM GUIDES (Not in Textbooks)	
	Earth Sciences Earth Features Bodies of Water Life Sciences Human Biology & Health Environmental and Resource Issues Related to Science Pollution Conservation of Material & Energy Resources World Population Food Production, Storage	
	CURRICULUM GUIDES (Included in Textbooks)	
Life Sciences Diversity, Organization, Structure of Living Things Animals Nature of Science Nature of Scientific Knowledge	Earth Sciences Earth Processes Weather & Climate Earth in the Universe Earth in The Solar System Life Sciences Diversity, Organization, Structure of Living Things Plants, Fungi* Animals* Organs, Tissues Interactions of Living Things Interdependence of Life Physical Sciences Matter Physical Properties of Matter Energy and Physical Processes Energy Types, Sources, Conversions Environmental and Resource Issues Conservation of Land, Water, and Sea Resources	Life Sciences Diversity, Organization, Structure of Living Things Plants, Fungi* Animals* Organs, Tissues Interactions of Living Things Biomes and Ecosystems Interdependence of Life Physical Sciences Matter Physical Properties of Matter Energy and Physical Processes Energy Types, Sources, Conversions Light Electricity

EXCLUSIVELY IN TEXTBOOKS

Earth Science

Earth Features
Landforms
Bodies of Water
Earth Processes
Weather and Climate
Physical Cycles
Earth in the Universe
Earth in the Solar System
Planets in the Solar System

Life Science

Diversity, Organization, Structure of Living Things
Plants, Fungi
Other Organisms
Organs, Tissues
Cells
Life Processes and Systems Enabling Life Functions
Energy Handling
Sensing and Responding
Life Spirals
Life Cycles
Reproduction
Evolution, Speciation, Diversity
Interactions of Living Things
Habitats and Niches
Interdependence of Life
Animal Behavior
Human Biology and Health
Nutrition

Physical Science

Matter
Classification of Matter
Physical Properties
Chemical Properties
Structure of Matter
Atoms, Ions, Molecules
Energy and Physical Processes
Energy Types, Sources, Conversions
Sound and Vibration
Light
Electricity
Forces and Motion
Types of Forces
Science, Technology, and Mathematics
Interactions of Science, Mathematics, and Technology
Applications of Science in Mathematics, Technology
Interactions of Science, Technology, and Society
Influence of Science, Technology on Society
History of Science and Technology
Environmental and Resource Issues
Conservation of Land, Water, and Sea Resources
Conservation of Material and Energy Resources
Food Production, Storage
Nature of Science
The Scientific Enterprise
Science and Other Disciplines
Science and Mathematics
Science and Other Disciplines

Earth Science

Earth Features
Landforms
Bodies of Water
Earth Processes
Weather & Climate
Physical Cycles
Earth in The Universe
Earth in the Solar System*
Planets in the Solar System

Life Sciences

Diversity, Organization, Structure of Living Things
Other Organisms
Cells
Life Processes and Systems Enabling Life Functions
Energy Handling
Sensing, Responding
Life Spirals, Genetic Continuity, Diversity
Life Cycles
Reproduction
Evolution, Speciation, Diversity
Interaction of Living Things
Habitats & Niches
Animal Behavior
Human Biology and Health
Nutrition

Physical Sciences

Matter
Classification of Matter
Chemical Properties
Structure of Matter
Atoms, Molecules, Ions
Energy and Physical Processes
Sound and Vibration
Forces and Motion
Types of Forces

Science, Technology, and Mathematics

Interactions of Science, Mathematics, and Technology
Applications of Science in Mathematics, Technology
Interactions of Science, Technology, and Society
Influence of Science, Technology on Society

History of Science & Technology

Environmental and Resources Issues Related to Science

Conservation of Land, Water, and Sea Resources
Conservation of Material & Energy Resources
Food production, Storage

Nature of Science

Nature of Scientific Knowledge
The Scientific Enterprise
Science and Other Disciplines
Science and Mathematics
Science and Other Disciplines

Display 29. Common U.S. and international Population 1 science performance expectations. U.S. and international curriculum guides and textbooks have comparable numbers of common performance expectations. State curriculum guides include performance expectations from only two major categories. U.S. textbooks include more. [This exhibit lists topics from the TIMSS' science framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 1 (U.S. grade 4). Bold-face labels are more general categories that subsume more specific (non-bold-face) performance expectations. Both lists (U.S. and international) are arranged in three categories — specific expectations listed only in 70 percent of curriculum guides, those listed in 70 percent of both curriculum guides and textbooks, and those listed only in 70 percent of the textbooks. Asterisks mark performance expectations receiving more extensive textbook attention.]

FIW Intentions	Intentions in TIMSS Countries	U.S. Intentions
	CURRICULUM GUIDES (Not in Textbooks)	
	Investigating the natural world Conducting investigations Interpreting investigational data	Using tools, routines procedures, and science processes Interpreting data
	CURRICULUM GUIDES (Included in Textbooks)	
Understanding Simple information Complex information	Understanding Simple information* Complex information	Understanding Simple information*
Solving problems Constructing and using models Making decisions	Using tools, routine procedures, and science processes Using apparatus, equipment, computers Conducting routine experimental operations Gathering data	Using tools, routine procedures, and science processes Using apparatus, equipment, computers Gathering data Organizing and representing data
Using tools, routine procedures, and science processes Using apparatus, equipment, computers Doing routine experimental operations Interpreting data		
Investigating the natural world Designing investigations		
	EXCLUSIVELY IN TEXTBOOKS	
Solving problems Use science principles to explain	Using tools, routine procedures, and science processes Organizing and representing data	Understanding Complex information
Investigating the natural world Identifying questions to investigate Formulating conclusions from data		Theorizing, analyzing, and solving problems Applying scientific principles to develop explanations Constructing, interpreting, and applying models
Communicating Accessing and processing information		Using tools, routine procedures, and science processes Conducting routine experimental operations
		Investigating the natural world Designing investigations Conducting investigations Interpreting investigational data
		Communicating Accessing and processing information Sharing information

Display 30. Common U.S. and international topics for Population 2 science.

FIW	International	U.S.
	CURRICULUM GUIDES (Not in Textbooks) Life Sciences Diversity, Organization, Structure of Living Things Other Organisms (Types of Microorganisms) Cells Life Spirals, Genetic Continuity, Diversity Evolution, Speciation, Diversity Interactions of Living Things Biomes & Ecosystems Habitats & Niches Animal Behavior Human Biology & Health Physical Sciences Structure of Matter Subatomic Particles Energy and Physical Processes Magnetism Environmental and Resource Issues World Population Food Production, Storage Effects of Natural Disasters Nature of Science Nature of Scientific Knowledge CURRICULUM GUIDES (Included in Textbooks) Earth Sciences Earth Features Rocks, Soil Earth Processes Weather & Climate Life Sciences Diversity, Organization, Structure of Living Things Plants, Fungi Animals Organs, Tissues* Life Processes and Systems Enabling Life Functions Energy Handling Sensing & Responding Life Spirals, Genetic Continuity, Diversity Life Cycles Reproduction Interactions of Living Things Interdependence of Life Human Biology and Health Disease Physical Sciences Matter Classification of Matter Physical Properties Chemical Properties Structure of Matter Atoms, Ions, Molecules Energy and Physical Processes Energy Types, Sources, Conversions Heat & Temperature Light Electricity Chemical Transformations Explanations of Chemical Changes Forces and Motion Types of Forces Science, Technology, and Mathematics Interactions of Science, Mathematics and Technology Science Applications in Math, Technology Interactions of Science, Technology and Society Influence of Science, Technology on Society Environmental and Resource Issues Pollution	Life Sciences Diversity, Organization, Structure of Living Things Plants, Fungi Organs, Tissues Interactions of Living Things Interdependence of Life Physical Sciences Matter Physical Properties Chemical Properties Energy and Physical Processes Energy Types, Sources, Conversions Electricity Forces and Motion Time, Space, and Motion Environmental and Resource Issues Pollution

Conservation of Land, Water, & Sea Resources
Conservation of Material & Energy Resources

Nature of Science
Nature of Scientific Knowledge

EXCLUSIVELY IN TEXTBOOKS

Earth Sciences

Earth Features
Landforms
Bodies of Water
Atmosphere
Rocks, Soil
Earth Processes
Weather and Climate
Earth in the Universe
Earth in the Solar System
Planets in the Solar System
Beyond the Solar System

Life Sciences

Diversity, Organization, Structure of Living Things
Plants, Fungi
Animals
Organs, Tissues
Life Processes and Systems Enabling Life Functions
Energy Handling
Human Biology and Health
Nutrition
Disease

Physical Sciences

Matter
Physical Properties
Structure of Matter
Atoms, Ions, Molecules
Subatomic Particles
Energy and Physical Processes
Energy Types, Sources, Conversions
Heat and Temperature
Light
Electricity
Magnetism
Physical Transformations
Physical Changes
Explanations of Physical Changes
Chemical Transformations
Chemical Changes
Nuclear Chemistry
Forces and Motion
Types of Forces

Science, Technology, and Mathematics

Nature or Conceptions of Technology
Interactions of Science, Mathematics, and Technology
Applications of Science in Mathematics, Technology
Interactions of Science, Technology and Society
Influence of Science, Technology on Society
Influence of Society on Science, Technology

History of Science and Technology

Environmental and Resource Issues
Conservation of Land, Water, and Sea Resources
Conservation of Material and Energy Resources

Nature of Science

The Scientific Enterprise
Science and Other Disciplines
Science and Mathematics

Earth Sciences

Earth Features

Rocks, Soil

Physical Sciences

Physical Transformations
Physical Changes

Forces and Motion

Time, Space, & Motion

History of Science & Technology

Earth Sciences

Earth Features
Landforms
Bodies of Water
Atmosphere
Rocks, Soil
Ice Forms
Earth Processes
Weather & Climate
Physical Cycles
Earth's History
Earth in the Universe
Earth in the Solar System
Planets in the Solar System

Life Sciences

Diversity, Organization, Structure of Living Things
Animals
Other Organisms
Cells
Life Processes and Systems Enabling Life Functions
Energy Handling
Sensing & Responding
Life Spirals, Genetic Continuity, Diversity
Life Cycles
Reproduction
Evolution, Speciation, Diversity
Interaction of Living Things
Biomes & Ecosystems
Human Biology and Health
Nutrition
Disease

Physical Sciences

Matter
Classification of Matter
Structure of Matter
Atoms, Ions, Molecules
Subatomic Particles
Energy and Physical Processes
Heat & Temperature
Sound & Vibration
Physical Transformations
Physical Changes
Chemical Transformations
Chemical Changes
Nuclear Chemistry
Forces and Motion
Types of Forces

Science, Technology, and Mathematics

Nature or Conceptions of Technology
Interactions of Science, Mathematics and Technology
Applications of Science in Math, Technology
Interactions of Science, Technology, and Society
Influence of Science, Technology on Society

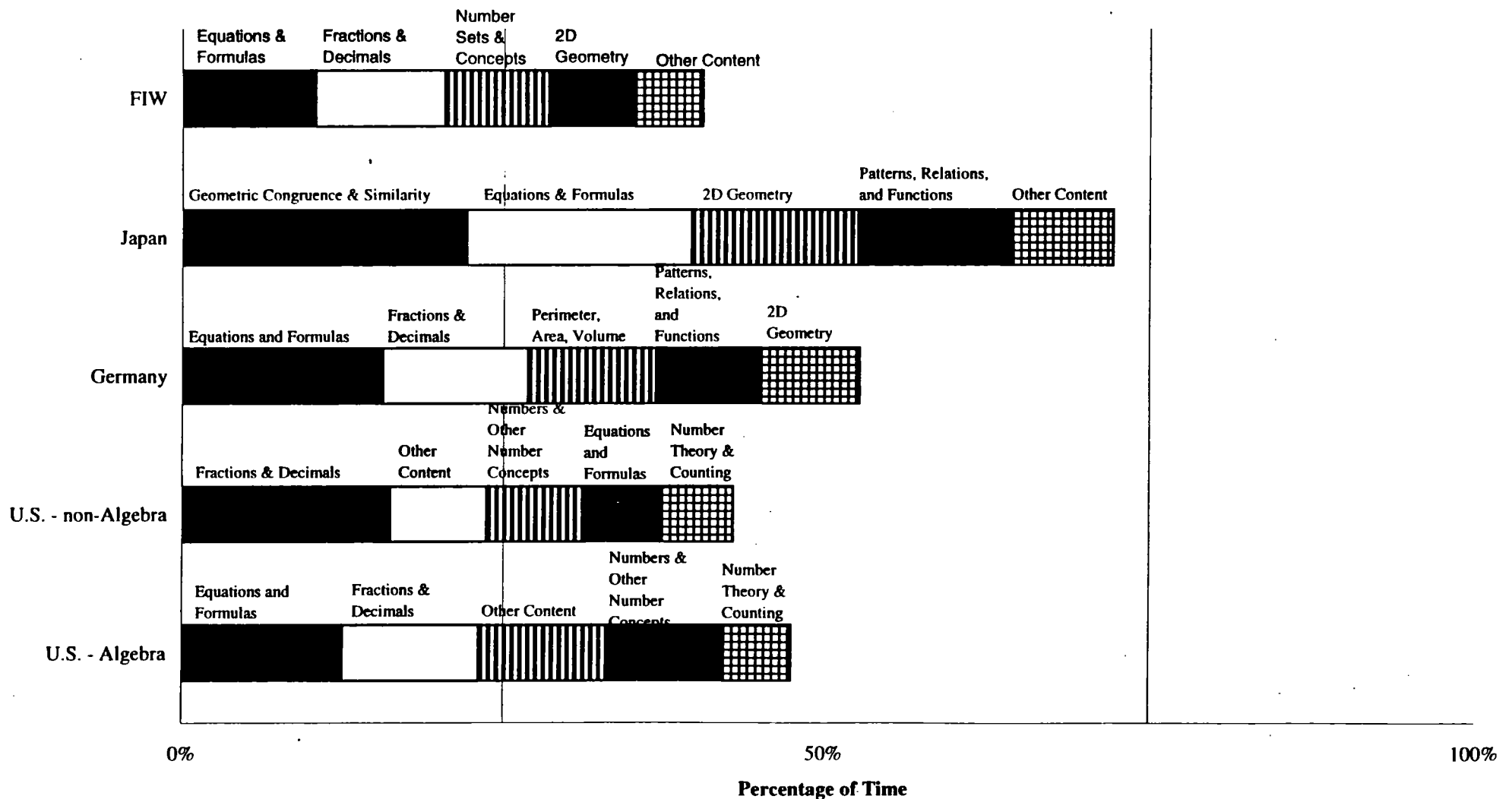
History of Science & Technology

Environmental and Resource Issues
Conservation of Land, Water, & Sea Resources
Conservation of Material & Energy Resource
Food Production, Storage
Effect of Natural Disasters
Nature of Science
The Scientific Enterprise
Science and Other Disciplines
Scientific and Mathematics
Science and Other Disciplines

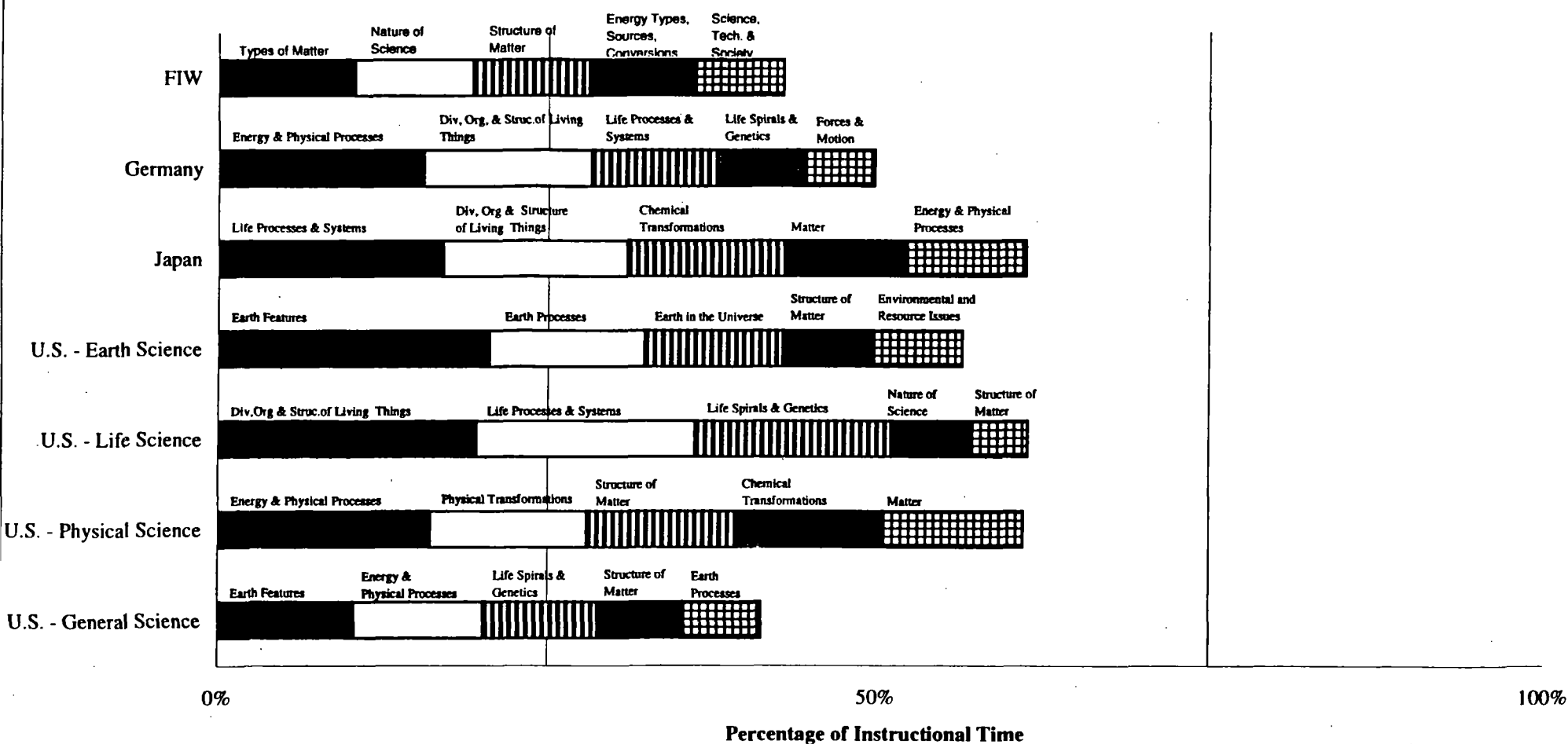
Display 31. Common U.S. and International Population 2 science performance expectations. For Population 2 science, the U.S. has fewer common performance expectations compared to those common internationally. State curriculum guides include performance expectations from several major categories. U.S. textbooks include even more. The only emphasized expectation is the least demanding. (This exhibit lists topics from the TIMSS' science framework intended by at least 70 percent of the countries (international) or at least 70 percent of sampled state guides (U.S.) for the upper grade of Population 2 (U.S. grade 8). Bold-face labels are more general categories that subsume specific (non-bold-face) performance expectations. Both lists (U.S. and international) are arranged in three categories — specific expectations listed only in 70 percent of curriculum guides, those listed in 70 percent of both curriculum guides and textbooks, and those listed only in 70 percent of the textbooks. Asterisks mark performance expectations receiving more extensive textbook attention.)

FIW Intentions	Intentions in TIMSS Countries	U.S. Intentions
	CURRICULUM GUIDES (Not in Textbooks)	
Investigating the natural world Designing investigation:	Theorizing, analyzing, and solving problems Making decision: Investigating the natural world Identifying questions to investigate Designing investigation: Formulating conclusions from investigational data Communicating Sharing information	Investigating the natural world Interpreting investigational data
	CURRICULUM GUIDES (Included in Textbooks)	
Understanding Simple information Complex information Solving problems Constructing and using models Making decisions Using tools, routine procedures, and science processes Using apparatus, equipment, computers Doing routine experimental operations Interpreting data	Understanding Simple information* Complex information* Thematic information Theorizing, analyzing, and solving problems Abstracting & deducing scientific principles Applying scientific principles to solve quantitative science problems Applying scientific principles to develop explanations Constructing, interpreting, and applying models Using tools, routine procedures, and science processes Using apparatus, equipment, computers Conducting routine experimental operations Gathering data Organizing and representing data Interpreting data Investigating the natural world Conducting investigations Interpreting investigational data Communicating Accessing & processing information	Understanding Simple information* Theorizing, analyzing, and solving problems Constructing, interpreting, and applying models Using tools, routine procedures, and science processes Using apparatus, equipment, computers Gathering data Organizing and representing data Interpreting data
	EXCLUSIVELY IN TEXTBOOKS	
Solving problems Solve quantitative science problem: Use science principles to explain Using tools, routine procedures, and science processes Gathering data Investigating the natural world Identifying questions to investigate Formulating conclusions from data Communicating Accessing and processing information		Understanding Complex information Theorizing, analyzing, and solving problems Applying scientific principles to solve quantitative problem Applying scientific principles to develop explanation Making decision: Investigating the natural world Designing investigation: Conducting investigation: Communicating Accessing and processing information

Display 32. The five topics emphasized most by grade 8 mathematics teachers. U.S. grade 8 mathematics teachers' five most extensively covered topics accounted for less than half of their instructional periods. This is even more so since one of the topics was 'other content,' a combination of smaller topics. This was true both for Algebra I teachers and other grade 8 mathematics teachers. Japanese teachers' five most extensively covered topics included almost 75 percent of instructional periods (65 percent if 'other content' is omitted). U.S. teachers' actual content coverage echoes the inclusive, unfocused character of U.S. official curricula and textbooks in mathematics. [Each bar shows the cumulative percentage of intended class periods, averaged across teachers, devoted to the five topics allocated most time by grade 8 mathematics teachers. We show bars for Japan, Germany, and the U.S. Each bar segment shows the specific TIMSS framework topics (e.g., 'equations and formulas') involved. Corresponding international data are not yet approved for release.]



Display 33. The five topics emphasized most by grade 8 science teachers. U.S. grade 8 general science teachers' five most extensively covered topics accounted for only about 40 percent of their instructional periods. Japanese teachers' five topics most extensively covered included over 60 percent of instructional periods, and German teachers' five topics about 50 percent. U.S. grade 8 teachers for specialized science courses ('earth science,' etc.) showed more focused coverage. Their five most extensively covered topics included over 50 percent of instructional time. [Each bar shows the cumulative percentage of intended class periods, averaged across teachers, devoted to the five topics allocated most time by grade 8 science teachers. We show bars for Japan, Germany, and the U.S. Each bar segment shows the specific TIMSS framework topics (e.g., 'earth features') involved. Corresponding international data are not yet approved for release.]



Display 34 Number of periods grade 8 mathematics teachers covered specific topics. Grade 8 mathematics teachers surveyed in Germany, Japan, and the U.S. indicated for the most part that they taught a few periods of almost every topic listed. [We asked teachers to report within specified ranges the number of periods that they had devoted to specific mathematics topics. We surveyed teachers from both grades of Population 2. We obtained the topics used for our survey by combining more specific topics from the TIMSS' mathematics framework to yield a list of familiar topics broadly appropriate to these grade levels. The instrument given teachers to gather these data provided brief descriptions of each topic. We use four different icons here to show which ranges of intended content coverage grade 8 teachers reported on average for each of the countries.]

	Average Number of Periods					
	Grade 8					
	FIW	Germany	Japan	U.S. - Regular	U.S. - Pre-Alg.	U.S. - Alg.
Whole Numbers	○	○	○	○	○	○
Fractions & Decimals	●	●	○	●	●	●
Other Numbers and Number Concepts	○	○	○	○	○	○
Number Theory and Counting	○	○	○	○	○	○
Estimation and Number Sense	○	○	○	○	○	○
Measurement Units	○	○	○	○	○	○
Perimeter, Area and Volume	○	○	○	○	○	○
Measurement Estimation and Error	○	○	○	○	○	○
2-D Geometry	○	○	○	○	○	○
Geometry Transformations	○	○	○	○	○	○
Congruence and Similarity	○	○	●	○	○	○
3-D Geometry, Vectors, Constructions	○	○	○	○	○	○
Proportionality Concepts	○	○	○	○	○	○
Proportionality Problems	○	○	○	○	○	○
Slope and Trigonometry	○	○	○	○	○	○
Linear Interpolation and Extrapolation	○	○	○	○	○	○
Patterns, Relations, and Functions	○	○	○	○	○	○
Equations and Formulas	●	●	●	○	○	●
Data Representation and Analysis	○	○	○	○	○	○
Uncertainty and Probability	○	○	○	○	○	○
Sets and Logic	○	○	○	○	○	○
Other Content	○	○	○	○	○	○

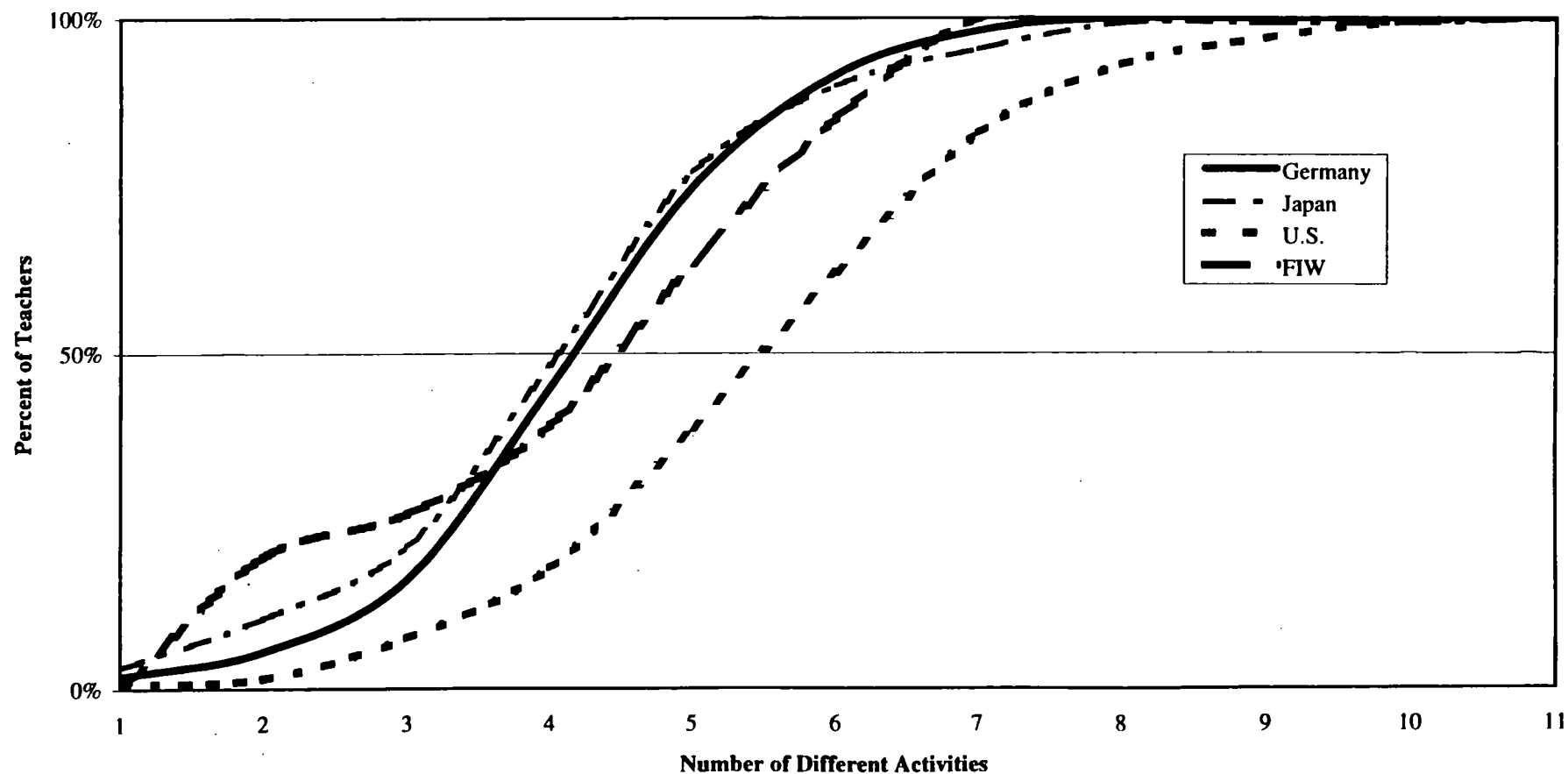
Legend: ○ = <1 period
○ = 1 - 13 periods
● = 14 -19 periods
● = >19 periods

Display 35. Number of periods grade 8 science teachers covered specific topics. Grade 8 science teachers surveyed in Germany, Japan, and the U.S. indicated that they taught at least a few periods of most every topic listed. Grade 8 physical and general science teachers indicated that there was no topic on which they spent more than 13 instructional periods. A few topics received more extensive coverage in Japan and Germany, as well as by U.S. earth and life science teachers. [We asked teachers to report within specified ranges the number of periods that they had devoted to specific science topics. We surveyed teachers from both grades of Population 2. We obtained the topics used for our survey by combining more specific topics from the TIMSS' science framework to yield a list of familiar topics broadly appropriate to these grade levels. The instrument given teachers to gather these data provided brief descriptions of each topic. We use four different icons here to show which ranges of intended content coverage grade 8 teachers reported on average for each of the countries.]

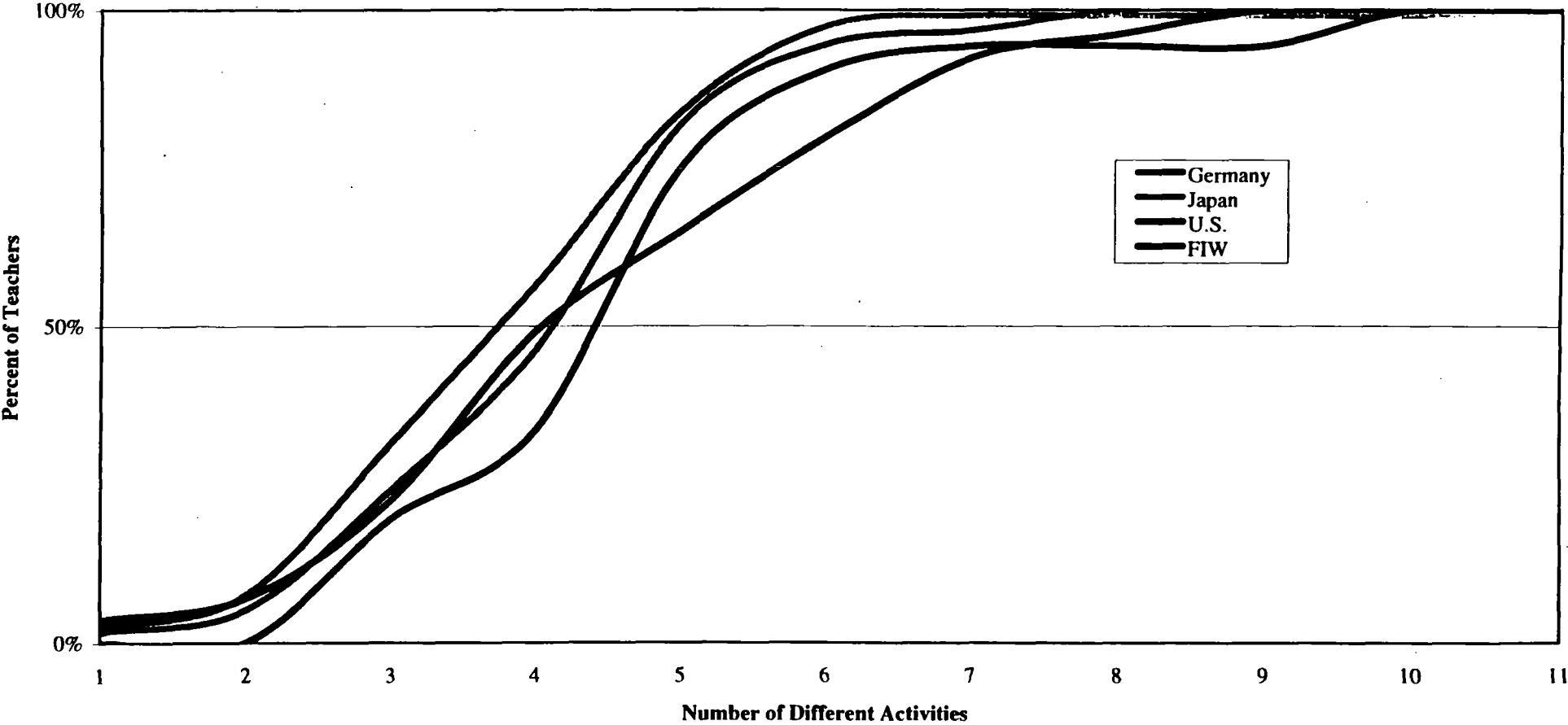
	Average Number of Periods						
	Grade 8						
	FIW	Germany	Japan	U.S. Earth	U.S. Life	U.S. Physical	U.S. General
Earth Features	○	○	●	●	○	○	○
Earth Processes	○	○	○	○	○	○	○
Earth in the Universe	○	○	○	○	○	○	○
Div., Org. & Struc. of Living Things	○	○	○	○	○	○	○
Life Processes & Systems	○	○	○	○	○	○	○
Life Spirals, Genetic Continuity & Div.	○	○	○	○	○	○	○
Interactions of Living Things	○	○	○	○	○	○	○
Human Biology & Health	○	○	○	○	○	○	○
Matter	○	○	○	○	○	○	○
Structure of Matter	○	○	○	○	○	○	○
Energy & Physical Processes	○	○	○	○	○	○	○
Physical Transformations	○	○	○	○	○	○	○
Chemical Transformations	○	○	○	○	○	○	○
Forces & Motion	○	○	○	○	○	○	○
Science, Technology & Society	○	○	○	○	○	○	○
History of Science & Technology	○	○	○	○	○	○	○
Environmental & Resource Issues	○	○	○	○	○	○	○
Nature of Science	○	○	○	○	○	○	○

Legend: ○ = <1 period
○ = 1 - 13 periods
● = 14 - 19 periods
● = >19 periods

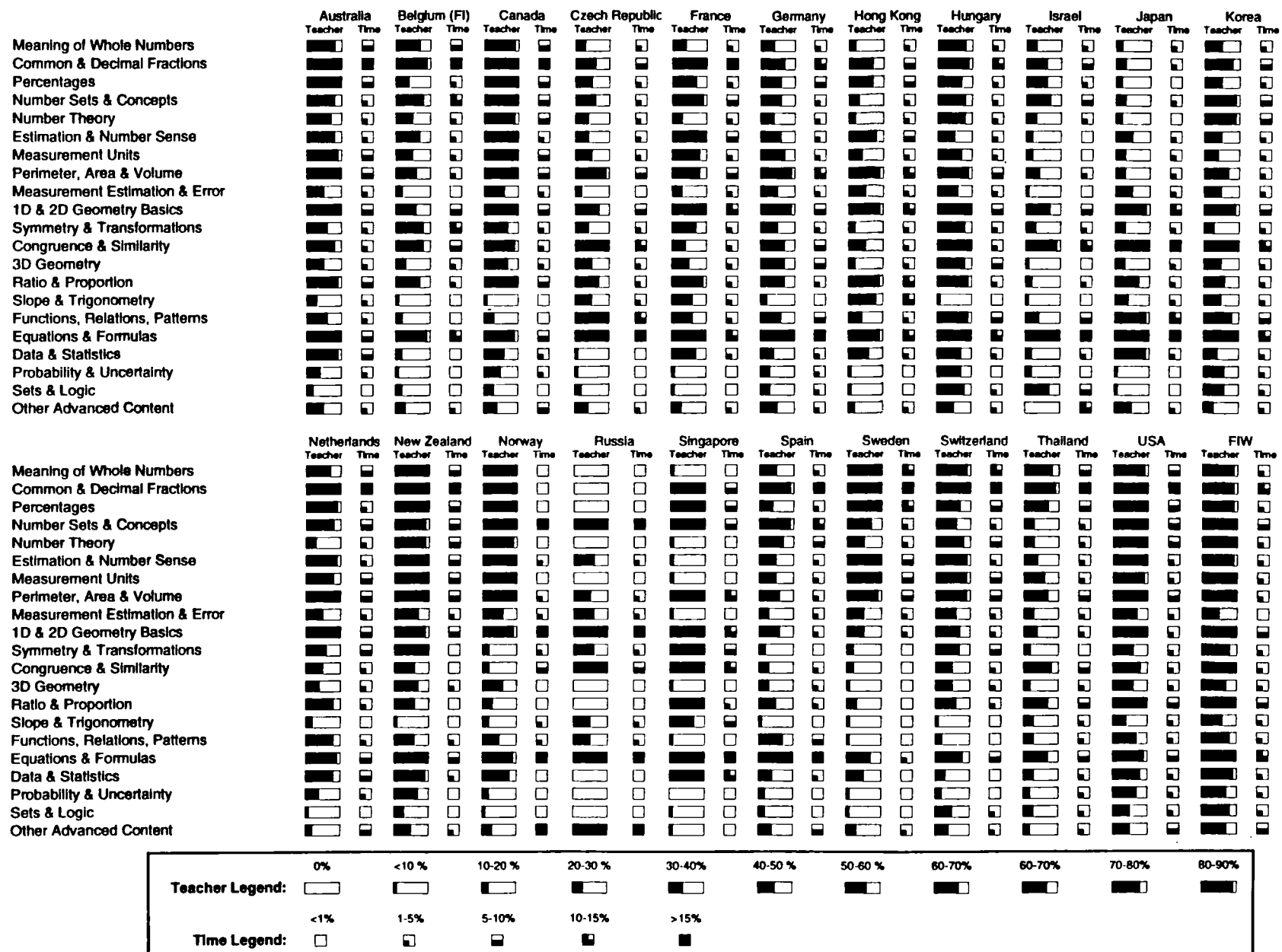
Display 36. Cumulative distribution of the number of activities used by grade 8 mathematics teachers in one period. US grade 8 mathematics teachers report consistently using more different activities than their counterparts in Germany and Japan. [We represent each country by a curve showing the cumulative proportion of their teachers using different numbers of activities. For any point on one of the curves, the point's distance to the right indicates how many different activities are being considered. The point's height indicates the percentage of that country's grade 8 mathematics teachers who use that many or fewer activities in a typical lesson. Curves that lie further to the right indicate typical use of more different activities.]



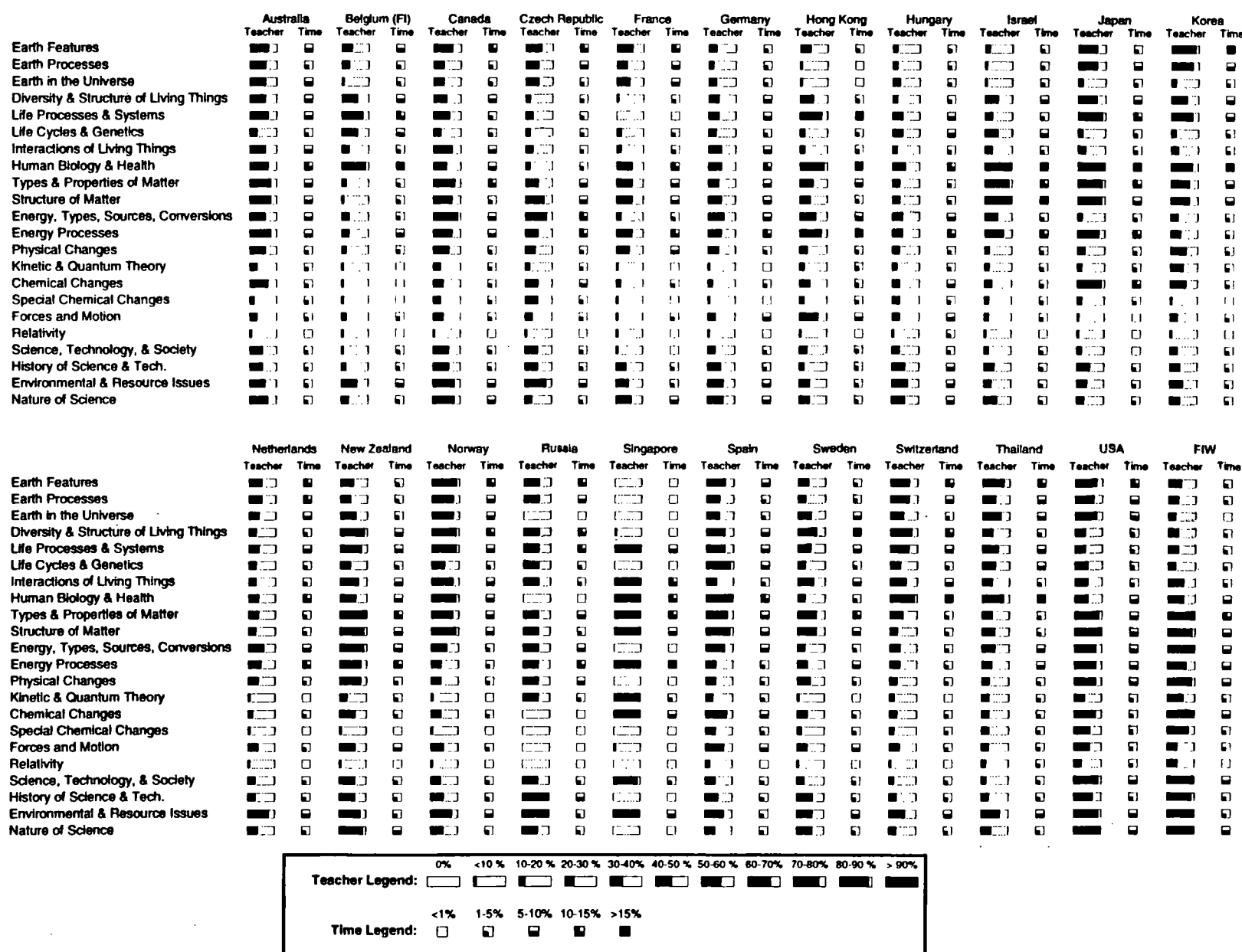
Display 37. Cumulative distribution of the number of activities used by grade 8 science teachers in one period. U.S. grade 8 science teachers report consistently using more different activities than their counterparts in Germany and Japan, but the differences are smaller compared to those among grade 8 mathematics teachers. [We represent each country by a curve showing the cumulative proportion of their teachers using different numbers of activities. For any point on one of the curves, the point's distance to the right indicates how many different activities are being considered. The point's height indicates the percentage of that countries grade 8 science teachers who use that many or fewer activities in a typical lesson. Curves that lie further to the right indicate typical use of more different activities.]



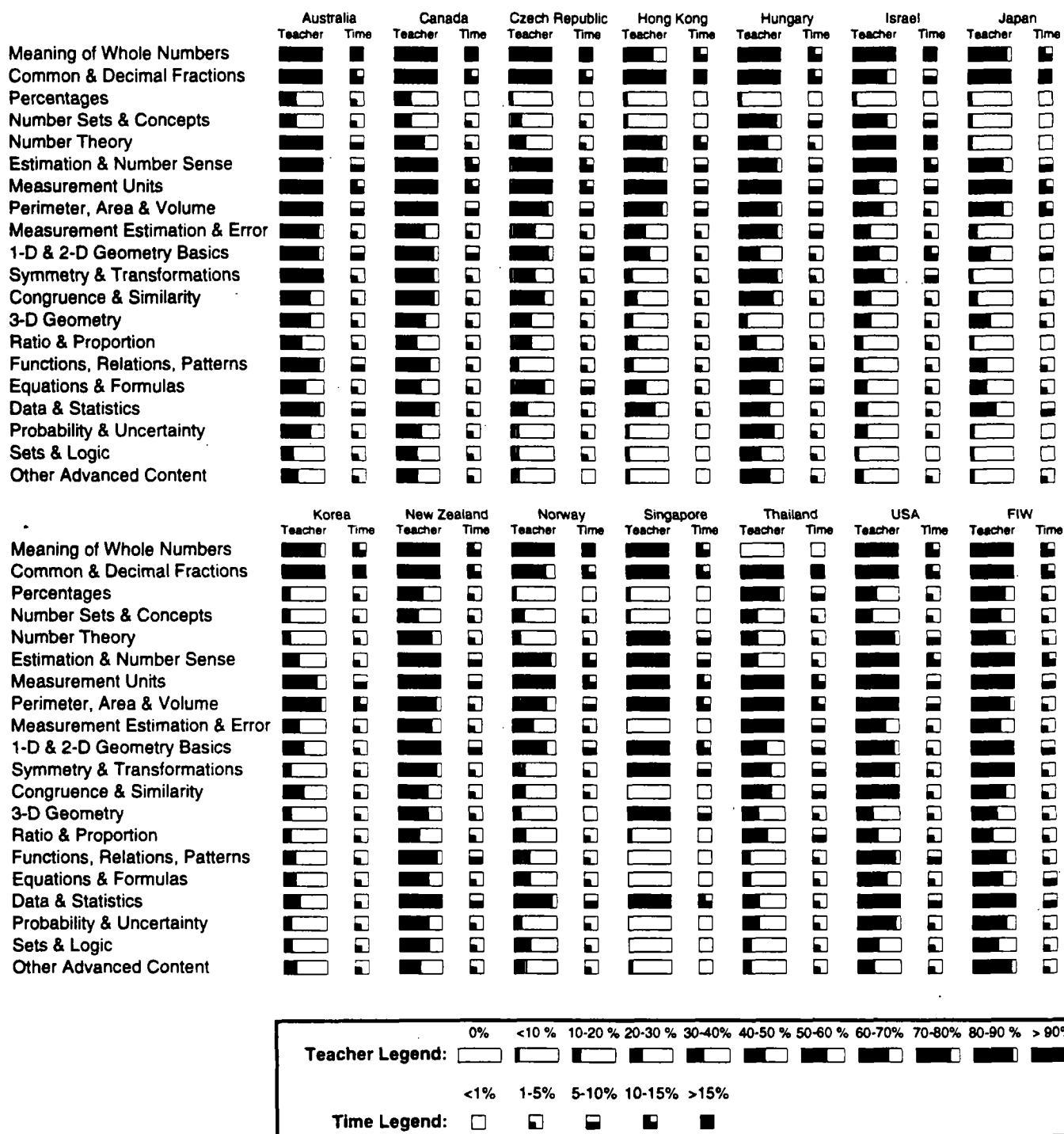
Display 38. Mathematics topics covered by eighth grade teachers (percent of teachers covering the topics and percent of time spent)



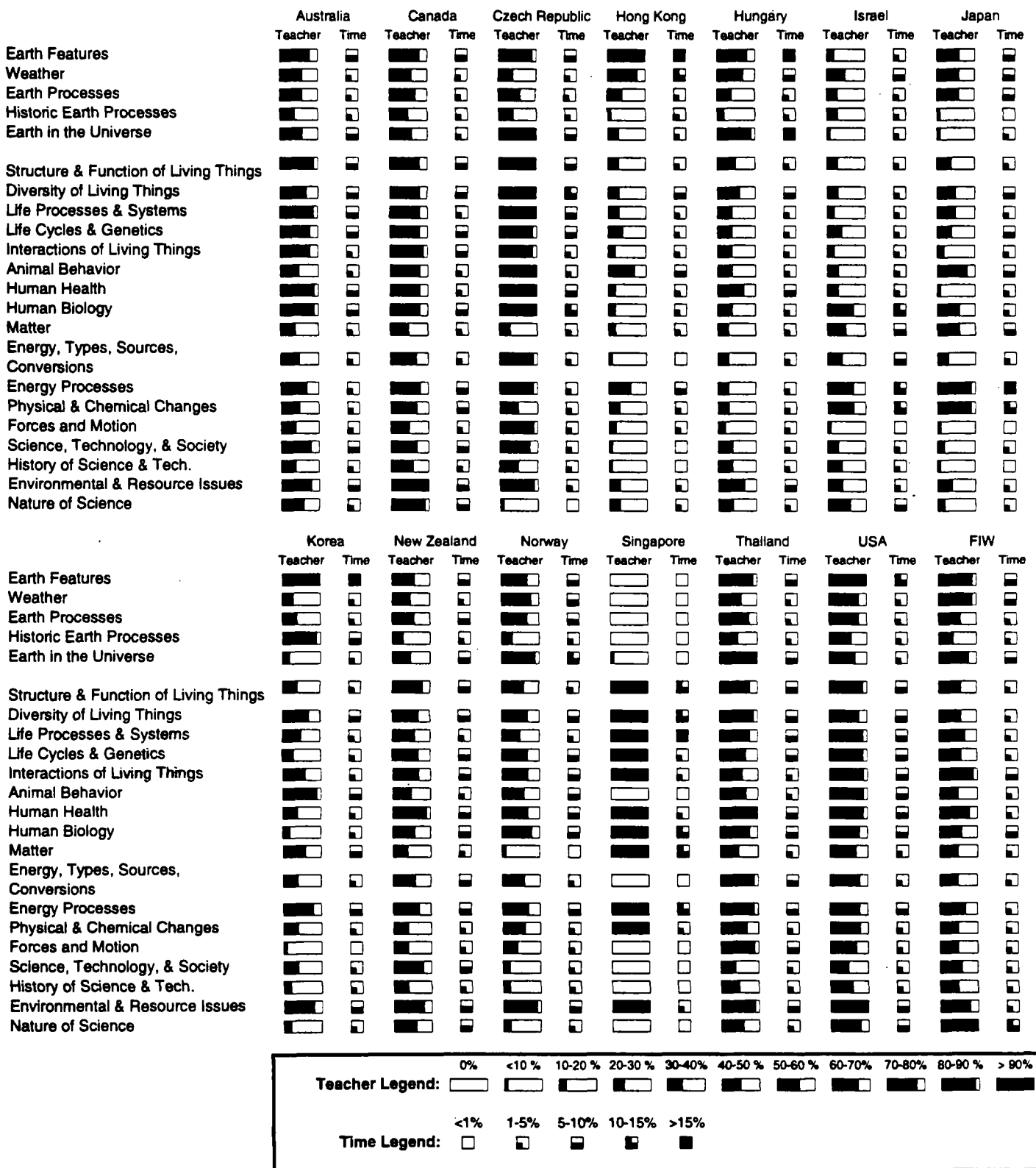
Display 39. Science Topics Covered By Eighth Grade Teachers (percent of teachers covering topics and percent of time spent)



Display 40. Mathematics topics covered by fourth grade teachers (percent of teachers covering the topics and percent of time spent)



Display41. Science topics covered by fourth grade teachers (percent of teachers covering the topics and percent of time spent)



Display 42. Topics Covered by Grade 8 Mathematics Teachers

USA Teachers

Topics Taught By 90-100% of the Teachers
Common and Decimal Fractions
Percentages
Number Sets and Concepts
Number Theory
Estimation and Number Sense
Perimeter, Area, and Volume
Basics of 1 and 2-D Geometry
Ratio and Proportion
Topics Taught by 75-89% of the Teachers
Whole Numbers
Measurement Units and Processes
Equations, Inequalities, and Formulas
Topics Taught by 50-74% of the Teachers
Estimation and Error of Measurements
Geometric Transformations and Symmetry
Geometric Congruence and Similarity
Constructions and 3-D Geometry
Functions, Relations, and Patterns
Statistics and Data
Probability and Uncertainty
Topics Taught by Less Than 50% of the Teachers
Slope, Trigonometry, and Interpolation
Sets and Logic
Other Advanced Topics

FIW Teachers

Topics Taught By 90-100% of the Teachers
Number Sets and Concepts
Number Theory
Measurement Units and Processes
Perimeter, Area and Volume
Basics of 1 and 2-D Geometry
Geometric Congruence and Similarity
Ratio and Proportion
Equations, Inequalities, and Formulas
Topics Taught By 75-89% of the Teachers
Whole Numbers
Common and Decimal Fractions
Percentages
Estimation and Number Sense
Functions, Relations, and Patterns
Statistics and Data
Topics Taught by 50-74% of the Teachers
Geometric Transformations and Symmetry
Constructions and 3-D Geometry
Slope, Trigonometry, and Interpolation
Probability and Uncertainty
Sets and Logic
Other Advanced Content
Topics Taught by Less Than 50% of the Teachers
Estimation and Error of Measurements

Display 43. Topics Covered by Grade 8 Science Teachers

US Teachers

Topics Taught by 90-100% of the Teachers
Structure of Matter Nature of Science
Topics Taught by 75-89% of the Teachers
Types and Properties of Matter Energy Types, Sources, and Conversions Physical Changes Science, Technology, and Society Environmental and Resource Issues
Topics Taught by 50-74% of the Teachers
Earth Features Earth Processes Earth in the Universe Energy Processes General Chemical Changes Specialized Chemical Changes Forces and Motion History of Science and Technology
Topics Taught by Less than 50% of the Teachers
Diversity and Structure of Living Things Life Processes and Systems Enabling Life Functions Life Cycles, Genetic Continuity, and Diversity Interactions of Living Things Human Biology and Health Kinetic and Quantum Theory Relativity Theory

FIW Teachers

Topics Taught by 90-100% of the Teachers
Types and Properties of Matter Energy, Types, Sources, and Conversions Chemical Changes Science, Technology, and Society Environmental and Resource Issues Nature of Science
Topics Taught by 75-89% of the Teachers
Structure of Matter Physical Changes History of Science and Technology
Topics Taught by 50-74% of the Teachers
Interactions of Living Things Human Biology and Health Energy Processes Kinetic and Quantum Theory Specialized Chemical Changes
Topics Taught by Less than 50% of the Teachers
Earth Features Earth Processes Earth in the Universe Diversity and Structure of Living Things Life Processes and Systems Life Cycles and Genetics Forces and Motion Relativity Theory

Display 44. Topics Covered by Grade 4 Mathematics Teachers

USA Teachers

Topics Taught by 90-100% of the Teachers
Whole Numbers Common and Decimal Fractions Estimation and Number Sense Measurement Units and Processes Perimeter, Area, and Volume Geometric Congruence and Similarity Data Representation and Statistics
Topics Taught by 75-89% of the Teachers
Number Theory Basics of 1- and 2-D Geometry Geometric Transformations and Symmetry Functions, Relations, and Patterns Probability
Topics Taught by 50-74% of the Teachers
Estimation and Error of Measurements Equations and Formulas
Topics Taught by Less Than 50% of the Teachers
Percentages Number Sets and Concepts 3-Dimensional Figures and Constructions Sets and Logic Ratio and Proportion Other Advanced Topics

FIW Teachers

Topics Taught by 90-100% of the Teachers
Whole Numbers Common and Decimal Fractions Estimation and Number Sense Measurement Units Basics of 1- and 2-D Geometry Geometric Transformations and Symmetry Data Representation and Statistics
Topics Taught by 75-89% of the Teachers
Percentages Number Theory Perimeter, Area and Volume Geometric Congruence and Similarity Probability Other Advanced Topics
Topics Taught by 50-74% of the Teachers
Number Sets & Concepts Measurement Estimation & Error 3-Dimensional Figures and Constructions Functions, Relations, and Patterns Equations and Formulas Sets and Logic
Topics Taught by Less Than 50% of the Teachers
Ratio and Proportion

Display 45. Topics Covered by Grade 4 Science Teachers

US Teachers

Topics Taught by 90-100% of the Teachers
Earth Features Environmental and Resource Issues
Topics Taught by 75-89% of the Teachers
Weather Earth Processes Diversity of Living Things Human Health Human Biology Structure and Function of Living Things Life Processes and Systems Life Cycles and Genetics Interaction of Living Things Animal Behavior Energy Processes Nature of Science
Topics Taught by 50-74% of the Teachers
Historic Earth Processes Earth in the Universe Matter Energy Types, Sources, and Conversions Physical and Chemical Changes Forces and Motion History of Science and Technology
Topics Taught by 25-49% of the Teachers
Science, Technology, and Society

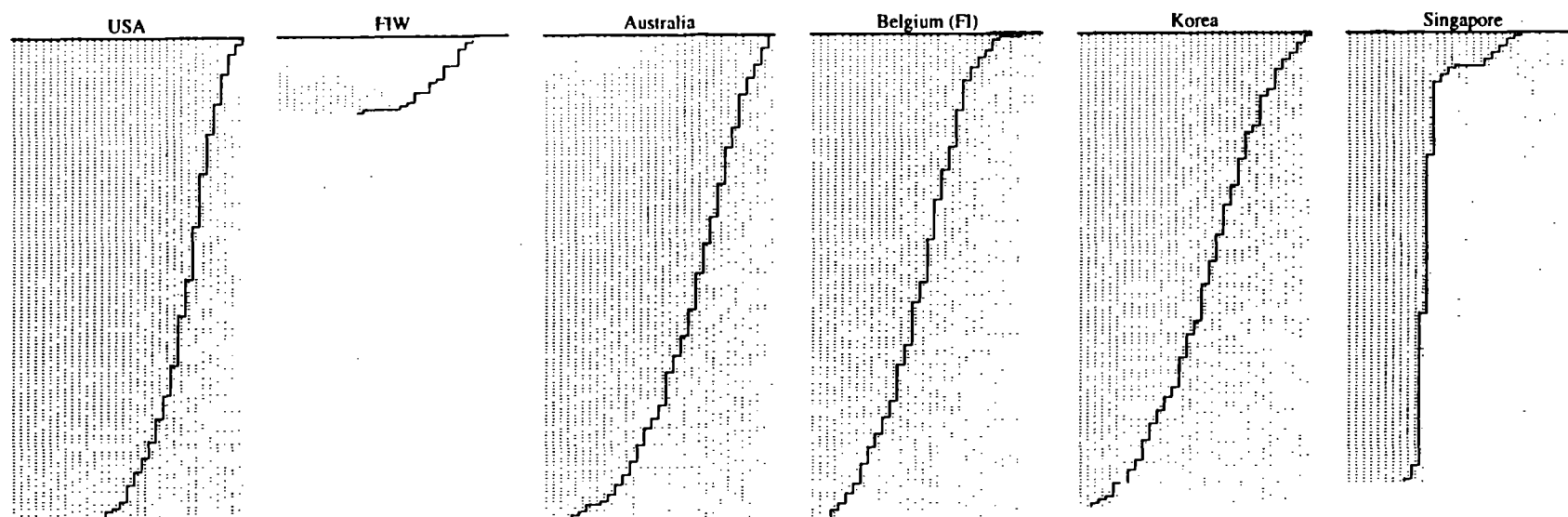
FIW Teachers

Topics Taught by 90-100% of the Teachers
Nature of Science
Topics Taught by 75-89% of the Teachers
Earth Features Weather Interactions of Living Things
Topics Taught by 50-74% of the Teachers
Earth Processes Earth in the Universe Structure and Function of Living Things Diversity of Living Things Life Processes and Systems Life Cycles and Genetics Animal Behavior Human Health Human Biology Energy Processes Science, Technology, and Society Environmental and Resource Issues
Topics Taught by 25-49% of the Teachers
Historic Earth Processes Matter Energy, Types, Sources, and Conversions Physical and Chemical Changes Forces and Motion History of Science and Technology

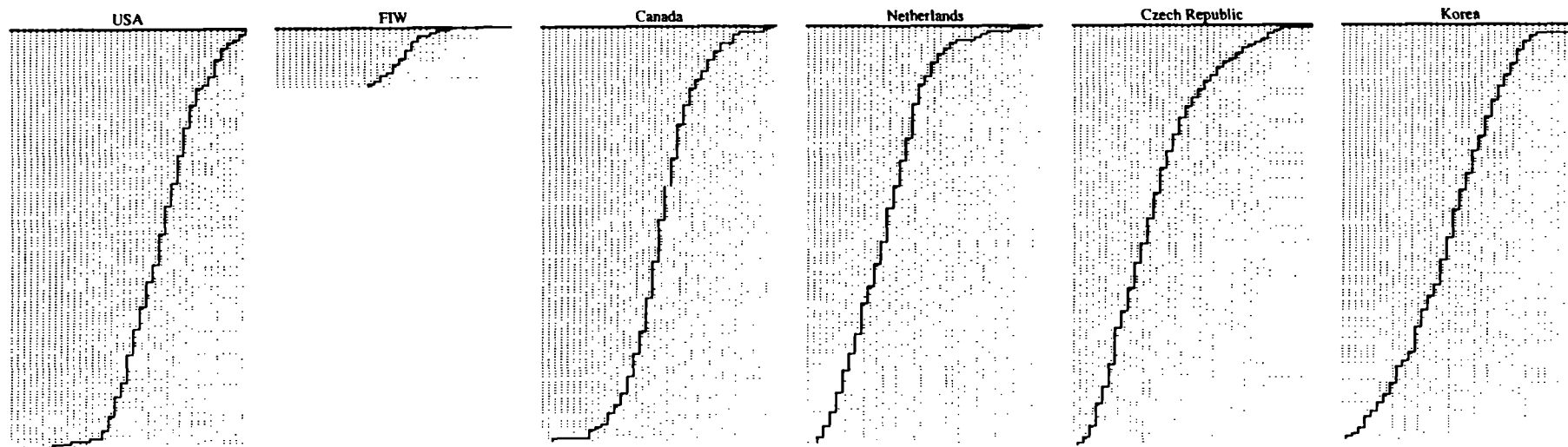
SCHOOL LISTINGS BY TOPIC INDICATING COVERAGE ACROSS GRADES

- | |
|--|
| <ul style="list-style-type: none">. not intended for coverage1 intended coverage2 intended for focused coverage |
|--|

Display 46. Number of topics covered by sampled eighth grade math teachers in selected countries.

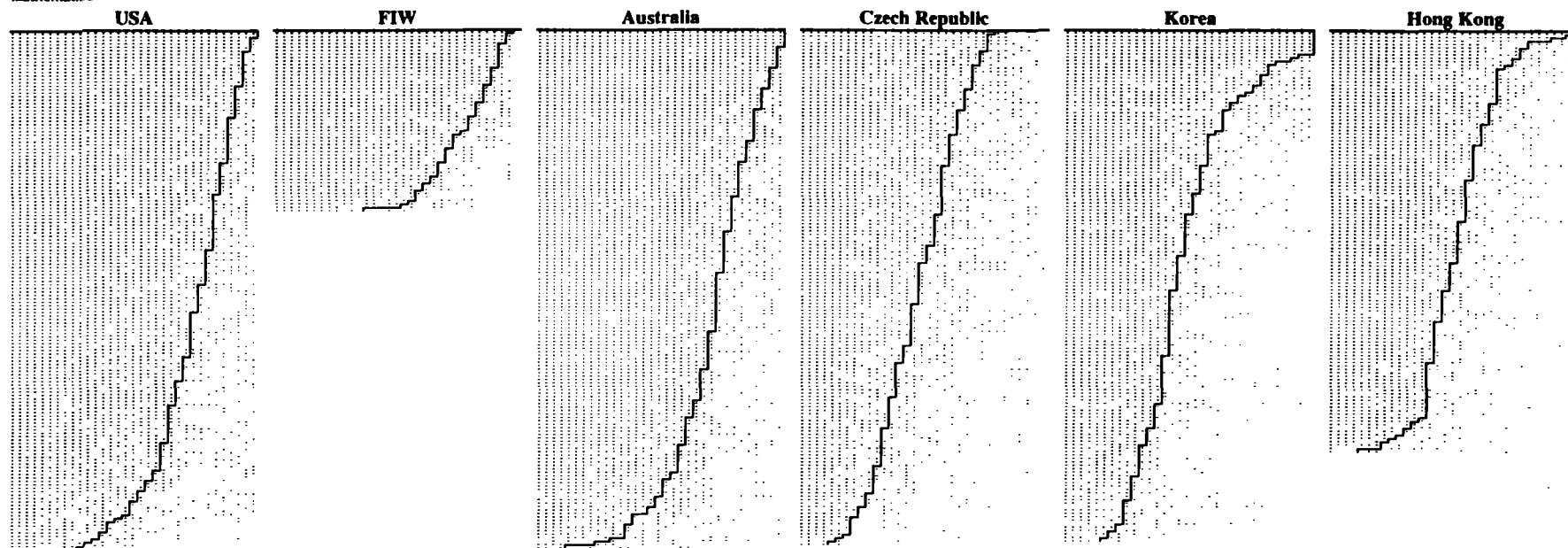


Display 47. Number of topics covered by sampled eighth grade science teachers in selected countries.



Display 48. Number of topics covered by sampled fourth grade students' mathematics teachers for a selected set of countries.

Mathematics



Display 49. Number of topics covered by sampled fourth grade students' science teachers for a selected set of countries.

