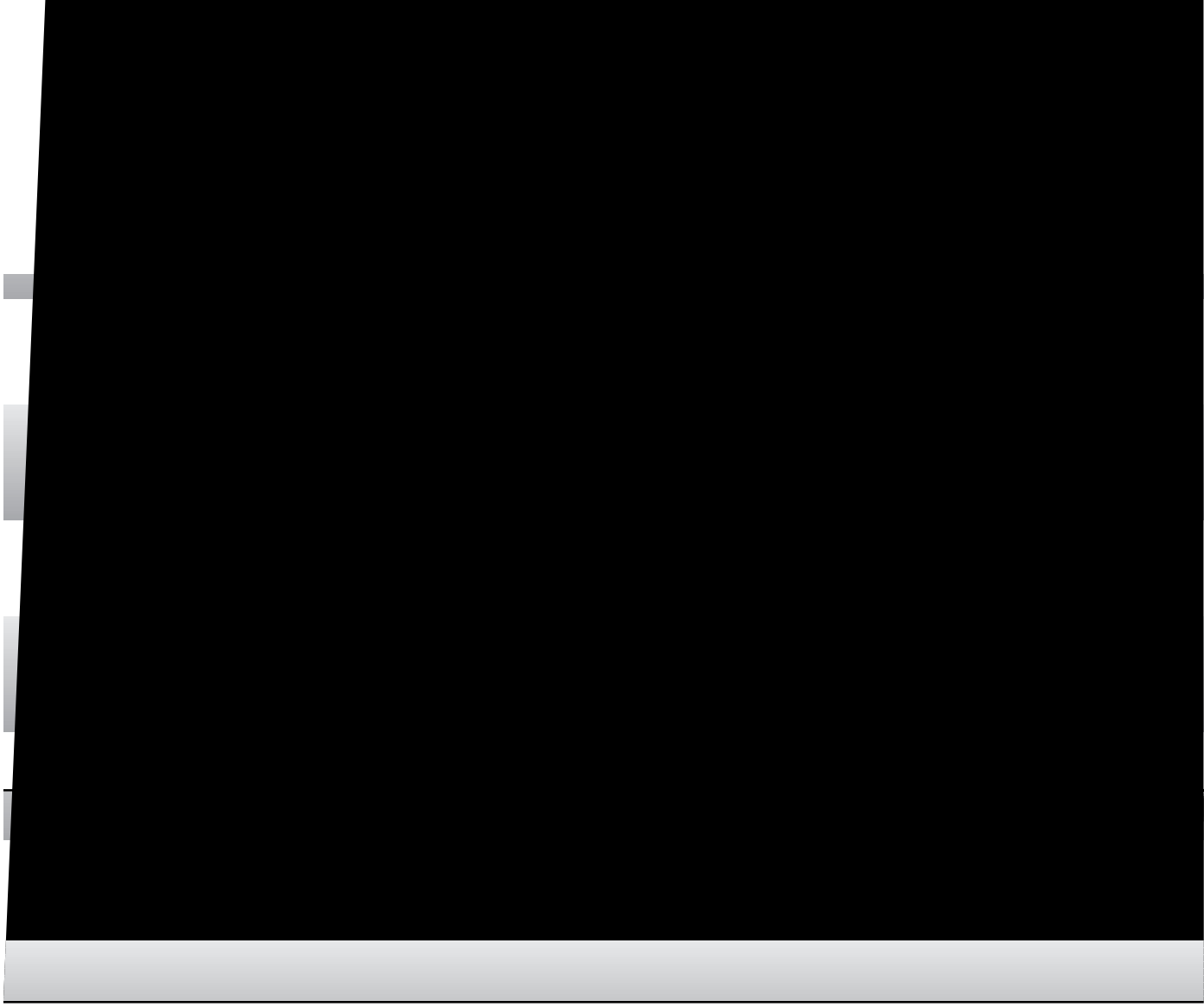

Chapter 2

nominated by participating countries and representing a range of nations and cultures.[2]

Since the test items were developed in English and translated into 34 0 ® v d ﻏ ч ʎ

Exhibit 2.1 **Overview of the TIMSS 2003 Framework and Test Development Process**
(…Continued)

Date(s)		Group and Activity
October	2001	Second Science and Mathematics Item Review Committee Meeting (Portsmouth)
		Review, ! — k T t w ! v 3 `

Exhibit 2.1 **Overview of the TIMSS 2003 Framework and Test Development Process**
(…Continued)

Date(s)	Group and Activity
December 2002	TIMSS International Study Center Update TIMSS Assessment Frameworks and Specifications document to

Following the meeting, four extensive assessment topic questionnaires (mathematics and science at fourth and eighth grades) were distributed to each NRC to be completed with the assistance of experts in mathematics and science curriculum in each country. The questionnaires asked countries to indicate for ex "] ɜ

Exhibit 2.2 **Target Percentages of TIMSS 2003 Mathematics Assessment Devoted to Content and Cognitive Domains by Grade Level**

	Grade 4	Grade 8
Mathematics Content Domains		
Number	40%	30%
Algebra*	15%	25%
Measurement	20%	15%
Geometry	15%	15%
Data	10%	15%
Mathematics Cognitive Domains		
Knowing Facts and Procedures	20%	15%
Using Concepts	20%	20%
Solving Routine Problems	40%	40%
Reasoning	20%	25%

* At fourth grade, the algebra content domain is called patterns and relationships.

2.3.1 Content Domains

For each of the five content domains, the mathematics framework identifies several topic areas to be included in the assessment, as shown in Exhibit 2.3. For example, *number* is further categorized by *whole numbers, fractions and decimals, integers,* and *ratio, proportion, and percent.* Each topic area is presented

Exhibit 2.3 Main Topics Included in the Mathematics Content Domains

Content Domains	Main Topics
Number	Whole numbers Fractions and decimals Integers (grade 8 only) Ratio, proportion, and percent
Algebra	Patterns Algebraic expressions (grade 8 only) Equations and formulas Relationships
Measurement	Attributes and units Tools, techniques, and formulas
Geometry	Lines and angles Two- and three-dimensional shapes Congruence and similarity Locations and spatial relationships Symmetry and transformations
Data	Data collection and organization Data representation Data interpretation Uncertainty and probability (grade 8 only)

Knowing Facts and Procedures: *Facts*

mathematical properties (e.g., solving equations). Though they range in difficulty, routine problems are expected to be sufficiently familiar to students that they essentially involve selecting and applying learned procedures.

Reasoning: Mathematical reasoning involves the capacity for logical, systematic thinking. It includes intuitive and inductive reasoning based on patterns and regularities that can be used to arrive at solutions to non-routine problems, i.e., problems very likely to be unfamiliar to students. Such problems may be purely mathematical or may have real-life settings, and involve application of knowledge and skills to new situations, with interactions among reasoning skills usually a feature.

Examples of the behaviors associated with each of the cognitive domains may be found in Mullis et al. (2003).

2.3.3 Communicating Mathematically

Communicating mathematical ideas and processes is important for many aspects of living and fundamental to the teaching and learning of mathematics. In the TIMSS framework, communication is not a separate cognitive domain but rather an overarching dimension across all mathematics content areas and processes. Communication is fundamental to each of the four TIMSS cognitive domains (*knowing facts and procedures, using concepts, solving routine problems, and reasoning*), and students' communication in and about mathematics should be regarded as assessable in each of these areas. Students in TIMSS may demonstrate communication skills through description and explanation, such as describing or discussing a mathematical object, concept, or model. Communication also occurs in using mathematical terminology and notation, demonstrating the procedure used in solving an equation, or using particular representational modes to present mathematical ideas.

2.3.4 Calculator Policy

The TIMSS policy on calculator use at the eighth grade is to give students the best opportunity to operate in settings that mirror their classroom experience. Beginning with 2003, calculators were permitted but not required for newly-developed eighth-grade assessment materials. Participating countries could decide whether or not their students were allowed to use calculators for the new items. Since calculators were not permitted at the eighth grade in the 1995 or 1999 assessments, the 2003 eighth-grade test booklets were designed so that items from these assessments were placed in the first half and items new in 2003 placed in the second half. Where countries chose to permit eighth-grade students to use calculators, they could use them for the

2.4 Science Assessment Framework and Specifications

The science assessment framework for TIMSS 2003, like the mathematics framework, is framed by two organizing dimensions, a content dimension and a cognitive dimension. There are five content domains: life science, chemistry, physics, earth science, and environmental science, and three cognitive domains: factual knowledge, conceptual understanding, and reasoning and analysis. Exhibit 2.4 shows the target percentages of the total science assessment time to be devoted to each of the science content and cognitive domains for fourth and eighth grades. In contrast to TIMSS 1999, where a separate reporting category of "Scientific Inquiry and the Nature of Science" was included, the TIMSS 2003 framework treats scientific inquiry as a separate assessment strand that overlaps all of the fields of science and has both content- and skills-based components. Although scientific inquiry is not treated as a separate reporting category in TIMSS 2003, the framework specifies that outcomes related to scientific inquiry will represent up to 15 percent of the total science assessment time at each grade level to permit some level of reporting student performance in this area. Further descriptions of the assessment specifications for the content domains, cognitive domains, and scientific inquiry assessment strand are provided in the following sections.

Exhibit 2.4 **Target Percentages of TIMSS 2003 Science Assessment Devoted to Content and Cognitive Domains by Grade Level**

	Grade 4	Grade 8
Science Content Domains		
Life Science	45%	30%
Physical Science	35%	*
Chemistry	*	15%
Physics	*	25%
Earth Science	20%	15%
Environmental Science	*	15%
Science Cognitive Domains		
Factual Knowledge	40%	30%
Conceptual Understanding	35%	35%
Reasoning and Analysis	25%	35%

* At fourth grad

2.4.1 Content Domains

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2.5.2 Developing the International Item Pool for TIMSS 2003

Test development for TIMSS 2003 was an international collaborative process, involving participants from more than 30 countries. To maximize the effec-

Exhibit 2.8 **Problem-Solving and Inquiry Tasks Selected for the Field Test – Grade 4**

Exhibit 2.10 **Problem-Solving and Inquiry Tasks Selected for the Main Survey at Grade 4 and Grade 8**

science. At the eighth grade, a total of 386 items were included in the field test, 190 in mathematics and 196 in science. Since some constructed-response items contribute two score points, this correspon] ľ

Based on the recommendations of the SMIRC, the International Study Center prepared draft instruments for the assessment to be reviewed by the National Research Coordinators at their fifth meeting in August 2002. The draft instruments were well received and widely discussed by NRCs, who recommended a number of additional improvements that were incorporated into the final instruments distributed in September 2002. A

pletely blank responses. In general, only a few diagnostic codes are used to track high-frequency correct or partial approaches or common misconceptions and errors, and a particular effort was made in TIMSS 2003 to minimize the number of diagnostic codes used. In addition to the international codes, second digit codes of 7 and 8 may be used by national centers to monitor specific responses not already captured by the internationally-defined codes. The general TIMSS two-digit scoring scheme is summarized in Exhibit 2.14.

Exhibit 2.14 **TIMSS Two-Digit Scoring Scheme for Constructed-Response Items**

Two- Point Items			One-Point Items		
Correctness Level	**International Code(s)**		**Correctness Level**	**International Code(s)**	
Correct Responses	20 – 25:	category/method #1 - #5	Correct Responses	10 – 15:	category/method #1- #5
	29:	other correct method		19:	other correct method
Partial Responses	10 – 15:	category/method #1- #5	Incorrect Responses		
	19:	other partial method			

test also was used to make improvements in the scoring guides. In addition, sets of student booklets from the field test were collected from all of the English-test countries as sources of example student responses to clarify codes and prepare scoring training materials for the assessment.

in Bucharest, Romania, was for the remaining countries. At each session, a full day of training was devoted to each subject for eighth grade and a little less for fourth grade (about a half day for mathematics and three-quarters for science). After the completion of scoring training, code sheets for the example and practice papers were distributed to NRCs for use in organizing scoring training materials in their own countries.

2.6 Assessment Booklet Design

In order to cover the frameworks, the pool of items and tasks included in the TIMSS asssessment is extensive and would require much more testing time than could be alloted for individual students (about seven hours at grade 8 and five and one-half hours at grade 4). Therefore, as in the 1995 and 1999 assessments, TIMSS 2003 uses a matrix-sampling technique that involves dividing the entire assessment pool into a set of unique item blocks, distributing these blocks across a set of booklets, and rotating the booklets among the students. Each student takes one booklet containing both mathematics and science items.[6]

2.6.1 Block and Booklet Design

The TIMSS design for 2003 divides the 313 items at fourth grade and 383 items at eighth grade into 28 item blocks at each grade, 14 mathematics blocks labeled M01 through M14, and 14 science blocks labeled S01 through S14. Each block contains either mathematics items only or science items only. This general block design, shown in Exhibit 2.15, is the same for both grades, although for the assessment time is 12 minutes for fourth-grade blocks and 15 minutes for eighth-grade blocks. At the eighth grade, six blocks in each subject (blocks 01 – 06) contain secure items from 1995 and 1999 to measure trends and ei ˆ s eelo] p 5e thpЛ ! ľ ɔpe] pdr A] p r l
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Exhibit 2.15 **General Design of the TIMSS 2003 Matrix-Sampling Blocks**

Source of Items	Mathematics Blocks	Science Blocks
Trend Items (TIMSS 1995 or 1999)	M01	S01
Trend Items (TIMSS 1995 or 1999)	M02	S02
Trend Items (TIMSS 1995 or 1999)	M03	S03
Trend Items (TIMSS 1999)	M04	S04
Trend Items (TIMSS 1999)	M05	S05

Exhibit 2.17 **TIMSS 2003 Mathematics and Science Blocks – Grade 4: Number of Items from 1995 Trend Clusters and Score Points by Assessment Year**

Exhibit 2.18

Exhibit 2.20

The block and booklet design for TIMSS 2003 ensures that the student booklets contain an appropriate balance of mathematics and science content.

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Exhibit 2.26 shows the number of multiple-choice, short-answer, and extended-response items in each content domain for the eighth-grade assessment. As in the fourth grade, each of the content domains at eighth grade includes a range of item types.