

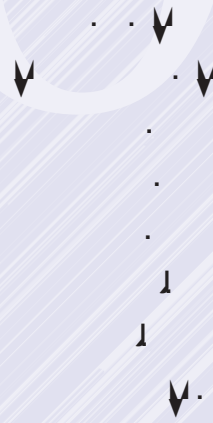
# TIMSS

Trends in Mathematics  
and Science Study

W κ  
2003

# 2003

2



W κ



— 2003 年 1 月 1 日起  
E 类 企业 (EA)

FA  
2003 年 2 月 1 日起  
FA 2003

CA 类 企业 (CA)  
E 类 企业 (EA)  
B 类 企业 (B)  
C 类 企业 (C)  
CA 类 企业 (CA) : 2003101238  
B : 1 889938 30 0

FA 类 企业 (FA)  
E 类 企业 (EA)  
B 类 企业 (B)  
C 类 企业 (C)  
A 02467

: +1-617-552-1600  
A : +1-617-552-1203

- A : @  
://

B 类 企业 (B)  
C 类 企业 (C)  
A 类 企业 (A)  
E 类 企业 (EA)

# Contents

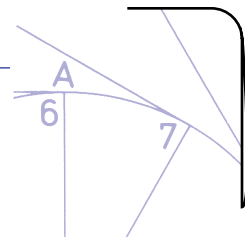
Preface	i
---------	---

---

Introduction	1
--------------	---









---

Overview	3
The TIMSS Curriculum Model	3
The Development Process for the TIMSS Assessment Frameworks and Specifications	4
The TIMSS Tests	5
Student Populations Assessed	6



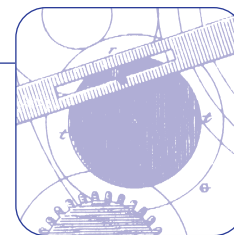
Mathematics Framework	7
-----------------------	---

---

Overview	9
Mathematics Content Domains	11
	12
	1
	1
	1
	21
Mathematics Cognitive Domains	25
	2
	2
	30
	32
Communicating Mathematically	34
Guidelines for Calculator Use	34

## Science Framework

35



Overview 37

Science Content Domains 38

0

P 0

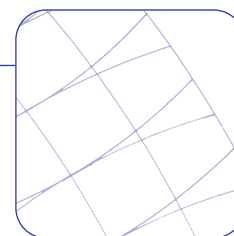
Science Cognitive Domains 61

W 3

Scientific Inquiry 69

## Contextual Framework

71



Overview 73

The Curriculum 73

The Schools 75

Teachers and Their Preparation 76

Classroom Activities and Characteristics 78

The Students 81

## Assessment Design 83

---

Scope of the Assessment	85
Dividing up the Item Pool	85
Block Design for Student Booklets	86
Question Types and Scoring Procedures	88
Scales for Reporting Student Achievement	89
Releasing Assessment Material to the Public	90
Background Questionnaires	90



## Endnotes 93

---

## Appendix A 97

---

National Research Coordinators

## Appendix B 103

---

Example Mathematics Items

## Appendix C 121

---

Example Science Items



## Background

Advancing science and mathematics education has long been the focus of studies by the IEA, the International Association for the Evaluation of Educational Achievement. Reflecting the seminal place that these two key curriculum areas hold in all educational systems as fundamental to developing technologically proficient societies, IEA has been measuring student achievement and collecting contextual information to facilitate student learning in mathematics and science for nearly 40 years.

The conduct of the First International Mathematics Study (FIMS) dates back to 1964, and science first was assessed as part of the Six Subject Study in 1970-71. Mathematics and science were again the focus of major research efforts in 1980-82 and 1983-84, respectively. In 1990, the IEA General Assembly determined to assess science and mathematics together on a regular basis every four years. This decision marked the first of the large-scale international studies to measure trends in student performance, beginning with the original TIMSS (the Third International Mathematics and Science Study) conducted in 1995, TIMSS-Repeat in 1999, and now TIMSS 2003 (renamed the Trends in International Mathematics and Science Study), also known as TIMSS Trends.

## Frameworks for TIMSS 2003

A particular challenge for TIMSS 2003 was developing this set of frameworks articulating important content for students to have learned in mathematics and science, as well as describing important home and school contexts influencing achievement in these subjects. It is important that these frameworks capture important issues for mathematics and science education today, while providing the vision necessary to take the TIMSS cycle of studies beyond the 2003 assessment. The frameworks, produced at the beginning of the new millennium, are designed to shape future IEA assessments in mathematics and science so that they can evolve with the times, while recognizing the axiom – *If you want to measure change, do not change the measure.*

The TIMSS International Study Center at Boston College prepared this second edition of the frameworks to provide examples of the types of assessment questions contained in the TIMSS 2003 assessment. The example items for mathematics are presented in Appendix B and for science in Appendix C. The second edition also contains some minor revisions, in particular to the section on the assessment design.

## Acknowledgments

The IEA was founded in 1959 for the purpose of conducting comparative research studies on educational policies, practices, and outcomes. Since then, IEA studies have contributed a deeper understanding of the educational process both within and among the nearly 60 member countries. The IEA has a permanent Secretariat in Amsterdam, the Netherlands, and a Data Processing Center in Hamburg, Germany. TIMSS is directed by IEA's International Study Center at Boston College. The strength, quality, and success of IEA's studies, however, derive from the expertise among its members in curriculum, measurement, and education and their collaboration in conducting the research.

Also, extremely crucial to success is securing the funding necessary to carry out the extensive development and review work required by international projects of this magnitude. Without such support a project like TIMSS is not possible. The IEA is deeply grateful to the U.S. National Science Foundation, the U.S. National Center for Education Statistics, and for the fees paid by participating countries for helping to fund the development of the TIMSS frameworks presented herein.

The TIMSS frameworks are the result of considerable collaboration among individuals from around the world, most notably the specialists comprising the TIMSS Expert Panel in Mathematics and Science, the National Research Coordinators from the participating countries, staff from IEA's International Study Center at Boston College, and staff from IEA's Secretariat and Data Processing Center. I am extremely grateful for the contribution of each person who devoted his or her energy and time to this important and comprehensive effort. In particular, I would like to acknowledge the work of the TIMSS Mathematics Coordinator Robert Garden and the Science Coordinator Teresa Smith. Kelvin Gregory, the TIMSS Coordinator at the time the frameworks were developed, had special responsibility for the contextual framework. The Director of Operations and Analysis of the International Study Center and TIMSS, Eugene Gonzalez, oversaw development of the assessment design.

Without a dedicated, continuing center from which to coordinate projects like TIMSS and the experienced staff from the consortium of organizations that implements the studies, success would be limited. I would like to express my thanks to the staff at the International Study Center at Boston College, the IEA Secretariat, the IEA Data Processing Center, Statistics Canada, and Educational Testing Service. Finally, I would like to especially thank the Co-Directors of the International Study Center and TIMSS, Ina V.S. Mullis and Michael O. Martin, for their leadership and dedication to this project.



## The International Study Center at Boston College

The International Study Center (ISC) at Boston College is dedicated to conducting comparative studies in educational achievement. Principally, it serves as the International Study Center for IEA's studies in mathematics, science, and reading – the Trends in International Mathematics and Science Study (TIMSS), and the Progress in International Reading Literacy Study (PIRLS). The staff at the ISC is responsible for the design and implementation of these studies. In developing and producing the TIMSS frameworks, ISC staff conducted a collaborative effort involving a series of reviews by an Expert Panel and the National Research Coordinators. The following individuals were instrumental in this process.

Ina V.S. Mullis  
Co-Director, TIMSS

Michael O. Martin  
Co-Director, TIMSS

Eugenio J. Gonzalez  
Director of Operations and  
Data Analysis

Kelvin D. Gregory  
TIMSS Coordinator (2000-2001)

Teresa A. Smith  
Science Coordinator

Robert A. Garden  
Mathematics Coordinator

Steven J. Chrostowski  
Development Specialist

Kathleen M. O'Connor  
Development Specialist

Christine O'Sullivan  
Science Consultant

Eugene Johnson  
Psychometric/Methodology  
Consultant



## International Expert Panel in Mathematics and Science

The Expert Panel worked with staff from the International Study Center in developing all aspects of the frameworks and particularly the mathematics and science frameworks. They made recommendations for the content areas, cognitive domains, problem-solving and inquiry tasks, and focus areas for policy-orientated research.

**Khattab Abu-Libdeh**  
*Jordan*

**Anica Aleksova**  
*Republic of Macedonia*

**Kiril Bankov**  
*Bulgaria*

**Aarnout Brombacher**  
*South Africa*

**Anna Maria Caputo**  
*Italy*

**Joan Ferrini-Mundy**  
*United States*

**Jim Fey**  
*United States*

**Derek Holton**  
*New Zealand*

**Jeremy Kilpatrick**  
*United States*

**Pekka Kupari**  
*Finland*

**Mary Lindquist**  
*United States*

**David Robitaille**  
*Canada*

**Graham Ruddock**  
*United Kingdom*

**Hanako Senuma**  
*Japan*

**K.Th. (Kerst) Boersma**  
*The Netherlands*

**Rodger Bybee**  
*United States*

**Audrey Champagne**  
*United States*

**Reinders Duit**  
*Germany*

**Martin Hollins**  
*United Kingdom*

**Eric Jakobsson**  
*United States*

**Galina Kovalyova**  
*Russian Federation*

**Svein Lie**  
*Norway*

**Jan Lokan**  
*Australia*

**Francisco Mazzitelli**  
*Argentina*

**Gabriella Noveanu**  
*Romania*

**Margery Osborne**  
*United States*

**Jana Paleckova**  
*Czech Republic*

**Hong Kim Tan**  
*Singapore*

**Khadija Zaim-Idrissi**  
*Morocco*

