

TIMSS 2007 International Science Report

Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades

Michael O. Martin

Ina V.S. Mullis

Pierre Foy

In collaboration with

John F. Olson

Ebru Erberber

Corinna Preuschoff

Joseph Galia



Copyright © 2008 International Association for the Evaluation of Educational Achievement (IEA)

Published December 2008, Revised August 2009

TIMSS 2007 International Science Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades

 $\label{lem:michael O. Martin, Ina V.S. Mullis, Pierre Foy in collaboration with John F. Olson, Ebru Erberber, Corinna Preuschoff, Joseph Galia$

Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College

Library of Congress Catalog Card Number: 2008902433

ISBN: 1-889938-49-1

For more information about timss contact:

TIMSS & PIRLS International Study Center

Lynch School of Education

Boston College

Chestnut Hill, MA 02467

United States

tel: +1-617-552-1600

fax: +1-617-552-1203

e-mail: timss@bc.edu

http://timssandpirls.bc.edu

Boston College is an equal opportunity, affirmative action employer.

Printed and bound in the United States.



Contents

Foreword	1
Executive	e Summary
Introduc	tion
What Is TIMSS	
Which Countr	ies Participated in TIMSS 2007?
Exhibit 1	Countries Participating in TIMSS 2007
Exhibit 2	Countries Participating in TIMSS 1995 Through 2007
Exhibit 3	Selected Characteristics of TIMSS 2007 Countries
What Was the	Nature of the TIMSS 2007 Science Test?
How Was Info	rmation Collected About the Contexts for Learning Science?
Who Conduct	s TIMSS?
Chapter	1
Internationa	al Student Achievement in Science
How Do Coun	tries Differ in Science Achievement?
Exhibit 1.1	TIMSS 2007 Distribution of Science Achievement
Exhibit 1.2	TIMSS 2007 Multiple Comparisons of Average Science Achievement
How Has Scien	nce Achievement Changed Since 1995, 1999, and 2003?
Exhibit 1.3	Trends in Science Achievement – 1995 Through 2007
Trends Across	Grades: Fourth to Eighth Grade Cohort Analysis
Exhibit 1.4	Cohort Comparison: 2003 Fourth Grade Students in Eighth Grade in 2007 54
What Are the	Gender Differences in Science Achievement?
Exhibit 1.5	TIMSS 2007 Average Science Achievement by Gender
Exhibit 1.6	Trends in Average Science Achievement by Gender – 1995 Through 2007

Chapter 2	2
Performance	at the TIMSS 2007 International Benchmarks
for Science A	chievement
	tries Compare with the TIMSS 2007 International Benchmarks of Science
Exhibit 2.1	TIMSS 2007 International Benchmarks of Science Achievement
Exhibit 2.2	Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Science Achievement
Exhibit 2.3	Trends in Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Science Achievement
Fourth Grade:	Achievement at the Advanced International Benchmark
Exhibit 2.4	Description of the TIMSS 2007 Advanced International Benchmark (625) of Science Achievement
Exhibit 2.5	TIMSS 2007 Advanced International Benchmark (625) of Science Achievement - Example Item 1
Exhibit 2.6	TIMSS 2007 Advanced International Benchmark (625) of Science Achievement - Example Item 2
Fourth Grade:	Achievement at the High International Benchmark
Exhibit 2.7	Description of the TIMSS 2007 High International Benchmark (550) of Science Achievement
Exhibit 2.8	TIMSS 2007 High International Benchmark (550) of Science Achievement - Example Item 3
Exhibit 2.9	TIMSS 2007 High International Benchmark (550) of Science Achievement - Example Item 4
Fourth Grade:	Achievement at the Intermediate International Benchmark
Exhibit 2.10	Description of the TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement
Exhibit 2.11	TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement - Example Item 5
Exhibit 2.12	TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement - Example Item 6
Fourth Grade:	Achievement at the Low International Benchmark
	Description of the TIMSS 2007 Low International Benchmark (400) of Science Achievement
Exhibit 2.14	TIMSS 2007 Low International Benchmark (400) of Science Achievement - Example Item 7
Exhibit 2.15	TIMSS 2007 Low International Benchmark (400) of Science Achievement - Example Item 8
Eighth Grade	Achievement at the Advanced International Benchmark
_	Description of the TIMSS 2007 Advanced International Benchmark (625) of Science Achievement
Exhibit 2.17	TIMSS 2007 Advanced International Benchmark (625) of Science Achievement - Example Item 1
Exhibit 2.18	TIMSS 2007 Advanced International Benchmark (625) of Science Achievement - Example Item 2



Eighth Grade:	Achievement at the High International Benchmark					
Exhibit 2.19	Description of the TIMSS 2007 High International Benchmark (550) of Science Achievement					
Exhibit 2.20	TIMSS 2007 High International Benchmark (550) of Science Achievement - Example Item 3					
Exhibit 2.21	TIMSS 2007 High International Benchmark (550) of Science Achievement - Example Item 4					
Eighth Grade:	Achievement at the Intermediate International Benchmark					
	Description of the TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement					
Exhibit 2.23	TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement - Example Item 5					
Exhibit 2.24	TIMSS 2007 Intermediate International Benchmark (475) of Science Achievement - Example Item 6					
Eighth Grade:	Achievement at the Low International Benchmark					
	Description of the TIMSS 2007 Low International Benchmark (400) of Science Achievement					
Exhibit 2.26	TIMSS 2007 Low International Benchmark (400) of Science Achievement - Example Item 7					
Exhibit 2.27	TIMSS 2007 Low International Benchmark (400) of Science Achievement - Example Item 8					
	or science Active Example Item o					
Chapter 3						
	3					
lverage Achi	B					
Average Achi How Does Ach	B					
Average Achi How Does Ach and Cognitive	3					
How Does Ach and Cognitive Exhibit 3.1 In Which Scier	3					
How Does Ach and Cognitive Exhibit 3.1 In Which Scier	B					
How Does Ach and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2	Sevement in the Science Content and Cognitive Domains Nievement Differ Across the TIMSS 2007 Science Content Domains?					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the cand Cognitive	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the cand Cognitive Exhibit 3.3	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the and Cognitive Exhibit 3.3	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the and Cognitive Exhibit 3.3 Chapter 4	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the and Cognitive Exhibit 3.3 Chapter 4	Revement in the Science Content and Cognitive Domains Inievement Differ Across the TIMSS 2007 Science Content Domains?					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the and Cognitive Exhibit 3.3 Chapter 4 Students' Back What Education	B					
How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the and Cognitive Exhibit 3.3 Chapter 4 Students' Back What Education Exhibit 4.1	Revement in the Science Content and Cognitive Domains Inievement Differ Across the TIMSS 2007 Science Content Domains?					
How Does Achi How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the Gand Cognitive Exhibit 3.3 Chapter 4 Students' Back What Education Exhibit 4.1 Exhibit 4.2	Rievement in the Science Content and Cognitive Domains Average Achievement in the Science Content and Cognitive Domains					
How Does Achi How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the Gand Cognitive Exhibit 3.3 Chapter 4 Students' Back What Education Exhibit 4.1 Exhibit 4.2 Exhibit 4.3	Revement in the Science Content and Cognitive Domains sievement Differ Across the TIMSS 2007 Science Content Domains?					
How Does Achi How Does Achi and Cognitive Exhibit 3.1 In Which Scier or Weak? Exhibit 3.2 What Are the cand Cognitive Exhibit 3.3 Chapter 4 Students' Back What Education Exhibit 4.1 Exhibit 4.2 Exhibit 4.3 Exhibit 4.4	Revement in the Science Content and Cognitive Domains sievement Differ Across the TIMSS 2007 Science Content Domains?					



	Fheir Out-of-school Time Do Students Spend on Homework nool Week?				
Exhibit 4.7					
What Are Stud	lents' Attitudes Toward Science?				
Exhibit 4.8	Index of Students' Positive Affect Toward Science (PATS) with Trends				
Exhibit 4.9	Index of Students' Valuing Science (SVS) with Trends				
Exhibit 4.10	Index of Students' Self-Confidence in Learning Science (SCS) with Trends 186				
Exhibit 4.11	Index of Students' Self-Confidence in Learning Science (SCS) by Gender 192				
Chapter 5	5				
The Science (Curriculum				
Which Science	Subjects Are Offered Up to and Including Eighth Grade?				
Exhibit 5.1	Science Subjects Offered Up To and Including Eighth Grade199				
How Much Ins	tructional Time Is Spent on Science?				
Exhibit 5.2	Weekly Intended and Implemented Instructional Time for Science with Trends 202 $$				
Exhibit 5.3	Yearly Hours of Implemented Instructional Time for Science with Trends 206				
Exhibit 5.4	Percentage of Time in Science Class Devoted to TIMSS Content Domains During the School Year				
Are the TIMS	Science Topics Included in the Intended Curriculum Taught in School? 212				
Exhibit 5.5	Summary of TIMSS Science Topics in the Intended Curriculum				
Exhibit 5.6	Summary of Students Taught the TIMSS Science Topics				
	Which TIMSS Science Topics Are in the Intended and Implemented				
Curriculum? .					
Exhibit 5.7	Intended and Taught TIMSS Life Science Topics				
Exhibit 5.8	Intended and Taught TIMSS Physical Science Topics				
Exhibit 5.9	Intended and Taught TIMSS Earth Science Topics				
-	Which TIMSS Science Topics Are in the Intended and Implemented				
	Intended and Taught TIMSS Biology Topics				
	Intended and Taught TIMSS Chemistry Topics				
	Intended and Taught TIMSS Physics Topics				
Exhibit 5.13	Intended and Taught TIMSS Earth Science Topics				
	5259				
Teachers of S	cience				
What Are the I	Background Characteristics of Science Teachers?				
Exhibit 6.1	Science Teachers' Gender, Age, and Number of Years Teaching with Trends 261				
What Education	on and Training Do Teachers Have for Teaching Science?				
Exhibit 6.2	Highest Educational Level of Science Teachers				
Exhibit 6.3	Teachers' Educational Emphasis on Science and Teaching				
Exhibit 6.4	Teachers' Major Area of Study in Science				
Exhibit 6.5	Teachers' Participation in Professional Development in Science 270				
Evhihit 6.6	Frequency of Collaboration Among Science Teachers with Trends 273				



How Well Prep	pared Do Teachers Feel They Are to Teach Science?				
Exhibit 6.7	hibit 6.7 Summary of Students Whose Teachers Feel "Very Well" Prepared to Teach the TIMSS Science Topics				
Exhibit 6.8	Students Whose Teachers Feel "Very Well" Prepared to Teach the TIMSS Science Topics				
Chapter 7	7				
Classroom C	haracteristics and Instruction				
How Do the C	haracteristics of Science Classrooms Impact Instruction?				
Exhibit 7.1	Class Size for Science Instruction with Trends				
Exhibit 7.2	Achievement and Class Size for Science Instruction				
Exhibit 7.3	Index of Teachers' Reports on Teaching Science Classes with Few or No Limitations on Instruction due to Student Factors (SCFL)				
How Is Scienti	fic Inquiry Emphasized in Science Lessons?				
Exhibit 7.4	Students' Reports on Doing Science Investigations				
Exhibit 7.5	Teachers' Reports on Students Doing Science Investigations				
How Are Diffe	rent Learning Activities Emphasized in Science Lessons?				
Exhibit 7.6	Students' Reports on Learning Activities in Science Lessons				
Exhibit 7.7	Teachers' Reports on Learning Activities in Science Lessons				
What Instructi	onal Strategies Are Used in Science Classes?				
Exhibit 7.8	Textbook Use in Teaching Science with Trends				
Exhibit 7.9	Percentage of Time in Science Lessons Students Spend on Various Activities in a Typical Week				
How Are Com	puters Used in Science Classes?				
Exhibit 7.10	Computer Use in Science Class with Trends				
What is the Ro	le of Homework?				
Exhibit 7.11	Index of Teachers' Emphasis on Science Homework (ESH) with Trends				
Exhibit 7.12	Use of Science Homework				
Exhibit 7.13	Types of Science Homework with Trends				
What Types of	Assessments Are Used in Science Classes?				
Exhibit 7.14	Emphasis on Sources to Monitor Students' Progress in Science				
Exhibit 7.15	Frequency of Teachers Giving Science Tests with Trends				
	Item Formats Used by Teachers in Science Tests or Examinations with Trends 330 $$				
Exhibit 7.17	Types of Questions on Science Tests				
Chapter 8	3				
School Conte	exts for Science Learning and Instruction				
What Are the	Characteristics of the Schools' Student Population?				
Exhibit 8.1	Principals' Reports on the Percentages of Students in Their Schools Coming from Economically Disadvantaged Homes with Trends				
Exhibit 8.2	Principals' Reports on the Percentages of Students Having the Language of the Test as Their Native Language with Trends				
Exhibit 8.3	Index of Good Attendance at School (GAS)				
Exhibit 8.4	High Index of Good Attendance at School (GAS) with Trends				



What Is the Ro	ole of the School Principal?
Exhibit 8.5	Principals' Time Spent on Various School-related Activities with Trends
Do Schools En	courage Home Involvement?
Exhibit 8.6	Schools' Encouragement of Parental Involvement
What School F	Resources Are Available to Support School Learning?
Exhibit 8.7	Index of Availability of School Resources for Science Instruction (ASRSI) 368
Exhibit 8.8	High Index of Availability of School Resources for Science Instruction (ASRSI) with Trends
Exhibit 8.9	Schools with Science Laboratory
Exhibit 8.10	Index of Teachers' Adequate Working Conditions (TAWC)
Exhibit 8.11	Schools' Reports on Teachers' Mathematics and Science Professional Development in the Past 2 Years
What Are the	Perceptions of School Climate?
Exhibit 8.12	Index of Principals' Perception of School Climate (PPSC) with Trends
Exhibit 8.13	Index of Science Teachers' Perception of School Climate (TPSC) with Trends 386 $$
How Safe and	Orderly Are Schools?
Exhibit 8.14	Index of Science Teachers' Perception of Safety in School (TPSS) with Trends 390
Exhibit 8.15	Index of Students' Perception of Being Safe in School (SPBSS) with Trends 392
	x A
Supporting I	Documentation
TIMSS 2007 Sc	ience Framework
Exhibit A.1	Overview of TIMSS 2007 Science Framework
Number of Ite	ms by Science Content and Cognitive Domains
Exhibit A.2	Distribution of Science Items by Content Domain and Cognitive Domain 400
Grades and Ag	ges Assessed
Exhibit A.3	Information About the Grades and Ages of Students Tested in TIMSS 2007 404
Sample Imple	mentation and Participation Rates
Exhibit A.4	Coverage of TIMSS 2007 Target Population
Exhibit A.5	School Sample Sizes
Exhibit A.6	Student Sample Sizes
Exhibit A.7	Participation Rates (Weighted)
Exhibit A.8	Trends in Student Populations
Translation an	d Layout Verification
Survey Operat	tions for Data Collection
Scoring the Co	onstructed-Response Items
Test Reliability	<i>,</i>
Scaling the Ac	hievement Data
Exhibit A.9	Average Percent Correct in the Science Content and Cognitive Domains 430
Scale Anchori	ng Analysis
Estimating Sta	andard Frrors 433



Appendix	K B
Multiple Con	nparisons of Average Achievement in Science Content
and Čognitiv	ve Domains
Exhibit B.1	Multiple Comparisons of Average Achievement in Life Science
Exhibit B.2	Multiple Comparisons of Average Achievement in Physical Science 438
Exhibit B.3	Multiple Comparisons of Average Achievement in Earth Science 440 $$
Exhibit B.4	eq:Multiple Comparisons of Average Achievement in Knowing
Exhibit B.5	Multiple Comparisons of Average Achievement in Applying
Exhibit B.6	Multiple Comparisons of Average Achievement in Reasoning
Exhibit B.7	Multiple Comparisons of Average Achievement in Biology
Exhibit B.8	Multiple Comparisons of Average Achievement in Chemistry 450 $$
Exhibit B.9	Multiple Comparisons of Average Achievement in Physics
Exhibit B.10	Multiple Comparisons of Average Achievement in Earth Science
Exhibit B.11	Multiple Comparisons of Average Achievement in Knowing
Exhibit B.12	Multiple Comparisons of Average Achievement in Applying
Exhibit B.13	$\label{eq:Multiple Comparisons} Multiple \ Comparisons \ of \ Average \ Achievement \ in \ Reasoning. \ \dots \ \dots \ . \ . \ . \ . \ . \ . \ . \ $
	CC
Exhibit C.1	Average Percent Correct for Test-Curriculum Matching Analysis – Science 468
Exhibit C.2	Standard Errors for the Test-Curriculum Matching Analysis – Science
Appendix	x D
* *	nd Standard Deviations of Science Achievement
Exhibit D.1	Percentiles of Achievement in Science
Exhibit D.2	Standard Deviations of Achievement in Science
Appendix	x E
Mongolia—S	Science Achievement
Exhibit E.1	
Appendix	x F
	ns and Individuals Responsible for TIMSS 2007
Organizalioi	as una maiviauais Kesponsivie jor 1 miss 2007

