Appendix A Trends in International Mathematics and Science Study (TIMSS): Overview

A.1 TIMSS 2011: introduction

The TIMSS 2011 survey is the fifth in the IEA's[142] series of comparative international surveys of mathematics and science achievement. TIMSS is administered on a four-yearly cycle, so the 2011 survey updates the picture of performance from 2007. Earlier cycles took place in 2003, 1999 and 1995.[143] The next TIMSS cycle is planned for 2015.

A.2 TIMSS 2011 participants

TIMSS 2011 involved 74 participants: 60 countries and 14 benchmarking participants,[144] taking part at one or both of the target grades: 'fourth grade', ages 9-10 and 'eighth grade', ages 13-14 (Year 5 and Year 9 respectively in England). Participant numbers were:

- Fourth grade – 57 participants (50 countries and 7 benchmarking participants)
- Eighth grade – 56 participants (42 countries and 14 benchmarking participants).[145]

Table A.1 gives the list of participants at each grade, and Exhibit A.1 in the international mathematics and science reports indicates the previous cycles in which each participant was involved.

The TIMSS 2011 participants are varied, ranging from highly developed countries or regions through to developing ones. Their education systems also vary, differing for example in the age at which children start school.[146] More information about the educational system in each participating country and region can be found in the TIMSS encyclopaedia (Mullis *et al*, 2012).

142 International Association for the Evaluation of Educational Achievement (IEA): http://www.iea.nl

143 The 1995 TIMSS study was originally entitled the Third International Mathematics and Science Study, and followed earlier mathematics surveys in 1964 and 1980-1982 and science surveys in 1970 and 1984.

144 Countries participating in TIMSS follow guidelines and strict sampling targets to provide samples that are nationally representative. 'Benchmarking participants' are regional entities which follow the same guidelines and targets to provide samples that are representative at regional level.

144 Three participants tested only pupils older than the target age. Botswana and Honduras administered the 4th grade assessment to 6th grade pupils (Y7 equivalent); Yemen administered it to both 4th and 6th grade pupils. Botswana, South Africa and Honduras administered the 8th grade assessment to 9th grade pupils (Y10 equivalent). Out-of-grade result are not included in this national report.

145 See Appendix C.1 in the international mathematics and science reports for a summary of school starting ages in the participating countries/regions.

Table A1 TIMSS 2011 participants

Participant	4th grade, ages 9-10	8th grade, ages 13-14
Countries		
Armenia	✓	✓
Australia	✓	✓
Austria	✓	
Azerbaijan	✓	
Bahrain	✓	✓
Belgium (Flemish)	✓	
Chile	✓	✓
Chinese Taipei	✓	✓
Croatia	✓	
Czech Republic	✓	
Denmark	✓	
England	✓	✓
Finland	✓	✓
Georgia	✓	✓
Germany	✓	
Ghana		✓
Hong Kong SAR	✓	✓
Hungary	✓	✓
Indonesia		✓
Iran, Islamic Rep. of	✓	✓
Ireland, Rep. of	✓	
Israel		✓
Italy	✓	✓
Japan	✓	✓
Jordan		✓
Kazakhstan	✓	✓
Korea, Rep. of	✓	✓
Kuwait	✓	
Lebanon		✓
Lithuania	✓	✓
Benchmarking participants		
Alberta, Canada	✓	✓
Ontario, Canada	✓	✓
Quebec, Canada	✓	✓
Abu Dhabi, UAE	✓	✓
Dubai, UAE	✓	✓
Alabama, US		✓
California, US		✓

Participant	4th grade, ages 9-10	8th grade, ages 13-14
Countries		
Macedonia, Rep. of		✓
Malaysia		✓
Malta	✓	
Morocco	✓	✓
Netherlands	✓	
New Zealand	✓	✓
Northern Ireland	✓	
Norway	✓	✓
Oman	✓	✓
Palestinian Nat'l Auth.		✓
Poland	✓	
Portugal	✓	
Qatar	✓	✓
Romania	✓	✓
Russian Federation	✓	✓
Saudi Arabia	✓	✓
Serbia	✓	
Singapore	✓	✓
Slovak Republic	✓	
Slovenia	✓	✓
Spain	✓	
Sweden	✓	✓
Syrian Arab Republic		✓
Thailand	✓	✓
Tunisia	✓	✓
Turkey	✓	✓
Ukraine		✓
United Arab Emirates	✓	✓
United States	✓	✓
Yemen	✓	
Benchmarking participants		
Colorado, US		✓
Connecticut, US		✓
Florida, US	✓	✓
Indiana, US		✓
Massachusetts, US		✓
Minnesota, US		✓
North Carolina, US	✓	✓

Source: Exhibit A.1, international mathematics and science reports

A.3 TIMSS 2011 in the UK

The countries which comprise the United Kingdom are regarded separately by the IEA, and, of the four, England and Northern Ireland chose to participate in the 2011 survey. England has participated in all TIMSS cycles, so comparisons can be made with all earlier cycles where appropriate. The 2011 cycle represented Northern Ireland's first TIMSS participation. Scotland has also participated in previous cycles.

In all three participating UK nations, the TIMSS surveys were administered by NFER. Outcomes from previous cycles of TIMSS internationally and in the UK are available through the NFER website: www.nfer.ac.uk/timss

A.4 TIMSS 2011 sampling strategy

TIMSS samples are drawn based on internationally specified criteria, and are designed to be representative of the national population of pupils in the target age group (or regional population, for benchmarking participants). Each participant is therefore expected to provide a sampling pool that covers all or almost all of the target national population. Where exclusions are considered necessary, these must be within set limits. Exclusions may be for a variety of reasons, including:

- geographical (e.g. remote and/or very small schools may be excluded at sampling stage);
- linguistic (e.g. participants may exclude some language groups at sampling stage, if they opt to translate the assessment into majority languages only, not all languages spoken within the country/region); or
- special educational needs (e.g. special schools teaching pupils who cannot access the assessment may be excluded at sampling stage, or individual pupils who cannot access the assessment may be excluded at the administration stage).

TIMSS guidance stipulates that no more than five per cent of the population in total should be excluded across all stages of the survey. See the technical report (Martin and Mullis (Eds.), 2011) and Appendix C of the international reports for more information.

In TIMSS, each participating country has a 'main sample' and two matched 'replacement samples' which are used if the main sample schools decline to participate. The main sample is designed to be nationally representative of pupils in the target age group and so the sampling criteria ('stratifiers') for each country are designed to address key characteristics of the nation's school system.[147] Each main sample school is then assigned a 'first replacement' school and a 'second replacement' school, both of which share the same key sampling characteristics as the main sample school. This ensures that, if the main sample school declines to participate, its first replacement school can be used instead and the sample will still be nationally representative. If the first replacement school also declines to participate, the second replacement school will be invited to participate and, again, the sample will remain nationally representative. If the second replacement school declines to participate, then the country cannot include any other school, to avoid skewing the sample.

147 Schools are sampled using systematic, random sampling with probability proportional to their measures of size.

Classes of pupils of the target age are then randomly sampled within the participating schools and 95 per cent of these classes are expected to take part. Within each sampled class, at least 85 per cent of pupils are expected to take part. Samples are inspected and, if they meet the sampling criteria, accepted by the IEA's sampling referee.

In order to meet the stringent TIMSS participation targets, countries are expected to achieve participation of:

- At least 85 per cent of their main sample schools; OR
- At least 85 per cent of sampled schools of which at least 50 per cent must be from the main sample and the remainder matched replacement schools; OR
- A combined pupil/school rate of at least 75 per cent.

Participants achieving at least 85 per cent of the main sample schools or a combined pupil/school figure of at least 75 per cent are deemed to have met the sampling requirements fully. Those achieving at least 85 per cent with the use of replacement schools are deemed to have achieved a sample that is suitably representative at national level, but are 'annotated' in the report, to indicate that replacement schools were used.

A.5 England's TIMSS 2011 samples

England's sampling strategy

Samples for England were drawn by Statistics Canada, assisted by the NFER Research and Statistics teams. The sample was stratified by attainment band and school type (comprehensive school 11-16, comprehensive school 11-18, independent school, or other). Schools were recruited by the NFER Research Operations team. Once a school had agreed to participate, one or more classes from the target year group were randomly sampled, using the IEA's within-school sampling software. This selected the number of classes automatically. In primary schools, Y5 classes were sampled and in secondary schools, Y9 mathematics classes were used as the sampling unit.[148]

England's Y5 sample

The Y5 sample in England met the stringent sampling standards described above. Of 150 schools sampled, a total of 125 primary schools took part (122 main sample schools and just three replacement schools). Class participation was 100 per cent and pupil participation 94 per cent (see Table A.2). Overall participation was 78 per cent, exceeding the combined target of at least 75 per cent of pupils and schools. Total exclusions for England at Y5 were just 2 per cent.

Internationally, participation rates at this grade ranged from 70 per cent in Norway to 100 per cent in Azerbaijan. Overall exclusion rates ranged from 0.3 per cent in Kuwait to 12.1 per cent in Florida (a benchmarking participant). The highest exclusion rate among countries at Y5 was 9.4 per cent in Serbia.

148 The class sampling strategy had implications for the number of teachers completing questionnaires. The Y5 teacher questionnaire was generally completed by a class teacher but, where pupils had separate mathematics and science teachers, each teacher completed a questionnaire. At Y9 the mathematics teacher questionnaire was completed by the teacher of the sampled class and all science teachers teaching the sampled pupils completed a science teacher questionnaire. Therefore, each individual TIMSS pupil was linked to multiple teachers at Y9 and a greater number of science than mathematics teachers took part.

The average age of participating Y5 pupils in England was 10.2. The range internationally for those in the target grade was from 9.7 (in Italy, Kuwait and Norway) to 11.2 in Yemen.

Table A.2 Y5 sample information for England

The information in this table is taken from the international mathematics and science reports. The source of each element within the reports is indicated.

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
England	150	150	122	3	125

Source: Exhibit C.4, international mathematics and science reports

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
England	94%	3,689	49	13	3,627	230	3,397

Source: Exhibit C.6, international mathematics and science reports

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
England	81%	83%	100%	94%	76%	78%

Source: Exhibit C.8, international mathematics and science reports

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
England	100%	n/a	1.7%	0.4%	2.0%

Source: Exhibit C.2, international mathematics and science reports

England's Y9 sample

Of 150 schools sampled, a total of 118 secondary schools took part (113 main sample schools and just five replacement schools). Class participation was 100 per cent and pupil participation 89 per cent (see Table A.3). Overall participation was 70 per cent, just below the combined target of at least 75 per cent. Total exclusions for England at Y9 were just 2.2 per cent.

England's Y9 sample is annotated in the international report to indicate that the sample "nearly satisfied guidelines for sample participation rates after replacement schools were included". Further initial analysis of the achieved sample (comparing the 118 participating Y9 schools and the Y9 main sample schools that declined to take part) confirmed that there were no significant differences between the responding and non-responding schools, based on England's stratifying variables of attainment and school type. The Y9 achieved sample can, therefore, be regarded as nationally representative in terms of the stratifying variables.

England's overall participation rate at Y9 was the lowest internationally, followed by Hong Kong at 75 per cent. The highest was 99 per cent in Chinese Taipei, Iran, Korea, Qatar, Romania and Thailand. Overall exclusion rates ranged from 0.1 per cent in Malaysia and Morocco to 22.6 per cent in Israel. The next highest exclusion rate among countries was 7.2 per cent in the United States.

The average age of participating Y9 pupils in England was 14.2. The range internationally was from 13.7 in Norway to 15.8 in Ghana.

Table A.3 Y9 sample information for England

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
England	150	150	113	5	118

Source: Exhibit C.5, international mathematics and science reports

Country	Within-school Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
England	89%	4,382	88	3	4,291	449	3,842

Source: Exhibit C.7, international mathematics and science reports

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
‡ England	75%	79%	100%	89%	67%	70%

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

Source: Exhibit C.9, international mathematics and science reports

Country	International Target Population		Exclusions from National Target Population		
	Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
England	100%	n/a	2.2%	0.1%	2.2%

Source: Exhibit C.3, international mathematics and science reports

Appendix B Trend performance of England and selected countries

This appendix summarises the trend performance of the TIMSS participants performing similarly to England in 2011 and those which performed better than England in TIMSS 2011. A description of the trend is given in each case (where a participant has taken part in more than one cycle), with a graphic showing the trend. Rankings are given for TIMSS 2007 and 2011, where applicable. England is given in each table for comparison. Benchmarking participants are shown in square brackets.[149]

149 Rankings are not given for benchmarking participants as they are reported separately from countries in the international rankings.

Table B1 Trends among participants performing similarly to England in Y5 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003 and 2003-2007; stable 2007-2011	484		531	541	542
			Rank		2007: 7th		2011: 9th
Belgium (Flemish)	2011, 2003	No significant change over time			551		549
			Rank		2007: n/a		2011: 7th
Finland	2011	n/a	n/a				
			Rank		2007: n/a		2011: 5th
[Florida, US]	2011	n/a	n/a				
Russian Federation	2011, 2007, 2003	No significant change over time			532	544	542
			Rank		2007: 6th		2011: 10th
United States	2011, 2007, 2003, 1995	Stable 1995 - 2003, then significant increase in 2007 and again in 2011	518		518	529	541
			Rank		2007: 11th		2011: 11th
Netherlands	2011, 2007, 2003, 1995	Significant decrease 1995-2003; no significant differences thereafter	549		540	535	540
			Rank		2007: 9th		2011: 12th
Denmark	2011, 2007	Improved significantly 2007-2011				523	537
			Rank		2007: 13th		2011: 13th

Source: Exhibits 1.5 and 1.7, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007

Table B2 Trends among participants performing better than England in Y5 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003 and 2003-2007; stable 2007-2011	484		531	541	542
			Rank		2007: 7th		2011: 9th
Singapore	2011, 2007, 2003, 1995	2011 significantly higher than 1995; otherwise, no significant change	590		594	599	606
			Rank		2007: 2nd		2011: 1st
Korea	2011, 1995	Significant increase	581				605
			Rank		2007: n/a		2011: 2nd
Hong Kong	2011, 2007, 2003, 1995	Significant increases 1995-2003 and 2003-2007; stable thereafter	557		575	607	602
			Rank		2007: 1st		2011: 3rd
Chinese Taipei	2011, 2007, 2003	Significant increases in each cycle			564	576	591
			Rank		2007: 3rd		2011: 4th
Japan	2011, 2007, 2003, 1995	Increase in 2011	567		565	568	585
			Rank		2007: 4th		2011: 5th
Northern Ireland	2011	n/a					
			Rank		2007: n/a		2011: 6th
[North Carolina, US]	2011	n/a	n/a				

Source: Exhibits 1.5 and 1.7, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007.

Table B3 Trends among participants performing similarly to England in Y9 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	Stable 1995-2003; increased 2003-2007; stable 2007-2011	498	496	498	513	507
			Rank	2007: 7th		2011: 10th	
[Indiana, US]	2011, 2003, 1999	No significant differences		515	508		522
[Colorado, US]	2011	n/a	n/a				
[Connecticut, US]	2011, 1999	No significant difference		512			518
Israel	2011, 2007, 2003, 1999	Trends not reported	n/a				
			Rank	2007: 24th		2011: 7th	
Finland[150]	2011, 1999	(7th grade scores) declined since 1999; no 8th grade (Y9) trends		520			482
			Rank (8th grade)	2007: n/a		2011: 8th	
[Florida, US]	2011	n/a	n/a				
[Ontario, Canada]	2011, 2007, 2003, 1999, 1995	Improved significantly 1995-1999; 2011 significantly lower than 2003	501	517	521	517	512

150 In 1999, Finland participated at 7th grade (pupils a year younger than the 8th grade (Y9) pupils tested in TIMSS 2011); in 2011, Finland tested both 7th and 8th graders (Y8 and Y9 equivalents). The trend data given here is, therefore, for 7th graders only. Ranking data is for 8th graders (Y9 equivalent).

Table B3 Trends among participants performing similarly to England in Y9 mathematics (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
United States	2011, 2007, 2003, 1999, 1995	2003 scores onwards significantly higher than 1995; otherwise, no significant changes	492	502	504	508	509
			Rank			2007: 9th	2011: 9th
[Alberta, Canada]	2011, 1999, 1995	2011 scores declined compared with 1995 and 1999	527	531			505
Hungary	2011, 2007, 2003, 1999, 1995	2007 and 2011 scores declined compared with all previous years	527	532	529	517	505
			Rank			2007: 6th	2011: 11th
Australia	2011, 2007, 2003, 1995	2007 scores lower than 1995; otherwise, no significant differences	509		505	496	505
			Rank			2007: 14th	2011: 12th
Slovenia	2011, 2007, 2003, 1995	Stable since 2007; recent scores improved on 2003 and 1995 performance	494		493	501	505
			Rank			2007: 12th	2011: 13th
Lithuania	2011, 2007, 2003, 1999, 1995	2003 increased on previous years; stable since then	472	482	502	506	502
			Rank			2007: 10th	2011: 14th
Italy	2011, 2007, 2003, 1999	2011 scores improved on all previous cycles		479	484	480	498
			Rank			2007: 19th	2011: 15th
[California, US]	2011	n/a	n/a				

Source: Exhibits 1.6 and 1.8, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007.

Table B4 Trends among participants performing better than England in Y9 mathematics

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	Stable 1995-2003; increased 2003-2007; stable 2007-2011	498	496	498	513	507
			Rank	2007: 7th		2011: 10th	
Korea	2011, 2007, 2003, 1999, 1995	Significant increase every cycle except 2003	581	587	589	597	613
			Rank	2007: 2nd		2011: 1st	
Singapore	2011, 2007, 2003, 1999, 1995	Declined in 2007 but a significant increase in 2011	609	604	605	593	611
			Rank	2007: 3rd		2011: 2nd	
Chinese Taipei	2011, 2007, 2003, 1999	Stable 1999-2003, with significant increases in each subsequent cycle		585	585	598	609
			Rank	2007: 1st		2011: 3rd	
Hong Kong	2011, 2007, 2003, 1999, 1995	A very mixed picture. Broadly, stable 1995-1999 and 1999-2003; declined 2003-2007; stable 2007-2011; but 2003 and 2011 scores significantly higher than 1995 score.[151]	569	582	586	572	586
			Rank	2007: 4th		2011: 4th	

151 See Exhibits 1.5 and 1.7 in the international mathematics report for more information.

Table B4 Trends among participants performing better than England in Y9 mathematics (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Japan	2011, 2007, 2003, 1999, 1995	Stable scores since 2003; scores since then significantly higher than those of 1995/1999.	581	579	570	570	570
			Rank			2007: 5th	2011: 5th
[Massachusetts, US]	2011, 2007, 1999	No significant difference 2007-2011; these scores significantly higher than 1999 score.		513		547	561
[Minnesota, US]	2011, 2007, 1995	2011 score significantly higher than 1995 score.	518			532	545
Russian Federation	2011, 2007, 2003, 1999, 1995	Significant decline 1999-2003; significant increase 2007-2011	524	526	508	512	539
			Rank			2007: 8th	2011: 6th
[North Carolina, US]	2011, 1999	Significant increase		495			537
[Quebec, Canada]	2011, 2007, 2003, 1999, 1995	Significant decline in 2003 and 2007 compared with all previous years; stable 2007-2011.	556	566	543	528	532

Source: Exhibits 1.6 and 1.8, international mathematics report, TIMSS 2011; and Exhibit 1.1, international mathematics report, TIMSS 2007

Table B5 Trends among participants performing similarly to England in Y5 science

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003; stable 2003-2007; decreased 2007-2011	528		540	542	529
			Rank			2007: 7th	2011: 15th
[North Carolina, US]	2011	n/a	n/a				
Hong Kong	2011, 2007, 2003, 1995	Increased from 1995-2003 and 2003-2007, decreased 2007-2011	508		542	554	535
			Rank			2007: 3rd	2011: 9th
Hungary	2011, 2007, 2003, 1995	Increased 1995-2003; stable since	508		530	536	534
			Rank			2007: 9th	2011: 10th
Sweden	2011, 2007	Increased 2007-2011				525	533
			Rank			2007: 16th	2011: 11th
Slovak Republic	2011, 2007	No significant change				526	532
			Rank			2007: 14th	2011: 12th

Table B5 Trends among participants performing similarly to England in Y5 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Austria	2011, 2007, 1995	Stable since 1995; decreased 2003-2007	538			526	532
			Rank			2007: 15th	2011: 13th
Netherlands	2011, 2007, 2003, 1995	Stable since 1995; increased 2007-2011	530		525	523	531
			Rank			2007: 17th	2011: 14th
Denmark	2011, 2007	Increased 2007-2011				517	528
			Rank			2007: 19th	2011: 16th
Germany	2011, 2007	No significant change				528	528
			Rank			2007: 12th	2011: 17th
[Ontario, Canada]	2011, 2007, 2003, 1995	Increased 1995-2003; stable since	516		540	536	528
Italy	2011, 2007, 2003	Increased 2003-2007; decreased 2007-2011			516	535	524
			Rank			2007: 10th	2011: 18th
Portugal	2011, 1995	Increased 1995-2011	452				522
			Rank			2007: n/a	2011: 19th

Source: Exhibits 1.5 and 1.7, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B6 Trends among participants performing better than England in Y5 science

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1995	Increased 1995-2003; stable 2003-2007; decreased 2007-2011	528		540	542	529
			Rank		2007: 7th		2011: 15th
Korea	2011, 1995	Significant increase	576				587
			Rank		2007: n/a		2011: 1st
Singapore	2011, 2007, 2003, 1995	Increases each cycle, then stable 2007-2011	523		565	587	583
			Rank		2007: 1st		2011: 2nd
Finland	2011	n/a	n/a				
			Rank		2007: n/a		2011: 3rd
Japan	2011, 2007, 2003, 1995	Decrease 1995-2003; increase 2007-2011	553		543	548	559
			Rank		2007: 4th		2011: 4th
Russian Federation	2011, 2007, 2003	Increase 2003-2007; stable 2007-2011			526	546	552
			Rank		2007: 5th		2011: 5th

Table B6 Trends among participants performing better than England in Y5 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Chinese Taipei	2011, 2007, 2003	Increase 2003-2007; stable 2007-2011			551	557	552
			Rank		2007: 2nd		2011: 6th
[Florida, US]	2011	n/a	n/a				
United States	2011, 2007, 2003, 1995	Significant increase 2003-2011; otherwise stable.	542		536	539	544
			Rank		2007: 8th		2011: 7th
[Alberta, Canada]	2011, 2007, 1995	No significant increases	555			543	541
Czech Republic	2011, 2007, 1995	Decrease 1995-2007; increase 2007-2011	532			515	536
			Rank		2007: 20th		2011: 8th

Source: Exhibits 1.5 and 1.7, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B7 Trends among participants performing similarly to England in Y9 science

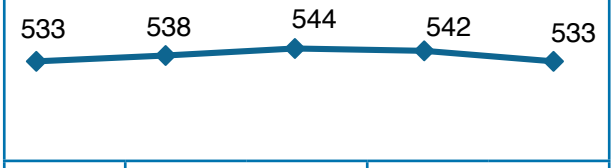
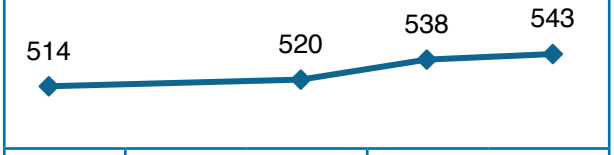
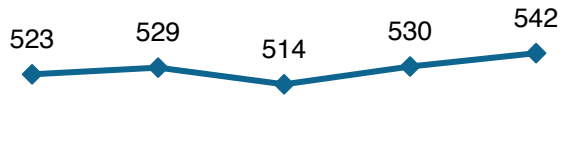
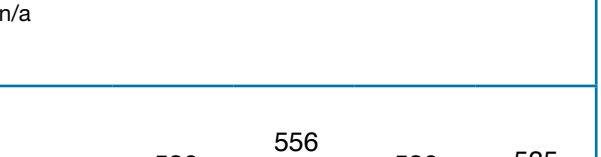
Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	No significant differences					
			Rank	2007: 5th		2011: 9th	
Slovenia	2011, 2007, 2003, 1995	Significant increases 1995-2003 and 2003-2007; stable 2007-2011					
			Rank	2007: 8th		2011: 6th	
Russian Federation	2011, 2007, 2003, 1999, 1995	Stable 1995-1999, significant decrease 1999-2003, increases 2003-2007 and 2007-2011					
			Rank	2007: 10th		2011: 7th	
[Colorado, US]	2011	n/a	n/a				
Hong Kong	2011, 2007, 2003, 1999, 1995	Increases 1995-1999 and 1999-2003; decreased 2003-2007; stable 2007-2011					
			Rank	2007: 9th		2011: 8th	

Table B7 Trends among participants performing similarly to England in Y9 science (continued)

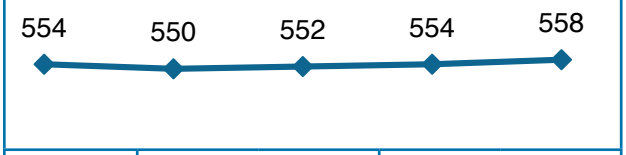
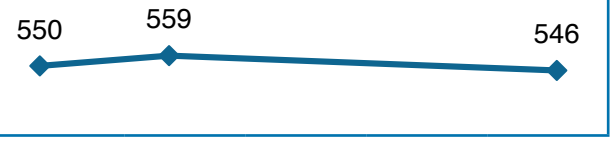
Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
[Indiana, US]	2011, 2003, 1999	No significant differences		534	531		533
[Connecticut, US]	2011, 1999	No significant differences		529			532
[North Carolina, US]	2011, 1999	Increased 1999-2011		508			532
[Florida, US]	2011	n/a	n/a				
United States	2011, 2007, 2003, 1999, 1995	Increased 1999-2003; 2011 score higher than 1995 score; no other significant differences		513	515	527	520 525
			Rank		2007: 11th		2011: 10th
Hungary	2011, 2007, 2003, 1999, 1995	Increased 1995-1999; decreased 1999-2003; stable 2003 -2007; decreased 2007-2011		537	552	543	539 522
			Rank		2007: 6th		2011: 11th

Source: Exhibits 1.6 and 1.8, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

Table B8 Trends among participants performing better than England in Y9 science

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
England	2011, 2007, 2003, 1999, 1995	No significant differences	533	538	544	542	533
			Rank	2007: 5th		2011: 9th	
Singapore	2011, 2007, 2003, 1999, 1995	2011 score higher than most previous cycles (2007, 2003, 1999)	580	568	578	567	590
			Rank	2007: 1st		2011: 1st	
[Massachusetts, US]	2011, 2007, 1999	2007 and 2011 scores higher than 1995; no other significant differences	533			556	567
Chinese Taipei	2011, 2007, 2003, 1999	Decreased 2003-2007; no other significant differences		569	571	561	564
			Rank	2007: 2nd		2011: 2nd	
Korea	2011, 2007, 2003, 1999, 1995	Increased 1999-2003; decreased 2003-2007; increased 2007-2011	546	549	558	553	560
			Rank	2007: 4th		2011: 3rd	

Table B8 Trends among participants performing better than England in Y9 science (continued)

Participant	TIMSS cycles at this age	Trend (description)	Trend (diagram)				
			1995	1999	2003	2007	2011
Japan	2011, 2007, 2003, 1999, 1995	2011 score significantly higher than 1999 score; no other significant differences		Rank	2007: 3rd		2011: 4th
[Minnesota, US]	2011, 2007, 1995	Increased 2007-2011					
Finland [152]	2011, 1999	No significant difference (7th grade)		Rank (8th grade)	2007: n/a		2011: 5th
[Alberta, Canada]	2011, 1999, 1995	No significant differences					

Source: Exhibits 1.6 and 1.8, international science report, TIMSS 2011; and Exhibit 1.1, international science report, TIMSS 2007

152 In 1999, Finland participated at 7th grade (pupils a year younger than the Y9 pupils tested in TIMSS 2011); in 2011, Finland tested both 7th and 8th graders (Y8 and Y9 equivalents). The trend data given here is, therefore, for 7th graders only. Ranking data is for 8th graders (Y9 equivalent).

Appendix C Example mathematics and science items

Interpreting the data: example items

The items exemplify attainment at each of the benchmark levels. The figures accompanying each item show: the percentage answering each item correctly for England; the international average; and the highest percentage answering the item correctly. The items are the 'source version', provided for translation and/or adaptation in each country as required. Any translations and adaptations must be approved by the International Study Centre in order to verify that the changes made do not affect the demand or intent of the question.

Each item is classified by its content domain and by its cognitive domain. For mathematics, these are:

- Y5 – Number, Geometric Shapes and Measures, Data Display; Knowing, Applying and Reasoning
- Y9 - Number, Algebra, Geometry, Data and Chance; Knowing, Applying and Reasoning.

These areas map reasonably well onto the mathematics national curriculum in England.

For science, the content and cognitive domains are:

- Y5 – Life Science, Physical Science, Earth Science; Knowing, Applying and Reasoning
- Y9 – Biology, Chemistry, Physics, Earth Science; Knowing, Applying and Reasoning.

These areas map reasonably well onto the science national curriculum in England. For Y5, subject content related to Materials and their Properties is included within the TIMSS Physical Science category. Some elements of the TIMSS Earth Science category are covered by the Geography curriculum in England.

C.1 Y5 mathematics

Example item A **Low attainment benchmark, Y5 mathematics**

Content Domain: Number
Cognitive Domain: Applying

Description: Solves a word problem involving addition of three-digit whole numbers

There are 218 passengers and 191 crew members on a ship.
How many people are on the ship altogether?

Answer: 409

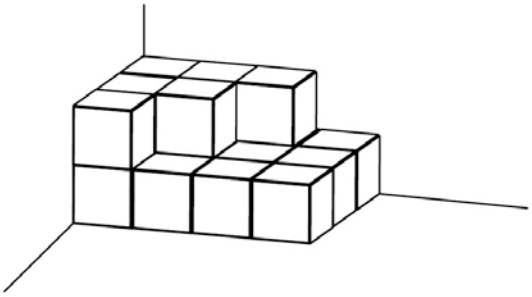
The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	78 (2.3) – above average
International average	73 (0.3)
Highest score	93 (0.8) - Singapore

Source: Exhibit 2.5, international mathematics report

Example item B **Intermediate attainment benchmark, Y5 mathematics**

Content Domain: Geometric Shapes and Measures
Cognitive Domain: Applying
Description: Determines the number of cubes in a stack with some hidden



Ann stacks these boxes in the corner of the room. All the boxes are the same size. How many boxes does she use?

Ⓐ 25
Ⓑ 19
● 18
Ⓓ 13

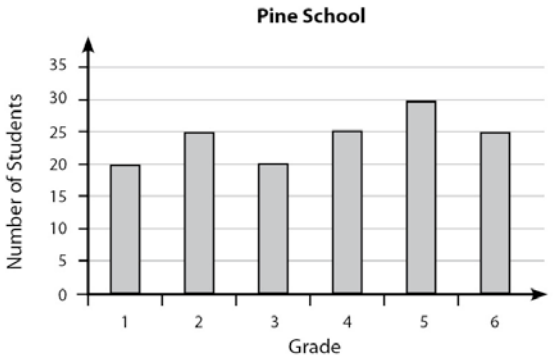
England's score (and standard error)	67 (2.5) – average
International average	63 (0.3)
Highest score	95 (0.8) – Chinese Taipei

Source: Exhibit 2.9, international mathematics report

Example item C **High attainment benchmark, Y5 mathematics**

Content Domain: Data Display
Cognitive Domain: Reasoning
Description: Solves a multi-step reasoning problem using data from a bar graph

The graph shows the number of students at each grade in the Pine School.



In the Pine School there is room in each grade for 30 students.
How many more students could be in the school?

Ⓐ 20
Ⓑ 25
Ⓒ 30
● 35

England's score (and standard error)	65 (2.5) – above average
International average	54 (0.3)
Highest score	79 (1.9) – Chinese Taipei

Source: Exhibit 2.14, international mathematics report

Example item D **Advanced attainment benchmark, Y5 mathematics**

Content Domain: Number
Cognitive Domain: Reasoning
Description: Solves a multi-step numerical reasoning problem

In a soccer tournament, teams get:

3 points for a win
1 point for a tie
0 points for a loss

Zedland has 11 points.

What is the **smallest** number of games Zedland could have played?

Answer: 5

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	47 (2.3) – above average
International average	27 (0.3)
Highest score	59 (2.2) – Hong Kong

Source: Exhibit 2.16, international mathematics report

C.2 Y9 mathematics

Example item E **Low attainment benchmark, Y9 mathematics**

Content Domain: Algebra
Cognitive Domain: Knowing

Description: Evaluates a simple algebraic expression

$$y = \frac{a+b}{c}$$

$a = 8$, $b = 6$, and $c = 2$

What is the value of y?

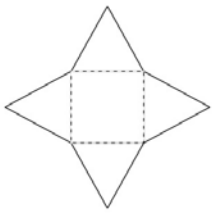
● 7
Ⓑ 10
Ⓒ 11
Ⓓ 14

England's score (and standard error)	73 (2.9) – average
International average	71 (0.3)
Highest score	94 (1.3) - Massachusetts

Source: Exhibit 2.23, international mathematics report

Example item F Intermediate attainment benchmark, Y9 mathematics

Content Domain: Geometry
Cognitive Domain: Knowing
Description: Given a net of a three-dimensional object, completes a two-dimensional drawing of it from a specific viewpoint



The shape shown above is cut out of cardboard. The triangle flaps are then folded up along the dotted lines until they touch the edges of the flaps next to them.

Complete the diagram below to show what the shape would look like when viewed from directly above.

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	82 (2.1) – above average
International average	58 (0.3)
Highest score	90 (1.7) – Massachusetts

Source: Exhibit 2.26, international mathematics report

Example item G **High attainment benchmark, Y9 mathematics**

Content Domain: Number
Cognitive Domain: Knowing
Description: Given the part and the whole can express the part as a percentage and given the whole and the percentage can find the part

Peter, James, and Andrew each had 20 tries at throwing balls into a basket.

Complete the missing boxes below.

Name	Number of Successful Shots	Percentage of Successful Shots
Peter	10 out of 20	50 %
James	15 out of 20	75 %
Andrew	16 out of 20	80%

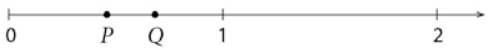
The answer shown illustrates the type of student response that was given 2 of 2 points.

England's score (and standard error)	48 (3.0) – above average
International average	37 (0.3)
Highest score	89 (1.2) - Singapore

Source: Exhibit 2.28, international mathematics report

Example item H **Advanced attainment benchmark, Y9 mathematics**

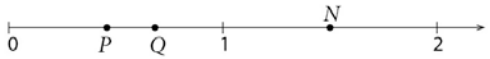
Content Domain: Number
Cognitive Domain: Reasoning
Description: Given two points on a number line representing unspecified fractions, identifies the point that represents their product

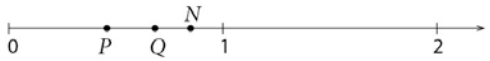


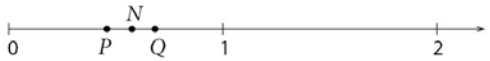
P and Q represent two fractions on the number line above.

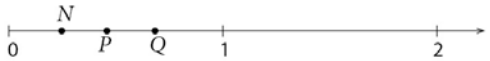
$P \times Q = N$.

Which of these shows the location of N on the number line?

Ⓐ 

Ⓑ 

Ⓒ 

● 

England's score (and standard error)	29 (3.0) – above average
International average	23 (0.3)
Highest score	53 (2.0) – Chinese Taipei

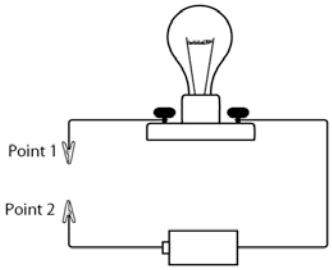
Source: Exhibit 2.32, international mathematics report

C.3 Y5 science

Example item I **Low attainment benchmark, Y5 science**

Content Domain: Physical Science
Cognitive Domain: Applying
Description: From a simple circuit diagram, recognizes that an iron nail can complete an electrical circuit

The following picture shows a lightbulb connected to a battery in an electrical circuit. Which of the following objects connected to Points 1 and 2 will allow the bulb to glow?



● iron nail
Ⓑ plastic spoon
Ⓒ rubber band
Ⓓ wooden stick

England's score (and standard error)	84 (1.7) – above average
International average	71 (0.3)
Highest score	94 (1.1) – Japan

Source: Exhibit 2.6, international science report

Example item J **Intermediate attainment benchmark, Y5 science**

Content Domain: Life Science
Cognitive Domain: Applying
Description: Pairs pictures of three animals with their distinguishing biological characteristics (skeleton, milk production, number of legs)


Monkey


Crocodile


Grasshopper


Octopus

Answer the following questions using the animals shown above. Write the name for the correct animal in the spaces below.

Which animal has an internal skeleton and produces milk for its young?

monkey

Which animal has an external skeleton and three pairs of legs?

grasshopper

Which animal has a soft body and no skeleton?

octopus

The answer shown illustrates the type of student response that was given 1 of 1 points.

England's score (and standard error)	67 (2.4) – above average
International average	58 (0.3)
Highest score	88 (1.4) – Korea

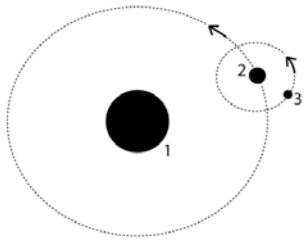
Source: Exhibit 2.8, international science report

Example item K **High attainment benchmark, Y5 science**

Content Domain: Earth Science
Cognitive Domain: Reasoning

Description: Identifies the Earth, Moon, and Sun from a diagram of their orbits

The figure below shows Earth, the Moon, and the Sun. Each body is labeled by a number. The arrows show the direction each body is moving.



Fill in the correct number next to each body (1, 2 or 3).

Earth is body number: 2

The Moon is body number: 3

The Sun is body number: 1

The answer shown illustrates the type of student response that was given 1 of 1 points.

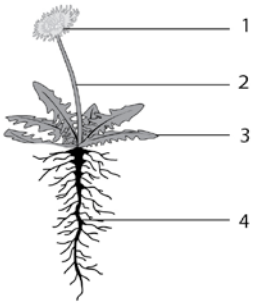
England's score (and standard error)	63 (2.5) – above average
International average	49 (0.3)
Highest score	78 (2.2) – Portugal

Source: Exhibit 2.12, international science report

Example item L **Advanced attainment benchmark, Y5 science**

Content Domain: Life Science
Cognitive Domain: Knowing
Description: From a diagram of a flowering plant, identifies numbered parts and states a function of most of these parts

The diagram shows a flowering plant. Four of its parts are numbered.



In the table below, write the name of each part, and state its function.

Part Number	Name of Part	Function of Part
1	flower	produces seeds
2	stem	transports water and food.
3	leaf	makes food for the plant
4	root	absorbs water, minerals, and nutrients into the plant

The answer shown illustrates the type of student response that was given 2 of 2 points.

England's score (and standard error)	21 (2.8) – average
International average	21 (0.3)
Highest score	80 (1.6) – Singapore

Source: Exhibit 2.14, international science report

C.4 Y9 science

Example item M **Low attainment benchmark, Y9 science**

Content Domain: Chemistry
Cognitive Domain: Knowing
Description: Recognizes the chemical formula of carbon dioxide

What is the chemical formula for carbon dioxide?

Ⓐ CO
● CO_2
Ⓒ C
Ⓓ O_2

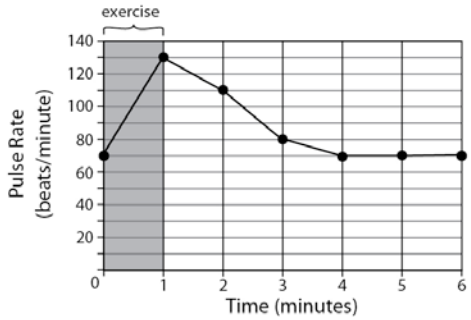
England's score (and standard error)	92 (1.3) – above average
International average	85 (0.2)
Highest score	99 (0.3) – Japan

Source: Exhibit 2.22, international science report

Example item N **Intermediate attainment benchmark, Y9 science**

Content Domain: Biology
Cognitive Domain: Reasoning
Description: Interprets a graph showing changes in pulse rates before, during, and after exercise and recognizes what can be concluded from the graph

John measures his pulse rate before he exercises. It is 70 beats per minute. He exercises for one minute and measures his pulse rate again. He then measures it every minute for several minutes. He draws a graph to show his results.



What can be concluded from his results?

Ⓐ His pulse rate increased by 50 beats per minute.
Ⓑ His pulse rate took less time to slow down than to increase.
Ⓒ His pulse rate after 4 minutes was 80 beats per minute.
● His pulse rate returned to normal in less than 6 minutes.

England's score (and standard error)	69 (2.6) – above average
International average	57 (0.3)
Highest score	82 (1.7) – Japan

Source: Exhibit 2.24, international science report

Example item O **High attainment benchmark, Y9 science**

Content Domain: Physics
Cognitive Domain: Knowing
Description: Recognizes what happens to molecules of a liquid as the liquid cools

What happens to the molecules of a liquid when the liquid cools?

- ● They slow down.
- Ⓑ They speed up.
- Ⓒ They decrease in number.
- Ⓓ They decrease in size.

England's score (and standard error)	65 (2.3) – above average
International average	58 (0.3)
Highest score	86 (1.6) – Alberta

Source: Exhibit 2.28, international science report

Example item P **Advanced attainment benchmark, Y9 science**

Content Domain: Physics
Cognitive Domain: Applying
Description: Recognizes that the force of gravity acts on a person regardless of position and movement

The figure shows a parachute jumper in four positions.

1. In the aircraft before the jump

2. In freefall immediately after jumping before parachute opens

3. Falling to the ground after the parachute opens

4. On the ground just after landing

In which of the positions does the force of gravity act on the jumper?

Ⓐ Position 2 only.
Ⓑ Positions 2 and 3 only.
Ⓒ Positions 1, 2 and 3 only.
● Positions 1, 2, 3, and 4.

England's score (and standard error)	43 (2.9) – above average
International average	32 (0.3)
Highest score	63 (2.0) – Korea

Source: Exhibit 2.32, international science report