where England stands

in the trends in international mathematics and science study (TIMSS) 2003

national report for England

nfer

department for education and skills

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Graham Ruddock
Linda Sturman
Ian Schagen
Ben Styles
Michela Gnaldi
Hanna Vappula

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Executive summary

1 The 2003 TIMSS survey

The 2003 Trends in International Mathematics and Science Survey (TIMSS) is the third in a series of surveys which began in 1995. In the 2003 survey year 5 and year 9 pupils participated in England. These correspond to grades 4 and 8 internationally and these terms are used in this report. Year 9 pupils in England participated in both previous surveys, in 1995 and 1999, as did grade 8 students from a wide range of countries. Year 5 pupils from England participated in the last TIMSS survey of this age group, in 1995, along with grade 4 pupils from a variety of countries.

The 2003 survey allows us to identify our current standing and changes over time in the performance of both year 5 and year 9 pupils in England in mathematics and science. It also allows us to examine performance in England against that of countries of particular interest, such as our economic competitors, and the average performance of all the participating countries. In the National Report for England, another yardstick is used against which to judge England's performance. This is the average performance of a group of developed countries chosen to represent some of our economic competitors, the English speaking world and our European neighbours. This Comparison Group consists of: England, Australia, Hong Kong, Hungary, Japan, New Zealand, Singapore, USA, Belgium (Flemish), Italy, the Netherlands and Scotland. These countries were chosen because they have participated in all or almost all of the TIMSS surveys for grades 4 and 8. Their average performance provides a much more demanding standard than the international average for the survey, which reflects the performance of both developed and developing countries.

International surveys such as TIMSS adopt stringent sampling requirements in terms of both schools and pupils. The sample for grade 4 (year 5) in England met the international sampling requirements, meeting the standard for schools and pupils. It was not possible to achieve these requirements for grade 8 (year 9) because not enough schools from the first choice sample would agree to participate. The proportion of pupils participating, 86 per cent, did exceed the required standard, 85 per cent. In the international report, data for England at grade 8 is therefore shown after that for other countries and below a line. However, the data used for grade 8 in England has been weighted using schools' performance in national tests and examinations to ensure that it is in fact representative. This reweighting resulted in the grade 8 science scaled score being six scale points lower and that for mathematics seven scale points lower.

Because of this reweighting and the acceptable level of pupil participation, England's performance at grade 8 is compared in this report with that of the other participating countries.

In the sections which follow, references to the section of the main report where further information on the topic concerned can be found are given. References to significance are to differences that are statistically significant at the five per cent level and are differences which are also considered to be important – significant in the everyday sense of the word.

2 England's performance in the 2003 TIMSS survey

Students taking part in the survey took tests including both mathematics and science items. They, their teachers and their headteachers answered questionnaires to provide background information which was used to analyse performance. From the test results each pupil was given a score for mathematics and for science. From these, average scores were produced for each participating country. These scores are related to those in earlier surveys, when the international average was set to a mean of 500 (with standard deviation of 100). For the current survey the international averages are around 490 for grade 4 and around 470 for grade 8, since more developing countries are now included. This level of change at grade 8 represents roughly 30 per cent of a standard deviation. Using these scores, a summary of England's performance is given below:

Grade 4 science (year 5)

- England's score of 540 was significantly higher than the international average, 489, and the average score for the 12 comparison group countries, 530.
- Only two countries out of the 25 participating, Singapore (565) and Chinese Taipei (551) outperformed England.
- Three other countries, Japan, Hong Kong and the United States scored at a level not significantly different from England (between 536 and 543).
- All other countries scored at a significantly lower level than England. These included seven of the comparison group countries.
- In summary, the performance of primary children in England in science is currently among the best in the world (See section 2.1).

Grade 4 mathematics (year 5)

- England's score of 531 was significantly higher than the international average, 495, but at a similar level to the average for the comparison group, 532.

- Six countries out of the 25 participating, Singapore (594), Hong Kong, Japan, Chinese Taipei, Belgium (Flemish) and the Netherlands (540) scored significantly higher than England.
- Four other countries, including Hungary and the Russian Federation scored at a similar level to England (between 529 and 536).
- All other countries scored at a significantly lower level than England. These included five of the comparison group countries.
- In summary, the performance of primary children in England in mathematics is high by statistical standards but not at the highest level seen in developed countries. (2.2)

Using the reweighted data to ensure that the sample is representative, England's performance at grade 8 can be summarised as:

Grade 8 science (year 9)

- England's score of 544 was significantly higher than the international average, 474, and the average score for the comparison group, 533.
- Only four countries out of the 46 participating, Singapore (578), Chinese Taipei, Korea and Hong Kong (556) outperformed England.
- Four other countries, including Japan, Hungary and the Netherlands scored at a level not significantly different from England (between 536 and 552).
- All other countries scored at a significantly lower level than England.
- In summary, the performance of secondary school pupils in England in science is amongst the highest in the world, but is less prominent than in primary science. (2.3)

Grade 8 mathematics (year 9)

- England's score of 498 was significantly higher than the international average, 467, but significantly lower than the average for the comparison group, 529.
- Nine countries out of the 46 participating, including six from the comparison group – Singapore (605), Hong Kong, Japan, Belgium (Flemish), the Netherlands and Hungary (529) – scored significantly higher than England.
- Twelve other countries, including Australia, United States, Scotland and New Zealand from the comparison group performed at a similar level to England (between 493 and 508).
- All other countries scored at a significantly lower level than England. These included Italy from the comparison group countries.

- In summary, the performance of secondary school pupils in England in mathematics is below that of a number of developed countries, and similar to that in a range of others. (2.4)

In general England performed better in science than in mathematics and better at grade 4 than grade 8. This was the case when comparing England's performance against the comparison group countries or against all participating countries.

Exhibit 1.1 gives full details of all countries performing at a similar level to England or higher. Only comparison group countries performing at a lower level than England are listed. Countries outside the comparison group are shown in italics.

At the extremes of the comparison group, Singapore performed at a higher level than England in all four assessments, while England outscored Italy in all four. England also performed strongly against Scotland, Australia and New Zealand, outscoring them in science at both grades and grade 4 mathematics while performing at a similar level in mathematics at grade 8. (2.5)

3 England's performance over time

Each TIMSS survey contains items used in previous surveys. These common items allow trends in performance over time to be analysed. Fifteen countries tested grade 4 pupils in both 1995 and 2003. For these countries, analysis of trends in performance over time has been possible. More countries have been involved at grade 8, and for 35 it is possible to look at trends in performance from 1995 and/or 1999 to 2003. England's performance over this period is summarised below:

Grade 4 (year 5)

- In both science and mathematics England's score at grade 4 increased significantly from 1995 to 2003.

In mathematics:

- England's mathematics score rose from 484 to 531; this rise, 47 scale points (nearly half a standard deviation), was the largest in any of the 15 countries (by 12 scale points).

- England's rise in mathematics score was much larger than the average change for the ten comparison group countries involved, a rise of 9.5 scale points.

- England's percentage correct on the 37 mathematics items used in 1995 and 2003 rose by nearly 10 per cent, from 63 per cent to 72 per cent.

Exhibit 1.1 England's standing in TIMSS 2003

	Grade 4 Science	Grade 4 Mathematics	Grade 8 Science	Grade 8 Mathematics
All countries performing at a significantly **higher level than England**	**Singapore 565** *Chinese Taipei 551*	**Singapore 594** Hong Kong 575 Japan 565 *Chinese Taipei 564* Belgium (Fl) 551 Netherlands 540	**Singapore 578** *Chinese Taipei 571* *Korea 558* Hong Kong 556	**Singapore 605** *Korea 589* Hong Kong 586 *Chinese Taipei 585* Japan 570 Belgium (Fl) 537 Netherlands 536 *Estonia 531* Hungary 529 ***Comparison group ave ⇨ 529***
All countries performing at a **similar level to England**	Japan 543 Hong Kong 542 **England 540** United States 536	*Latvia 536* *Lithuania 534* ***Comparison group ave ⇨ 532*** **England 531** Hungary 529	*Estonia 552* Japan 552 **England 544** Hungary 543 Netherlands 536	*Malaysia 508* *Latvia 508* *Russian Fed 508* *Slovak Republic 508* Australia 505 United States 504 *Lithuania 502* *Sweden 499* **England 498** Scotland 498 *Israel 496* New Zealand 494 *Slovenia 493*
Comparison group **countries only** performing at a significantly **lower level than England**	***Comparison group ave ⇨ 530*** Hungary 530 Netherlands 525 Australia 521 New Zealand 520 Belgium (Fl) 518 Italy 516 Scotland 502 *(and 12 other countries)* ***International average ⌧ 489***	United States 518 Italy 503 Australia 499 ***International average ⌧ 495*** New Zealand 493 Scotland 490 *(and 9 other countries)*	***Comparison group ave ⇨ 533*** United States 527 Australia 527 New Zealand 520 Belgium (Fl) 516 Scotland 512 Italy 491 *(and 31 other countries)* ***International average ⌧ 474***	Italy 484 *(and 23 other countries)* ***International average ⌧ 467***

The international average ⌧ and the average for the 12 comparison group countries ⇨ are shown
Countries outside the comparison group are shown in italics

- The increase for items assessing number, rather than other aspects of mathematics was higher, over 11 per cent.
- In three of the comparison group countries, including England, mathematics scores rose during this period, in six of these countries there was no significant change and in one country there was a decline. (3.2, 3.6)

In science:

- England's science score rose by 13 points from 528 to 540, a smaller rise than in mathematics but from a higher base. The average increase for the ten comparison group countries was 9.4 scale points.
- England's percentage correct on the 32 science items used in 1995 and 2003 rose by just under 4 per cent, from 76 per cent to 80 per cent; again a smaller rise than in mathematics but from a higher base.
- England was one of five comparison group countries to show a rise in science score, while three showed no change and in two countries there was a decline. (3.1, 3.6)

The results from the 2003 TIMSS survey provide confirmatory evidence of an improvement in mathematics and science performance in the later years of key stage 2 from 1995 to 2003.

Grade 8 (year 9)

Using the reweighted data to ensure that the sample is representative, England's performance at grade 8 can be summarised as:

- In both science and mathematics England's score at grade 8 showed no significant change from 1995 or 1999 to 2003.

In mathematics:

- England's mathematics scores were 498 in 1995, 496 in 1999 and 498 in the current survey, a very consistent pattern.
- No change in performance was the most common pattern in the comparison group countries, England being one of eight of these 12 countries to show no change from either 1995 or 1999 to 2003. Only two showed an increase, both from 1995 to 2003.
- In the 12 comparison group countries the average scale score fell by 2 scale points from 1999 to 2003.
- No change in performance was also the most common pattern overall in grade 8 mathematics; 17 of the 35 countries showed no change from either 1995 or 1999 to 2003, while 11 showed a decline in performance. (3.4)

In science:

- England's science scores were 533 in 1995, 538 in 1999 and 544 in the current survey; neither change to 2003's score being statistically significant.
- No significant change in performance was also a common pattern in the 12 comparison group countries. England was one of seven comparison group countries to show no change, while three showed an increase.
- The average score of the comparison group countries rose by nearly 8 scale points from 1995 to 2003, but by less than 3 points from 1999 to 2003.
- Of all 35 countries roughly one third showed no change, a similar proportion showed an increase while the remaining third showed a decline. (3.3)

The increases in England's performance levels at grade 4 have caused changes in its standing relative to the other countries in the comparison group. In 1995, the United States and Australia scored significantly higher than England in mathematics but this position was reversed by 2003. Also in mathematics, England now outperforms Scotland and New Zealand, rather than performing at a similar level, as in 1995, while England is no longer outscored by Hungary.

The smaller increase in performance in grade 4 science also produced changes in England's standing. England now outperforms the Netherlands, Australia and Scotland, rather than performing at a similar level, as in 1995. Japan and the United States performed at a similar level to England in 2003, rather than at a higher level as in 1995. England's performance relative to Hong Kong and Singapore was less favourable in the current survey than in 1995. Both of these countries had bigger rises in performance than England, 42 scale points and 35 points respectively, some of the largest amongst the participating countries. (3.5)

4 England's performance at the international benchmarks

The international benchmarks in the 2003 study were defined by scale points, 625 for the advanced benchmark, 550 for the high benchmark, 475 for the intermediate and 400 for the low for both grades and subjects. These can be compared with the country level performance already illustrated. The intermediate benchmark, 475, is very close to the international averages for grade 4, but up to 20 points below those for grade 8. Important features of England's performance against these benchmarks are summarised below. As would be expected, performance at the international benchmarks was closely related both to England's overall performance in the four assessments in 2003 and to the changes in performance over time already reported.

Grade 4 (year 5)

In science:

- In England 15 per cent of pupils reached the advanced benchmark compared with the international average of 7 per cent and the comparison group average of 10 per cent; only in Singapore did more pupils achieve this level of performance than in England (25 per cent).
- The proportion of English pupils reaching each of the high, intermediate and low benchmarks increased significantly from 1995. (4.1)

In mathematics:

- Fourteen per cent of pupils reached the advanced benchmark, higher than the international average of 8 per cent and just above the comparison group average of 12 per cent.
- The proportion of English pupils reaching all of the benchmarks increased significantly from 1995; the proportion reaching the advanced benchmark doubled, while that reaching the high benchmark increased by nearly 20 per cent, to 43 per cent with a similar rise for the intermediate benchmark. (4.2)

Using the reweighted datato ensure that the sample is representative, England's performance at grade 8 can be summarised as:

Grade 8 (year 9)

In science:

- In England 15 per cent of pupils reached the advanced benchmark compared with the international average of 6 per cent and the comparison group average of 11 per cent.
- Forty-eight per cent of pupils reached the high benchmark compared with the international average of 26 per cent and the comparison group average of 43 per cent.
- The proportion of English pupils reaching the intermediate benchmark increased significantly from 1995 and more pupils reached the low benchmark than in either 1995 or 1999. (4.3)

In mathematics:

- Five per cent of pupils reached the advanced benchmark, similar to the international average of 6 per cent and below the comparison group average of 13 per cent.

- Performance at the high benchmark was similar to the international average, but ahead of it for the intermediate and low benchmarks.
- There were no significant changes in the proportions reaching the various benchmarks from 1995 or 1999. (4.4)

The 2003 survey does not support claims that there is a long tail of underachievement as measured by the proportions of pupils reaching the low international benchmark. The proportion of English pupils reaching this benchmark ranged from 96 per cent in grade 8 science to 90 per cent in grade 8 mathematics. For science at both grades and for grade 4 mathematics the proportion of pupils reaching this benchmark was very close to the average for the comparison group countries. For grade 8 mathematics 3 per cent fewer pupils in England reached the low benchmark than the average for the comparison group countries. (4.5)

5 England's performance by content area

In general, England's performance in the different content areas of the TIMSS framework mirrored overall performance. Relative to overall performance the variations from this were:

- In grade 4 science, performance was stronger in physical science rather than in life science or earth science. (5.1)
- In grade 4 mathematics, performance was strongest in data and geometry, at a similar level to overall performance in measurement and relatively weaker in number and patterns and relationships. (5.2)
- In grade 8 science, performance was similar to overall performance in physics, life science, earth science and environmental science but relatively weaker in chemistry. (5.3)
- In grade 8 mathematics, England's performance profile was largely similar to that for grade 4, strongest in data, at a similar level to overall performance in measurement and relatively weakest in number. This pattern was also found in Scotland, Australia and New Zealand. (5.4)

6 Gender differences

When analysed by gender, the performance of boys and girls in England was very similar in three of the four assessments:

- In mathematics at both grade 4 and grade 8 and science at grade 4 there were no significant differences in overall performance between boys and girls in England. This was also the case in Australia, Hong Kong, Japan and New Zealand. (6.1, 6.2, 6.4)

- In science at grade 8 boys (550) performed at a significantly higher level than girls (538). This gender difference was also evident in ten of the 12 comparison group countries. (6.3)
- Of the comparison group countries only New Zealand showed no significant gender differences in all four assessments; while only Singapore showed differences in favour of girls (in both mathematics assessments). The other differences found were in favour of boys, including in all four assessments in the United States and in three of the four assessments for Scotland, the Netherlands and Italy. (6.1 to 6.4)
- The improvement in England's grade 4 science score can be attributed to an increase in the performance of girls, rather than boys but in mathematics the scores of both genders increased significantly. (6.1)
- Girls' scores also improved significantly from both 1995 and 1999 to 2003 in grade 8 science, and had boys scores changed similarly, England's overall performance would have increased significantly from the 1995 level. (6.3)

The increases in girls' scores in science at both grades from those in earlier surveys are interesting and may add fuel to the debate about underachievement by boys.

7 Pupils' attitudes in England

Grade 4 (year 5)

- The majority of grade 4 pupils are confident of their abilities in mathematics and science, believe they do well, and enjoy their lessons in each subject. Almost half would welcome more science lessons and a similar proportion would welcome more mathematics lessons.
- The percentages agreeing that they enjoy learning science and mathematics have fallen significantly since 1995 (from 80 per cent to 68 per cent for science and from 84 per cent to 70 per cent for mathematics), although the overall percentages agreeing that they usually do well in science and mathematics are similar. There were some significant changes in the distribution of responses in these areas. (7.1, 7.2).

Grade 8 (year 9)

- The majority of grade 8 pupils are confident of their abilities in science and enjoy their lessons. The percentage agreeing that they enjoy science a lot has not changed significantly since the 1995 and 1999 surveys, although the percentage saying that they enjoy it a little has decreased, in line with many of the comparison group countries. Just over half would welcome more science lessons and 43 per cent would like a job involving science. This is lower than in the previous surveys.

- Just over three-quarters value their science lessons, seeing them as intrinsically enjoyable and/or a route to future goals, such as a university place or job of their choice. However, only 35 per cent reported feeling that the majority of their science lessons were relevant to their daily lives.
- The majority of grade 8 pupils are confident of their abilities in mathematics. Just over half enjoy their mathematics lessons, a drop from previous surveys. One third would like to study more mathematics and 37 per cent, again lower than in previous surveys, would like a job involving mathematics.
- Eighty-five per cent value their mathematics lessons, seeing them as intrinsically enjoyable and/or a route to future goals, such as a university place or job of their choice. However, only 27 per cent reported feeling that the majority of their mathematics lessons were relevant to their daily lives. (7.3, 7.4)

Underlying trends

Underlying trends were obtained from the outcomes of multilevel modelling analysis. For more information on this type of analysis, see Section 10. It is important to note that a statistically significant outcome identified in a model may not imply a straightforward causal relationship, particularly as no measure of prior attainment was included.

- Grade 4 boys were more confident than girls and had higher levels of enjoyment in mathematics, but no such differences were found in science and no significant differences in performance were observed. Grade 8 boys were more confident than girls and had higher levels of enjoyment in both science and mathematics. However, grade 8 boys outperformed girls in science only; not in mathematics.
- As the time that grade 4 pupils estimated spending on practising computation without a calculator increased, their confidence in and enjoyment of mathematics rose. However, as the estimated time spent on activities other than computation increased, enjoyment of mathematics increased but confidence decreased.
- Attitudes to science lessons at both grades were more positive in schools where pupils perceived that investigation, observation and explanation of phenomena were frequently part of their classroom activities.
- Confidence in mathematics lessons at grade 4 and science lessons at grade 8 was higher in schools where pupils perceived that working on their own or listening to lecture-style presentations from the teacher were frequent in their classroom activities.
- The value placed on mathematics and science lessons was a significant predictor of enjoyment and confidence in these subjects at grade 8.

- Attitudes were more positive in schools at both grades where students reported feeling valued by their teachers and felt that their peers tried hard.
- As the number of resources available to pupils at home increased, so their enjoyment and confidence in science and their confidence in mathematics increased. Those pupils with greater access to computers for schoolwork also showed greater enjoyment and confidence in science and greater enjoyment in mathematics.
- Students who reported that they 'never' or 'only sometimes' spoke English at home tended to enjoy mathematics more at both grades, compared with those who reported speaking English at home more frequently. At grade 4, pupils also showed more enjoyment and confidence in science if they used a computer for schoolwork more frequently. (7.5)

8 The teachers and the schools in England

Grade 4 (year 5)

- Almost all grade 4 pupils participating in TIMSS 2003 were based in schools whose 'climate' and level of safety were rated positively by their teachers and headteachers. Pupils' perceptions were a little different, with roughly three quarters of grade 4 pupils feeling safe at school. All pupils were taught in schools whose headteachers were largely positive about their school's resourcing, an improvement on the position in the 1995 survey.
- Compared with the international average, grade 4 pupils in England were more likely to carry out investigations and to plan and design their own investigations in half or more of their science lessons, as measured by their teachers' reports. Just over a third were taught science without the use of a text book, with only six per cent using one as a primary resource. Most pupils used computers in their science lessons; 12 per cent of the TIMSS 2003 sample did not.
- Grade 4 pupils in England were close to the international average in terms of the percentage estimated by their teachers to be working on fractions, decimals and computation in half or more of their mathematics lessons. They were less likely to engage in measuring, data-handling and shape activities with equal frequency, however. Most lesson time was spent working on problems with or without the teacher's guidance, and listening to lecture-style presentations.
- Just over a quarter were taught mathematics using a textbook as a primary resource, with 11 per cent not using a textbook at all. Almost all grade 4 pupils used calculators in their mathematics lessons, most commonly for solving complex problems. Most pupils used computers in their mathematics lessons; 19 per cent of the TIMSS sample did not. (8.1, 8.2)

Grade 8 school climate, safety and resources

- As at grade 4, almost all pupils participating in TIMSS 2003 at grade 8 were based in schools whose 'climate' and level of safety were rated positively by their headteachers. Teachers tended to rate their schools differently than did headteachers, however.

- Most grade 8 pupils (93 per cent for science and 91 per cent for mathematics) were taught in schools whose headteachers were largely positive about their school's resourcing, a position which, for science, has not changed significantly since the 1995 and 1999 surveys. Resourcing in mathematics has changed, with significantly fewer students taught in schools in the 'medium' resourcing range. Both the 'high' and 'low' resourcing categories increased, but not to a significant degree.

- Almost all grade 8 pupils were in schools rated by their mathematics and science teachers as safe places to be. Pupils' perceptions of safety at school differed from those of their teachers in both subjects, though to a lesser degree than was the case at grade 4. (8.3, 8.4)

Grade 8 science

- Compared with the international average, grade 8 pupils in England were more likely to carry out investigations in their science lessons, but planned and designed their own investigations less frequently than did grade 4 pupils. They more frequently watched teacher demonstrations of experiments than did grade 4 pupils. According to their teachers' estimates, the largest percentage of class time each week was spent on working with the teachers' guidance, and 64 per cent had their grade 8 science learning related to their daily lives in half or more of their lessons. Pupil estimates of this were lower, at 35 per cent.

- Grade 8 science teachers estimated that only six per cent of class time was spent on average in taking tests. This was below the international average of ten per cent. Just over half of grade 8 pupils in the sample took a test about once a month; a further quarter less frequently. Most tests encountered required pupils to construct a response; only a quarter typically experience a roughly half-and-half mixture of constructed response and multiple choice tests, the most common format internationally.

- Textbook use in science is more common at grade 8 than grade 4 but, even so, only 18 per cent used one as a primary resource and nine per cent did not use a textbook.

- Almost a third of grade 8 students did not use computers in their science lessons. (8.3)

Grade 8 mathematics

- Pupils practised basic computation in half or more of their mathematics lessons, according to both teachers' and pupils' estimates. According to teachers' estimates, the largest percentage of class time each week was spent on working on problems with the teachers' guidance. Students were less likely than their teachers to report that teachers related their learning to their daily lives: teachers estimated that 46 per cent of pupils experienced this in half of the lessons or more; pupil estimates gave a figure of 27 per cent.

- Only four per cent of mathematics class time was estimated to be given over to tests, less than the international average of ten per cent. Pupils appeared to be tested less often in mathematics than they were in science, with just over half receiving a mathematics test a few times a year or less often. Very few pupils encounter multiple choice tests in mathematics; almost all are tested in only or mostly constructed response format. While this was the most common format internationally for mathematics tests, there were few countries where as many pupils as in England experience this type of test.

- Textbook use was more likely to be a main resource for mathematics than it was for science, with almost half the pupils using them as a primary basis for their grade 8 mathematics lessons. Even so, 14 per cent were taught without a textbook.

- All pupils had access to calculators in their mathematics lessons and these were used mostly for solving complex problems and checking answers. Computers were less common, with a third of pupils not having access to them for mathematics. (8.4)

Underlying trends

Underlying trends were obtained from the outcomes of multilevel modelling analysis. For more information on this type of analysis, see Section 10. It is important to note that a statistically significant outcome identified in a model may not imply a straightforward causal relationship, particularly as no measure of prior attainment was included.

- At both grades and in both subjects, as the percentage of pupils eligible for free school meals increased, so attainment decreased.

- Where grade 8 mathematics and science teachers perceived that the student intake and the attitudes of students placed limitations on their teaching, student attainment was lower. However, it tended to be higher in mathematics where teachers perceived that shortages of equipment and the numbers of students in the class placed limitations on their teaching.

- As the frequency (according to grade 4 pupils' estimates) of listening to the teacher talk and working individually to answer questions increased, so pupils' attainment in both mathematics and science increased.

- Similarly, as grade 4 pupils' estimates of time spent on practising computation increased, so their mathematics scores increased. However, as their estimates of time spent on activities other than practising computation increased, so their mathematics scores fell.
- In grade 4 science, as the perceived time spent on scientific investigation increased, achievement in all areas of science increased, as did performance in most areas of mathematics.
- Safety at school was important in attainment at grade 4, with pupils achieving more highly if they felt safe at school. No such effect was found at grade 8. In contrast, if pupils at grade 4 perceived the school climate to be positive, their scores were likely to be lower. (8.5)

The curriculum in England

The intended curriculum for England in science and mathematics matched the topics tested in TIMSS very well.

- For both grades and subjects over 80 per cent of the topics in TIMSS were intended to be taught to all or almost all pupils.
- Teachers' reports of which topics had been taught to the pupils tested were similarly high.

9 The pupils and the home

Grade 4

- The average age of grade 4 pupils who participated in TIMSS 2003 was 10.3 years. The majority (94 per cent) reported speaking English at home always or almost always.
- Just over a third of these pupils estimated that there were at least 100 books at home (other than school books), while eight per cent indicated that there were 10 books or fewer. Most (91 per cent) had a computer at home, and a study desk for the pupil's own use was also common. These data may suggest that a high proportion of TIMSS pupils were drawn from relatively privileged backgrounds. However, as noted above, the schools involved at both grades can be considered a typical cross-section of schools in England, and it is likely, that the pupils were also, therefore, fairly typical.
- Most (79 per cent) reported using a computer both at school and at home. Eleven per cent said they used a computer at home but not at school, while eight per cent said they used one at school but not at home.
- Just under a fifth of grade 4 pupils reported having received extra tutoring in mathematics (either at school or beyond school) at least once or twice a week and a further third received extra tutoring sometimes. The comparable figures for extra tutoring in science were ten per cent and 28 per cent.

- According to their own reports, England's pupils received less homework than their peers in other countries. Homework was given more frequently in mathematics than in science. Teachers reported less emphasis on homework than was perceived by pupils. (9.1)

Grade 8

- The average age of grade 8 pupils who participated in TIMSS 2003 was 14.3 years. The majority (97 per cent) reported speaking English at home always or almost always.
- Just under half estimated that there were at least 100 books at home (other than school books), while 13 per cent indicated that there were 10 books or fewer. Most (94 per cent) had a computer at home and, as at grade 4, a study desk for the pupil's own use was also common. As noted at grade 4, these data may suggest that a high proportion of TIMSS pupils were drawn from relatively privileged backgrounds. However, as discussed above, the schools involved at both grades can be considered a typical cross-section of schools in England, and it is likely, that the pupils were also, therefore, fairly typical.
- Most (81 per cent) reported using a computer both at school and at home. Seven per cent said they used a computer at school but not at home, while ten per cent reported using one at home but not at school.
- Extra tutoring (in or out of school) was less common at grade 8 than at grade 4. Six per cent reported having received extra tutoring in mathematics (either at school or beyond school) at least once or twice a week and a further 15 per cent sometimes. The comparable figures for extra tutoring in science were four per cent and 13 per cent.
- According to their own reports, England's grade 8 pupils received less homework than their peers in other countries, particularly in science. At grade 8, in contrast to grade 4, teachers reported a higher emphasis on homework than that reported by their pupils. (9.2)

Underlying trends

Underlying trends were obtained from the outcomes of multilevel modelling analysis. For more information on this type of analysis, see Section 10. It is important to note that a statistically significant outcome identified in a model may not imply a straightforward causal relationship, particularly as no measure of prior attainment was included.

- Where pupils reported more resources in the home, their attainment was higher. This was true at both grades and for both subjects.
- Also true of both subjects and both grades were the findings that pupils who were born outside the UK generally performed less well, as did those who received extra tutoring. It is likely that extra tutoring was targeted at pupils who were experiencing difficulties with the subject.

- Pupils who never or only sometimes spoke English at home tended to perform less well in science overall at both grades. There were no such effects on the overall mathematics score at either grade. These findings were independent of the finding related to place of birth.
- Age was related to attainment at grade 4 but not at grade 8. At grade 4, older pupils were more confident than younger pupils, and also performed better in both subjects.
- The more frequently that grade 4 pupils used a computer for schoolwork, the less well they performed in mathematics and science.
- As the frequency of science homework (as reported by teachers) increased, so did students' overall attainment in mathematics and science at grade 8. The amount of homework was not a significant factor in either case. (9.3)

The 2003 TIMSS survey has provided a wealth of information on England's standing in the world in primary and secondary mathematics and science. This report has only scratched the surface of the data available, and further work is needed to help clarify messages and inform future developments.

1 Background to TIMSS 2003

TIMSS 2003 is the latest in a series of comparative international studies of mathematics and science achievement. TIMSS (Trends in International Mathematics and Science Study) was first conducted in 1994–1995 and repeated in 1998–1999. The 1994–1995 study was originally entitled the Third International Mathematics and Science Study and followed earlier mathematics surveys in 1964 and 1980–1982 and science ones in 1970 and 1984. The first TIMSS survey involved 41 countries and five grade levels (year groups), including pupils aged 8/9, 13/14 and those at sixth form level, while the 1999 repeat involved grade 8 (year 9 in England) pupils in 38 countries. TIMSS 2003 reports on the achievement of grade 4 (year 5 in England) and grade 8 pupils (year 9 in England); the former in 25 countries and four benchmarking communities, and the latter in 46 countries and three benchmarking communities. The benchmarking communities were states or provinces rather than complete countries, and included Canada's two largest provinces, Ontario and Quebec. Canada as a nation did not participate. The international TIMSS surveys are conducted by the International Association for the Evaluation of Educational Achievement (IEA) and a further international TIMSS survey is planned for 2007. The countries which comprise the United Kingdom are regarded separately by IEA, and, of the four, England and Scotland chose to participate in the 2003 survey. In England, the 2003 survey, like previous ones, was administered by the National Foundation for Educational Research, NFER.

While the 2003 survey followed broadly the same structure as previous surveys, some updating was built into the survey framework. As part of the updating the TIMSS assessment frameworks for both subjects for both content and process, an emphasis on problem solving and enquiry was added for both grades. This added larger scale tasks to the assessment with a number of questions being derived from a problem solving context. This complemented the existing assessments, a combination of multiple choice and constructed response items.

The assessment framework for TIMSS has two dimensions, content domains and cognitive domains. These are outlined below:

Mathematics

Content domains:	*number, algebra; measurement; geometry and data*
Cognitive domains:	*knowing facts and procedures, using concepts, solving routine problems and reasoning.*

Science (grade 8)

Content domains:	*life science; chemistry; physics; earth science and environmental science*
Cognitive domains:	*factual knowledge, conceptual understanding and reasoning and analysis.*

The content domains are familiar ones, but some of the content in science would be covered in England under other subject headings, geography for example. The same domains are used for both grade 8 and grade 4 in mathematics, but the interpretation of them differs. Algebra at grade 4, for example, is entitled patterns and relationships, reflecting what is assessed.

For grade 4 science, physics and chemistry are combined as physical science. Environmental science is not a separate domain, but some aspects are addressed in life science and earth science.

In mathematics, the role of the calculator was the subject of heated debate at meetings of the participating countries. The resolution was to continue to prohibit calculators at grade 4 (year 5) but to allow their use in half of the grade 8 (year 9) assessment if this reflected normal classroom practice in the country concerned. TIMSS tests had always been in two parts, so it was arranged that the second part of a grade 8 test would be calculator available if desired. Items used in previous surveys, and forming the basis of measurement of trends over time, were placed in the first half of the test and were thus unaffected by this change.

Each student therefore took a test in two parts, 45 minutes each for grade 8 and 36 minutes each for grade 4. In addition, each student also answered a questionnaire to provide details of their attitudes, experiences, preferences and background. There were also teacher questionnaires, one for the class teacher for grade 4 and separate ones for the mathematics and science teacher of a grade 8 student. Information on the school was obtained by a school questionnaire, answered by the headteacher.

Samples for England were drawn by Statistics Canada, assisted by NFER, and for each grade consisted of a first choice sample and two back-up samples. Each first choice school was approached and if that school refused to participate, its designated back-up school from the first reserve sample was approached. If, in turn, the first back-up school also declined to participate the second reserve was approached.

For grade 4 (year 5) each of the three samples consisted of 150 schools. Of the first choice sample, 79 schools agreed to participate and these were complemented by 44 schools from the reserve samples, giving a total of 123 schools. The achieved sample met the IEA sampling requirements for schools, that over 50 per cent of first choice schools participated and that, with reserves, the rate of school participation, 82 per cent of sampled schools, multiplied by the pupil participation rate, 93 per cent, exceeded 75 per cent, and that at least 50 per cent of each sampled class participated. The sample was inspected by IEA's sampling referee and accepted.

For grade 8 (year 9) each of the three samples consisted of 160 schools. Of the first choice sample, 62 schools agreed to participate and these were complemented by 25 schools from the reserve samples, giving a total of 87 schools. In spite of repeated requests to the first choice schools concerned, it was not possible to achieve the IEA sampling requirements that over 50 per cent of such schools should participate. This reflects the difficulties of gaining co-operation from schools in societies where schools are free to decide whether or not to participate. It is unfortunate that the year group involved in England is year 9, which take national tests in the same period as the TIMSS tests have to be administered.

The sample did, however, meet the requirement for pupil participation rate, the 86 per cent achieved being 1 per cent above that required. Close analysis found the achieved sample to over-represent schools average and above average in terms of national examination (or test) results. This sample was therefore re-weighted using this measure of performance to remove this effect. The reweighting resulted in England's science score being 6 scale points lower and its mathematics score 7 scale points lower. The reweighted data, giving a fair representation of England's performance, is reported in the international report and here. Because England's sample did not meet the sampling criteria, the results for England are shown below a line which follows the last of the participating countries. In such tables, where relevant, a placeholder has been added for England to show where it would appear when the countries are ordered by score.

2 Pupils' achievements in mathematics and science

The international TIMSS reports set out the achievement of pupils in both subjects at both grades. This national report considers achievement both in relation to those international comparisons and in particular focuses on England's performance relative to a comparison group formed mainly from those countries which participated in all three TIMSS surveys. This group contains good representation from our economic competitors, from the English speaking world and from Western Europe. The group comprises: England, Australia, Hong Kong, Hungary, Japan, New Zealand, Singapore, USA (all of the countries with complete data at both grades for 1995, 1999 and 2003); and Belgium (Flemish), Italy, the Netherlands, Scotland (countries with almost complete data: the first three did not participate in grade 4 in 1995 while Scotland did not participate in grade 8 in 1999). (Neither France nor Germany participated in TIMSS 2003 so they could not be included in the comparison group.) This group consists only of developed countries and, where appropriate, England's performance is related to the average performance of this group of countries and to that of its members. This is in addition to comparison with the international average for the survey, an average which varies according to which countries choose to participate and their level of performance. The comparison group average is always considerably higher than the international average.

In this report grade 4 (year 5) results are dealt with first, followed by those for grade 8 (year 9). For both age groups science results are reported first, followed by those for mathematics.

2.1 Pupils' achievements in grade 4 science

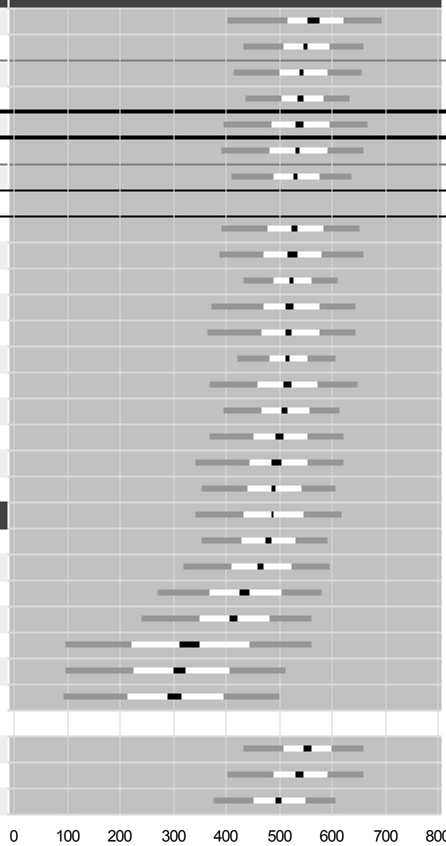
Exhibit 2.1 gives the distribution of achievement in science at grade 4 (year 5). The participants are shown in order of average (mean) scale scores which range, at grade 4 from 565 (Singapore) to 304 (Morocco) with an international mean of 489. England's score, 540, was significantly higher than the international mean. Also shown is the mean score for the comparison group countries, 530, and England's mean score was significantly higher than this. The scores presented here are scaled scores, and the international average was set to be close to a mean of 500 in earlier surveys, with a standard deviation of 100. (England's score of 540 is thus one half of a standard deviation higher than the international average.)

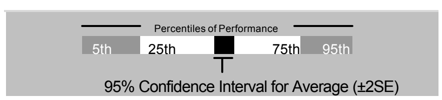
In Exhibit 2.1, the two horizontal dotted lines mark the boundaries of the group of countries with scores not significantly different from England's. Countries

Exhibit 2.1	Distribution of Science Achievement	4th grade	TIMSS 2003 Science

Countries	Years of Schooling*	Average Age	Average Scale Score		Human Development Index**
Singapore	4	10.3	565 (5.5)	▲	0.884
Chinese Taipei	4	10.2	551 (1.7)	▲	–
Japan	4	10.4	543 (1.5)	▲	0.932
† Hong Kong, SAR	4	10.2	542 (3.1)	▲	0.889
† England	5	10.3	540 (3.6)	▲	0.930
† United States	4	10.2	536 (2.5)	▲	0.937
Latvia	4	11.1	532 (2.5)	▲	0.811
Comparison group			530	▲	–
Hungary	4	10.5	530 (3.0)	▲	0.837
Russian Federation	3 or 4	10.6	526 (5.2)	▲	0.779
† Netherlands	4	10.2	525 (2.0)	▲	0.938
† Australia	4 or 5	9.9	521 (4.2)	▲	0.939
New Zealand	4.5 - 5.5	10.0	520 (2.5)	▲	0.917
Belgium (Flemish)	4	10.0	518 (1.8)	▲	0.937
Italy	4	9.8	516 (3.8)	▲	0.916
Lithuania	4	10.9	512 (2.6)	▲	0.824
† Scotland	5	9.7	502 (2.9)	▲	0.930
Moldova, Rep. of	4	11.0	496 (4.6)		0.700
Slovenia	3 or 4	9.8	490 (2.5)		0.881
International Avg.	4	10.3	489 (0.9)		–
Cyprus	4	9.9	480 (2.4)	▼	0.891
ø Norway	4	9.8	466 (2.6)	▼	0.944
Armenia	4	10.9	437 (4.3)	▼	0.729
Iran, Islamic Rep. of	4	10.4	414 (4.1)	▼	0.719
Philippines	4	10.8	332 (9.4)	▼	0.751
Tunisia	4	10.4	314 (5.7)	▼	0.740
Morocco	4	11.0	304 (6.7)	▼	0.606
Benchmarking Participants					
Indiana State, US	4	9.5	553 (3.7)	▲	–
Ontario Province, Can.	4	9.8	540 (3.7)	▲	–
Quebec Province, Can	4	10.1	500 (2.5)	▲	–

Science Achievement Distribution





▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* Represents years of schooling counting from the first year of ISCED Level 1.

** Taken from United Nations Development Program's *Human Development Report 2003*, p. 237-240.

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

ø Norway: 4 years of formal schooling, but First Grade is called "First grade/Preschool."

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.

above the higher line, in this case only Singapore and Chinese Taipei, outperformed England. This illustrates the very high performance level of year 5 English pupils in science. (Singapore's score was significantly higher than that of Chinese Taipei, thus outscoring all other countries.) Those countries appearing between the two lines, along with England, are the ones whose scores did not differ significantly from that of England. In this case there are only three, Japan, Hong Kong and United States. The rest of the countries were outperformed by England. It should be noted that the significance level used is 5 per cent and that there has been no adjustment made for multiple comparisons being undertaken.

Exhibit 2.2 summarises the situation, but only comparison group countries with scores significantly lower than England's are listed. Countries not in the comparison group performing at a level above or similar to that of England are shown in italics. Exhibit 2.1 gives details of other countries with scores below England's and the International TIMSS Science report gives full details of significant differences between other countries.

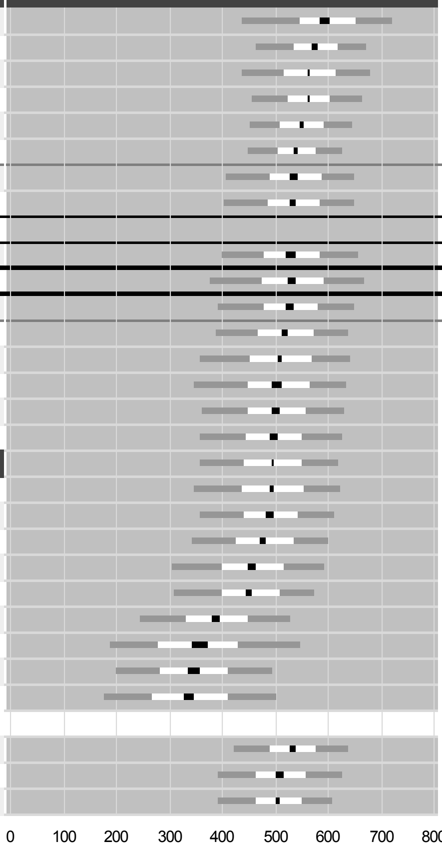
Exhibit 2.2 England's overall performance in science, grade 4

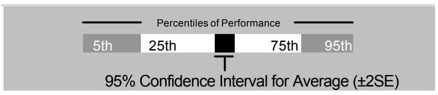
Countries Outperforming England *Scores of 551 and above*	Singapore *Chinese Taipei*
Countries Performing at the Same Level as England (No Significant Difference in Performance) *Scores in the 536 to 543 range, England 540*	Japan Hong Kong United States
Countries Performing at a Lower Level than England *Scores of 532 and below*	*All other countries*, including Hungary Netherlands Australia New Zealand Belgium (Flemish) Italy Scotland

2.2 Pupils' achievements in grade 4 mathematics

Exhibit 2.3 shows how the participating countries performed in mathematics at grade 4 (year 5). Singapore, with a score of 594, again outperformed all other countries. England's score, 531, was significantly higher than the international average, 495, but did not differ significantly from the mean for the comparison group countries, 532. The lowest score was for Tunisia, 339.

Countries	Years of Schooling *	Average Age	Mathematics Achievement Distribution	Average Scale Score		Human Development Index**
Singapore	4	10.3		594 (5.6)	▲	0.884
† Hong Kong, SAR	4	10.2		575 (3.2)	▲	0.889
Japan	4	10.4		565 (1.6)	▲	0.932
Chinese Taipei	4	10.2		564 (1.8)	▲	–
Belgium (Flemish)	4	10.0		551 (1.8)	▲	0.937
† Netherlands	4	10.2		540 (2.1)	▲	0.938
Latvia	4	11.1		536 (2.8)	▲	0.811
Lithuania	4	10.9		534 (2.8)	▲	0.824
Comparison group				532		
Russian Federation	3 or 4	10.6		532 (4.7)	▲	0.779
† England	5	10.3		531 (3.7)	▲	0.930
Hungary	4	10.5		529 (3.1)	▲	0.837
† United States	4	10.2		518 (2.4)	▲	0.937
Cyprus	4	9.9		510 (2.4)	▲	0.891
Moldova, Rep. of	4	11.0		504 (4.9)		0.700
Italy	4	9.8		503 (3.7)	▲	0.916
† Australia	4 or 5	9.9		499 (3.9)		0.939
International Avg.	4	10.3		495 (0.8)		–
New Zealand	4.5 - 5.5	10.0		493 (2.2)		0.917
† Scotland	5	9.7		490 (3.3)		0.930
Slovenia	3 or 4	9.8		479 (2.6)	▼	0.881
Armenia	4	10.9		456 (3.5)	▼	0.729
ø Norway	4	9.8		451 (2.3)	▼	0.944
Iran, Islamic Rep. of	4	10.4		389 (4.2)	▼	0.719
Philippines	4	10.8		358 (7.9)	▼	0.751
Morocco	4	11.0		347 (5.1)	▼	0.606
Tunisia	4	10.4		339 (4.7)	▼	0.740
Benchmarking Participants						
Indiana State, US	4	9.5		533 (2.8)	▲	–
Ontario Province, Can	4	9.8		511 (3.8)	▲	–
Quebec Province, Can	4	10.1		506 (2.4)	▲	–





▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* Represents years of schooling counting from the first year of ISCED Level 1.

** Taken from United Nations Development Program's *Human Development Report 2003*, p. 237-240.

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

ø Norway: 4 years of formal schooling, but First Grade is called "First grade/Preschool."

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

Benchmarking Participants

A dash (–) indicates comparable data are not available.

Exhibit 2.4 illustrates the performance of England in relation to the comparison group countries and to those countries outperforming England or performing at a similar level. England scored higher than a range of English speaking countries including, the United States, Australia, New Zealand and Scotland.

Exhibit 2.4 England's overall performance in mathematics, grade 4

Countries outperforming England *Scores of 540 and above*	Singapore Hong Kong Japan *Chinese Taipei* Belgium Flemish Netherlands
Countries performing at the same level as England (No significant difference in performance) *Scores in the 529 to 536 range, England 531*	*Latvia* *Lithuania* *Russian Federation* Hungary
Countries performing at a lower level than England *Scores of 518 and below*	*All other countries*, including United States Italy Australia New Zealand Scotland

2.3 Pupils' achievements in grade 8 science

Exhibit 2.5 shows the performance of pupils in science at grade 8 (year 9), with pupils in England scoring a mean of 544 (compared with the international average of 474). (This score is that after reweighting, before reweighting the score was 550.) The scores achieved by the participating countries ranged from 578 for Singapore to 244 for South Africa. England, because of sampling difficulties is shown separately, but the point in the main list where England would have been is indicated. As for grade 4, the two horizontal dotted lines separate the countries outperforming England from those performing at a similar level to England and identify the boundary between this group and the group of countries scoring at a lower level than England.

Exhibit 2.5 shows that England's year 9 (grade 8) pupils were significantly outscored by those in only four countries (Singapore, Chinese Taipei, Korea and Hong Kong). England's mean score, 544, was significantly higher than both that for the comparison group countries, 533, and the international mean, 474 (see Exhibit 2.6). As in grade 4 science, England outperformed Australia, New Zealand and Scotland.

Exhibit 2.5	Distribution of Science Achievement	8th grade	TIMSS 2003 Science

Countries	Years of Schooling*	Average Age	Average Scale Score		Human Development Index**
Singapore	8	14.3	578 (4.3)	▲	0.884
Chinese Taipei	8	14.2	571 (3.5)	▲	–
¿ Korea, Rep. of	8	14.6	558 (1.6)	▲	0.879
† Hong Kong, SAR	8	14.4	556 (3.0)	▲	0.889
Estonia	8	15.2	552 (2.5)	▲	0.833
Japan	8	14.4	552 (1.7)	▲	0.932
¶ England				▲	
Hungary	8	14.5	543 (2.8)	▲	0.837
† Netherlands	8	14.3	536 (3.1)	▲	0.938
Comparison group			533		
‡ United States	8	14.2	527 (3.1)	▲	0.937
Australia	8 or 9	13.9	527 (3.8)	▲	0.939
Sweden	8	14.9	524 (2.7)	▲	0.941
Slovenia	7 or 8	13.8	520 (1.8)	▲	0.881
New Zealand	8.5 - 9.5	14.1	520 (5.0)	▲	0.917
Lithuania	8	14.9	519 (2.1)	▲	0.824
Slovak Republic	8	14.3	517 (3.2)	▲	0.836
Belgium (Flemish)	8	14.1	516 (2.5)	▲	0.937
Russian Federation	7 or 8	14.2	514 (3.7)	▲	0.779
Latvia	8	15.0	512 (2.6)	▲	0.811
† Scotland	9	13.7	512 (3.4)	▲	0.930
Malaysia	8	14.3	510 (3.7)	▲	0.790
Norway	7	13.8	494 (2.2)	▲	0.944
Italy	8	13.9	491 (3.1)	▲	0.916
Israel	8	14.0	488 (3.1)	▲	0.905
Bulgaria	8	14.9	479 (5.2)		0.795
Jordan	8	13.9	475 (3.8)		0.743
International Avg.	8	14.5	474 (0.6)		–
Moldova, Rep. of	8	14.9	472 (3.4)		0.700
Romania	8	15.0	470 (4.9)		0.773
Serbia	8	14.9	468 (2.5)	▼	–
Armenia	8	14.9	461 (3.5)	▼	0.729
Iran, Islamic Rep. of	8	14.4	453 (2.3)	▼	0.719
Macedonia, Rep. of	8	14.6	449 (3.6)	▼	0.784
Cyprus	8	13.8	441 (2.0)	▼	0.891
Bahrain	8	14.1	438 (1.8)	▼	0.839
Palestinian Nat'l Auth.	8	14.1	435 (3.2)	▼	0.731
Egypt	8	14.4	421 (3.9)	▼	0.648
Indonesia	8	14.5	420 (4.1)	▼	0.682
Chile	8	14.2	413 (2.9)	▼	0.831
Tunisia	8	14.8	404 (2.1)	▼	0.740
Saudi Arabia	8	14.1	398 (4.0)	▼	0.769
‡ Morocco	8	15.2	396 (2.5)	▼	0.606
Lebanon	8	14.6	393 (4.3)	▼	0.752
Philippines	8	14.8	377 (5.8)	▼	0.751
Botswana	8	15.1	365 (2.8)	▼	0.614
Ghana	8	15.5	255 (5.9)	▼	0.567
South Africa	8	15.1	244 (6.7)	▼	0.684
¶ England	9	14.3	544 (4.1)	▲	0.930
Benchmarking Participants					
Basque Country, Spain	8	14.1	489 (2.7)	▲	–
Indiana State, US	8	14.5	531 (4.8)	▲	–
Ontario Province, Can.	8	13.8	533 (2.7)	▲	–
Quebec Province, Can.	8	14.2	531 (3.0)	▲	–

Science Achievement Distribution: 0 100 200 300 400 500 600 700 800

Percentiles of Performance: 5th 25th 75th 95th

95% Confidence Interval for Average (±2SE)

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* Represents years of schooling counting from the first year of ISCED Level 1.

** Taken from United Nations Development Program's *Human Development Report 2003*, p. 237-240.

† Met guidelines for sample participation rates only after replacement schools were included.

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

¶ Did not satisfy guidelines for sample participation rates.

1 National Desired Population does not cover all of International Desired Population.

2 National Defined Population covers less than 90% of National Desired Population.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

Exhibit 2.6 England's overall performance in science, grade 8

Countries outperforming England *Scores of 556 and above*	Singapore *Chinese Taipei* *Korea* Hong Kong
Countries performing at the same level as England (No significant difference in performance) *Scores in the 536 to 552 range, England 544*	*Estonia* Japan Hungary Netherlands
Countries performing at a lower level than England *Scores of 527 and below*	*All other countries*, including United States Australia New Zealand Belgium (Flemish) Scotland Italy

2.4 Pupils' achievements in grade 8 mathematics

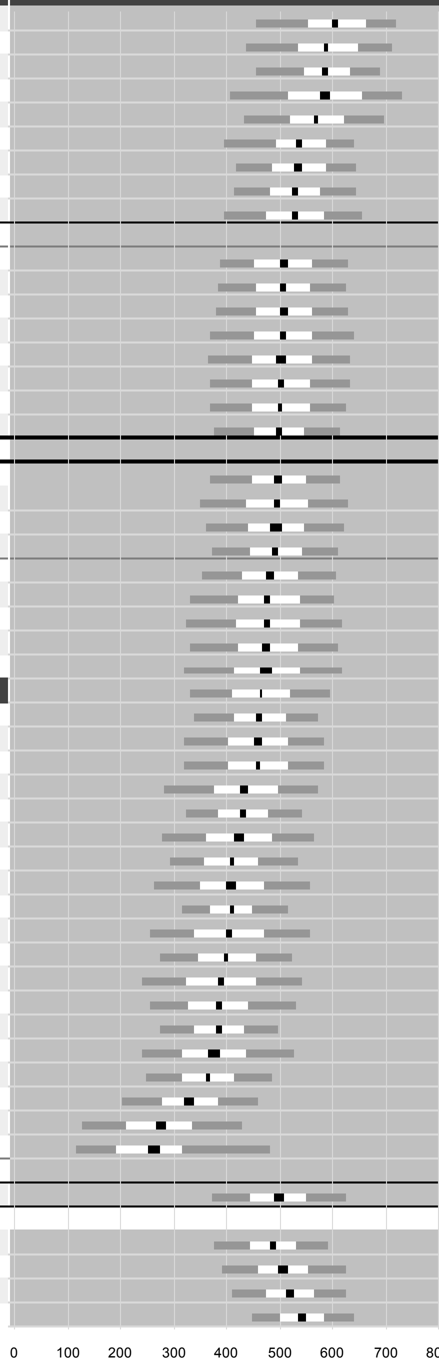
Exhibit 2.7 shows how the participating countries performed in mathematics at grade 8 (year 9). Scores ranged from 605, for Singapore to 264 for South Africa. England's score, 498, was significantly higher than the international average, 467, but significantly below the average for the comparison group countries, 529. (Before reweighting England's mathematics score was 505.)

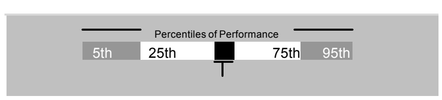
Exhibit 2.8 summarises performance in grade 8 mathematics. In this case a large group of countries performed at a similar level to England, including Australia, United States, Scotland and New Zealand from the comparison group.

Exhibit 2.7 Distribution of Mathematics Achievement

Countries	Years of Schooling*	Average Age	Average Scale Score		Human Development Index**
Singapore	8	14.3	605 (3.6)	▲	0.884
¿ Korea, Rep. of	8	14.6	589 (2.2)	▲	0.879
† Hong Kong, SAR	8	14.4	586 (3.3)	▲	0.889
Chinese Taipei	8	14.2	585 (4.6)	▲	–
Japan	8	14.4	570 (2.1)	▲	0.932
Belgium (Flemish)	8	14.1	537 (2.8)	▲	0.937
† Netherlands	8	14.3	536 (3.8)	▲	0.938
Estonia	8	15.2	531 (3.0)	▲	0.833
Hungary	8	14.5	529 (3.2)	▲	0.837
Comparison group			529		
Malaysia	8	14.3	508 (4.1)	▲	0.790
Latvia	8	15.0	508 (3.2)	▲	0.811
Russian Federation	7 or 8	14.2	508 (3.7)	▲	0.779
Slovak Republic	8	14.3	508 (3.3)	▲	0.836
Australia	8 or 9	13.9	505 (4.6)	▲	0.939
‡ United States	8	14.2	504 (3.3)	▲	0.937
Lithuania	8	14.9	502 (2.5)	▲	0.824
Sweden	8	14.9	499 (2.6)	▲	0.941
¶ England				▲	
† Scotland	9	13.7	498 (3.7)	▲	0.930
Israel	8	14.0	496 (3.4)	▲	0.905
New Zealand	8.5 - 9.5	14.1	494 (5.3)	▲	0.917
Slovenia	7 or 8	13.8	493 (2.2)	▲	0.881
Italy	8	13.9	484 (3.2)	▲	0.916
Armenia	8	14.9	478 (3.0)	▲	0.729
Serbia	8	14.9	477 (2.6)	▲	–
Bulgaria	8	14.9	476 (4.3)	▲	0.795
Romania	8	15.0	475 (4.8)		0.773
International Avg.	8	14.5	467 (0.5)		–
Norway	7	13.8	461 (2.5)	▼	0.944
Moldova, Rep. of	8	14.9	460 (4.0)		0.700
Cyprus	8	13.8	459 (1.7)	▼	0.891
Macedonia, Rep. of	8	14.6	435 (3.5)	▼	0.784
Lebanon	8	14.6	433 (3.1)	▼	0.752
Jordan	8	13.9	424 (4.1)	▼	0.743
Iran, Islamic Rep. of	8	14.4	411 (2.4)	▼	0.719
Indonesia	8	14.5	411 (4.8)	▼	0.682
Tunisia	8	14.8	410 (2.2)	▼	0.740
Egypt	8	14.4	406 (3.5)	▼	0.648
Bahrain	8	14.1	401 (1.7)	▼	0.839
Palestinian Nat'l Auth.	8	14.1	390 (3.1)	▼	0.731
Chile	8	14.2	387 (3.3)	▼	0.831
‡ Morocco	8	15.2	387 (2.5)	▼	0.606
Philippines	8	14.8	378 (5.2)	▼	0.751
Botswana	8	15.1	366 (2.6)	▼	0.614
Saudi Arabia	8	14.1	332 (4.6)	▼	0.769
Ghana	8	15.5	276 (4.7)	▼	0.567
South Africa	8	15.1	264 (5.5)	▼	0.684
¶ England	9	14.3	498 (4.7)	▲	0.930
Benchmarking Participants					
Basque Country, Spain	8	14.1	487 (2.7)	▲	–
Indiana State, US	8	14.5	508 (5.2)	▲	–
Ontario Province, Can	8	13.8	521 (3.1)	▲	–
Quebec Province, Can	8	14.2	543 (3.0)	▲	–

Mathematics Achievement Distribution





95% Confidence Interval for Average (±2SE)

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

* Represents years of schooling counting from the first year of ISCED Level 1.
** Taken from United Nations Development Program's *Human Development Report 2003*, p. 237-240.
† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.

Exhibit 2.8 England's overall performance in mathematics, grade 8

Countries outperforming England *Scores of 529 and above*	Singapore *Korea* Hong Kong *Chinese Taipei* Japan Belgium (Flemish) Netherlands *Estonia* Hungary
Countries performing at the same level as England (No significant difference in performance) *Scores in the 508 to 493 range, England 498*	*Malaysia* *Latvia* *Russian Federation* *Slovak Republic* Australia United States *Lithuania* *Sweden* Scotland *Israel* New Zealand *Slovenia*
Countries performing at a lower level than England *Scores of 484 and below*	*All other countries*, including Italy

2.5 Achievement in England compared with that of comparison group countries

Exhibit 2.9 summarises England's performance against that of the comparison group countries for mathematics and science at both grades.

Exhibit 2.9 Summary of England's performance against comparison group countries

Country	Science		Mathematics	
	Grade 4 Year 5	**Grade 8** Year 9	**Grade 4** Year 5	**Grade 8** Year 9
Italy	+	+	+	+
Australia	+	+	+	
Scotland	+	+	+	
New Zealand	+	+	+	
United States		+	+	
Belgium (Fl)	+	+		
Hungary	+			
Netherlands	+			
Japan				
Hong Kong				
Singapore				

\+ England has higher level of performance than Comparison Group Country

No significant difference in performance between England and Comparison Group Country

England has lower level of performance than Comparison Group Country

England's performance was strongest in grade 4 science, where only Singapore scored significantly higher, and weakest in grade 8 mathematics, where England outperformed only Italy of the comparison group. In general, science performance was better, compared with the comparison group, than mathematics performance. It should be noted that even in the weakest area, grade 8 mathematics, England's performance was at a similar level to that in four comparison group countries, Australia, Scotland, New Zealand and the USA.

Comparing England's performance with the other comparison group countries, this was strongest against Italy, outscored by England in all four assessments. It was also strong against Australia, Scotland and New Zealand, outperformed by

England in science at both grades and in grade 4 mathematics but with similar performance in grade 8 mathematics. England outperformed the United States in two of the assessments and performed at a similar level in the other two. Performance was more mixed against the remaining countries, particularly those from the Pacific rim. It should be noted that Singapore outperformed every other country in both subjects at both grades except for Chinese Taipei in grade 8 science.

3 Trends in performance over time

The 2003 TIMSS study provides two complementary measures of change in performance over time. For the younger students, grade 4 (England's year 5) the change in performance is measured from 1995, since this cohort was not tested in the 1999 TIMSS survey. For grade 8 (England's year 9) there are two measures of change which may be reported, change from 1995 to 2003 and change from 1999 to 2003. In all cases the changes have been calculated using the items in common with previous survey(s) to perform Item Response Theory scaling to put the scores in the various surveys on the same scale.

Changes from 1995 to 1999 in grade 8 were reported on as part of the 1999 survey report. There were none in England. As before, grade 4 is discussed first beginning with science.

3.1 Trends in grade 4 science performance

England's performance in science increased significantly (in the statistical sense) from 1995 to 2003. The 2003 score, 540, was significantly higher than the 1995 score, 528. Exhibit 3.1 shows the performance in 1995 and 2003 of all 15 countries participating in grade 4 on both occasions.

Of these 15 countries, nine increased their performance, three showed no change and three showed a decline in performance. Ten of the countries are from the comparison group, and of these, five showed an increase in score while two showed a decline. The average change for the comparison group was a rise of 9.5 scale points, smaller than the 13 point increase in England. Two of the largest increases were made by comparison group countries, Singapore (42) and Hong Kong (35). Norway showed the largest decline, 38 scale points. The largest changes in grade 4 science were over one third of a standard deviation.

3.2 Trends in grade 4 mathematics performance

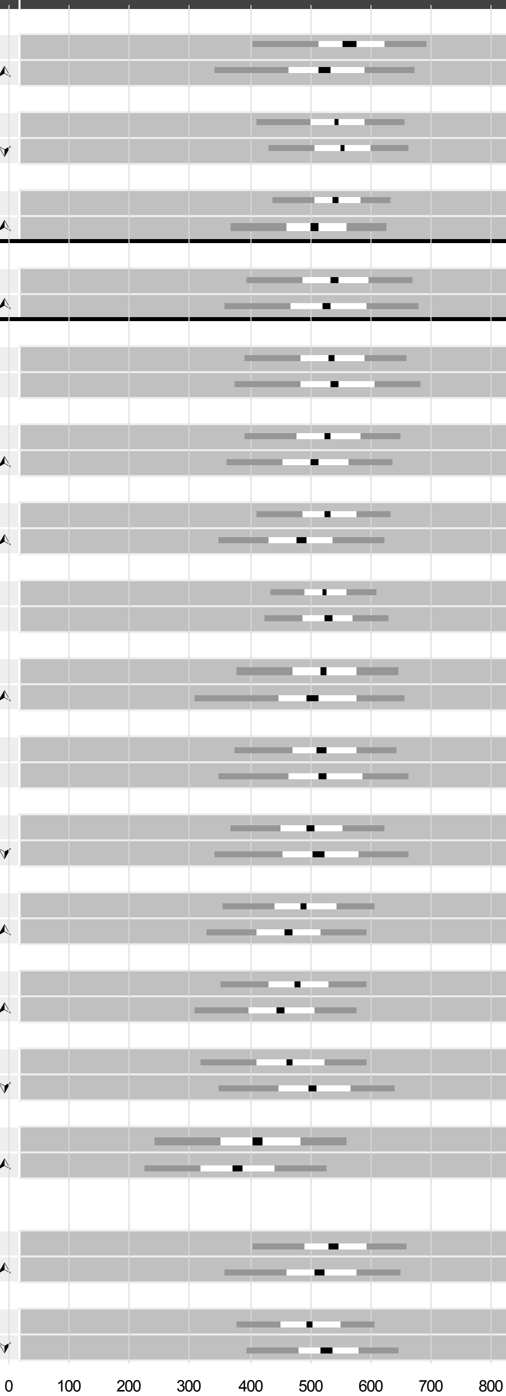
In mathematics at grade 4, as in science, England's score increased significantly from 1995 to 2003, from 484 to 531. This increase, 47 scale points, was the largest of any achieved in grade 4 mathematics, the next largest being in the mid 30s, for Cyprus and Latvia. Another way of looking at this increase is that it is almost half a standard deviation. Exhibit 3.2 gives details of mathematics performance for all 15 countries with relevant data.

Exhibit 3.1 Trends in Science Achievement

4th grade Science — TIMSS 2003

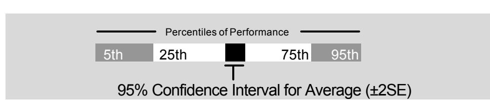
Countries		Average Scale Score	1995 to 2003 Difference		Average Age
Singapore					
	2003	565 (5.5)			10.3
	1995	523 (4.8)	42 (7.3)	▲	10.3
Japan					
	2003	543 (1.5)			10.4
	1995	553 (1.8)	-10 (2.3)	▼	10.4
Hong Kong, SAR					
	2003	542 (3.1)			10.2
	1995	508 (3.3)	35 (4.5)	▲	10.1
England					
	2003	540 (3.6)			10.3
	1995	528 (3.1)	13 (4.8)	▲	10.0
United States					
	2003	536 (2.5)			10.2
	1995	542 (3.3)	-6 (4.2)		10.2
Hungary					
	2003	530 (3.0)			10.5
	1995	508 (3.4)	22 (4.4)	▲	10.4
Latvia (LSS)					
	2003	530 (2.8)			11.1
	1995	486 (4.9)	43 (5.6)	▲	10.5
Netherlands					
	2003	525 (2.0)			10.2
	1995	530 (3.2)	-5 (3.5)		10.3
New Zealand					
	2003	523 (2.3)			10.0
	1995	505 (5.3)	18 (5.8)	▲	10.0
Australia					
	2003	521 (4.2)			9.9
	1995	521 (3.8)	-1 (5.6)		9.9
Scotland					
	2003	502 (2.9)			9.7
	1995	514 (4.5)	-12 (5.3)	▼	9.7
Slovenia					
	2003	490 (2.5)			9.8
	1995	464 (3.1)	26 (4.0)	▲	9.9
Cyprus					
	2003	480 (2.4)			9.9
	1995	450 (3.2)	30 (3.9)	▲	9.8
Norway					
	2003	466 (2.6)			9.8
	1995	504 (3.7)	-38 (4.6)	▼	9.9
Iran, Islamic Rep. of					
	2003	414 (4.1)			10.4
	1995	380 (4.6)	34 (6.1)	▲	10.5
Benchmarking Participants					
Ontario Province, Can.					
	2003	540 (3.7)			9.8
	1995	516 (3.7)	24 (5.3)	▲	9.9
Quebec Province, Can.					
	2003	500 (2.5)			10.1
	1995	529 (4.8)	-28 (5.4)	▼	10.3

Science Achievement Distribution



▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year



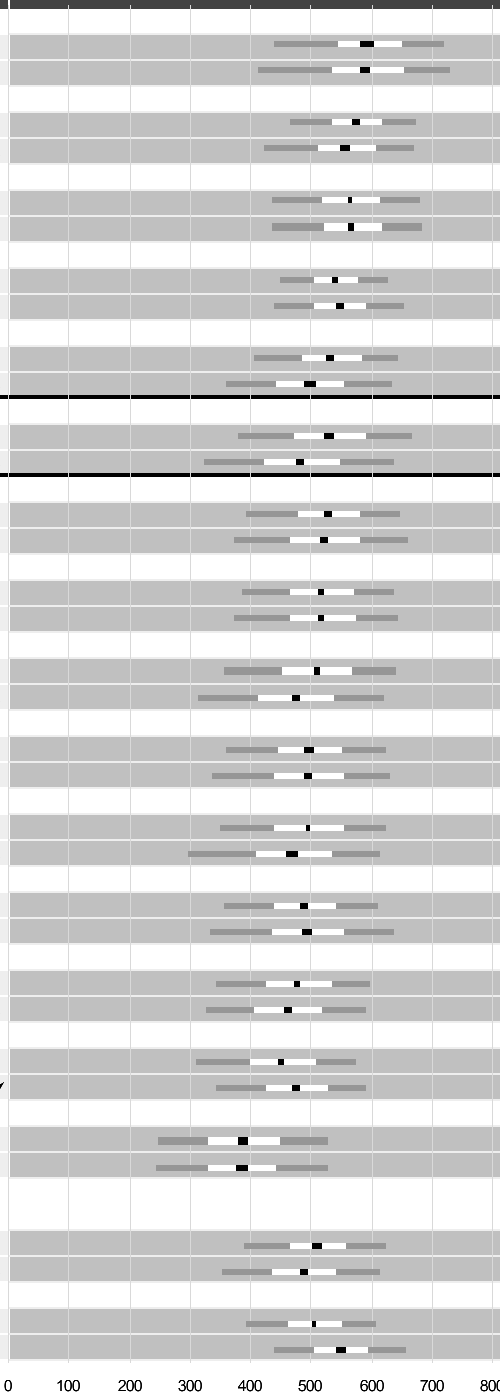
SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries		Average Scale Score	1995 to 2003 Difference	Average Age
Singapore				
	2003	594 (5.6)		10.3
	1995	590 (4.5)	4 (7.2)	10.3
Hong Kong, SAR				
	2003	575 (3.2)		10.2
	1995	557 (4.0)	18 (5.0) ▲	10.1
Japan				
	2003	565 (1.6)		10.4
	1995	567 (1.9)	-3 (2.5)	10.4
Netherlands				
	2003	540 (2.1)		10.2
	1995	549 (3.0)	-9 (3.7) ▼	10.3
Latvia (LSS)				
	2003	533 (3.1)		11.1
	1995	499 (4.6)	34 (5.5) ▲	10.5
England				
	2003	531 (3.7)		10.3
	1995	484 (3.3)	47 (5.0) ▲	10.0
Hungary				
	2003	529 (3.1)		10.5
	1995	521 (3.6)	7 (4.8)	10.4
United States				
	2003	518 (2.4)		10.2
	1995	518 (2.9)	0 (3.8)	10.2
Cyprus				
	2003	510 (2.4)		9.9
	1995	475 (3.2)	35 (4.1) ▲	9.8
Australia				
	2003	499 (3.9)		9.9
	1995	495 (3.4)	4 (5.2)	9.9
New Zealand				
	2003	496 (2.1)		10.0
	1995	469 (4.4)	26 (4.9) ▲	10.0
Scotland				
	2003	490 (3.3)		9.7
	1995	493 (4.2)	-3 (5.3)	9.7
Slovenia				
	2003	479 (2.6)		9.8
	1995	462 (3.1)	17 (4.1) ▲	9.9
Norway				
	2003	451 (2.3)		9.8
	1995	476 (3.0)	-25 (3.7) ▼	9.9
Iran, Islamic Rep. of				
	2003	389 (4.2)		10.4
	1995	387 (5.0)	2 (6.5)	10.5
Benchmarking Participants				
Ontario Province, Can.				
	2003	511 (3.8)		9.8
	1995	489 (3.5)	23 (5.2) ▲	9.9
Quebec Province, Can.				
	2003	506 (2.4)		10.1
	1995	550 (4.2)	-44 (4.8) ▼	10.3

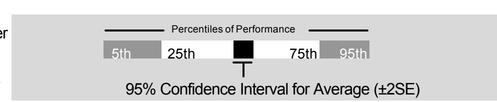
Mathematics Achievement Distribution



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year



Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

In six countries scores increased over the period, there was no significant change in seven countries, while in two countries scores declined. Three of the comparison group countries England, Hong Kong and New Zealand showed an increase in score while the Netherlands showed a decline. The average change for the comparison group countries was a rise of 9.4 scale points, very similar to that for grade 4 science. The largest decline was again in Norway, 25 scale points.

3.3 Trends in grade 8 science performance

Using the reweighted data, in science at grade 8, there was no significant difference between England's score in 2003, 544, and those in 1999 and 1995, 538 and 533 respectively. Exhibit 3.3 shows the patterns of performance over time for all 35 countries with trend data.

Of the 12 comparison group countries, England was one of seven to show no trend in performance over time. Australia, Hong Kong and the United States showed improvements, while Hungary and Belgium (Flemish) showed declines. Average scale scores for the comparison group rose by nearly eight points from 1995 to 2003 but by less than three points from 1999 to 2003, a pattern not dissimilar to that in England.

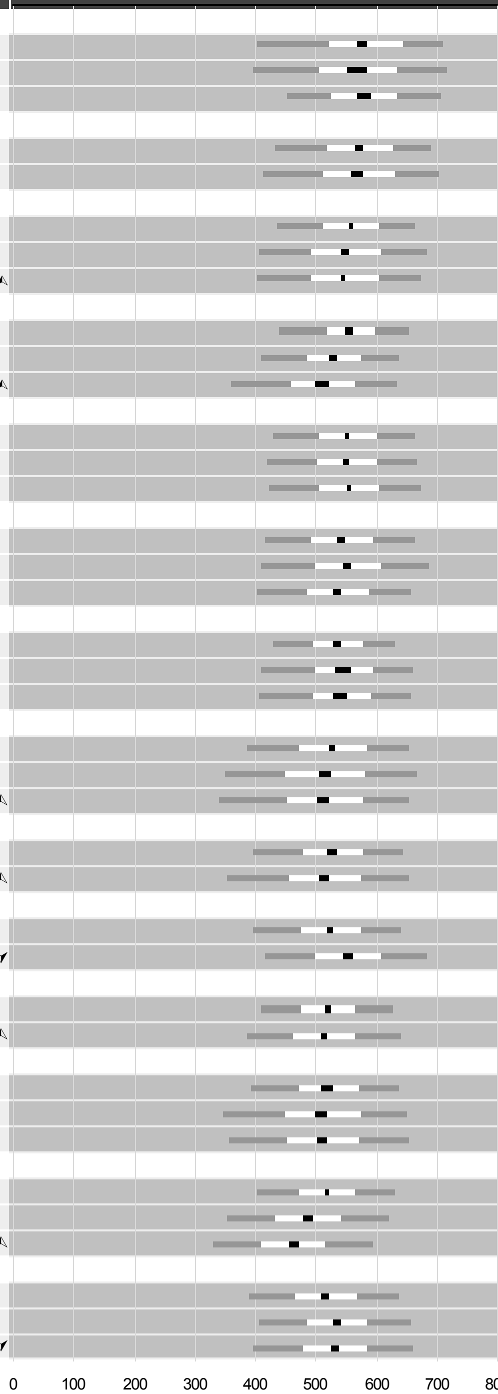
Of all the 35 countries 12 showed no change from either 1995 or 1999 to 2003. A similar number of countries showed an increase in one or both time periods while 11 countries showed a decline. The pattern of change in grade 8 science was more varied than in grade 4 where the most common pattern was an increase.

3.4 Trends in grade 8 mathematics performance

In grade 8 mathematics, as in science, England's score showed no significant change when the reweighted 2003 score, 498, was compared with those for 1999 and 1995, 496 and 498 respectively. The 12 comparison countries as a group also showed little change over time, their average score dropping by two scale points from 1999 to 2003 and being very similar in 1995 and 2003. As in grade 8 science, England's pattern of change scores show a strong resemblance to the average for the comparison group. Eight of the comparison group countries showed no trend in performance to 2003 from either of the earlier surveys. Japan and Belgium showed declines in performance while Hong Kong and the United States showed increases from their 1995 score levels.

Countries	Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Singapore				
2003	578 (4.3)			14.3
1999	568 (8.0)	10 (9.1)		14.4
1995	580 (5.5)		-3 (7.0)	14.5
Chinese Taipei				
2003	571 (3.5)			14.2
1999	569 (4.4)	2 (5.5)		14.2
Korea, Rep. of				
2003	558 (1.6)			14.6
1999	549 (2.6)	10 (3.1) ▲		14.4
1995	546 (2.0)		13 (2.6) ▲	14.2
Hong Kong, SAR				
2003	556 (3.0)			14.4
1999	530 (3.7)	27 (4.8) ▲		14.2
1995	510 (5.8)		46 (6.6) ▲	14.2
Japan				
2003	552 (1.7)			14.4
1999	550 (2.2)	3 (2.8)		14.4
1995	554 (1.8)		-2 (2.5)	14.4
Hungary				
2003	543 (2.8)			14.5
1999	552 (3.7)	-10 (4.7) ▼		14.4
1995	537 (3.1)		6 (4.2)	14.3
Netherlands				
2003	536 (3.1)			14.3
1999	545 (6.9)	-9 (7.6)		14.2
1995	541 (6.0)		-6 (6.8)	14.4
United States				
2003	527 (3.1)			14.2
1999	515 (4.6)	12 (5.6) ▲		14.2
1995	513 (5.6)		15 (6.4) ▲	14.2
Australia				
2003	527 (3.8)			13.9
1995	514 (3.9)		13 (5.5) ▲	13.9
Sweden				
2003	524 (2.7)			14.9
1995	553 (4.4)		-28 (5.2) ▼	14.9
Slovenia				
2003	520 (1.8)			13.8
1995	514 (2.7)		7 (3.3) ▲	13.8
New Zealand				
2003	520 (5.0)			14.1
1999	510 (4.9)	10 (7.0)		14.0
1995	511 (4.9)		9 (7.0)	14.0
Lithuania				
2003	519 (2.1)			14.9
1999	488 (4.1)	31 (4.6) ▲		15.2
1995	464 (4.0)		56 (4.6) ▲	14.3
Slovak Republic				
2003	517 (3.2)			14.3
1999	535 (3.3)	-18 (4.6) ▼		14.3
1995	532 (3.3)		-15 (4.7) ▼	14.3

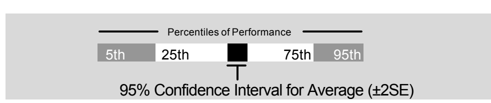
Science Achievement Distribution



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year



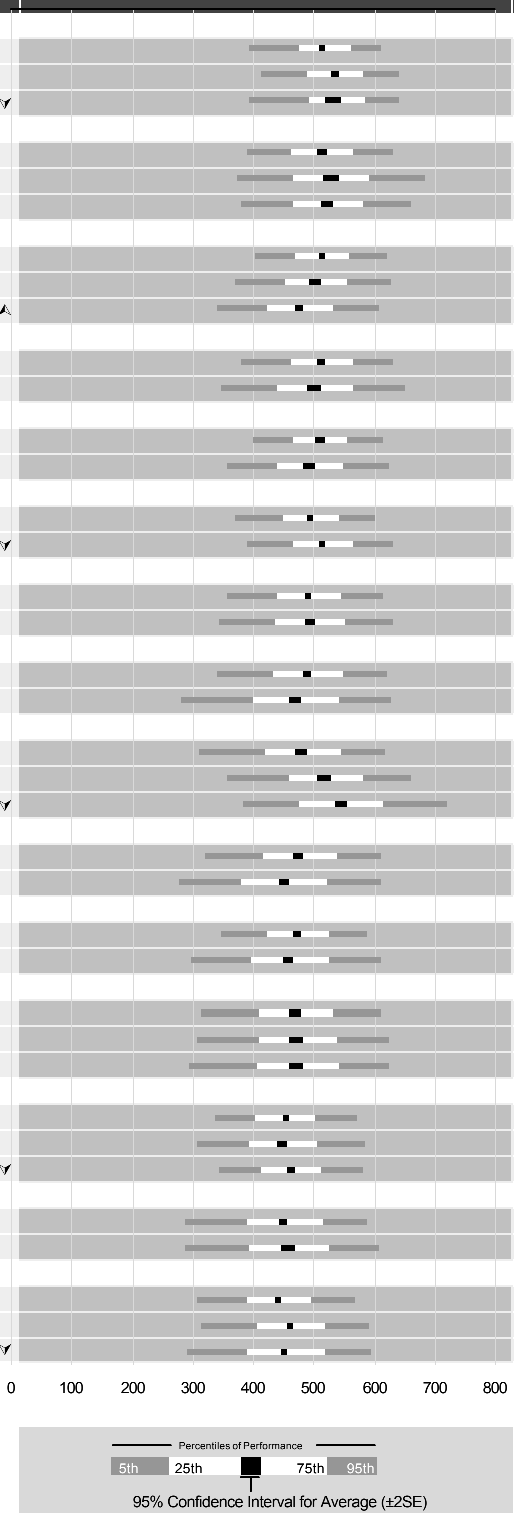
Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 3.3 | Trends in Science Achievement | 8th grade Science | TIMSS 2003

Countries	Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Belgium (Flemish)				
2003	516 (2.5)			14.1
1999	535 (3.1)	-19 (3.9) ▼		14.1
1995	533 (6.4)		-17 (6.8) ▼	14.1
Russian Federation				
2003	514 (3.7)			14.2
1999	529 (6.4)	-16 (7.2) ▼		14.1
1995	523 (4.5)		-9 (5.8)	14.0
Latvia (LSS)				
2003	513 (2.9)			15.1
1999	503 (4.8)	11 (5.5)		14.5
1995	476 (3.3)		37 (4.4) ▲	14.3
Scotland				
2003	512 (3.4)			13.7
1995	501 (5.6)		10 (6.6)	13.7
Malaysia				
2003	510 (3.7)			14.3
1999	492 (4.4)	18 (5.8) ▲		14.4
Norway				
2003	494 (2.2)			13.8
1995	514 (2.4)		-21 (3.3) ▼	13.9
Italy				
2003	491 (3.1)			13.9
1999	493 (3.9)	-2 (5.1)		14.0
Israel				
2003	488 (3.1)			14.0
1999	468 (4.9)	20 (5.7) ▲		14.1
Bulgaria				
2003	479 (5.2)			14.9
1999	518 (5.4)	-39 (7.5) ▼		14.8
1995	545 (5.2)		-66 (7.3) ▼	14.0
Jordan				
2003	475 (3.8)			13.9
1999	450 (3.8)	25 (5.5) ▲		14.0
Moldova, Rep. of				
2003	472 (3.4)			14.9
1999	459 (4.0)	13 (5.1) ▲		14.4
Romania				
2003	470 (4.9)			15.0
1999	472 (5.8)	-2 (7.4)		14.8
1995	471 (5.1)		-1 (7.1)	14.6
Iran, Islamic Rep. of				
2003	453 (2.3)			14.4
1999	448 (3.8)	5 (4.4)		14.6
1995	463 (3.6)		-9 (4.2) ▼	14.6
Macedonia, Rep. of				
2003	449 (3.6)			14.6
1999	458 (5.2)	-9 (6.3)		14.6
Cyprus				
2003	441 (2.0)			13.8
1999	460 (2.4)	-19 (3.4) ▼		13.8
1995	452 (2.1)		-11 (3.0) ▼	13.7

Science Achievement Distribution



▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

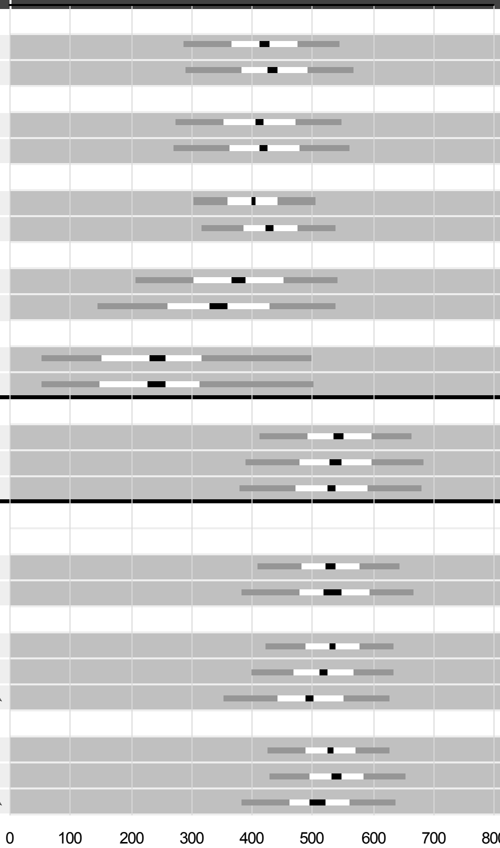
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 3.3 Trends in Science Achievement

8th grade Science — TIMSS 2003

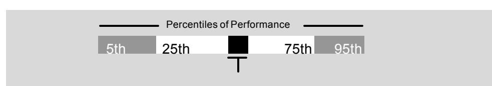
Countries	Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Indonesia				
2003	420 (4.1)			14.5
1999	435 (4.5)	-15 (6.1) ▼		14.6
Chile				
2003	413 (2.9)			14.2
1999	420 (3.7)	-8 (4.7)		14.4
Tunisia				
2003	404 (2.1)			14.8
1999	430 (3.4)	-26 (3.7) ▼		14.8
Philippines				
2003	377 (5.8)			14.8
1999	345 (7.5)	32 (9.7) ▲		14.1
South Africa				
2003	244 (6.7)			15.1
1999	243 (7.8)	1 (10.2)		15.5
¶ England				
2003	544 (4.1)			14.3
1999	538 (4.8)	5 (6.4)		14.2
1995	533 (3.6)		11 (5.5)	14.0
Benchmarking Participants				
Indiana State, US				
2003	531 (4.8)			14.5
1999	534 (7.0)	-4 (8.5)		14.4
Ontario Province, Can.				
2003	533 (2.7)			13.8
1999	518 (3.1)	15 (4.1) ▲		13.9
1995	496 (3.7)		37 (4.6) ▲	14.0
Quebec Province, Can.				
2003	531 (3.0)			14.2
1999	540 (4.8)	-9 (5.7)		14.3
1995	510 (6.9)		21 (7.5) ▲	14.5

Science Achievement Distribution



▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year



95% Confidence Interval for Average (±2SE)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

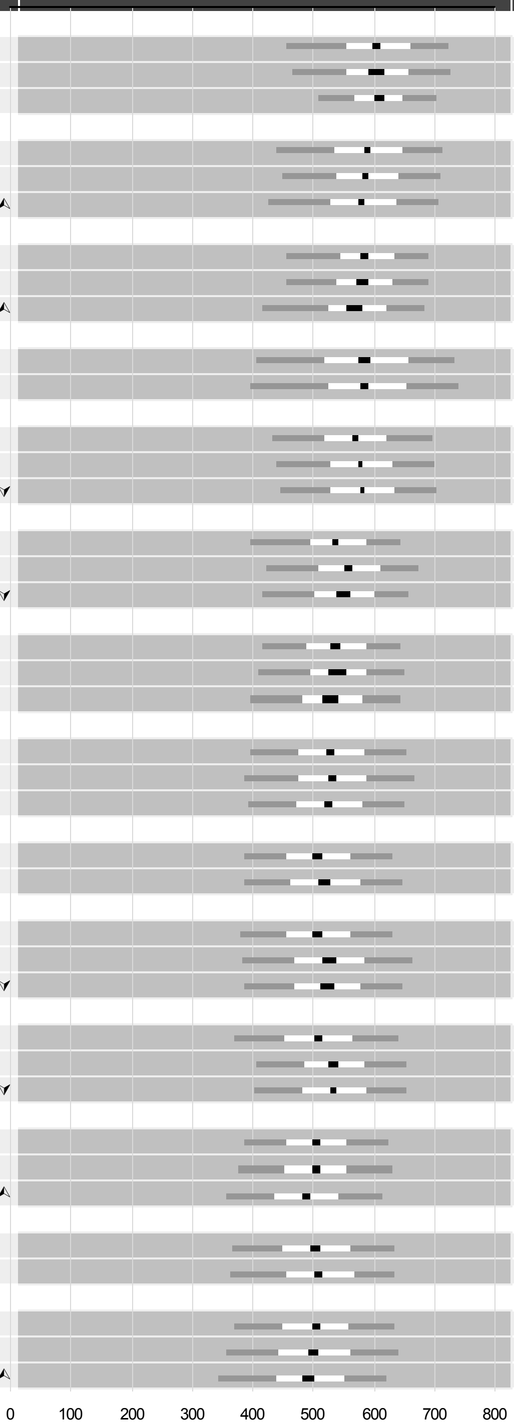
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 3.4 Trends in Mathematics Achievement

8th grade — TIMSS 2003 — Mathematics

Countries	Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Singapore				
2003	605 (3.6)			14.3
1999	604 (6.3)	1 (7.2)		14.4
1995	609 (4.0)		-3 (5.4)	14.5
Korea, Rep. of				
2003	589 (2.2)			14.6
1999	587 (2.0)	2 (2.9)		14.4
1995	581 (2.0)		8 (3.0) ▲	14.2
Hong Kong, SAR				
2003	586 (3.3)			14.4
1999	582 (4.3)	4 (5.4)		14.2
1995	569 (6.1)		17 (7.0) ▲	14.2
Chinese Taipei				
2003	585 (4.6)			14.2
1999	585 (4.0)	0 (6.0)		14.2
Japan				
2003	570 (2.1)			14.4
1999	579 (1.7)	-9 (2.6) ▼		14.4
1995	581 (1.6)		-11 (2.6) ▼	14.4
Belgium (Flemish)				
2003	537 (2.8)			14.1
1999	558 (3.3)	-21 (4.1) ▼		14.1
1995	550 (5.9)		-13 (6.5) ▼	14.1
Netherlands				
2003	536 (3.8)			14.3
1999	540 (7.1)	-4 (8.1)		14.2
1995	529 (6.1)		7 (7.3)	14.4
Hungary				
2003	529 (3.2)			14.5
1999	532 (3.7)	-2 (4.9)		14.4
1995	527 (3.2)		3 (4.5)	14.3
Malaysia				
2003	508 (4.1)			14.3
1999	519 (4.4)	-11 (6.0)		14.4
Russian Federation				
2003	508 (3.7)			14.2
1999	526 (5.9)	-18 (7.1) ▼		14.1
1995	524 (5.3)		-16 (6.5) ▼	14.0
Slovak Republic				
2003	508 (3.3)			14.3
1999	534 (4.0)	-26 (5.1) ▼		14.3
1995	534 (3.1)		-26 (4.4) ▼	14.3
Latvia (LSS)				
2003	505 (3.8)			15.1
1999	505 (3.4)	0 (5.1)		14.5
1995	488 (3.6)		17 (5.2) ▲	14.3
Australia				
2003	505 (4.6)			13.9
1995	509 (3.7)		-4 (6.0)	13.9
United States				
2003	504 (3.3)			14.2
1999	502 (4.0)	3 (5.2)		14.2
1995	492 (4.7)		12 (5.8) ▲	14.2

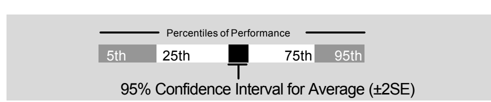
Mathematics Achievement Distribution



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year

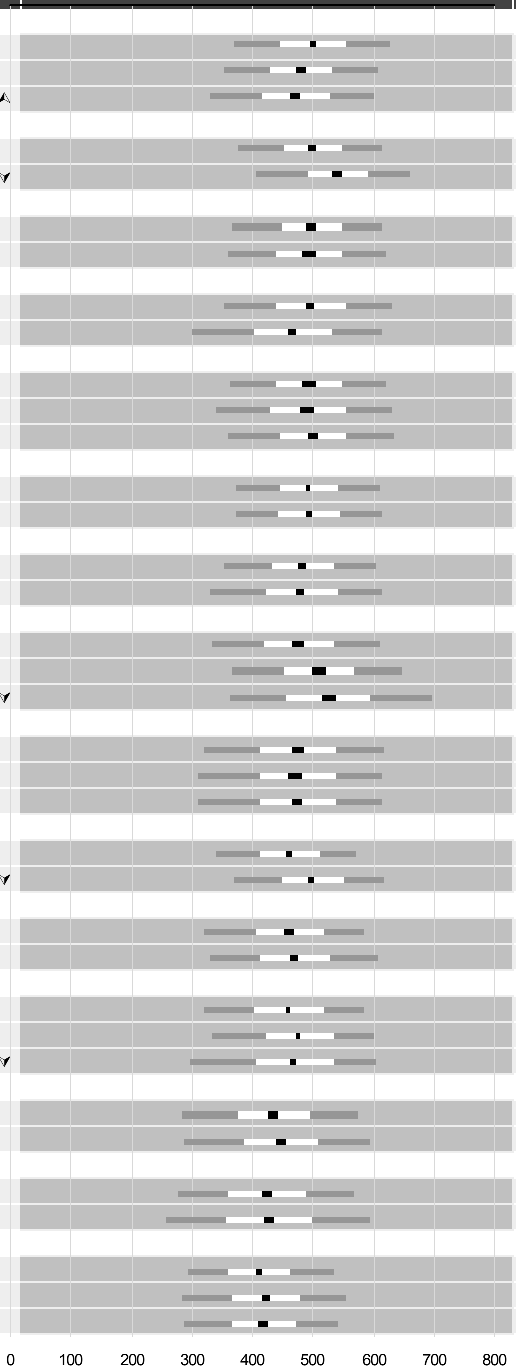


Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003
than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Lithuania				
2003	502 (2.5)			14.9
1999	482 (4.3)	20 (5.0) ▲		15.2
1995	472 (4.1)		30 (4.8) ▲	14.3
Sweden				
2003	499 (2.6)			14.9
1995	540 (4.3)		-41 (5.0) ▼	14.9
Scotland				
2003	498 (3.7)			13.7
1995	493 (5.7)		4 (6.7)	13.7
Israel				
2003	496 (3.4)			14.0
1999	466 (3.9)	29 (5.2) ▲		14.1
New Zealand				
2003	494 (5.3)			14.1
1999	491 (5.2)	3 (7.4)		14.0
1995	501 (4.7)		-7 (7.1)	14.0
Slovenia				
2003	493 (2.2)			13.8
1995	494 (2.9)		-2 (3.7)	13.8
Italy				
2003	484 (3.2)			13.9
1999	479 (3.8)	4 (4.9)		14.0
Bulgaria				
2003	476 (4.3)			14.9
1999	511 (5.8)	-34 (7.3) ▼		14.8
1995	527 (5.8)		-51 (7.2) ▼	14.0
Romania				
2003	475 (4.8)			15.0
1999	472 (5.8)	3 (7.5)		14.8
1995	474 (4.6)		2 (6.6)	14.6
Norway				
2003	461 (2.5)			13.8
1995	498 (2.2)		-37 (3.3) ▼	13.9
Moldova, Rep. of				
2003	460 (4.0)			14.9
1999	469 (3.9)	-9 (5.5)		14.4
Cyprus				
2003	459 (1.7)			13.8
1999	476 (1.8)	-17 (2.4) ▼		13.8
1995	468 (2.2)		-8 (3.0) ▼	13.7
Macedonia, Rep. of				
2003	435 (3.5)			14.6
1999	447 (4.2)	-12 (5.5) ▼		14.6
Jordan				
2003	424 (4.1)			13.9
1999	428 (3.6)	-3 (5.5)		14.0
Iran, Islamic Rep. of				
2003	411 (2.4)			14.4
1999	422 (3.4)	-11 (4.2) ▼		14.6
1995	418 (3.9)		-7 (4.5)	14.6

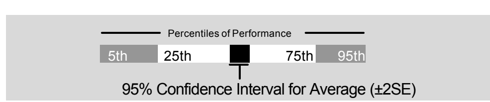
Mathematics Achievement Distribution



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year

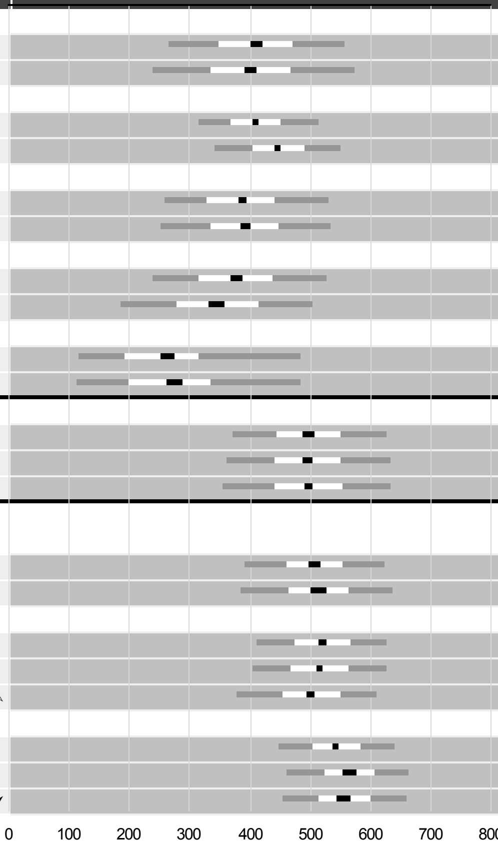


Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003
than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries		Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	Average Age
Indonesia					
	2003	411 (4.8)			14.5
	1999	403 (4.9)	8 (6.8)		14.6
Tunisia					
	2003	410 (2.2)			14.8
	1999	448 (2.4)	-38 (3.4) ▼		14.8
Chile					
	2003	387 (3.3)			14.2
	1999	392 (4.4)	-6 (5.2)		14.4
Philippines					
	2003	378 (5.2)			14.8
	1999	345 (6.0)	33 (7.8) ▲		14.1
South Africa					
	2003	264 (5.5)			15.1
	1999	275 (6.8)	-11 (8.4)		15.5
¶ England					
	2003	498 (4.7)			14.3
	1999	496 (4.1)	2 (6.2)		14.2
	1995	498 (3.0)		1 (5.6)	14.0
Benchmarking Participants					
Indiana State, US					
	2003	508 (5.2)			14.5
	1999	515 (7.2)	-6 (8.9)		14.4
Ontario Province, Can.					
	2003	521 (3.1)			13.8
	1999	517 (3.0)	4 (4.3)		13.9
	1995	501 (2.9)		20 (4.3) ▲	14.0
Quebec Province, Can.					
	2003	543 (3.0)			14.2
	1999	566 (5.3)	-23 (6.1) ▼		14.3
	1995	556 (5.9)		-13 (6.6) ▼	14.5

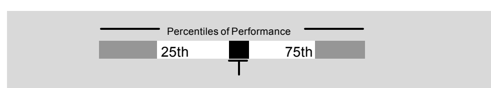
Mathematics Achievement Distribution



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 country average significantly higher than previous assessment year

▼ 2003 country average significantly lower than previous assessment year



95% Confidence Interval for Average (±2SE)

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003
than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

No change was the most common pattern in the 35 trend countries, applying to roughly half of them (17). Seven countries showed an increase from 1995 and/or 1999 to 2003, while 11 showed a decline. As in science, this pattern of change contrasts with grade 4 mathematics, where only 2 of the 15 countries exhibited a significant decline in score.

3.5 Trends in performance in England compared with the comparison group countries

When compared with all the countries participating in TIMSS 2003, England conformed to the most common pattern of change, increases in performance in grade 4 science and mathematics compared with 1995 levels, and no change in grade 8 performance in either subject. There were however a range of patterns of change in performance in both developed and developing countries.

To illustrate how these changes in performance at grade 4 have affected England's standing relative to the comparison group countries at grade 4, Exhibit 3.5 shows how England's performance in science has changed against that of comparison group countries. England's performance in grade 4 science improved over this time period and the exhibit indicates whether performance in the comparison group country also changed.

Exhibit 3.5 Summary of England's performance against comparison group countries over time – grade 4 science

	1995	**2003**	**Relative to other country, England's Performance:**	**Other Country's Performance 1995 to 2003**
Japan			Improved	▼
United States			Improved	No change
Netherlands		+	Improved	No change
Australia		+	Improved	No change
Scotland		+	Improved	▼
Hungary	+	+		▲
New Zealand	+	+		▲
Hong Kong	+		Declined	▲
Singapore			Declined	▲

+	England has higher level of performance than Comparison Group Country
(empty box)	No Significant Difference Between England and Comparison Group Country
(dark grey box)	England has lower level of performance than Comparison Group Country

England's performance improved against five of the comparison group countries, two of which, Japan and Scotland had lower scores in 2003 than in 1995. In spite of England's improved performance, ground was lost against both Singapore and Hong Kong, countries with larger increases in score than England over this period.

Exhibit 3.6 gives similar information for grade 4 mathematics over time.

Exhibit 3.6 Summary of England's performance against comparison group countries over time – grade 4 mathematics

	1995	2003	Relative to other country, England's Performance	Other Country's Performance 1995 to 2003
Hong Kong				▲
Singapore				No change
Japan				No change
Netherlands				▼
Hungary			Improved	No change
United States		+	Improved	No change
Australia		+	Improved	No change
Scotland		+	Improved	No change
New Zealand		+	Improved	▲

Key as for Exhibit 3.5, above

England's improvement in grade 4 mathematics score, larger than that in science, produced an improvement in standing against five comparison group countries and no change against the other four, which on both occasions outscored England. In both mathematics and science at grade 4, England's performance improved from 1995 to 2003 against that of the United States, Scotland and Australia.

Since England's performance at grade 8 did not change from 1995 or 1999 to 2003 in either subject, similar tables are not shown for grade 8. At grade 8 level, changes in relative standings are explained either by changes in performance in the comparison group country and/or by statistically non-significant changes in opposite directions being involved. As has already been discussed, the patterns of change in England's score from the earlier surveys to 2003 were similar to the changes in the average scores for the 12 comparison group countries.

3.6 Trends in performance at grade 4 on common items

The trends found in grade 4 science and mathematics have also been evaluated by looking at England's performance on the items in common between the 1995 and 2003 surveys. Exhibit 3.7 summarises performance on the two occasions.

Exhibit 3.7 Summary of England's Performance on grade 4 Common Items, 1995 and 2003

Grade 4	Number of common items	Average Success rate in 1995	Average Success rate in 2003	Increase in Performance
Science	32	76.0%	79.8%	3.8%
Mathematics	37	62.8%	72.2%	9.4%

As would be expected from the analyses already reported, the increase in success rates in mathematics was higher than in science, over 9 per cent compared with just under 4 per cent. Within mathematics the items assessing Number were examined separately. There were 19 such items, almost half the total. Success rates for Number rose from 59.4 per cent to 70.7 per cent, an increase of 11.4 per cent, higher than for mathematics items as a whole.

In science six items showed a small decline in success rate while 26 showed an increase. The increases ranged from less than 1 per cent to just over 17 per cent, but only two increases were greater than 10 per cent. Two science items showing reasonably typical increases in performance are shown below.

In mathematics only four items showed a decline in success rate, usually small, while the largest increase was nearly 23 per cent. The first of the two items shown below has a typical increase in performance, around 10 per cent.

The second item gives an example of an item with a large increase in success rate.

S011033

What will be most likely to affect your adult height?

Ⓐ The height of your parents

Ⓑ The height of your brothers and sisters

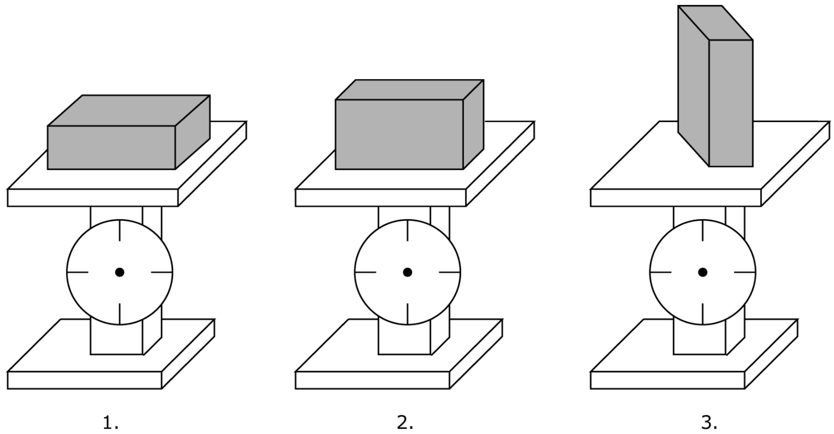
Ⓒ Your hair colour

Ⓓ Your weight

Success rates: 1995 45 per cent 2003 49 per cent

S011009

The same brick is put on a scale in three different ways.



What will the scale show?

Ⓐ 1 will show the greatest weight.

Ⓑ 2 will show the greatest weight.

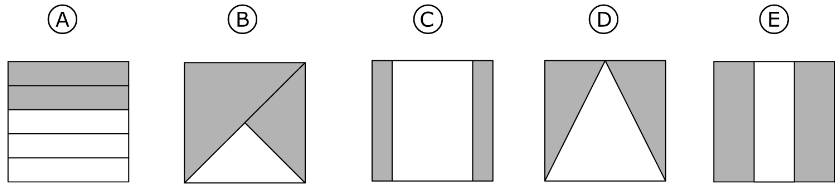
Ⓒ 3 will show the greatest weight.

Ⓓ All will show the same weight.

Success rates: 1995 72 per cent 2003 76 per cent

M012044

Which shows $\frac{2}{3}$ of the square shaded?



Success rates: 1995 47 per cent 2003 58 per cent

M011018

Which figure is in the hundreds place in 2345 ?

- Ⓐ 2
- Ⓑ 3
- Ⓒ 4
- Ⓓ 5

Success rates: 1995 68 per cent 2003 87 per cent

The previous item, on place value, showed a large increase. Other items to do so included identifying a number which rounds to 600 (62 per cent to 84 per cent), identifying a decimal equivalent to 7/10 (25 per cent to 46 per cent) and identifying the sum of 2.5 and 3.8 (51 per cent to 73 per cent).

Since the grade 8 data for England did not show any significant changes in performance over time, similar analyses of performance on common items are not presented in this report.

3.7 Trends shown by TIMSS in England

The analyses reported here show that there was no significant change in performance at grade 8 in either science or mathematics. At grade 4 there were significant increases in performance in both subjects. In mathematics the increase was 47 scale points and in science 13 scale points. When the items common to the surveys were examined the rises in percentage correct were 9.4 per cent and 3.8 per cent respectively. These are the changes in performance shown using the TIMSS assessment framework, items and methodology. They provide confirmation of improvements in performance in mathematics and science in the late primary years as found in national surveys. Because of the different scales used to report international and national performance levels it is not possible in this report to compare the size of the changes shown in the two arenas.

4 Performance at the international benchmarks

The benchmarks for the 2003 TIMSS study have been selected as 625, 550, 475 and 400 scale points. These are described as advanced, high, intermediate and low. The use of scale points to define these benchmarks was adopted in order to make easy comparisons over time. (The previous benchmarks, based on percentages, would have produced problems if maintained since the percentages would not have stayed the same over time.) Associated with each benchmark are summary descriptions and more detailed descriptions of what pupils at these benchmarks know and can do. The descriptions were produced by expert committees which examined the items associated with each benchmark (see Exhibit 4.2). An item was associated with a particular benchmark if 65 per cent of students at that benchmark were successful, but fewer than 50 per cent of students at the next lowest benchmark were successful.

This section follows the order of previous ones, with grade 4 science dealt with first. For each grade and subject a summary of how England performed is given first. This is followed by the general description of the benchmarks, followed by an exhibit showing the proportion of pupils in each country reaching each benchmark. A second exhibit then shows trends over time in pupils reaching these percentages. Then the detailed descriptions of each benchmark are given together with sample items illustrative of the benchmark concerned. Percentages of successful students in each country are given along with each item. At the end of each section a commentary on England's performance on the sample items is given.

4.1 Performance at the grade 4 science international benchmarks

England's performance was well above the international average, as shown in the summary percentages reaching each benchmark below. Proportions of pupils reaching all but the highest benchmark also increased from 1995 (see Exhibit 4.1).

Exhibit 4.1 Proportions of pupils reaching each benchmark, grade 4 science

	Advanced International Benchmark	High International Benchmark	Intermediate International Benchmark	Low International Benchmark
England 2003	15%	47%	79%	94%
Comparison Group Average	10%	41%	78%	94%
International Average	7%	32%	65%	84%
England 1995	15%	42%	72%	90%

Only in Singapore did more pupils (25 per cent) achieve the advanced benchmark than in England, 15 per cent. The international average was 7 per cent. Performance was also very strong at the high, intermediate and low benchmarks relative to the other countries. Against comparison group countries as a group, England performed better at the two highest benchmarks.

The proportion of pupils reaching the advanced benchmark had not changed since 1995, but the percentage of pupils reaching the high, intermediate and low benchmarks all rose significantly from the 1995 levels, the increase being around 5 per cent in each case. Given the rise in performance generally since 1995 such increases would be expected.

Taken overall, England's performance on the eight sample items (see Exhibits 4.6 to 4.16) was probably just below the level expected given its overall score and that of the comparison group countries. England's average percentage correct, 64 per cent, was exceeded by Singapore, 73 per cent. The average for the comparison group countries was 63 per cent. England's performance stood out on two items. Performance on example item 1 was disappointing, but for no obvious reason. The Comparison group average was 32 per cent for this item. At the other extreme, on example item 4 England did extremely well, 74 per cent against an average of 57 per cent for the comparison group. This may reflect the emphasis on the differences between solids and liquids in the National Curriculum.

Advanced International Benchmark – 625

Students can apply knowledge and understanding in beginning scientific inquiry. Students demonstrate some understanding of Earth's features and processes and the solar system. They can communicate their understanding of structure, function, and life processes in organisms and classify organisms according to major physical and behavioral features. They demonstrate some understanding of physical phenomena and properties of common materials. Students demonstrate beginning scientific inquiry knowledge and skills.

High International Benchmark – 550

Students can apply knowledge and understanding to explain everyday phenomena. Students demonstrate some knowledge of Earth structure and processes and the solar system and some understanding of plant structure, life processes, and human biology. They demonstrate some knowledge of physical states, common physical phenomena, and chemical changes. They provide brief descriptions and explanations of some everyday phenomena and compare, contrast, and draw conclusions.

Intermediate International Benchmark – 475

Students can apply basic knowledge and understanding to practical situations in the sciences. Students demonstrate knowledge of some basic facts about Earth's features and processes and the solar system. They recognize some basic information about human biology and health and show some understanding of development and life cycles of organisms. They know some basic facts about familiar physical phenomena, states, and changes. They apply factual knowledge to practical situations, interpret pictorial diagrams, and combine information to draw conclusions.

Low International Benchmark – 400

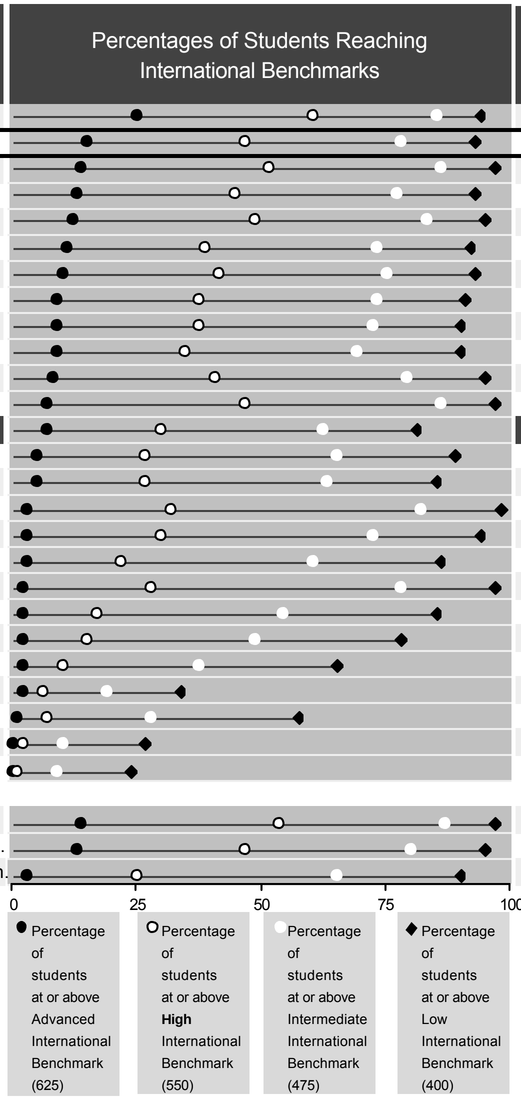
Students have some elementary knowledge of the earth, life, and physical sciences. Students recognize simple facts presented in everyday language and context about Earth's physical features, the seasons, the solar system, human biology, and the development and characteristics of animals and plants. They recognize facts about a range of familiar physical phenomena — rainbows, magnets, electricity, boiling, floating, and dissolving. They interpret labeled pictures and simple pictorial diagrams and provide short written responses to questions requiring factual information.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.3

Percentages of Students Reaching TIMSS 2003 International Benchmarks of Science Achievement

4th grade TIMSS 2003 Science



	Countries	Advanced International Benchmark (625)	High International Benchmark (550)	Intermediate International Benchmark (475)	Low International Benchmark (400)
	Singapore	25 (2.4)	61 (2.6)	86 (1.6)	95 (0.9)
†	England	15 (1.4)	47 (1.8)	79 (1.3)	94 (0.7)
	Chinese Taipei	14 (1.0)	52 (1.1)	87 (0.7)	98 (0.3)
†	United States	13 (0.8)	45 (1.4)	78 (1.0)	94 (0.5)
	Japan	12 (0.6)	49 (1.1)	84 (0.7)	96 (0.4)
	Russian Federation	11 (1.4)	39 (2.7)	74 (2.4)	93 (1.1)
	Hungary	10 (0.9)	42 (1.6)	76 (1.4)	94 (0.7)
†	Australia	9 (1.0)	38 (1.7)	74 (2.0)	92 (1.1)
	New Zealand	9 (0.7)	38 (1.3)	73 (1.2)	91 (0.8)
	Italy	9 (1.1)	35 (1.9)	70 (1.6)	91 (0.9)
	Latvia	8 (0.6)	41 (1.6)	80 (1.3)	96 (0.6)
†	Hong Kong, SAR	7 (0.8)	47 (2.2)	87 (1.2)	98 (0.3)
	International Avg.	7 (0.2)	30 (0.3)	63 (0.3)	82 (0.2)
†	Scotland	5 (0.5)	27 (1.5)	66 (1.5)	90 (0.9)
	Moldova, Rep. of	5 (0.9)	27 (1.9)	64 (2.1)	86 (1.3)
†	Netherlands	3 (0.5)	32 (1.5)	83 (1.2)	99 (0.4)
1	Lithuania	3 (0.5)	30 (1.3)	73 (1.6)	95 (0.7)
	Slovenia	3 (0.4)	22 (1.3)	61 (1.4)	87 (0.9)
	Belgium (Flemish)	2 (0.3)	28 (1.1)	79 (1.3)	98 (0.4)
	Cyprus	2 (0.3)	17 (1.0)	55 (1.4)	86 (0.8)
	Norway	2 (0.3)	15 (0.9)	49 (1.4)	79 (1.5)
	Armenia	2 (0.4)	10 (1.0)	38 (1.7)	66 (1.8)
	Philippines	2 (1.0)	6 (1.9)	19 (2.5)	34 (2.5)
	Iran, Islamic Rep. of	1 (0.2)	7 (0.7)	28 (1.5)	58 (1.7)
	Tunisia	0 (0.1)	2 (0.3)	10 (1.0)	27 (1.7)
	Morocco	0 (0.0)	1 (0.3)	9 (0.8)	24 (1.6)
Benchmarking Participants					
	Indiana State, US	14 (2.2)	54 (2.2)	88 (1.5)	98 (0.4)
	Ontario Province, Can.	13 (1.6)	47 (1.9)	81 (1.4)	96 (0.6)
	Quebec Province, Can.	3 (0.4)	25 (1.3)	66 (1.4)	91 (0.8)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.4

Trends in Percentages of Students Reaching TIMSS 2003 International Benchmarks of Science Achievement in 1995 and 2003

4th grade — TIMSS 2003 — Science

Countries	Advanced International Benchmark (625)		High International Benchmark (550)		Intermediate International Benchmark (475)		Low International Benchmark (400)	
	2003 (Percent of Students)	1995 (Percent of Students)	2003 (Percent of Students)	1995 (Percent of Students)	2003 (Percent of Students)	1995 (Percent of Students)	2003 (Percent of Students)	1995 (Percent of Students)
Singapore	25 (2.4)	14 (1.6) ▲	61 (2.6)	42 (2.2) ▲	86 (1.6)	71 (1.7) ▲	95 (0.9)	89 (0.9) ▲
England	**15 (1.4)**	**15 (1.1)**	**47 (1.8)**	**42 (1.7) ▲**	**79 (1.3)**	**72 (1.3) ▲**	**94 (0.7)**	**90 (0.8) ▲**
United States	13 (0.8)	19 (1.2) ▼	45 (1.4)	50 (1.6) ▼	78 (1.0)	78 (1.1)	94 (0.5)	92 (0.7)
Japan	12 (0.6)	15 (0.8) ▼	49 (1.1)	54 (1.3) ▼	84 (0.7)	87 (0.7) ▼	96 (0.4)	97 (0.4) ▼
Hungary	10 (0.9)	7 (0.7) ▲	42 (1.6)	32 (1.7) ▲	76 (1.4)	67 (1.8) ▲	94 (0.7)	90 (1.0) ▲
New Zealand	9 (0.7)	11 (1.2)	39 (1.3)	35 (1.8)	74 (1.2)	66 (1.8) ▲	92 (0.7)	85 (1.7) ▲
Australia	9 (1.0)	13 (1.1) ▼	38 (1.7)	40 (1.3)	74 (2.0)	72 (1.7)	92 (1.1)	89 (1.1)
Latvia (LSS)	7 (0.8)	5 (1.4)	39 (1.9)	21 (2.1) ▲	80 (1.5)	55 (2.1) ▲	96 (0.6)	85 (1.4) ▲
Hong Kong, SAR	7 (0.8)	5 (0.6)	47 (2.2)	30 (1.6) ▲	87 (1.2)	69 (1.7) ▲	98 (0.3)	91 (1.1) ▲
Scotland	5 (0.5)	12 (1.1) ▼	27 (1.5)	37 (1.8) ▼	66 (1.5)	68 (1.9)	90 (0.9)	88 (1.3)
Slovenia	3 (0.4)	2 (0.4)	22 (1.3)	14 (1.1) ▲	61 (1.4)	45 (1.5) ▲	87 (0.9)	79 (1.4) ▲
Netherlands	3 (0.5)	6 (0.7) ▼	32 (1.5)	38 (2.1) ▼	83 (1.2)	82 (1.6)	99 (0.4)	98 (0.7)
Norway	2 (0.3)	8 (0.9) ▼	15 (0.9)	32 (1.6) ▼	49 (1.4)	65 (1.7) ▼	79 (1.5)	88 (1.1) ▼
Cyprus	2 (0.3)	1 (0.4)	17 (1.0)	11 (1.0) ▲	55 (1.4)	39 (1.8) ▲	86 (0.8)	74 (1.3) ▲
Iran, Islamic Rep. of	1 (0.2)	0 (0.1) ▲	7 (0.7)	3 (0.7) ▲	28 (1.5)	15 (1.5) ▲	58 (1.7)	42 (2.1) ▲
International Avg.	8 (0.3)	9 (0.2) ▼	35 (0.5)	32 (0.4) ▲	71 (0.4)	63 (0.4) ▲	90 (0.3)	85 (0.3) ▲
Benchmarking Participants								
Ontario Province, Can.	13 (1.6)	10 (0.7) ▲	47 (1.9)	37 (1.7) ▲	81 (1.4)	71 (1.7) ▲	96 (0.6)	90 (1.0) ▲
Quebec Province, Can.	3 (0.4)	9 (1.3) ▼	25 (1.3)	40 (3.7) ▼	66 (1.4)	77 (2.5) ▼	91 (0.8)	94 (1.3)

▲ 2003 significantly higher

▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A diamond (') indicates the country did not participate in the assessment.

Advanced International Benchmark – 625

Summary

Students can apply knowledge and understanding in beginning scientific inquiry. Students demonstrate some understanding of Earth's features and processes and the solar system. They can communicate their understanding of structure, function, and life processes in organisms and classify organisms according to major physical and behavioral features. They demonstrate some understanding of physical phenomena and properties of common materials. Students demonstrate beginning scientific inquiry knowledge and skills.

Students demonstrate some understanding of Earth's features and processes and of the Moon in the solar system. They recognize that the Moon can be seen because it reflects the light from the Sun. They recognize that metals are found in rocks and can relate fossils to evidence of the past. From a plan of a house and garden, students can explain which side of the house receives most morning sun. They identify changes in soil from natural causes and recognize that decaying plants and animals enrich the soil and make plants grow. They can interpret a table of temperature and cloud cover data to predict a location where it snowed and interpret a map indicating that a river flows from mountains to the ocean.

Students can communicate their understanding of structure, function, and life processes in organisms by stating why humans need a skeleton, what the human body does to cool down during exercise, and how colds can be transmitted. They also can describe a physical change that takes place in children's bodies as they become adults. Students show some knowledge of reproduction by explaining why the last surviving member of an animal species cannot reproduce, that the color of a flower is determined by the flower color of the parent plant, and why some insects are important for flowering. They can recognize a group of animals that are all mammals, that the energy needed to heal a cut comes from food, and can select cheese from a list of common foods as the best source of calcium. They can combine information from a plan of a garden and a diagram showing plants and their light requirements to complete a table listing plants that would grow well in different areas of the garden. They can describe human activities that can lead to the extinction of animals.

Students demonstrate some understanding of physical properties of common materials and physical phenomena. They recognize that heat is required for melting and boiling but not for freezing. They also recognize that magnets with like poles repel and that magnetism, not gravity, makes objects repel each other. From a diagram, they recognize the direction of motion of two carts carrying magnets. They can identify two things wrong with a diagram showing a person's shadow and location of the sun. They can name one thing that shows that sunlight is made up of different colors. From investigations of the effects of different colored lights on the apparent color of a red shirt, students can describe the results and conclude that the color looks different under different colored light. They can also distinguish between renewable and non-renewable energy sources. In addition, they can recognize and explain that fine salt dissolves faster in water than coarse salt, and recognize the diagram that best shows how ice floats in water. They can interpret information from a table of physical properties to identify wood, rock and iron.

Students demonstrate beginning scientific inquiry knowledge and skills. They can describe the results of an investigation, draw conclusion from the results, and infer the purpose of an experiment from a table of data.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.6

TIMSS 2003 Advanced International Benchmark (625) of Science Achievement – Example Item 1

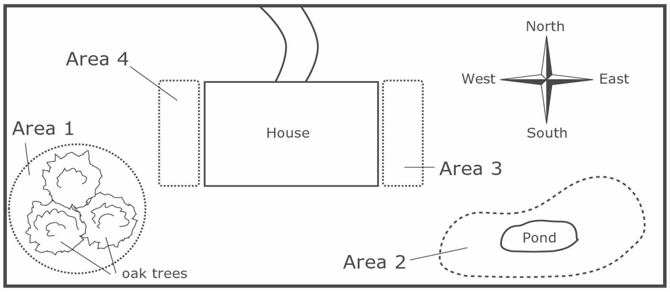
An Item that Students Reaching the Advanced International Benchmark are Likely to Answer Correctly*

4th grade Science — TIMSS 2003

Content Area: Earth Science

Description: From a plan of a house and garden showing North, South, East, and West, identifies the side of the house that receives the most sun in the morning and explains why.

A plan of Rebecca's house and garden is shown below. There are four areas in the garden where she would like to grow some plants (Areas 1, 2, 3, and 4).



Which side of Rebecca's house will receive the most sun in the morning?

(Check one box.)

- [x] East side (Area 3)
- [ ] West side (Area 4)

Explain your answer.

Because the sun comes up on the East side.

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Chinese Taipei	55 (2.3)	▲
† Hong Kong, SAR	51 (3.2)	▲
Japan	45 (2.6)	▲
Singapore	42 (2.7)	▲
Hungary	41 (2.5)	▲
Latvia	34 (3.3)	▲
† Netherlands	33 (3.0)	▲
Comparison group	32	
Slovenia	30 (3.6)	
Italy	30 (2.5)	
† United States	29 (1.8)	
Cyprus	28 (2.2)	
† Australia	28 (3.4)	
New Zealand	27 (2.7)	
International Avg.	26 (0.5)	
Lithuania	23 (2.8)	
Belgium (Flemish)	22 (2.6)	
† England	21 (2.9)	
Russian Federation	21 (2.3)	▼
Moldova, Rep. of	16 (2.8)	▼
Norway	14 (1.9)	▼
Iran, Islamic Rep. of	13 (1.9)	▼
† Scotland	11 (1.8)	▼
Morocco	10 (2.1)	▼
Philippines	7 (1.7)	▼
Tunisia	7 (1.5)	▼
Armenia	4 (0.9)	▼
Benchmarking Participants		
Indiana State, US	31 (4.2)	
Ontario Province, Can.	28 (3.2)	
Quebec Province, Can.	22 (2.7)	

▼ Country average significantly lower than international average

▲ Country average significantly higher than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* The item was answered fully correctly by a majority of students reaching this benchmark.

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.7 TIMSS 2003 Advanced International Benchmark (625) of Science Achievement – Example Item 2

An Item that Students Reaching the Advanced International Benchmark are Likely to Answer Correctly[1]

Content Area: Physical Science

Description: Interprets information from a table of physical properties of three materials to identify wood, rock, and iron).

The properties of three materials are compared in the table below.
One of the materials is wood, one is rock and one is iron.

Property	Material 1	Material 2	Material 3
Sinks in water?	Yes	No	Yes
Burns easily?	No	Yes	No
Attracted by a magnet?	Yes	No	No

Identify the three materials by filling in the spaces below.

Wood is material number: 2

Rock is material number: 3

Iron is material number: 1

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit	
	Singapore	74 (2.3)	▲
	Japan	69 (1.6)	▲
†	Netherlands	59 (2.7)	▲
†	Hong Kong, SAR	58 (2.7)	▲
†	England	53 (2.5)	▲
	Belgium (Flemish)	52 (2.4)	▲
	Comparison group	50	
	Chinese Taipei	48 (1.7)	▲
	Lithuania	45 (2.5)	▲
	Cyprus	44 (1.9)	▲
	Russian Federation	42 (2.8)	
	Latvia	42 (2.6)	
	Italy	41 (2.2)	
†	Australia	39 (2.8)	
†	United States	39 (1.7)	
	International Avg.	38 (0.4)	
†	Scotland	38 (2.6)	
	New Zealand	37 (1.9)	
	Hungary	35 (2.1)	
	Slovenia	35 (2.4)	
	Norway	25 (2.0)	▼
	Tunisia	15 (1.7)	▼
	Armenia	14 (1.6)	▼
	Philippines	12 (1.7)	▼
	Moldova, Rep. of	9 (1.3)	▼
	Iran, Islamic Rep. of	9 (1.4)	▼
	Morocco	7 (1.4)	▼
	Benchmarking Participants		
	Indiana State, US	47 (3.1)	▲
	Ontario Province, Can	43 (2.9)	
	Quebec Province, Can	41 (2.5)	

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average
▼ Country average significantly lower than international average

1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

High International Benchmark – 550

Summary

Students can apply knowledge and understanding to explain everyday phenomena. Students demonstrate some knowledge of Earth structure and processes and the solar system and some understanding of plant structure, life processes, and human biology. They demonstrate some knowledge of physical states, common physical phenomena, and chemical changes. They provide brief descriptions and explanations of some everyday phenomena and compare, contrast, and draw conclusions.

Students demonstrate some knowledge of Earth structure and processes and the solar system. They identify the Earth, Moon, and Sun from a diagram and can interpret a pictorial diagram of the angle/length of shadows cast by sunlight at different times of day. They explain that when moist air becomes very cold, water in the air may condense or freeze, and early-morning moisture can be due to condensation. From a diagram showing a variety of landscape features, they recognize the best location for growing crops.

Students demonstrate some understanding of plant structure and life processes. They can explain why plants are living things and can state one thing apart from light and water that plants need to grow well. They can infer from a picture how a plant's seeds are spread. They also compare and contrast different animals, including distinguishing plant eaters and meat eaters by their teeth and fish and sea mammals by their physical features and behaviors. Students demonstrate some understanding of human biology. For example, they can state one thing that can cause the temperature of the human body to be higher than normal, and can recognize that sensory messages are interpreted in the brain and that exercise causes an increase in breathing and pulse rates.

In the physical sciences, students demonstrate some understanding of physical states, common physical phenomena, and chemical changes. They describe changes in matter, such as how a liquid can be turned into a solid or gas, and can state one difference between solids and liquids. From a diagram, they recognize the direction of heat transfer along a metal ruler and that ice melts most slowly in a closed container. They recognize that more sugar will dissolve in hot water and that metal conducts heat better than wood. They can infer the color of a light bulb from the apparent color of a red shirt. They recognize that gravity causes objects to fall to the ground, and from a diagram showing a person blowing into water using straw, can explain why bubbles rise to the top. From a diagram showing powders, students recognize those likely to be mixtures.

Students provide brief descriptive responses combining knowledge of science concepts with information from everyday experience of physical and life processes (e.g., early morning moisture can be due to condensation, liquid can be converted to a gas by heating, and seeds can be spread by wind). Students can compare, contrast, and draw conclusions (e.g., the structure of teeth from plant eaters and meat eaters, the physical features or behaviors distinguishing fish from sea mammals).

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.9

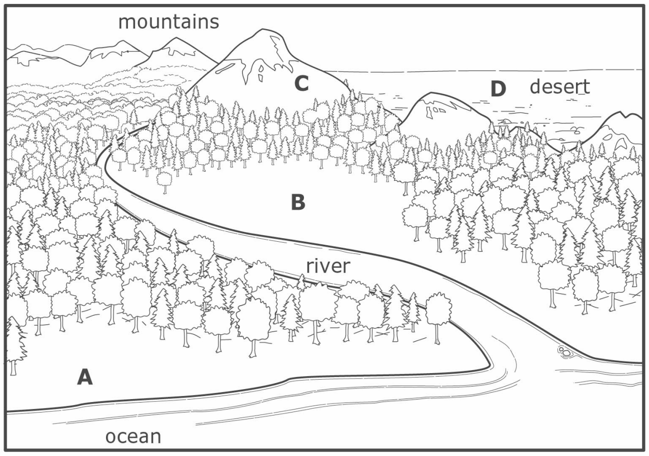
TIMSS 2003 High International Benchmark (550) of Science Achievement – Example Item 3

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly*

4th grade Science — TIMSS 2003

Content Area: Earth Science

Description: From a diagram showing a variety of landscape features, recognizes the best location for growing crops.



Look at the picture above. Where is the best location to grow crops?

- Ⓐ Location A
- ● Location B
- Ⓒ Location C
- Ⓓ Location D

	Country	Percent Full Credit	
	Japan	75 (1.6)	▲
	Latvia	70 (1.9)	▲
†	United States	70 (1.1)	▲
†	Hong Kong, SAR	70 (2.0)	▲
	Lithuania	69 (1.8)	▲
†	Netherlands	69 (2.2)	▲
	Hungary	69 (2.2)	▲
†	**England**	**69 (2.0)**	▲
†	Scotland	68 (2.0)	▲
	Italy	68 (2.0)	▲
	Chinese Taipei	67 (1.9)	▲
	Comparison group	66	
†	Australia	66 (2.5)	▲
	Norway	63 (2.3)	▲
	New Zealand	63 (2.3)	▲
	Russian Federation	63 (2.5)	▲
	Singapore	62 (2.0)	▲
	Cyprus	59 (2.2)	
	International Avg.	57 (0.4)	
	Slovenia	56 (2.5)	
	Moldova, Rep. of	54 (3.0)	
	Belgium (Flemish)	44 (2.2)	▼
	Armenia	34 (2.3)	▼
	Iran, Islamic Rep. of	32 (2.4)	▼
	Morocco	27 (2.0)	▼
	Philippines	24 (2.2)	▼
	Tunisia	22 (1.6)	▼
	Benchmarking Participants		
	Indiana State, US	75 (2.3)	▲
	Ontario Province, Can.	71 (2.4)	▲
	Quebec Province, Can.	66 (2.4)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▼ Country average significantly lower than international average

▲ Country average significantly higher than international average

* The item was answered correctly by a majority of students reaching this benchmark.

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.10

TIMSS 2003 High International Benchmark (550) of Science Achievement – Example Item 4

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly*

4th grade Science — TIMSS 2003

Content Area: Physical Science

Description: Describes one difference between solids and liquids.

Describe one difference between solids and liquids.

In solids, molecules are packed together. In liquids they are more spread.

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit		
†	England	74	(2.2)	▲
	Singapore	73	(2.0)	▲
†	United States	67	(1.6)	▲
	Chinese Taipei	66	(1.8)	▲
†	Australia	64	(2.1)	▲
	Hungary	64	(2.0)	▲
	New Zealand	62	(2.2)	▲
	Japan	59	(1.8)	▲
	Comparison group	57		
†	Scotland	57	(2.1)	▲
†	Hong Kong, SAR	56	(2.3)	▲
	Italy	55	(2.1)	▲
	Slovenia	51	(2.6)	▲
	Russian Federation	49	(2.5)	▲
	International Avg.	44	(0.4)	
	Latvia	44	(2.5)	
	Cyprus	41	(2.1)	
	Moldova, Rep. of	37	(2.2)	▼
	Belgium (Flemish)	32	(1.8)	▼
	Lithuania	30	(1.6)	▼
	Iran, Islamic Rep. of	29	(2.5)	▼
	Philippines	22	(3.2)	▼
†	Netherlands	21	(2.2)	▼
	Armenia	21	(1.7)	▼
	Norway	16	(2.0)	▼
	Tunisia	11	(1.5)	▼
	Morocco	8	(1.4)	▼
	Benchmarking Participants			
	Indiana State, US	71	(2.7)	▲
	Ontario Province, Can.	70	(1.9)	▲
	Quebec Province, Can.	51	(1.9)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▼ Country average significantly lower than international average

▲ Country average significantly higher than international average

* The item was answered fully correctly by a majority of students reaching this benchmark.

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Intermediate International Benchmark – 475

Summary

Students can apply basic knowledge and understanding to practical situations in the sciences Students demonstrate knowledge of some basic facts about Earth's features and processes and the solar system. They recognize some basic information about human biology and health and show some understanding of development and life cycles of organisms. They know some basic facts about familiar physical phenomena, states, and changes. They apply factual knowledge to practical situations, interpret pictorial diagrams, and combine information to draw conclusions.

Students know some basic facts about Earth's features and processes and the solar system. They can state one difference between the Sun and the Moon and one difference between two previously named seasons. They recognize the effect of rock hardness on abrasion and can recognize from its shape and size which rock has been carried furthest down a river. They also recognize that most of Earth's surface is covered by water, and that the water in the ocean is salty. They know that fossils are found in rocks, and that minerals come from rocks. Students recognize the effect of wind strength on a ribbon attached to a pole and can state two different uses humans have for wood.

In life science, students demonstrate knowledge of some basic facts related to human biology and health. For example, they recognize that a person's hair type can be predicted by parental hair type, and that excess food is stored as fat. They can state one thing that may happen to the body if not protected from the Sun. Students demonstrate some knowledge of the diversity, structure and habitats of animal life. For example, they recognize from pictorial diagrams the bird most likely to eat mammals, and the type of plants usually found in a tropical rain forest. They show some understanding of development and life cycles of organisms, including knowing that snakes shed their outer covering as they grow larger and classifying common organisms into those that give birth and those that lay eggs. From a list of common items, students can distinguish between living and non-living things. They can interpret from a food chain diagram that snakes eat voles and that tadpoles eat plants. They know that trees make their own food using sunlight, and can recognize from pictures of two types of seeds that they are scattered by the wind. They combine information from a plan of a garden and a diagram showing plants and their light requirements to explain why roses do not grow well under an oak tree.

Students show some understanding of familiar physical phenomena, states, and changes. They recognize that all objects have mass and that copper is a good heat conductor. They can state two uses of electricity in daily life. They recognize the state of a material from the shape it takes when transferred from a smaller to a larger container. Students can state one way that water in ice and liquid forms is used by humans. They recognize that salt water is a mixture, and can identify an object that is made of metal. They recognize that soap bubbles contain air. They can infer the color of a white shirt under a blue light. They recall that plant matter (apple core) will decay faster than other given substances. They can identify materials that burn, and from diagrams of candles in sealed containers, can identify the candle in the largest container as the last to go out.

Students apply factual knowledge to practical situations (e.g., recognize that excess food is stored as fat) and demonstrate some ability to interpret information in pictorial diagrams to reason to a conclusion (e.g., interpreting diagrams showing rocks of different shapes and sizes to identify the rock carried furthest down a river). They can also combine information from two sources to draw a conclusion (e.g., planning a garden).

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.12

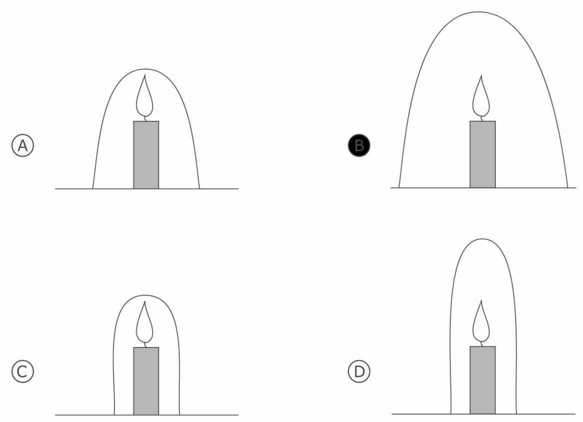
TIMSS 2003 Intermediate International Benchmark (475) of Science Achievement – Example Item 5

An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer

Content Area: Physical Science

Description: Recognizes that a candle in the largest sealed container will be the last to go out.

The pictures below show four identical burning candles. Each is covered by a glass container of a different size. Which candle flame will be the last to go out?



	Country	Percent Full Credit	
	Cyprus	81 (2.0)	▲
	Singapore	81 (2.4)	▲
†	Netherlands	81 (2.8)	▲
†	Hong Kong, SAR	80 (2.0)	▲
	Hungary	79 (2.6)	▲
	Latvia	78 (2.4)	▲
	Belgium (Flemish)	78 (2.3)	▲
	Chinese Taipei	75 (2.1)	▲
	Italy	74 (2.7)	▲
	Slovenia	73 (3.9)	
†	United States	72 (1.8)	▲
	Comparison group	72	
	Lithuania	71 (2.7)	
†	England	69 (3.4)	
	Norway	68 (2.7)	
	International Avg.	66 (0.6)	
	Russian Federation	66 (2.6)	
†	Australia	66 (3.1)	
†	Scotland	65 (2.6)	
	New Zealand	63 (2.9)	
	Moldova, Rep. of	61 (3.0)	
	Armenia	55 (3.0)	▼
	Iran, Islamic Rep. of	52 (3.8)	▼
	Japan	51 (3.0)	▼
	Philippines	47 (2.9)	▼
	Morocco	34 (3.5)	▼
	Tunisia	30 (2.8)	▼
	Benchmarking Participants		
	Indiana State, US	75 (3.1)	▲
	Ontario Province, Can.	72 (3.3)	
	Quebec Province, Can.	67 (2.7)	

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▼ Country average significantly higher than international average

▲ Country average significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

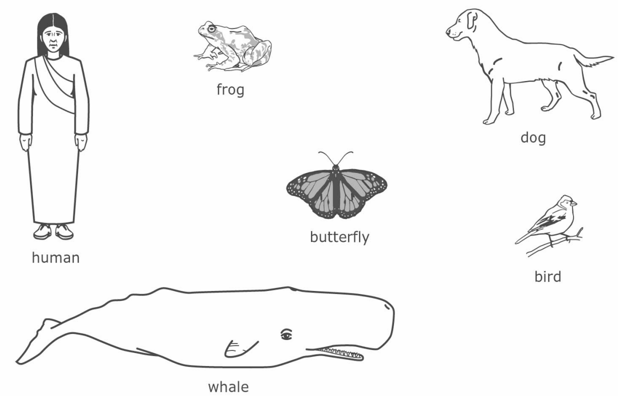
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.13 TIMSS 2003 Intermediate International Benchmark (475) of Science Achievement – Example Item 6

An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly*

Content Area: Life Science

Description: Given a diagram of six organisms, classifies them into those that give birth and those that lay eggs.



Some of the organisms shown above give birth to young that develop inside the mother. Some of the organisms have young that hatch from eggs that are laid outside the mother.

In the table below, write down the names of the organisms that belong to each group.

Organisms that give birth	Organisms that lay eggs
Human Dog Whale	Frog Butter fly Bird

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Singapore	84 (1.3)	▲
† United States	76 (1.1)	▲
New Zealand	74 (1.9)	▲
† Netherlands	73 (2.5)	▲
† Australia	72 (2.6)	▲
Comparison group	68	
† England	67 (2.0)	▲
Japan	67 (1.8)	▲
Italy	64 (2.5)	▲
Belgium (Flemish)	63 (2.2)	▲
Russian Federation	63 (2.7)	▲
Latvia	62 (2.1)	▲
Hungary	62 (2.0)	▲
Lithuania	60 (1.9)	
† Scotland	59 (2.1)	
Norway	58 (1.7)	
† Hong Kong, SAR	58 (2.3)	
International Avg.	58 (0.4)	
Cyprus	54 (2.1)	
Chinese Taipei	53 (1.9)	▼
Slovenia	52 (2.4)	▼
Moldova, Rep. of	51 (2.3)	▼
Armenia	46 (2.8)	▼
Philippines	41 (2.4)	▼
Iran, Islamic Rep. of	35 (2.5)	▼
Morocco	23 (2.3)	▼
Tunisia	19 (1.5)	▼
Benchmarking Participants		
Indiana State, US	80 (1.7)	▲
Ontario Province, Can.	70 (2.6)	▲
Quebec Province, Can.	67 (2.2)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* The item was answered fully correctly by a majority of students reaching this benchmark.
† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Low International Benchmark – 400

Summary

Students have some elementary knowledge of the earth, life, and physical sciences. Students recognize simple facts presented in everyday language and context about Earth's physical features, the seasons, the solar system, human biology, and the development and characteristics of animals and plants. They recognize facts about a range of familiar physical phenomena – rainbows, magnets, electricity, boiling, floating, and dissolving. They interpret labeled pictures and simple pictorial diagrams and provide short written responses to questions requiring factual

Students know some elementary facts about Earth's physical features, seasons, and the solar system. They identify oxygen as the gas in the air needed for breathing, can explain why people should not drink water directly from the oceans, and recognize the hottest of Earth's layers. They know that the Sun is hotter than the Earth, the Moon, or Mars, that the Earth moves around the Sun, and can state the names of two seasons.

In life science, students demonstrate knowledge of some simple facts related to human biology. They recognize that air enters the lungs, that washing hands prevents illness by removing germs, which teeth are used for grinding, and that rice is edible and cotton is not. They also demonstrate some knowledge of animal development and structure. For example, they recognize that tadpoles hatch from frogs' eggs, that the larval form of a butterfly, that fat layers help keep animals warm, and that birds sit on their eggs to keep them warm. They recognize wings as being common to birds, bats, and butterflies, which foot structure belongs to a bird that lives on water, and can identify insects by the presence of six legs. Given lists of familiar animals, students can identify those that exhibit specified characteristics, such as eating only plants, eating only animals, and not laying eggs. From pictorial diagrams, students identify an animal that lives in the desert and the root as the plant part that takes in water. They can communicate an effect of environmental change (temperature) on aquatic life.

Students are familiar with some everyday physical phenomena, for example, sunlight and rain are required to produce rainbows, water changes into vapor during boiling, and sugar dissolves in water. From a diagram, they can identify the heaviest floating object, and recognize that the weight of an object does not depend on how it is placed on a scale. They recognize that magnets attract iron and that iron nails rust. In addition, students recognize that an iron nail can complete an electrical circuit to allow a bulb to light, and given diagrams showing a light bulb connected to a battery, recognize in which one the bulb will light.

Students interpret labeled pictures and simple diagrams (e.g., plant parts, stages of development of animals, simple electrical circuit) and provide short written responses to questions requiring factual information (e.g., an example of temperature change on aquatic life).

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.15

TIMSS 2003 Low International Benchmark (400) of Science Achievement – Example Item 7

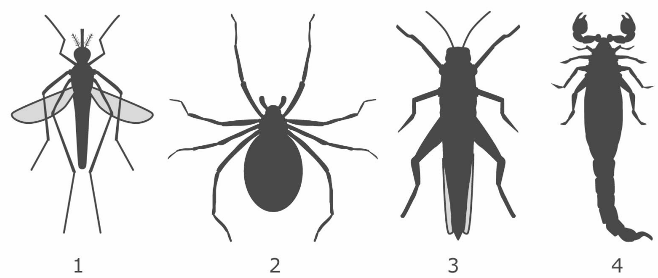
An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly[1]

4th grade Science — TIMSS 2003

Content Area: Life Science

Description: Given a diagram, recognizes insects by presence of six legs.

Which of these are insects?



- (A) 1 and 3 only (correct answer)
- (B) 1 and 4 only
- (C) 2 and 4 only
- (D) 3 and 4 only

Country	Percent Full Credit	
Lithuania	94 (1.1)	▲
Singapore	92 (1.0)	▲
Japan	91 (1.1)	▲
Italy	91 (1.1)	▲
Russian Federation	91 (1.2)	▲
† United States	91 (0.8)	▲
Norway	90 (1.3)	▲
Chinese Taipei	89 (1.2)	▲
Belgium (Flemish)	89 (1.4)	▲
† Netherlands	89 (1.6)	▲
† Australia	88 (1.6)	▲
Comparison group	88	
Hungary	86 (1.5)	▲
† England	86 (1.6)	▲
Cyprus	85 (1.7)	▲
New Zealand	85 (1.5)	▲
Moldova, Rep. of	85 (1.5)	▲
Latvia	84 (1.6)	▲
† Scotland	83 (1.5)	
International Avg.	81 (0.3)	
† Hong Kong, SAR	81 (1.5)	
Slovenia	79 (1.7)	
Iran, Islamic Rep. of	76 (2.0)	▼
Philippines	64 (2.0)	▼
Armenia	59 (2.7)	▼
Tunisia	49 (2.1)	▼
Morocco	35 (2.4)	▼
Benchmarking Participants		
Indiana State, US	92 (1.6)	▲
Ontario Province, Can.	89 (1.4)	▲
Quebec Province, Can.	88 (1.3)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

A dash (–) indicates comparable data are not available.

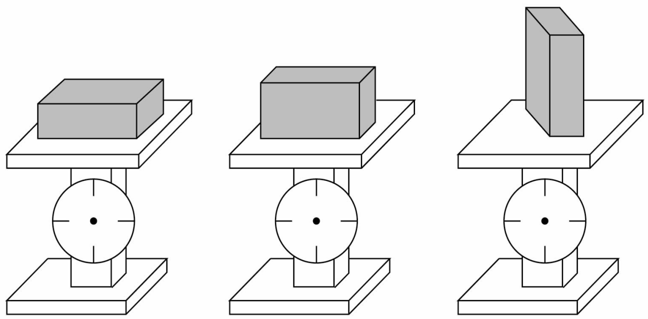
Exhibit 4.16 TIMSS 2003 Low International Benchmark (400) of Science Achievement – Example Item 8

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly[1]

Content Area: Physical Science

Description: Recognizes that the weight of an object does not change depending on its orientation on a scale.

The same brick is put on a scale in three different ways.



1. 2. 3.

What will the scale show?

Ⓐ 1 will show the greatest weight.

Ⓑ 2 will show the greatest weight.

Ⓒ 3 will show the greatest weight.

Ⓓ All will show the same weight.

Country	Percent Full Credit	
Lithuania	88 (1.4)	▲
Moldova, Rep. of	87 (1.7)	▲
Russian Federation	86 (1.5)	▲
Slovenia	85 (1.8)	▲
Chinese Taipei	85 (1.4)	▲
Latvia	84 (2.0)	▲
Singapore	79 (1.3)	▲
Hungary	79 (1.8)	▲
Italy	78 (2.0)	▲
† England	76 (1.7)	▲
Armenia	74 (2.6)	
† Netherlands	74 (2.3)	
† Australia	74 (2.3)	
Belgium (Flemish)	73 (1.7)	
† United States	73 (1.2)	
Comparison group	73	
International Avg.	72 (0.4)	
Iran, Islamic Rep. of	72 (2.2)	
† Hong Kong, SAR	69 (2.1)	
† Scotland	68 (2.0)	▼
Japan	66 (2.0)	▼
New Zealand	66 (1.6)	▼
Cyprus	63 (2.3)	▼
Norway	54 (2.2)	▼
Morocco	54 (2.8)	▼
Philippines	52 (2.3)	▼
Tunisia	45 (2.3)	▼
Benchmarking Participants		
Indiana State, US	78 (2.5)	▲
Ontario Province, Can.	68 (2.3)	
Quebec Province, Can.	65 (2.1)	▼

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

4.2 Performance at the grade 4 mathematics international benchmarks

As in science, England's performance was well above the international average at each benchmark and the proportion of pupils reaching each one increased substantially from 1995 (see Exhibit 4.17).

Exhibit 4.17 Proportions of pupils reaching each benchmark, grade 4 mathematics

	Advanced International Benchmark	High International Benchmark	Intermediate International Benchmark	Low International Benchmark
England 2003	14%	43%	75%	93%
Comparison Group Average	12%	43%	77%	94%
International Average	9%	33%	63%	84%
England 1995	7%	24%	54%	82%

In England 14 per cent of pupils attained the advanced benchmark in grade 4 mathematics. Singapore (38 per cent), Hong Kong, and Japan (21 per cent) outperformed England. England's performance was similar to the comparison group average at the other benchmarks. The international average was 9 per cent. Given the large rise in performance generally in England since 1995, increases in the proportions of students reaching each benchmark would be expected and were indeed found. The increase in performance in mathematics was thus apparent across the attainment range.

Overall in grade 4 mathematics England performed at a similar level to the average for the comparison group countries, but on these eight sample items (see Exhibits 4.22 to 4.32) performance in England was slightly lower than the comparison group average, 73 per cent against the comparison group average of 77 per cent. Example item 7 showed a wide range of performance with countries outside the comparison group scoring well. The international average for this item, 72 per cent was virtually the same as the average for the comparison group countries, 73 per cent. Of the comparison group, England, Scotland, Australia and New Zealand all scored below the international average. The results for sample item 1 reflect different levels of curriculum emphasis on decimals for this age group.

Advanced International Benchmark – 625

Students can apply their understanding and knowledge in a wide variety of relatively complex situations. They demonstrate a developing understanding of fractions and decimals and the relationship between them. They can select appropriate information to solve multi-step word problems involving proportions. They can formulate or select a rule for a relationship. They show understanding of area and can use measurement concepts to solve a variety of problems. They show some understanding of rotation. They can organize, interpret, and represent data to solve problems.

High International Benchmark – 550

Student can apply their knowledge and understanding to solve problems. Student can solve multi-step word problems involving addition, multiplication, and division. They can use their understanding of place value and simple fractions to solve problems. They can identify a number sentence that represents situations. Students show understanding of three-dimensional objects, how shapes can make other shapes, and simple transformation in a plane. They demonstrate a variety of measurement skills and can interpret and use data in tables and graphs to solve problems.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. They can read, interpret, and use different representations of numbers. They can perform operations with three- and four-digit numbers and decimals. They can extend simple patterns. They are familiar with a range of two-dimensional shapes and read and interpret different representations of the same data.

Low International Benchmark – 400

Students have some basic mathematical knowledge. Students demonstrate an understanding of whole numbers and can do simple computations with them. They demonstrate familiarity with the basic properties of triangles and rectangles. They can read information from simple bar graphs.

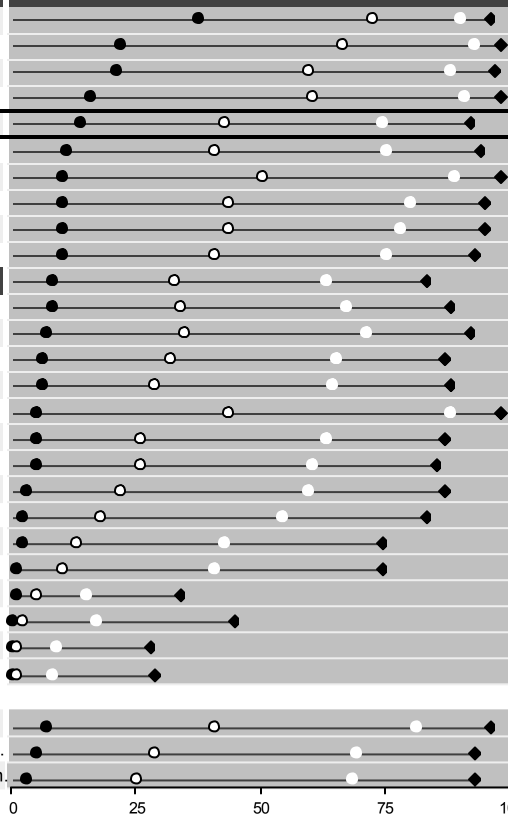
SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.19 Percentages of Students Reaching TIMSS 2003 International Benchmarks of Mathematics Achievement

4th grade — TIMSS 2003 — Mathematics

Countries	Advanced International Benchmark (625)	High International Benchmark (550)	Intermediate International Benchmark (475)	Low International Benchmark (400)
Singapore	38 (2.9)	73 (2.4)	91 (1.3)	97 (0.6)
† Hong Kong, SAR	22 (1.7)	67 (2.0)	94 (0.7)	99 (0.2)
Japan	21 (0.8)	60 (1.0)	89 (0.7)	98 (0.3)
Chinese Taipei	16 (0.9)	61 (1.1)	92 (0.7)	99 (0.2)
† England	14 (1.4)	43 (1.8)	75 (1.6)	93 (0.8)
Russian Federation	11 (1.6)	41 (2.6)	76 (2.0)	95 (0.8)
Belgium (Flemish)	10 (0.6)	51 (1.3)	90 (0.8)	99 (0.3)
Latvia	10 (0.9)	44 (1.9)	81 (1.3)	96 (0.7)
1 Lithuania	10 (1.1)	44 (1.7)	79 (1.3)	96 (0.7)
Hungary	10 (1.0)	41 (1.6)	76 (1.6)	94 (0.8)
International Avg.	9 (0.2)	33 (0.3)	63 (0.3)	82 (0.2)
Cyprus	8 (0.7)	34 (1.2)	68 (1.2)	89 (0.7)
† United States	7 (0.7)	35 (1.3)	72 (1.2)	93 (0.5)
Moldova, Rep. of	6 (1.0)	32 (2.1)	66 (2.1)	88 (1.5)
Italy	6 (1.0)	29 (1.8)	65 (1.7)	89 (1.1)
† Netherlands	5 (0.8)	44 (1.5)	89 (1.2)	99 (0.4)
† Australia	5 (0.7)	26 (1.7)	64 (1.9)	88 (1.3)
New Zealand	5 (0.5)	26 (1.2)	61 (1.3)	86 (1.0)
† Scotland	3 (0.4)	22 (1.4)	60 (1.6)	88 (1.2)
Slovenia	2 (0.4)	18 (1.0)	55 (1.5)	84 (1.0)
Armenia	2 (0.3)	13 (1.2)	43 (1.7)	75 (1.5)
Norway	1 (0.2)	10 (1.0)	41 (1.3)	75 (1.2)
Philippines	1 (0.7)	5 (2.1)	15 (2.7)	34 (2.6)
Iran, Islamic Rep. of	0 (0.1)	2 (0.3)	17 (1.3)	45 (2.2)
Tunisia	0 (0.1)	1 (0.3)	9 (1.0)	28 (1.7)
Morocco	0 (0.0)	1 (0.2)	8 (0.8)	29 (2.2)
Benchmarking Participants				
Indiana State, US	7 (1.2)	41 (1.6)	82 (1.5)	97 (0.6)
Ontario Province, Can.	5 (1.1)	29 (2.2)	70 (1.7)	94 (0.9)
Quebec Province, Can.	3 (0.4)	25 (1.5)	69 (1.4)	94 (0.8)

Percentages of Students Reaching International Benchmarks



● Percentage of students at or above Advanced International Benchmark (625)

○ Percentage of students at or above **High** International Benchmark (550)

○ Percentage of students at or above Intermediate International Benchmark (475)

◆ Percentage of students at or above Low International Benchmark (400)

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.20

Trends in Percentages of Students Reaching TIMSS 2003 International Benchmarks of Mathematics Achievement in 1995 and 2003

4th grade — TIMSS 2003 — Mathematics

Countries	Advanced International Benchmark (625)		High International Benchmark (550)		Intermediate International Benchmark (475)		Low International Benchmark (400)	
	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students
Singapore	38 (2.9)	38 (2.2)	73 (2.4)	70 (1.6)	91 (1.3)	89 (1.0)	97 (0.6)	96 (0.4) ▲
Hong Kong, SAR	22 (1.7)	17 (1.7)	67 (2.0)	56 (2.2) ▲	94 (0.7)	87 (1.3) ▲	99 (0.2)	97 (0.6) ▲
Japan	21 (0.8)	22 (1.0)	60 (1.0)	61 (1.1)	89 (0.7)	89 (0.7)	98 (0.3)	98 (0.2)
England	14 (1.4)	7 (0.8) ▲	43 (1.8)	24 (1.5) ▲	75 (1.6)	54 (1.6) ▲	93 (0.8)	82 (1.1) ▲
Hungary	10 (1.0)	11 (1.0)	41 (1.6)	38 (1.8)	76 (1.6)	72 (1.5) ▲	94 (0.8)	91 (0.9) ▲
Latvia (LSS)	9 (0.9)	6 (1.3)	43 (2.1)	27 (2.1) ▲	80 (1.4)	61 (1.9) ▲	96 (0.8)	88 (1.1) ▲
Cyprus	8 (0.7)	5 (0.6) ▲	34 (1.2)	21 (1.3) ▲	68 (1.2)	52 (1.5) ▲	89 (0.7)	79 (1.3) ▲
United States	7 (0.7)	9 (0.9)	35 (1.3)	37 (1.6)	72 (1.2)	71 (1.3)	93 (0.5)	92 (0.7)
Netherlands	5 (0.8)	12 (1.1) ▼	44 (1.5)	50 (1.9) ▼	89 (1.2)	87 (1.4)	99 (0.4)	99 (0.4)
Australia	5 (0.7)	6 (0.6)	26 (1.7)	27 (1.4)	64 (1.9)	61 (1.6)	88 (1.3)	86 (1.1)
New Zealand	5 (0.5)	4 (0.6)	27 (1.2)	19 (1.4) ▲	62 (1.3)	51 (1.9) ▲	86 (1.0)	78 (1.7) ▲
Scotland	3 (0.4)	7 (0.9) ▼	22 (1.4)	27 (1.7) ▼	60 (1.6)	60 (1.9)	88 (1.2)	85 (1.2)
Slovenia	2 (0.4)	2 (0.4)	18 (1.0)	14 (1.1) ▲	55 (1.5)	45 (2.0) ▲	84 (1.0)	77 (1.4) ▲
Norway	1 (0.2)	2 (0.4) ▼	10 (1.0)	16 (1.2) ▼	41 (1.3)	53 (2.0) ▼	75 (1.2)	84 (1.2) ▼
Iran, Islamic Rep. of	0 (0.1)	0 (0.2)	2 (0.3)	3 (0.7)	17 (1.3)	15 (1.9)	45 (2.2)	44 (2.5)
International Avg.	10 (0.3)	10 (0.3)	36 (0.4)	33 (0.4) ▲	69 (0.4)	63 (0.4) ▲	88 (0.3)	85 (0.3) ▲
Benchmarking Participants								
Ontario Province, Can.	5 (1.1)	4 (0.5)	29 (2.2)	22 (1.5) ▲	70 (1.7)	59 (1.9) ▲	94 (0.9)	86 (1.3) ▲
Quebec Province, Can.	3 (0.4)	13 (1.9) ▼	25 (1.5)	50 (3.4) ▼	69 (1.4)	87 (1.7) ▼	94 (0.8)	98 (0.7) ▼

▲ 2003 significantly higher

▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Benchmarking Participants

Advanced International Benchmark – 625

Summary

Students can apply their understanding and knowledge in a wide variety of relatively complex situations. They demonstrate a developing understanding of fractions and decimals and the relationship between them. They can select appropriate information to solve multi-step word problems involving proportions. They can formulate or select a rule for a relationship. They show understanding of area and can use measurement concepts to solve a variety of problems. They show some understanding of rotation. They can organize, interpret, and represent data to solve problems.

Students at this level demonstrate a developing understanding of fractions and decimals and the relationship between them. They can determine the fraction of a figure that is shaded. Given a fraction, they can identify a larger fraction with a different denominator. They can use tiles to represent one half. They can identify the decimal representation of fractions with denominators of 10 and subtract a one-place decimal from a two-place decimal. They can solve simple ratio problems and problems that involve halving whole numbers and fractions. They can select appropriate information to solve multi-step word problems involving proportions.

Students can identify the number that satisfies a number sentence with two terms on each side involving addition or division. They can identify a two-step rule for a linear relationship between the first and second numbers in a set of ordered pairs and between adjacent terms in a sequence of numbers. They can formulate a rule for a multiplicative relationship between the first and second numbers in a set of ordered pairs.

Students can use their knowledge of measurement to solve problems including conversion of metric units for capacity and time units. They can solve simple problems involving distance, time, and speed and problems involving two operations. They can estimate the length of a curved line next to the middle of a ruler. Students can use maps drawn to scale to solve problems, including locating a point between two specified points and estimating distance. Students show an understanding of area in that they can determine the area of a figure composed of squares and half squares. Students also can complete an irregular figure on a grid so that it has a given area, and recognize that area does not change when a figure is cut into parts and rearranged.

Student can draw angles greater than 90 degrees. They show some understanding of rotation in a plane and in space. For example, they can identify the position of a shape after a half-turn rotation in a plane and recognize the equivalent three-dimensional figure after rotation.

Students can organize, interpret, and represent data to solve problems. They can organize data and complete a tally chart to represent the data. They can solve problems that involve relating and interpreting values from two sets of data from a graph.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.22

TIMSS 2003 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 1

An Item that Students Reaching the Advanced International Benchmark are Likely to Answer Correctly[1]

4th grade Mathematics — TIMSS 2003

Content Area: Number

Description: Identifies the decimal representation for a fraction with a denominator of 10.

Which of these means $\frac{7}{10}$?

Ⓐ 70

Ⓑ 7

● 0.7

Ⓓ 0.07

	Country	Percent Full Credit	
	Singapore	95 (0.8)	▲
†	Hong Kong, SAR	78 (1.8)	▲
	Chinese Taipei	74 (1.8)	▲
	Belgium (Flemish)	73 (2.4)	▲
	Cyprus	65 (2.2)	▲
†	United States	62 (1.8)	▲
	Japan	60 (2.2)	▲
	Italy	58 (2.4)	▲
	Moldova, Rep. of	52 (2.6)	▲
	Comparison group	52	
	Philippines	49 (2.7)	▲
	Lithuania	48 (2.6)	▲
†	England	46 (2.5)	
	International Avg.	43 (0.4)	
†	Australia	42 (3.0)	
	Armenia	42 (2.5)	
	Russian Federation	39 (2.7)	
	New Zealand	37 (2.0)	▼
†	Netherlands	29 (2.0)	▼
	Morocco	23 (2.2)	▼
†	Scotland	22 (2.1)	▼
	Norway	17 (1.6)	▼
	Hungary	17 (1.6)	▼
	Iran, Islamic Rep. of	16 (1.6)	▼
	Tunisia	15 (1.5)	▼
	Latvia	12 (1.6)	▼
	Slovenia	8 (1.8)	▼
	Benchmarking Participants		
	Indiana State, US	59 (3.6)	▲
	Ontario Province, Can.	47 (3.3)	
	Quebec Province, Can.	26 (2.6)	▼

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.23

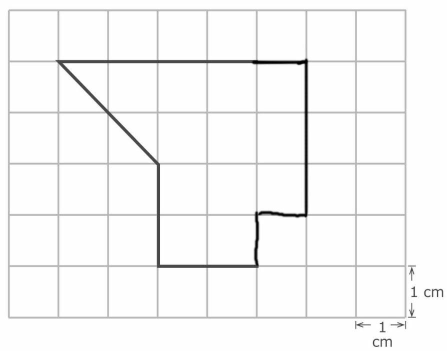
TIMSS 2003 Advanced International Benchmark (625) of Mathematics Achievement – Example Item 2

An Item that Students Reaching the Advanced International Benchmark are Likely to Answer Correctly[1]

4th grade TIMSS 2003 Mathematics

Content Area: Measurement

Description: Completes an irregular figure on a grid so that it has a given area.



The squares in the grid above have areas of 1 square centimeter. Draw lines to complete the figure so that it has an area of 13 square centimeters.

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Japan	68 (2.1)	▲
Chinese Taipei	66 (1.8)	▲
† Hong Kong, SAR	52 (2.8)	▲
Singapore	43 (2.2)	▲
Latvia	43 (2.9)	▲
Lithuania	40 (2.5)	▲
† Netherlands	37 (2.6)	▲
Moldova, Rep. of	35 (2.3)	▲
Cyprus	34 (2.3)	▲
Comparison group	34	
Russian Federation	30 (2.4)	
International Avg.	29 (0.4)	
† Scotland	29 (2.4)	
† England	29 (2.3)	
† Australia	29 (2.2)	
Belgium (Flemish)	28 (2.2)	
Hungary	26 (2.0)	
Armenia	25 (2.3)	
† United States	24 (1.7)	▼
Italy	22 (2.0)	▼
New Zealand	15 (1.6)	▼
Iran, Islamic Rep. of	11 (1.6)	▼
Slovenia	11 (1.7)	▼
Norway	10 (1.6)	▼
Morocco	9 (1.9)	▼
Tunisia	9 (1.2)	▼
Philippines	5 (1.5)	▼
Benchmarking Participants		
Indiana State, US	17 (2.2)	▼
Ontario Province, Can.	38 (2.6)	▲
Quebec Province, Can.	35 (2.6)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

High International Benchmark – 550

Summary

Student can apply their knowledge and understanding to solve problems. Student can solve multi-step word problems involving addition, multiplication, and division. They can use their understanding of place value and simple fractions to solve problems. They can identify a number sentence that represents situations. Students show understanding of three-dimensional objects, how shapes can make other shapes, and simple transformation in a plane. They demonstrate a variety of measurement skills and can interpret and use data in tables and graphs to solve problems.

Students at this level can solve multi-step word problems involving addition, multiplication, and division. They can solve word problem involving division of three-digit by one-digit whole numbers. They can use their understanding of place value to solve problems. For example, they can arrange single digits to create the largest and smallest possible numbers and to create sums and differences of numbers that meet specified criteria (i.e., sum closest to a given value, largest sum, and largest difference). They can round three-digit whole numbers to the nearest hundred, select the two-place decimal closest to a given whole number, and estimate the product of two two-digit numbers.

Students can solve problems involving 1/2 and 3/4 and by finding a fractional part of a set of objects. They can recognize the figure illustrating a simple ratio and select appropriate information to solve a simple proportional problem.

Students can extend entries in a table according to numeric rules described in a situation. They can select an expression that represents a situation involving multiplication. They can identify a number sentence that represents a situation involving division and can identify a number that satisfies such a number sentence. Students can identify the result of a specified sequence of operations on a given number and identify the missing number in a square whose rows and columns have the same sum.

Students can calculate the volume of a rectangular solid given the volume of one layer and the number of layers. Students can locate a point on a map drawn to scale between two given distances and can read scales when the interval scale represents more than one unit (e.g., 5 units). Students can solve multi step problems involving time and temperature. They can solve a word problem involving conversion between hours and minutes and read a thermometer to solve problems involving change in temperatures. Students can select an appropriate type of metric unit to measure weight (mass).

Students can use simple properties of triangles and rectangles to solve problems. They can compose and decompose shapes to make other simple shapes. They can identify two triangles that have the same shape but different sizes in a complex figure. Students have basic knowledge of transformations in a plane. For example, they can draw the reflection of a figure on a grid and identify a figure in which a line of symmetry is shown. Students demonstrate some familiarity with three-dimensional objects. They can identify a solid with curved and flat surfaces and recognize a net of a triangular prism.

Students can interpret and use data in tables and graphs to solve problems. They can use data from bar graphs, tally charts, and tables. They can compare data from two tables to draw conclusions. They can identify the label for a bar graph based on data in a tally chart.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.25 TIMSS 2003 High International Benchmark (550) of Mathematics Achievement – Example Item 3

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly¹

4th grade | TIMSS 2003 | Mathematics

Content Area: Patterns and Relationships

Description: Selects the expression that represents a situation involving multiplication.

□ represents the number of magazines that Lina reads each week.

Which of these represents the total number of magazines that Lina reads in 6 weeks?

Ⓐ $6 + \square$

● (B) $6 \times \square$

Ⓒ $\square + 6$

Ⓓ $(\square + \square) \times 6$

	Country	Percent Full Credit	
	Singapore	86 (1.4)	▲
	Chinese Taipei	81 (1.5)	▲
†	Hong Kong, SAR	76 (1.9)	▲
†	United States	72 (1.2)	▲
†	Netherlands	72 (2.7)	▲
	Belgium (Flemish)	67 (1.6)	▲
	Japan	67 (2.0)	▲
	Russian Federation	66 (2.6)	▲
	Latvia	66 (2.3)	▲
†	England	66 (2.5)	▲
	Comparison group	66	
	Cyprus	65 (2.0)	▲
	Moldova, Rep. of	64 (2.4)	▲
	Lithuania	62 (2.3)	
	Hungary	61 (2.2)	
	Slovenia	60 (2.2)	
†	Scotland	60 (2.2)	
	International Avg.	58 (0.4)	
†	Australia	56 (2.3)	
	New Zealand	54 (1.7)	▼
	Italy	50 (2.3)	▼
	Armenia	46 (2.4)	▼
	Philippines	38 (2.3)	▼
	Norway	37 (2.1)	▼
	Iran, Islamic Rep. of	34 (2.3)	▼
	Morocco	29 (2.2)	▼
	Tunisia	20 (2.0)	▼
	Benchmarking Participants		
	Indiana State, US	74 (2.0)	▲
	Ontario Province, Can.	61 (2.5)	
	Quebec Province, Can.	60 (2.4)	

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Country average significantly higher than international average ▲

Country average significantly lower than international average ▼

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.26 | TIMSS 2003 High International Benchmark (550) of Mathematics Achievement – Example Item 4 (Part B)

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly*

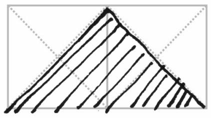
4th grade Mathematics | TIMSS 2003

Content Area: Geometry

Description: Part B–Makes and draws one square from four triangle tiles (square tiles divided diagonally into one white and one black triangle).

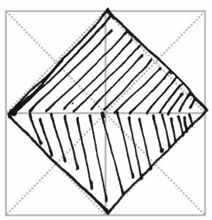
A. Use 2 of the triangle tiles to make one large black triangle. Then show what you did with your tiles by shading in your triangle below.

Shade in Your Triangle Here



B. Use all 4 triangle tiles to make a black square. Then show what you did with your tiles by shading in your square below.

Shade in Your Square Here



C. What fraction of the figure is shaded in part B above?

Answer: 1/2

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit	
	Japan	71 (2.0)	▲
†	Netherlands	60 (3.2)	▲
	Russian Federation	57 (2.3)	▲
	Lithuania	57 (2.3)	▲
	Belgium (Flemish)	55 (2.0)	▲
	Chinese Taipei	54 (1.5)	▲
†	England	54 (2.4)	▲
†	Australia	52 (3.0)	▲
	New Zealand	52 (2.3)	▲
	Comparison group	52	
	Italy	51 (2.9)	▲
†	Scotland	48 (2.9)	▲
	Norway	47 (3.1)	
	Cyprus	47 (2.3)	▲
†	Hong Kong, SAR	46 (2.0)	▲
	Singapore	45 (2.3)	
	Hungary	45 (2.1)	
	Slovenia	44 (2.6)	
†	United States	42 (1.7)	
	International Avg.	42 (0.5)	
	Moldova, Rep. of	37 (2.9)	
	Latvia	33 (2.2)	▼
	Tunisia	15 (1.5)	▼
	Iran, Islamic Rep. of	13 (2.0)	▼
	Armenia	10 (1.3)	▼
	Philippines	7 (1.0)	▼
	Morocco	5 (1.7)	▼
	Benchmarking Participants		
	Indiana State, US	42 (3.4)	
	Ontario Province, Can.	49 (2.4)	▲
	Quebec Province, Can.	49 (2.9)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* The item was answered fully correctly by a majority of students reaching this benchmark.

† Met guidelines for sample participation rates only after replacement schools were included

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Intermediate International Benchmark – 475

Summary

Students can apply basic mathematical knowledge in straightforward situations. They can read, interpret, and use different representations of numbers. They can perform operations with three- and four-digit numbers and decimals. They can extend simple patterns. They are familiar with a range of two-dimensional shapes and read and interpret different representations of the same data.

Students at this level demonstrate an understanding of and can order and operate with whole numbers. They can recognize and translate between different representations of whole numbers, including number line, pictorial representations, and expanded notation. They can identify the appropriate operations to solve multiplication and division problems. They can solve problems that involve the addition of four-digit numbers, multiplication of a three-digit by a one-digit whole number, multiplication of two two-digit numbers, and division of a three-digit by a one-digit whole number. Students can add and subtract two-place decimals. They can recognize the fractional part of a set of objects or a region, can identify the fraction that represents a given part-whole situation, and select information to solve a simple proportion problem.

Students show understanding of patterns. They can generalize from the first several terms of a numeric sequence to select another number (e.g., the tenth) that is also in the sequence. They can extend sequences based on geometric patterns or patterns involving time. They can identify the next terms in an alternating number pattern involving counting forward and backward by ones. Students can identify an expression that represents a situation involving multiplication and a number sentence that represents a situation involving subtraction.

Students have some basic knowledge of area. For example, they recognize that area does not change when parts of a figure are rearranged and the inverse relationship between the size and number of units needed to cover an area. They can read a one-month calendar and use the fact that a week has seven days to solve a problem. They can select a reasonable weight, given in metric units, for an adult.

Students are familiar with a range of two-dimensional shapes. They can draw a line to divide a rectangle into two triangles and can name common geometrical shapes in a picture. They also can identify a three dimensional object given the pictorial representation of its faces. They can locate position on a grid and describe the movement from one position to another. Students can draw a line parallel to an oblique line on a grid, and identify a pattern generated by a quarter-turn clockwise.

Students can read and interpret different representations of the same data. For example, they can match data in pie charts to tables and bar graphs. Given verbal descriptions of data or problem situations, they can use that information to complete bar graphs and a two-by-two table. They can also use information to identify the number of symbols needed to complete a pictograph when the symbol represents more than one unit.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.28

TIMSS 2003 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 5

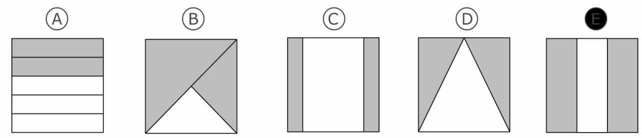
An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly[1]

4th grade Mathematics | TIMSS 2003

Content Area: Number

Description: Recognizes a familiar fraction represented by a figure with shaded parts (region model).

Which shows $\frac{2}{3}$ of the square shaded?



	Country	Percent Full Credit	
	Singapore	93 (1.0)	▲
†	Hong Kong, SAR	86 (1.7)	▲
†	United States	82 (1.1)	▲
	Chinese Taipei	81 (1.5)	▲
	Belgium (Flemish)	79 (1.8)	▲
	Japan	76 (1.5)	▲
	Cyprus	75 (1.8)	▲
†	Netherlands	73 (2.1)	▲
	Comparison group	70	
†	England	67 (2.2)	▲
†	Australia	62 (2.2)	▲
	Latvia	60 (2.8)	
	New Zealand	59 (2.2)	
	International Avg.	57 (0.4)	
	Hungary	56 (2.7)	
	Lithuania	56 (2.2)	
	Italy	55 (2.4)	
†	Scotland	52 (2.2)	▼
	Philippines	50 (2.3)	▼
	Russian Federation	49 (2.8)	▼
	Iran, Islamic Rep. of	47 (2.7)	▼
	Moldova, Rep. of	43 (2.7)	▼
	Slovenia	34 (2.5)	▼
	Armenia	29 (2.2)	▼
	Norway	29 (2.0)	▼
	Morocco	13 (1.7)	▼
	Tunisia	12 (1.6)	▼
	Benchmarking Participants		
	Indiana State, US	89 (2.2)	▲
	Ontario Province, Can.	69 (2.8)	▲
	Quebec Province, Can.	67 (2.6)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.29

TIMSS 2003 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 6

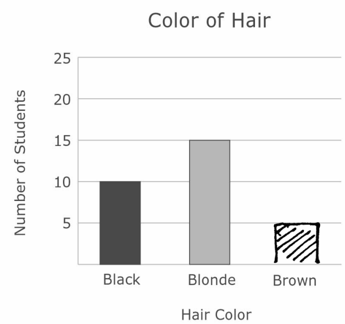
An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly*

4th grade TIMSS 2003 Mathematics

Content Area: Data

Description: Completes a bar graph based on the solution of a word problem.

In a class of 30 students, 10 have black hair, 15 have blonde hair, and the rest have brown hair. Complete the graph below to show the number of students with brown hair.



The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Belgium (Flemish)	93 (1.1)	▲
† Netherlands	93 (1.1)	▲
† Hong Kong, SAR	92 (1.0)	▲
Chinese Taipei	92 (1.1)	▲
Singapore	90 (1.2)	▲
Japan	90 (1.3)	▲
Latvia	88 (1.4)	▲
Lithuania	87 (1.8)	▲
† England	86 (1.7)	▲
Comparison group	85	
Hungary	84 (1.7)	▲
† Scotland	83 (1.8)	▲
Russian Federation	82 (2.4)	▲
† United States	82 (1.3)	▲
Cyprus	80 (1.3)	▲
New Zealand	80 (1.7)	▲
Slovenia	79 (2.3)	▲
† Australia	76 (2.1)	
Norway	75 (1.9)	
International Avg.	73 (0.4)	
Italy	71 (1.8)	
Moldova, Rep. of	67 (2.2)	▼
Armenia	50 (2.2)	▼
Philippines	29 (2.5)	▼
Iran, Islamic Rep. of	28 (2.3)	▼
Morocco	24 (3.1)	▼
Tunisia	21 (2.1)	▼
Benchmarking Participants		
Indiana State, US	84 (1.7)	▲
Ontario Province, Can.	85 (2.0)	▲
Quebec Province, Can.	83 (1.8)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

* The item was answered fully correctly by a majority of students reaching this benchmark.
† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Low International Benchmark – 400

Summary

Students have some basic mathematical knowledge. Students demonstrate an understanding of whole numbers and can do simple computations with them. They demonstrate familiarity with the basic properties of triangles and rectangles. They can read information from simple bar graphs.

Students at this level demonstrate an understanding of whole numbers. They are familiar with numbers into the thousands. They demonstrate understanding of place value and can translate between representations of whole numbers. They can add a four-digit and a three-digit whole number, multiply a two-digit by a one-digit whole number, and subtract two fractions with the same denominator. They can solve problems involving addition. Students can find the missing number in a number sentence involving multiplication by a one-digit whole number.

Students can compare areas by counting squares, identify two figures with the same shape, and draw a line to divide a rectangle into two rectangles. Students demonstrate familiarity with triangles. For example, they can identify two triangles with the same size and shape in a complex figure, recognize triangles in a set of polygons, and identify that a triangle has three sides. Given the base on a grid, students can draw a triangle whose other two sides are each the same length. Students can read information from simple bar graphs.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.31

TIMSS 2003 Low International Benchmark (400) of Mathematics Achievement – Example Item 7

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly

4th grade Mathematics — TIMSS 2003

Content Area: Number

Description: Multiply a two-digit by a one-digit whole number.

$15 \times 9 =$

Answer: 135

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit	
	Chinese Taipei	94 (1.0)	▲
	Singapore	93 (1.0)	▲
†	Hong Kong, SAR	91 (1.0)	▲
	Russian Federation	90 (1.3)	▲
	Moldova, Rep. of	88 (1.2)	▲
	Lithuania	87 (1.7)	▲
	Japan	86 (1.6)	▲
†	Netherlands	86 (1.5)	▲
	Latvia	86 (1.9)	▲
	Hungary	85 (1.6)	▲
	Armenia	85 (1.4)	▲
	Belgium (Flemish)	84 (1.4)	▲
	Cyprus	76 (1.6)	▲
	Italy	75 (2.0)	
†	United States	73 (1.2)	
	Comparison group	73	
	International Avg.	72 (0.4)	
	Tunisia	68 (2.0)	
	Slovenia	67 (2.6)	
	Iran, Islamic Rep. of	61 (2.5)	▼
†	England	59 (2.7)	▼
	Philippines	59 (2.5)	▼
†	Scotland	54 (2.2)	▼
†	Australia	45 (2.4)	▼
	New Zealand	41 (2.0)	▼
	Morocco	36 (3.1)	▼
	Norway	30 (1.9)	▼
Benchmarking Participants			
	Indiana State, US	78 (2.3)	▲
	Ontario Province, Can.	54 (2.7)	▼
	Quebec Province,	66 (2.3)	▼

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

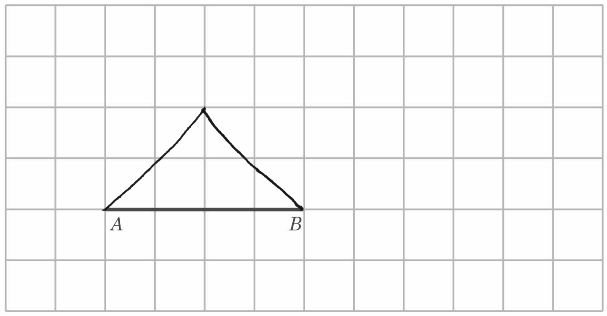
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

Exhibit 4.32 TIMSS 2003 Low International Benchmark (400) of Mathematics Achievement – Example Item 8

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly¹

Content Area: Measurement

Description: Given the base draws a triangle on a grid with the other two sides the same length.



Draw a triangle in the grid so that the line AB is the base of the triangle and the two new sides are the same length as each other.

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
† Hong Kong, SAR	95 (0.9)	▲
Latvia	84 (1.4)	▲
Japan	80 (1.8)	▲
New Zealand	80 (1.8)	▲
Singapore	77 (1.8)	▲
Russian Federation	77 (2.3)	▲
Belgium (Flemish)	77 (1.8)	▲
† Australia	77 (2.1)	▲
Italy	77 (1.9)	▲
Comparison group	77	
Lithuania	74 (1.9)	▲
† England	73 (2.1)	▲
Hungary	72 (2.0)	▲
† Scotland	71 (2.2)	
Chinese Taipei	70 (1.5)	
Moldova, Rep. of	67 (2.8)	
International Avg.	67 (0.4)	
Slovenia	64 (2.7)	
† United States	63 (1.4)	▼
Norway	58 (2.3)	▼
Cyprus	57 (2.1)	▼
Armenia	56 (2.0)	▼
Iran, Islamic Rep. of	48 (2.7)	▼
Philippines	45 (2.7)	▼
Morocco	42 (2.6)	▼
Tunisia	28 (1.7)	▼
Benchmarking Participants		
Indiana State, US	64 (2.9)	
Ontario Province, Can.	76 (2.2)	▲
Quebec Province, Can.	68 (2.2)	

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

1 National Desired Population does not cover all of International Desired Population.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

4.3 Performance at the grade 8 science international benchmarks

As in science at grade 4, England's performance was well above the international average at each benchmark for grade 8 (see Exhibit 4.33).

Exhibit 4.33 Proportions of pupils reaching each benchmark, grade 8 science

	Advanced International Benchmark	High International Benchmark	Intermediate International Benchmark	Low International Benchmark
England 2003	15%	48%	81%	96%
International Average	6%	26%	56%	79%
Comparison Group Average	11%	43%	78%	95%
England 1999	17%	45%	76%	94%
England 1995	15%	43%	75%	93%

In England 15 per cent of pupils attained the advanced benchmark in grade 8 science. Singapore (33 per cent) and Chinese Taipei (26 per cent) outperformed England. England's performance was similar at the other benchmarks. The international average was 6 per cent and that for the comparison group 11 per cent. While there was no rise in performance in England generally, more English students reached the intermediate benchmark than in 1995, and more achieved the low benchmark than in 1995 or 1999.

England's performance on the eight sample items (see Exhibits 4.38 to 4.48) was in line with the country's overall performance and compared with that of the comparison group countries. England's average percentage correct for these items was 66 per cent, while the group as whole averaged 63 per cent. England's performance relative to the group was best on samples items 1 and 4, in both cases England scoring 12 per cent higher than the group average. England's performance was also strong on the two items illustrating the low benchmark, items 7 and 8.

Advanced International Benchmark – 625

Students demonstrate a grasp of some complex and abstract science concepts. They can apply knowledge of the solar system and of Earth features, processes, and conditions, and apply understanding of the complexity of living organisms and how they relate to their environment. They show understanding of electricity, thermal expansion, and sound, as well as the structure of matter and physical and chemical properties and changes. They show understanding of environmental and resource issues. Students understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations to communicate scientific knowledge.

High International Benchmark – 550

Students demonstrate conceptual understanding of some science cycles, systems, and principles. They have some understanding of Earth's processes and the solar system, biological systems, populations, reproduction and heredity, and structure and function of organisms. They show some understanding of physical and chemical changes, and the structure of matter. They solve some basic physics problems related to light, heat, electricity, and magnetism, and they demonstrate basic knowledge of major environmental issues. They demonstrate some scientific inquiry skills. They can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge and cause/effect relationships.

Intermediate International Benchmark – 475

Students can recognize and communicate basic scientific knowledge across a range of topics. They recognize some characteristics of the solar system, water cycle, animals, and human health. They are acquainted with some aspects of energy, force and motion, light reflection, and sound. Students demonstrate elementary knowledge of human impact on and changes in the environment. They can apply and briefly communicate knowledge, extract tabular information, extrapolate from data presented in a simple linear graph, and interpret pictorial diagrams.

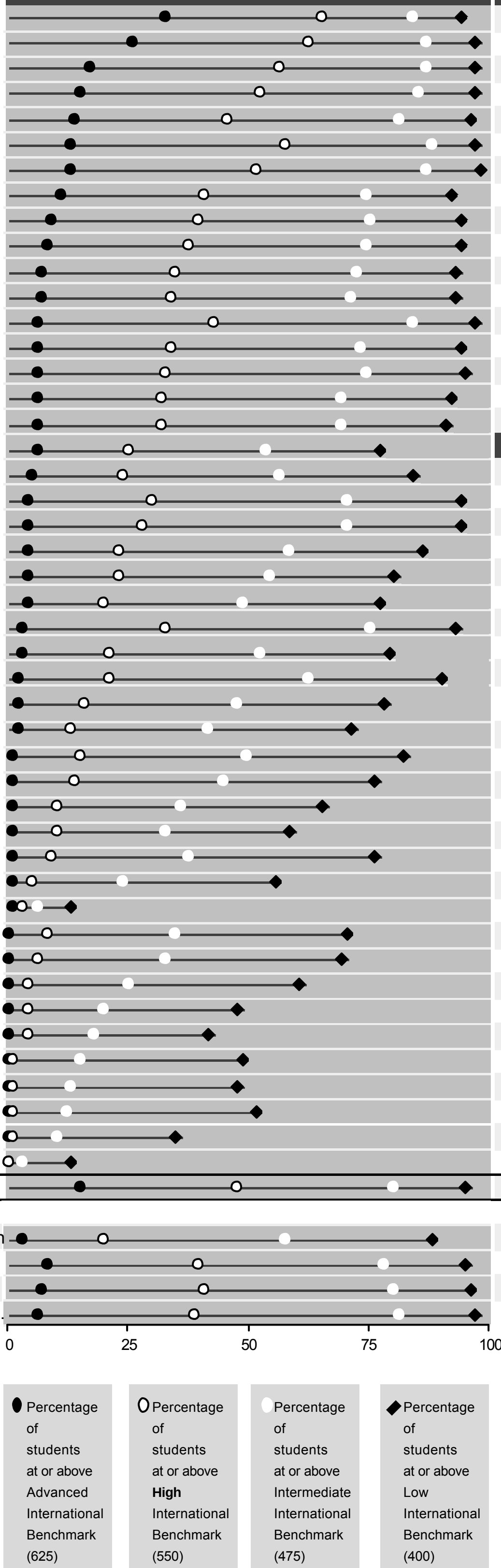
Low International Benchmark – 400

Students recognize some basic facts from the life and physical sciences. They have some knowledge of the human body and heredity, and demonstrate familiarity with some everyday physical phenomena. Students can interpret some pictorial diagrams and apply knowledge of simple physical concepts to practical situations.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.35 Percentages of Students Reaching TIMSS 2003 International Benchmarks of Science Achievement

8th grade Science — TIMSS 2003



	Countries	Advanced International Benchmark (625)	High International Benchmark (550)	Intermediate International Benchmark (475)	Low International Benchmark (400)
	Singapore	33 (1.6)	66 (2.3)	85 (1.7)	95 (0.8)
	Chinese Taipei	26 (1.5)	63 (1.9)	88 (1.1)	98 (0.4)
¿	Korea, Rep. of	17 (0.9)	57 (1.1)	88 (0.7)	98 (0.4)
⚐	Japan	15 (0.7)	53 (1.1)	86 (0.8)	98 (0.3)
	Hungary	14 (1.1)	46 (1.7)	82 (1.1)	97 (0.6)
†	Hong Kong, SAR	13 (1.2)	58 (1.9)	89 (1.4)	98 (0.7)
	Estonia	13 (1.0)	52 (1.6)	88 (1.2)	99 (0.3)
‡	United States	11 (0.8)	41 (1.7)	75 (1.4)	93 (0.8)
	Australia	9 (1.1)	40 (2.0)	76 (1.9)	95 (0.8)
	Sweden	8 (0.8)	38 (1.6)	75 (1.4)	95 (0.7)
	New Zealand	7 (1.5)	35 (3.0)	73 (2.2)	94 (1.3)
	Slovak Republic	7 (0.8)	34 (1.8)	72 (1.5)	94 (0.7)
†	Netherlands	6 (0.8)	43 (2.4)	85 (1.7)	98 (0.7)
1	Lithuania	6 (0.6)	34 (1.2)	74 (1.3)	95 (0.6)
	Slovenia	6 (0.5)	33 (1.3)	75 (1.3)	96 (0.6)
	Russian Federation	6 (0.8)	32 (1.8)	70 (1.8)	93 (0.9)
†	Scotland	6 (0.7)	32 (1.9)	70 (1.7)	92 (0.9)
	International Avg.	6 (0.1)	25 (0.2)	54 (0.2)	78 (0.2)
2	Israel	5 (0.5)	24 (1.3)	57 (1.6)	85 (1.1)
	Latvia	4 (0.4)	30 (1.5)	71 (1.6)	95 (0.6)
	Malaysia	4 (0.8)	28 (2.2)	71 (2.0)	95 (0.7)
	Italy	4 (0.6)	23 (1.5)	59 (1.5)	87 (1.1)
	Bulgaria	4 (0.7)	23 (1.7)	55 (2.1)	81 (2.0)
	Romania	4 (0.8)	20 (1.8)	49 (2.2)	78 (1.9)
	Belgium (Flemish)	3 (0.3)	33 (1.6)	76 (1.4)	94 (0.9)
	Jordan	3 (0.5)	21 (1.4)	53 (1.8)	80 (1.3)
	Norway	2 (0.3)	21 (1.1)	63 (1.3)	91 (0.8)
1	Serbia	2 (0.3)	16 (1.0)	48 (1.3)	79 (1.0)
2	Macedonia, Rep. of	2 (0.3)	13 (1.2)	42 (1.8)	72 (1.5)
	Moldova, Rep. of	1 (0.3)	15 (1.2)	50 (1.9)	83 (1.5)
	Armenia	1 (0.3)	14 (1.3)	45 (1.9)	77 (1.4)
	Palestinian Nat'l Auth.	1 (0.2)	10 (0.8)	36 (1.4)	66 (1.5)
	Egypt	1 (0.2)	10 (0.7)	33 (1.4)	59 (1.6)
	Iran, Islamic Rep. of	1 (0.2)	9 (0.6)	38 (1.3)	77 (1.3)
	Chile	1 (0.1)	5 (0.6)	24 (1.3)	56 (1.5)
	South Africa	1 (0.2)	3 (0.7)	6 (1.4)	13 (1.9)
	Cyprus	0 (0.2)	8 (0.6)	35 (1.0)	71 (1.2)
	Bahrain	0 (0.1)	6 (0.6)	33 (1.1)	70 (1.2)
1	Indonesia	0 (0.1)	4 (0.5)	25 (1.8)	61 (2.1)
	Lebanon	0 (0.1)	4 (0.7)	20 (1.5)	48 (2.0)
	Philippines	0 (0.1)	4 (0.6)	18 (1.7)	42 (2.5)
	Saudi Arabia	0 (0.0)	1 (0.4)	15 (1.5)	49 (2.3)
‡	Morocco	0 (0.0)	1 (0.3)	13 (1.1)	48 (1.9)
	Tunisia	0 (0.0)	1 (0.2)	12 (1.0)	52 (1.5)
	Botswana	0 (0.1)	1 (0.5)	10 (0.9)	35 (1.3)
	Ghana	0 (0.0)	0 (0.1)	3 (0.4)	13 (1.3)
⚐ ¶	England	15 (1.7)	48 (2.7)	81 (1.8)	96 (0.6)
	Benchmarking Participants				
	Basque Country, Spain	3 (0.6)	20 (1.5)	58 (1.9)	89 (0.9)
	Indiana State, US	8 (1.5)	40 (2.8)	79 (2.1)	96 (0.8)
	Ontario Province, Can.	7 (0.7)	41 (1.8)	81 (1.2)	97 (0.5)
	Quebec Province, Can.	6 (1.0)	39 (2.0)	82 (1.5)	98 (0.4)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
⚐ Shows where England's result would be if the sample participation rates had been satisfied.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.36

Trends in Percentages of Students Reaching TIMSS 2003 International Benchmarks of Science Achievement in 1995, 1999, and 2003

8th grade | TIMSS 2003 | Science

Countries	Advanced International Benchmark (625)			High International Benchmark (550)		
	2003 (Percent of Students)	1999 (Percent of Students)	1995 (Percent of Students)	2003 (Percent of Students)	1999 (Percent of Students)	1995 (Percent of Students)
Singapore	33 (1.6)	29 (3.2)	29 (3.2)	66 (2.3)	60 (3.5)	64 (2.8)
Chinese Taipei	26 (1.5)	27 (1.8)	' '	63 (1.9)	61 (2.1)	' '
Korea, Rep. of	17 (0.9)	19 (1.1)	17 (1.0)	57 (1.1)	50 (1.2) ▲	50 (1.2) ▲
Japan	15 (0.7)	16 (1.0)	18 (0.9) ▼	53 (1.1)	52 (1.3)	54 (1.1)
¶ England						
Hungary	14 (1.1)	19 (1.3) ▼	12 (1.1)	46 (1.7)	53 (1.8) ▼	44 (1.7)
Hong Kong, SAR	13 (1.2)	7 (0.9) ▲	7 (1.0) ▲	58 (1.9)	40 (2.1) ▲	33 (2.7) ▲
United States	11 (0.8)	12 (1.0)	11 (1.1)	41 (1.7)	37 (1.9)	38 (2.0)
Australia	9 (1.1)	– –	10 (1.1)	40 (2.0)	– –	36 (1.7)
Sweden	8 (0.8)	' '	19 (1.6) ▼	38 (1.6)	' '	52 (2.4) ▼
Slovak Republic	7 (0.8)	12 (1.1) ▼	12 (1.3) ▼	34 (1.8)	43 (1.7) ▼	42 (1.7) ▼
New Zealand	7 (1.5)	10 (1.3)	9 (1.2)	35 (3.0)	35 (2.2)	34 (2.1)
Netherlands	6 (0.8)	14 (2.1) ▼	12 (1.8) ▼	43 (2.4)	50 (3.6)	48 (2.8)
Russian Federation	6 (0.8)	15 (2.3) ▼	11 (1.1) ▼	32 (1.8)	41 (2.8) ▼	38 (2.3) ▼
Lithuania	6 (0.6)	5 (0.9)	2 (0.5) ▲	34 (1.2)	22 (1.8) ▲	14 (1.5) ▲
Scotland	6 (0.7)	' '	9 (1.4)	32 (1.9)	' '	30 (2.5)
Slovenia	6 (0.5)	– –	8 (0.8) ▼	33 (1.3)	– –	32 (1.5)
Israel	5 (0.5)	5 (0.5)	– –	24 (1.3)	23 (1.4)	– –
Latvia (LSS)	4 (0.6)	5 (1.1)	3 (0.6)	30 (1.8)	27 (2.5)	18 (1.1) ▲
Bulgaria	4 (0.7)	12 (2.0) ▼	22 (1.7) ▼	23 (1.7)	38 (2.6) ▼	46 (2.3) ▼
Italy	4 (0.6)	6 (0.9) ▼	– –	23 (1.5)	26 (1.8)	– –
Romania	4 (0.8)	5 (0.8)	5 (0.8)	20 (1.8)	21 (2.1)	22 (1.8)
Malaysia	4 (0.8)	5 (0.8)	' '	28 (2.2)	24 (2.0)	' '
Jordan	3 (0.5)	4 (0.5)	' '	21 (1.4)	17 (1.0) ▲	' '
Belgium (Flemish)	3 (0.3)	9 (1.3) ▼	9 (1.0) ▼	33 (1.6)	44 (1.5) ▼	45 (2.5) ▼
Norway	2 (0.3)	' '	6 (0.6) ▼	21 (1.1)	' '	32 (1.5) ▼
Macedonia, Rep. of	2 (0.3)	3 (0.4) ▼	' '	13 (1.2)	17 (1.9) ▼	' '
Moldova, Rep. of	1 (0.3)	4 (0.4) ▼	' '	15 (1.2)	17 (1.3)	' '
Iran, Islamic Rep. of	1 (0.2)	1 (0.3)	1 (0.4)	9 (0.6)	11 (1.3)	11 (1.3)
South Africa	1 (0.2)	0 (0.2)	– –	3 (0.7)	2 (0.7)	– –
Chile	1 (0.1)	1 (0.3)	' '	5 (0.6)	7 (1.1)	' '
Cyprus	0 (0.2)	2 (0.4) ▼	2 (0.4) ▼	8 (0.6)	14 (0.8) ▼	15 (1.0) ▼
Philippines	0 (0.1)	1 (0.2)	' '	4 (0.6)	4 (0.7)	' '
Indonesia	0 (0.1)	1 (0.3) ▼	' '	4 (0.5)	8 (1.0) ▼	' '
Tunisia	0 .	0 (0.1)	' '	1 (0.2)	3 (0.5) ▼	' '
¶ England	15 (1.7)	17 (1.7)	15 (1.7)	48 (2.7)	45 (2.4)	43 (1.8)
International Avg.	7 (0.2)	9 (0.2) ▼	11 (0.3) ▼	30 (0.3)	30 (0.3)	37 (0.4) ▼
Benchmarking Participants						
Indiana State, US	8 (1.5)	14 (2.1) ▼	' '	40 (2.8)	44 (3.5)	' '
Ontario Province, Can.	7 (0.7)	7 (0.9)	5 (0.6)	41 (1.8)	34 (1.6) ▲	26 (1.6) ▲
Quebec Province, Can	6 (1.0)	10 (2.2)	7 (1.5)	39 (2.0)	43 (3.7)	30 (2.8) ▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 4.36

Trends in Percentages of Students Reaching TIMSS 2003 International Benchmarks of Science Achievement in 1995, 1999, and 2003

8th grade TIMSS 2003 Science

Countries	Intermediate International Benchmark (475)			Low International Benchmark (400)		
	2003 (Percent of Students)	1999 (Percent of Students)	1995 (Percent of Students)	2003 (Percent of Students)	1999 (Percent of Students)	1995 (Percent of Students)
Singapore	85 (1.7)	84 (2.4)	91 (1.3) ▼	95 (0.8)	95 (1.2)	99 (0.2) ▼
Chinese Taipei	88 (1.1)	86 (1.3)	' '	98 (0.4)	96 (0.6) ▲	' '
Korea, Rep. of	88 (0.7)	81 (1.0) ▲	81 (0.9) ▲	98 (0.4)	96 (0.4) ▲	95 (0.5) ▲
Japan	86 (0.8)	84 (0.9)	85 (0.7)	98 (0.3)	97 (0.4)	97 (0.3)
¶ England						
Hungary	82 (1.1)	83 (1.3)	80 (1.5)	97 (0.6)	96 (0.8)	95 (0.7)
Hong Kong, SAR	89 (1.4)	80 (1.9) ▲	70 (2.7) ▲	98 (0.7)	96 (0.9)	90 (1.7) ▲
United States	75 (1.4)	67 (1.9) ▲	68 (2.2) ▲	93 (0.8)	87 (1.3) ▲	87 (1.6) ▲
Australia	76 (1.9)	– –	69 (1.6) ▲	95 (0.8)	– –	89 (1.0) ▲
Sweden	75 (1.4)	' '	83 (1.7) ▼	95 (0.7)	' '	97 (0.7) ▼
Slovak Republic	72 (1.5)	79 (1.4) ▼	77 (1.5) ▼	94 (0.7)	96 (0.6) ▼	95 (0.6)
New Zealand	73 (2.2)	66 (2.0) ▲	67 (2.2) ▲	94 (1.3)	88 (1.4) ▲	89 (1.2) ▲
Netherlands	85 (1.7)	83 (3.3)	82 (2.7)	98 (0.7)	96 (1.2)	96 (2.0)
Russian Federation	70 (1.8)	73 (2.3)	71 (2.2)	93 (0.9)	92 (1.0)	92 (1.1)
Lithuania	74 (1.3)	57 (2.0) ▲	45 (2.2) ▲	95 (0.6)	86 (1.7) ▲	79 (1.6) ▲
Scotland	70 (1.7)	' '	61 (2.2) ▲	92 (0.9)	' '	86 (1.4) ▲
Slovenia	75 (1.3)	– –	69 (1.6) ▲	96 (0.6)	– –	93 (0.7) ▲
Israel	57 (1.6)	50 (2.1) ▲	– –	85 (1.1)	75 (2.0) ▲	– –
Latvia (LSS)	72 (1.8)	65 (1.9) ▲	51 (1.8) ▲	95 (0.9)	91 (1.2) ▲	83 (1.4) ▲
Bulgaria	55 (2.1)	70 (2.0) ▼	75 (1.9) ▼	81 (2.0)	89 (1.4) ▼	93 (1.1) ▼
Italy	59 (1.5)	59 (2.0)	– –	87 (1.1)	86 (1.2)	– –
Romania	49 (2.2)	50 (2.6)	51 (2.2)	78 (1.9)	78 (2.0)	77 (1.7)
Malaysia	71 (2.0)	59 (2.2) ▲	' '	95 (0.7)	87 (1.4) ▲	' '
Jordan	53 (1.8)	42 (1.4) ▲	' '	80 (1.3)	69 (1.6) ▲	' '
Belgium (Flemish)	76 (1.4)	81 (1.5) ▼	80 (3.0)	94 (0.9)	97 (1.0) ▼	94 (2.0)
Norway	63 (1.3)	' '	72 (1.3) ▼	91 (0.8)	' '	94 (0.9) ▼
Macedonia, Rep. of	42 (1.8)	46 (2.0)	' '	72 (1.5)	73 (2.2)	' '
Moldova, Rep. of	50 (1.9)	44 (1.8) ▲	' '	83 (1.5)	74 (1.6) ▲	' '
Iran, Islamic Rep. of	38 (1.3)	38 (1.8)	43 (2.2) ▼	77 (1.3)	72 (1.8) ▲	81 (1.8) ▼
South Africa	6 (1.4)	7 (1.5)	– –	13 (1.9)	14 (2.1)	– –
Chile	24 (1.3)	27 (1.7)	' '	56 (1.5)	60 (1.5) ▼	' '
Cyprus	35 (1.0)	45 (1.5) ▼	43 (1.3) ▼	71 (1.2)	77 (1.1) ▼	72 (1.1)
Philippines	18 (1.7)	15 (1.9)	' '	42 (2.5)	34 (2.7) ▲	' '
Indonesia	25 (1.8)	33 (1.7) ▼	' '	61 (2.1)	68 (2.5) ▼	' '
Tunisia	12 (1.0)	25 (1.6) ▼	' '	52 (1.5)	68 (2.1) ▼	' '
¶ England	81 (1.8)	76 (1.9)	75 (1.4) ▲	96 (0.6)	94 (0.7) ▲	93 (0.7) ▲
International Avg.	61 (0.3)	58 (0.3) ▲	69 (0.4) ▼	84 (0.3)	81 (0.3) ▲	90 (0.2) ▼
Benchmarking Participants						
Indiana State, US	79 (2.1)	76 (2.6)	' '	96 (0.8)	93 (1.3) ▲	' '
Ontario Province, Can.	81 (1.2)	72 (1.6) ▲	61 (1.9) ▲	97 (0.5)	95 (0.5) ▲	88 (1.1) ▲
Quebec Province, Can	82 (1.5)	83 (2.4)	69 (3.5) ▲	98 (0.4)	98 (0.5)	92 (2.6) ▲

▲ 2003 significantly higher

▼ 2003 significantly lower

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An inverted comma (') indicates the country did not participate in the assessment.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Advanced International Benchmark – 625

Summary

Students demonstrate a grasp of some complex and abstract science concepts. They can apply knowledge of the solar system and of Earth features, processes, and conditions, and apply understanding of the complexity of living organisms and how they relate to their environment. They show understanding of electricity, thermal expansion, and sound, as well as the structure of matter and physical and chemical properties and changes. They show understanding of environmental and resource issues. Students understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations to communicate scientific knowledge.

Students can apply knowledge of the solar system and of Earth features, processes, and conditions. They relate the changing seasons to the tilt in Earth's axis as it orbits the Sun and the phases of the Moon to its motion around Earth. They recognize the gravitational pull of the moon as the major cause of tides. They recognize that surface temperature of a planet is amplified by atmospheric composition and can relate latitude to average yearly temperature. Students identify a physical process that causes weathering of rocks and, from a list of rock types, identify limestone as the type involved in the formation of underground caves. Students recognize the low percentage of water on Earth that is fresh.

Students show understanding of the complexity of living organisms and how they relate to their environment. They recognize the hierarchy of organization in living organisms, and can state one structure that is found in plant but not animal cells. They state two factors in addition to chlorophyll that are needed for photosynthesis, can explain that photosynthesis takes place when light is shone on a plant, and recognize that the gas given off is oxygen. They can justify their choice of plants or animals as the likely first inhabitants of an island, and state one effect of introducing a new predator. They recognize that producers use energy from the sun to make food chemical elements and that recycle back into the environment when animals and plants die. Students also know some animal adaptations needed for survival including physical and behavioral characteristics. In addition, they can list some conditions that are found at the bottom of oceans that make it difficult for most organisms to live there, and recognize that fossils found in sedimentary rock are formed from organisms that lived in the sea. In the area of human health, students recognize that leafy vegetables are a good source of minerals and that vaccines provide the body with long-term immunity.

Students show understanding of physics principles and phenomena, including electricity, thermal expansion, and sound. They interpret a circuit diagram and recognizes that the current flows through two bulbs is the same and recognize that an iron nail becomes magnetized when current flows through a wire coiled around the nail. They recognize that mass is conserved during thermal expansion and that railway tracks have gaps to allow for thermal expansion. They recognize that the motion and arrangement of particles of a liquid are slower and closer together than those of gas particles. Students also recognize that force of gravity acts on a person regardless of position and movement. They can describe what is seen when sunlight passes through a glass prism. They recognize that plucking a guitar string harder affects the volume rather than the pitch of sound produced, and they can predict the effect of removing air on the propagation of sound.

Students demonstrate an understanding of the structure of matter as well as of physical and chemical properties and changes. They recognize that the nucleus of most atoms is composed of protons and neutrons, that an ion is formed when a neutral atom gains an electron, and that the diagram that best represents the structure of water molecules. They identify which of oxygen, hydrogen, and water are elements and distinguish between mixtures and a pure substance (sugar). Students recognize that sugar molecules continue to exist when sugar is dissolved in water. They recognize that water should be added to a saline solution to make it half as concentrated, and determine the amount of water necessary. Based on an incomplete table comparing pure water and salt water, students can explain that the addition of salt to water produces a solution of greater density. They can distinguish between chemical and physical changes, identify oxygen as the gas that causes rust formation, and recognize that both burning coal and exploding fireworks release energy. Students explain why litmus paper does not change color in a mixture of the right proportions of an acid and a base. Students can identify a property of metals and describe how this property may be used to determine whether a substance is a metal or nonmetal. They recognize that electrical conductivity has been used to classify materials into two groups. Students can calculate the density of a metal in a block given the block's mass and length of its sides. They can compare the previously computed density of a metal block to the densities of different metals presented in a table, infer what metal the block is made of, and explain their answers.

Students show understanding of environmental and resource issues. They can state one renewable energy source and describe one way it can be used, and recognize coal as a non-renewable resource. Students recognize that increased algal growth in a lake is likely due to fertilizer runoff, can explain how acid rain is formed from the burning of fossil fuels, and can describe how science and technology may be used to address oil spills in the oceans. Based on demographic and other information, students can predict population change and explain how this will affect land use and pollution. They can state one reason why the human population increased rapidly over the last 200 years.

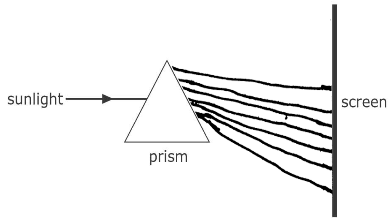
Students demonstrate understanding of some fundamentals of scientific investigation. In an experimental situation, they recognize which variables to control, what questions can be addressed by an investigation, why scientists make repeated measurements and how an estimate may be improved by averaging repeated measurements. Given a set of equipment, they can design a procedure to measure the volume of an irregularly-shaped object. They apply basic physical principles to solve some quantitative problems and develop explanations involving abstract concepts. They can compare information from several sources, combine information to draw conclusions, and interpret information in diagrams, maps, graphs, and tables to solve problems. They can provide written explanations to communicate scientific knowledge.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Content Area: Physics

Description: Describes that a spectrum can be seen when sunlight passes through by a glass prism.

The diagram shows a ray of sunlight entering a glass prism.



Describe what will be seen on the screen.
(You may draw on the diagram to help explain your answer.)

On the screen, you will see the 7 colors of the rainbow.

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit	
¿	Korea, Rep. of	74 (2.1)	▲
	Singapore	65 (2.5)	▲
	Malaysia	53 (3.0)	▲
†	Hong Kong, SAR	49 (2.5)	▲
‡	United States	49 (2.2)	▲
¶	England		▲
†	Netherlands	45 (3.5)	▲
	New Zealand	43 (3.3)	▲
	Chinese Taipei	38 (2.5)	▲
	Jordan	36 (2.8)	▲
	Comparison group	35	
	Bahrain	34 (2.8)	▲
	Armenia	33 (3.6)	▲
	Palestinian Nat'l Auth.	33 (2.6)	▲
	Lithuania	32 (3.0)	▲
	Iran, Islamic Rep. of	31 (2.6)	▲
†	Scotland	28 (2.9)	
	Sweden	25 (2.7)	
	Egypt	24 (2.0)	
	Hungary	24 (2.6)	
	Italy	24 (2.7)	
	International Avg.	23 (0.3)	
	Australia	22 (2.8)	
	Estonia	20 (2.5)	
	Romania	18 (2.3)	▼
	Israel	17 (2.3)	▼
	Latvia	17 (2.5)	▼
	Belgium (Flemish)	15 (1.9)	▼
	Norway	15 (2.0)	▼
	Slovenia	15 (2.3)	▼
	Saudi Arabia	14 (2.6)	▼
	Chile	11 (1.5)	▼
	Russian Federation	11 (2.0)	▼
	Philippines	10 (1.2)	▼
	Japan	10 (1.6)	▼
	Indonesia	9 (1.4)	▼
	Lebanon	7 (1.6)	▼
	Bulgaria	7 (1.7)	▼
	Macedonia, Rep. of	7 (1.6)	▼
	Slovak Republic	6 (1.4)	▼
	Botswana	5 (1.0)	▼
	Cyprus	4 (1.3)	▼
	South Africa	3 (0.9)	▼
	Moldova, Rep. of	2 (0.8)	▼
	Serbia	2 (0.8)	▼
	Ghana	1 (0.4)	▼
‡	Morocco	1 (0.7)	▼
	Tunisia	0 (0.3)	▼
¶	England	47 (4.7)	▲
	Benchmarking Participants		
	Basque Country, Spain	16 (3.0)	▼
	Indiana State, US	44 (3.4)	▲
	Ontario Province, Can.	66 (3.9)	▲
	Quebec Province, Can.	45 (3.0)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included (see Exhibit A.8).
¶ Did not satisfy guidelines for sample participation rates (see Exhibit A.8).
1 National Desired Population does not cover all of International Desired Population (see Exhibit A.5).
2 National Defined Population covers less than 90% of National Desired Population (see Exhibit A.5).
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

TIMSS 2003 Advanced International Benchmark (625) of Science Achievement – Example Item 2

An Item that Students Reaching the Advanced International Benchmark are Likely to Answer Correctly*

Content Area: Earth Science

Description: Given a table showing information about Venus and Mercury, recognizes that the higher average surface temperature on Venus is due to the greenhouse effect.

The table shows some information about the planets Venus and Mercury.

	Average Surface Temperature (°C)	Atmospheric Composition	Mean Distance from the Sun (millions of km)	Time to Revolve Around the Sun (Number of Days)
Venus	470	Mostly Carbon Dioxide	108	225
Mercury	300	Trace amounts of gases	58	88

Which of the following best explains why the surface temperature of Venus is higher than that of Mercury?

(A) There is less absorption of sunlight on Mercury because of the lack of atmospheric gases.

(B) The high percentage of carbon dioxide in the atmosphere of Venus causes a greenhouse effect.

(C) The longer time for Venus to revolve around the Sun allows it to absorb more heat from the Sun.

(D) The Sun's rays are less direct on Mercury because it is closer to the Sun.

	Country	Percent Full Credit	
¿	Korea, Rep. of	70 (1.9)	▲
†	Hong Kong, SAR	69 (1.7)	▲
	Chinese Taipei	69 (1.6)	▲
	Singapore	60 (1.8)	▲
‡	United States	49 (1.5)	▲
	Australia	48 (2.6)	▲
	Japan	47 (1.9)	▲
	Comparison group	46	
	Egypt	46 (1.8)	▲
	Sweden	46 (2.6)	▲
	New Zealand	45 (2.4)	▲
¶	England		▲
	Lithuania	44 (2.1)	▲
	Estonia	43 (2.6)	▲
	Israel	41 (2.3)	▲
	Hungary	41 (2.4)	▲
†	Scotland	40 (2.5)	
	Slovenia	39 (2.4)	
	Latvia	38 (2.3)	
	Italy	38 (2.2)	
†	Netherlands	38 (2.4)	
	Slovak Republic	38 (2.0)	
	Belgium (Flemish)	38 (1.6)	
	Russian Federation	37 (3.0)	
	International Avg.	36 (0.3)	
	Serbia	34 (2.1)	
	Norway	34 (2.0)	
	Iran, Islamic Rep. of	33 (1.9)	
	Bulgaria	33 (2.2)	
	Malaysia	31 (1.8)	▼
	Chile	30 (1.6)	▼
	Cyprus	30 (1.6)	▼
	Palestinian Nat'l Auth.	28 (1.6)	▼
	Bahrain	28 (1.8)	▼
	Romania	28 (2.2)	▼
	Philippines	28 (1.4)	▼
	Jordan	28 (1.9)	▼
	Botswana	24 (1.7)	▼
	Moldova, Rep. of	24 (2.1)	▼
	Lebanon	24 (1.6)	▼
	South Africa	23 (1.3)	▼
	Ghana	22 (1.7)	▼
	Tunisia	19 (1.3)	▼
	Saudi Arabia	18 (2.0)	▼
	Indonesia	16 (1.4)	▼
‡	Morocco	16 (1.8)	▼
	Macedonia, Rep. of	15 (1.7)	▼
	Armenia	15 (1.7)	▼
¶	England	44 (3.0)	▲
	Benchmarking Participants		
	Basque Country, Spain	34 (2.6)	
	Indiana State, US	45 (2.9)	▲
	Ontario Province, Can.	40 (2.3)	
	Quebec Province, Can.	47 (2.4)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

High International Benchmark – 550

Summary

Students demonstrate conceptual understanding of some science cycles, systems, and principles. They have some understanding of Earth's processes and the solar system, biological systems, populations, reproduction and heredity, and structure and function of organisms. They show some understanding of physical and chemical changes, and the structure of matter. They solve some basic physics problems related to light, heat, electricity, and magnetism, and they demonstrate basic knowledge of major environmental issues. They demonstrate some scientific inquiry skills. They can combine information to draw conclusions; interpret information in diagrams, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge and cause/effect relationships.

Students have some understanding of Earth's processes and the solar system. They can recognize a definition of sedimentary rock and know that fossil fuels are formed from the remains of living things. They recognize that Earthquakes and volcanoes occur along the boundaries of tectonic plates. Students recognize how a river changes as it flows from a mountain to a plain, can describe how atmospheric conditions on Earth change with increasing elevation, and can predict the likely location of a jungle relative to a mountain. Students recognize some features of the solar system, including the main differences between planets and moons, the definition of an Earth year and the relative distances of the Sun and Moon from Earth.

Students show some understanding of ecosystems, population, and structure and function. They interpret a diagram depicting the exchange of gases in a forest ecosystem, demonstrate an understanding of interrelations of plants and animals in ecosystems, and recognize that the loss of a food supply is likely the cause of a drop in population size. They also can explain that camouflage helps animals survive. They recognize that the main function of chlorophyll in plants is to absorb light energy. Students demonstrate some understanding of reproduction and heredity by recognizing that sperm and egg join during fertilization, and explaining that acquired characteristics such as the loss of a kidney cannot be passed onto the next generation. Students can state the importance of exercise for good health, and recognize which food source contains fat. They can identify some functions of blood, and know one function of the uterus. They can describe how body temperature in humans is controlled. In addition, students can determine characteristics used to sort animals into classification groups.

Students can analyze situations and solve some basic problems related to light, heat, magnetism, and electricity. For example, they can relate shadow size to distance from a light source. They can recognize a ray diagram showing the path of light reflected from a mirror. They can also explain why lightning is seen before thunder is heard. Students also recognize that conduction is a process by which heat is transferred along a metal rod, that metal conducts heat faster than glass, wood, or plastic, that the thermal expansion of alcohol is greater than that of glass, and that gas molecules move faster when temperature increases. They can demonstrate knowledge of magnetism by drawing and explaining the orientation of a compass needle under the influence of a magnet and by labeling the poles of magnets cut into pieces. Students also can complete a table showing a proportional relation between voltage and current. They also demonstrate understanding of some physical properties of matter. For example, they can compare the densities of helium and air by recognizing that helium balloons rise in air. They also recognize that the surface of a liquid remains horizontal in a tilted container. They can explain that the temperature of boiling water does not increase as heat is added.

Students show some evidence of understanding chemical and physical changes and the structure of matter. They can identify vinegar as acidic solution and explain what causes a balloon to inflate when sodium bicarbonate in the balloon is mixed with vinegar. They can explain that candles burning in closed containers will extinguish due to lack of oxygen. They use a four step decision diagram that describes how to separate iron filings, cork, sand and salt from a mixture to identify which component is separated by magnetism, floating/sinking, filtering, and evaporation. Students interpret data in a table of physical properties to identify iron, water, and oxygen, and recognize that a graph that shows the effect of temperature on the solubility of sugar in water. They recognize that objects are made up of atoms.

Students demonstrate basic knowledge of major environmental issues. They can explain why the depletion of the ozone layer may be harmful to people, and recognize that increased carbon dioxide in the atmosphere may lead to global warming and that using public transportation can reduce air pollution. They can distinguish renewable from nonrenewable energy sources, describe the effects of a dam on wildlife, state two reasons why some people do not have enough water to drink, and recognize that overgrazing can lead to soil erosion. Students can also distinguish between soil change caused by natural causes and by human activity.

Students demonstrate some scientific inquiry skills. They distinguish an observation from other types of scientific statements; combine information to draw conclusions; interpret information in various types of diagrams, contour maps, graphs and tables to solve problems; and provide short explanations conveying scientific knowledge, and cause/effect relationships.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.41

TIMSS 2003 High International Benchmark (550) of Science Achievement – Example Item 3

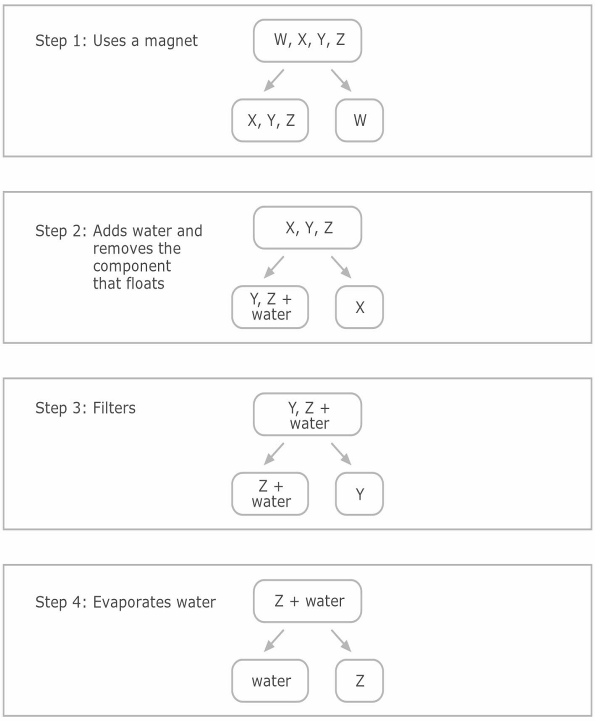
An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly*

8th grade Science — TIMSS 2003

Content Area: Chemistry

Description: Using a four-step decision diagram showing the steps used to separate iron filings, cork, sand, and salt from a mixture, identifies which component is separated by magnetism, floating/sinking, filtering, and evaporation.

Teresa is given a mixture of salt, sand, iron filings, and small pieces of cork. She separates the mixture using a 4-step procedure as shown in the diagram. The letters W, X, Y, and Z are used to stand for the four components but do not indicate which letter stands for which component.



Identify what each component is by writing *salt, sand, iron, or cork* in the correct spaces below.

Component W is: iron

Component X is: cork

Component Y is: sand

Component Z is: salt

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Singapore	68 (2.2)	▲
Chinese Taipei	67 (2.5)	▲
Japan	58 (2.5)	▲
† Hong Kong, SAR	58 (2.3)	▲
Estonia	56 (2.8)	▲
¿ Korea, Rep. of	54 (2.5)	▲
Hungary	51 (3.2)	▲
Slovak Republic	51 (3.0)	▲
Latvia	49 (3.4)	▲
Comparison group	49	
¶ England		▲
† Scotland	48 (2.9)	▲
† Netherlands	47 (3.3)	▲
Sweden	47 (2.3)	▲
Lithuania	47 (2.8)	▲
New Zealand	46 (4.1)	▲
Malaysia	46 (3.0)	▲
Russian Federation	45 (2.8)	▲
Australia	44 (3.5)	▲
Belgium (Flemish)	44 (2.4)	▲
Armenia	42 (3.5)	▲
Slovenia	41 (4.1)	
Italy	39 (3.0)	
‡ United States	35 (2.0)	
Jordan	35 (3.1)	
Romania	35 (3.0)	
International Avg.	34 (0.4)	
Moldova, Rep. of	34 (3.7)	
Israel	33 (2.6)	
Norway	26 (2.8)	▼
Lebanon	26 (2.5)	▼
Chile	26 (2.2)	▼
Iran, Islamic Rep. of	25 (2.1)	▼
Bahrain	23 (2.6)	▼
Egypt	22 (2.2)	▼
Bulgaria	21 (3.1)	▼
Palestinian Nat'l Auth.	20 (1.9)	▼
Serbia	20 (2.6)	▼
Cyprus	19 (2.3)	▼
Tunisia	15 (1.8)	▼
Saudi Arabia	14 (2.5)	▼
Macedonia, Rep. of	14 (2.3)	▼
Indonesia	12 (1.6)	▼
Philippines	11 (1.5)	▼
South Africa	8 (1.3)	▼
Botswana	7 (1.6)	▼
‡ Morocco	6 (1.9)	▼
Ghana	6 (1.2)	▼
¶ England	48 (3.8)	▲
Benchmarking Participants		
Basque Country, Spain	44 (3.8)	▲
Indiana State, US	42 (3.8)	▲
Ontario Province, Can.	37 (3.5)	
Quebec Province, Can.	50 (3.5)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.42

TIMSS 2003 High International Benchmark (550) of Science Achievement – Example Item 4

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly*

8th grade | TIMSS 2003 | Science

Content Area: Life Science

Description: Given that a community consists of mice, snakes, and wheat plants, explains what will happen to the mice and wheat plants if the snakes are killed.

The diagram above shows a community consisting of mice, snakes and wheat plants.

What would happen to this community if people killed the snakes?

Because there are no snakes, we would get more mice. This would cause less wheat plants.

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Singapore	78 (1.8)	▲
Malaysia	68 (2.1)	▲
¶ England		▲
Chinese Taipei	55 (2.0)	▲
Estonia	52 (2.3)	▲
Australia	50 (2.3)	▲
Sweden	48 (2.1)	▲
Hungary	48 (1.9)	▲
Belgium (Flemish)	46 (1.9)	▲
Comparison group	45	
† Netherlands	45 (2.6)	▲
‡ United States	44 (1.7)	▲
† Scotland	42 (2.5)	▲
Slovak Republic	41 (2.4)	▲
Lithuania	41 (2.2)	▲
Iran, Islamic Rep. of	40 (2.1)	▲
Jordan	39 (2.4)	▲
Russian Federation	38 (1.6)	▲
¿ Korea, Rep. of	38 (1.9)	▲
† Hong Kong, SAR	37 (2.0)	
Romania	37 (2.7)	
New Zealand	35 (3.2)	
Egypt	34 (1.9)	
Armenia	34 (2.1)	
International Avg.	33 (0.3)	
Slovenia	33 (2.0)	
Latvia	32 (2.3)	
Serbia	32 (2.1)	
Macedonia, Rep. of	32 (2.5)	
Japan	31 (1.6)	
Norway	31 (2.4)	
Indonesia	30 (1.7)	
Israel	30 (2.0)	▼
Italy	27 (2.1)	▼
Moldova, Rep. of	26 (2.2)	▼
Tunisia	26 (1.8)	▼
Saudi Arabia	24 (2.1)	▼
Bulgaria	22 (2.2)	▼
Cyprus	18 (1.5)	▼
Chile	16 (1.8)	▼
Bahrain	16 (1.3)	▼
Palestinian Nat'l Auth.	16 (1.3)	▼
‡ Morocco	16 (1.8)	▼
Philippines	16 (1.5)	▼
Lebanon	9 (1.6)	▼
Botswana	6 (1.1)	▼
South Africa	6 (1.1)	▼
Ghana	3 (0.6)	▼
¶ England	57 (2.4)	▲
Benchmarking Participants		
Basque Country, Spain	28 (2.4)	▼
Indiana State, US	40 (3.7)	
Ontario Province, Can.	55 (2.6)	▲
Quebec Province, Can.	41 (2.4)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Country average significantly higher than international average ▲

Country average significantly lower than international average ▼

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Intermediate International Benchmark – 475

Summary

Students can recognize and communicate basic scientific knowledge across a range of topics. They recognize some characteristics of the solar system, water cycle, animals, and human health. They are acquainted with some aspects of energy, force and motion, light reflection, and sound. Students demonstrate elementary knowledge of human impact on and changes in the environment. They can apply and briefly communicate knowledge, extract tabular information, extrapolate from data presented in a simple linear graph, and interpret pictorial diagrams.

Students demonstrate some familiarity with the solar system. They recognize the Sun as a star, and can draw the position of the moon relative to the Sun and Earth during a solar eclipse. Students demonstrate some understanding of the water cycle by ordering the processes involved in Earth's water cycle and by recognizing the Sun as the source of energy for the water cycle. They can recognize that gravity draws objects toward the center of Earth. They recognize examples of fossil fuels.

Students have some knowledge of the characteristics of animals and human health. They recognize that mammals feed milk to their young and demonstrate some understanding of the immune system by recognizing that bacteria can be destroyed by white blood cells and by explaining why some people catch colds and others do not. Students also recognize that gills have the same function as lungs.

In physics, students are acquainted with some aspects of energy, force, and motion. They recognize that a compressed spring has stored energy and that an object will move in a straight line when released from a circular path. They can explain why a nail becomes warmer when pulled out of a wooden board. Students can demonstrate some knowledge of light by recognizing the necessity of reflected light for visibility of an object and by identifying the apparent position of a reflected image in a mirror. They can recognize that sound needs a medium through which to travel.

Students have some chemistry knowledge related to everyday life. For example, they recognize that fanning a fire makes it burn faster by supplying more oxygen.

Students demonstrate elementary knowledge of human impact on and changes in the environment. They can describe both a positive and a negative effect on farming of a dam located upriver. From a list of common waste materials, they recognize that paper will break down most quickly. They can state how volcanic eruptions impact the environment.

Students can extract information from a table to draw conclusions and interpret pictorial diagrams. They also can extrapolate from data presented in a simple linear graph. Students can apply knowledge to practical situations and communicate their knowledge through brief descriptive responses.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.44

TIMSS 2003 Intermediate International Benchmark (475) of Science Achievement – Example Item 5

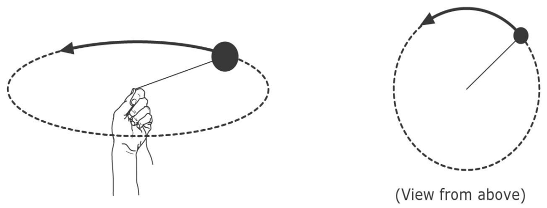
An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly*

8th grade Science — TIMSS 2003

Content Area: Physics

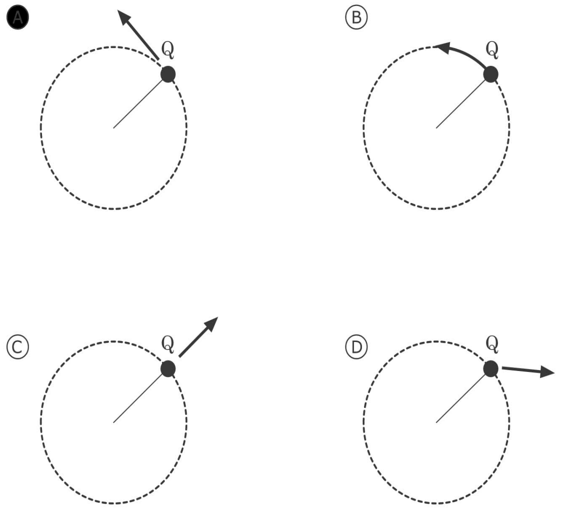
Description: Applies knowledge of circular motion to identify the diagram that shows that an object will move in a straight line when released from a circular path.

The diagram on the left shows a ball on the end of a string being whirled in a circle. The diagram on the right shows the whirling ball as viewed from above.



(View from above)

After several whirls, the string is released when the ball is at Q. Which of these diagrams shows the direction in which the ball will fly the instant the string is released?



Country	Percent Full Credit	
¿ Korea, Rep. of	87 (1.2)	▲
† Netherlands	82 (1.8)	▲
Estonia	80 (1.6)	▲
Singapore	79 (1.3)	▲
Australia	77 (1.9)	▲
Japan	77 (1.5)	▲
Hungary	77 (1.8)	▲
† Scotland	77 (1.4)	▲
New Zealand	77 (2.4)	▲
Belgium (Flemish)	76 (1.5)	▲
‡ United States	76 (1.4)	▲
Comparison group	75	
Lithuania	75 (1.6)	▲
Malaysia	75 (1.8)	▲
Sweden	74 (1.8)	▲
¶ England		▲
Russian Federation	74 (1.7)	▲
Slovak Republic	72 (2.2)	▲
Norway	72 (1.8)	▲
Latvia	71 (2.1)	▲
Slovenia	70 (2.0)	▲
† Hong Kong, SAR	69 (1.6)	▲
Chinese Taipei	68 (1.5)	▲
Italy	61 (2.1)	
Bulgaria	60 (2.6)	
Serbia	60 (2.2)	
International Avg.	60 (0.3)	
Cyprus	59 (1.8)	
Israel	58 (2.0)	
Romania	58 (2.8)	
Chile	58 (1.6)	
Armenia	58 (2.5)	
Macedonia, Rep. of	54 (2.4)	▼
Moldova, Rep. of	52 (3.0)	▼
Iran, Islamic Rep. of	48 (1.9)	▼
Jordan	47 (2.2)	▼
Indonesia	47 (1.9)	▼
Bahrain	44 (2.0)	▼
Philippines	42 (1.9)	▼
Saudi Arabia	38 (2.5)	▼
Palestinian Nat'l Auth.	36 (1.9)	▼
‡ Morocco	33 (2.2)	▼
Tunisia	31 (1.9)	▼
Egypt	30 (1.9)	▼
Lebanon	30 (2.1)	▼
Botswana	30 (1.7)	▼
South Africa	22 (1.8)	▼
Ghana	22 (1.6)	▼
¶ England	74 (2.0)	▲
Benchmarking Participants		
Basque Country, Spain	72 (2.3)	▲
Indiana State, US	77 (2.7)	▲
Ontario Province, Can.	78 (1.8)	▲
Quebec Province, Can.	79 (1.5)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

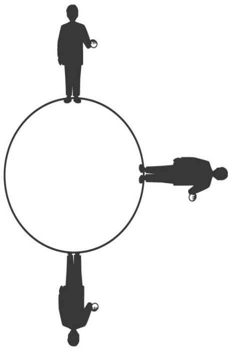
† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

TIMSS 2003 Intermediate International Benchmark (475) of Science Achievement – Example Item 6

An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly*

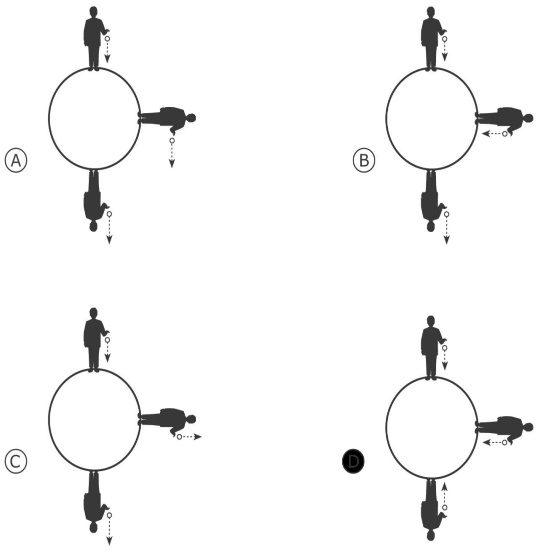
Content Area: Earth Science

Description: Uses knowledge of gravity to recognize that objects fall towards the center of Earth.



The diagram above shows a person holding a ball standing at three different places on Earth. If the person drops the ball, gravity will make it fall.

Which of the following diagrams best shows the direction the dropped ball will fall at the three different positions?



Country	Percent Full Credit	
Japan	92 (1.2)	▲
Estonia	91 (1.7)	▲
¿ Korea, Rep. of	90 (1.5)	▲
Hungary	88 (2.1)	▲
Sweden	87 (1.8)	▲
† Netherlands	87 (2.2)	▲
Malaysia	86 (1.5)	▲
Chinese Taipei	86 (1.7)	▲
Norway	84 (2.0)	▲
Slovenia	83 (2.4)	▲
Russian Federation	82 (1.8)	▲
Lithuania	81 (2.2)	▲
New Zealand	81 (2.9)	▲
† Hong Kong, SAR	81 (2.2)	▲
Comparison group	80	
Latvia	80 (2.5)	▲
Singapore	80 (1.7)	▲
Slovak Republic	80 (2.2)	▲
Australia	79 (2.5)	▲
¶ England		▲
Serbia	78 (2.6)	▲
Belgium (Flemish)	77 (2.2)	▲
‡ United States	75 (1.8)	▲
† Scotland	73 (2.9)	
Armenia	72 (2.4)	
Lebanon	72 (2.5)	
Italy	71 (2.6)	
International Avg.	70 (0.4)	
Romania	70 (3.3)	
Iran, Islamic Rep. of	67 (2.7)	
Bahrain	67 (2.3)	
Jordan	66 (2.6)	
Moldova, Rep. of	66 (3.7)	
Israel	65 (3.2)	
Philippines	65 (2.4)	▼
Indonesia	62 (2.2)	▼
Bulgaria	61 (4.0)	▼
Botswana	61 (2.7)	▼
Saudi Arabia	61 (3.1)	▼
Palestinian Nat'l Auth.	58 (2.3)	▼
Chile	58 (2.4)	▼
Cyprus	58 (3.3)	▼
Macedonia, Rep. of	54 (3.4)	▼
Egypt	51 (2.3)	▼
Tunisia	47 (2.5)	▼
Ghana	43 (2.9)	▼
South Africa	40 (2.1)	▼
‡ Morocco	6 (1.3)	▼
¶ England	78 (3.0)	▲
Benchmarking Participants		
Basque Country, Spain	67 (3.4)	
Indiana State, US	80 (3.3)	▲
Ontario Province, Can.	80 (2.5)	▲
Quebec Province, Can.	86 (1.8)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Low International Benchmark – 400

Summary

Students recognize some basic facts from the life and physical sciences. They have some knowledge of the human body and heredity, and demonstrate familiarity with some everyday physical phenomena. Students can interpret some pictorial diagrams and apply knowledge of simple physical concepts to practical situations.

Students demonstrate some basic knowledge of human biology. They identify the circulatory system from a list of its parts, and recognize that nerves carry sensory messages to the brain. They demonstrate some knowledge of inheritance by recognizing that traits are transferred through sperm and egg, and that traits are inherited from both parents.

Students recognize some facts about familiar physical phenomena. They can identify a situation where work is being done and the correct arrangement of batteries in a flashlight. They recognize evaporation as a process that takes place when clothes dry. Students are also able to identify a heterogeneous powder as a mixture.

Students can interpret some pictorial diagrams and apply knowledge of simple physical concepts to practical situations.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

TIMSS 2003 Low International Benchmark (400) of Science Achievement – Example Item 7

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly*

Content Area: Life Science

Description: Recognizes that traits are transferred to offspring through the sperm and egg.

Traits are transferred from generation to generation through the

(A) sperm only

(B) egg only

(C) sperm and the egg [correct answer, filled in]

(D) testes

	Country	Percent Full Credit	
	Chinese Taipei	97 (0.7)	▲
†	Hong Kong, SAR	97 (0.6)	▲
¿	Korea, Rep. of	91 (0.9)	▲
	Hungary	88 (1.6)	▲
¶	England		▲
	Sweden	87 (1.5)	▲
†	Netherlands	86 (1.6)	▲
	Singapore	86 (1.0)	▲
‡	United States	86 (1.2)	▲
	Israel	85 (1.4)	▲
†	Scotland	83 (1.8)	▲
	Estonia	83 (1.6)	▲
	Belgium (Flemish)	83 (1.5)	▲
	Chile	83 (1.1)	▲
	Comparison group	83	
	Romania	80 (2.3)	▲
	Slovak Republic	79 (2.0)	▲
	Italy	79 (1.9)	▲
	Malaysia	79 (1.4)	▲
	Norway	78 (1.9)	▲
	Latvia	77 (1.8)	▲
	Bulgaria	76 (2.3)	
	Philippines	76 (1.6)	
	Japan	76 (1.8)	
	Slovenia	76 (2.2)	
	Bahrain	75 (1.7)	
	Russian Federation	74 (2.0)	
	International Avg.	74 (0.3)	
	Australia	73 (2.2)	
	Lithuania	72 (1.9)	
	Egypt	71 (1.8)	
	Armenia	71 (1.9)	
	New Zealand	70 (2.6)	
	Moldova, Rep. of	68 (2.2)	▼
	Macedonia, Rep. of	68 (2.4)	▼
	Serbia	67 (1.9)	▼
	Indonesia	67 (1.9)	▼
‡	Morocco	66 (2.6)	▼
	Tunisia	64 (2.0)	▼
	Cyprus	63 (2.0)	▼
	Palestinian Nat'l Auth.	62 (2.0)	▼
	Jordan	57 (2.1)	▼
	Botswana	57 (1.8)	▼
	Saudi Arabia	52 (2.8)	▼
	South Africa	52 (1.5)	▼
	Iran, Islamic Rep. of	50 (1.9)	▼
	Ghana	50 (2.1)	▼
	Lebanon	37 (2.6)	
¶	England	88 (1.5)	▲
	Benchmarking Participants		
	Basque Country, Spain	81 (2.6)	▲
	Indiana State, US	87 (1.7)	▲
	Ontario Province, Can.	79 (2.1)	▲
	Quebec Province, Can.	89 (1.4)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

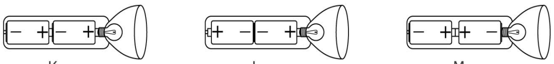
† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly*

Content Area: Physics

Description: Identifies the diagram depicting the correct arrangement of batteries in a flashlight.

The diagrams show a flashlight and three ways to put batteries in it.



In order to make the flashlight work, which way must the batteries be placed?

- Ⓐ (filled) Only as in K
- Ⓑ Only as in L
- Ⓒ Only as in M
- Ⓓ None of these ways would work.

	Country	Percent Full Credit	
	Singapore	97 (0.5)	▲
¶	England		▲
¿	Korea, Rep. of	93 (0.8)	▲
	Japan	93 (0.9)	▲
†	Hong Kong, SAR	93 (0.9)	▲
	Russian Federation	93 (1.0)	▲
	Slovak Republic	93 (1.1)	▲
	Estonia	93 (1.1)	▲
	Chinese Taipei	92 (0.8)	▲
	Malaysia	91 (1.0)	▲
	Romania	91 (1.2)	▲
	Latvia	91 (1.5)	▲
	Hungary	91 (1.2)	▲
	Bulgaria	91 (1.6)	▲
	Bahrain	90 (1.2)	▲
	Lithuania	90 (1.1)	▲
	Moldova, Rep. of	90 (1.6)	▲
	Comparison group	89	
	Sweden	89 (1.0)	▲
‡	United States	89 (0.8)	▲
	Armenia	88 (1.5)	▲
	New Zealand	88 (2.0)	
	Slovenia	87 (1.3)	▲
	Lebanon	86 (1.4)	
†	Netherlands	86 (1.7)	
	Australia	85 (1.8)	
	Belgium (Flemish)	85 (1.4)	
	Cyprus	85 (1.5)	
	International Avg.	85 (0.2)	
†	Scotland	84 (1.6)	
	Indonesia	84 (1.2)	
	Serbia	84 (1.5)	
	Macedonia, Rep. of	84 (1.7)	
	Italy	83 (1.4)	
	Iran, Islamic Rep. of	83 (1.3)	
	Chile	82 (1.2)	
	Israel	82 (1.6)	
	Norway	81 (1.5)	▼
	Botswana	81 (1.3)	▼
‡	Morocco	81 (2.2)	
	Jordan	78 (1.9)	▼
	Saudi Arabia	78 (2.3)	▼
	Palestinian Nat'l Auth.	78 (1.8)	▼
	Philippines	77 (1.6)	▼
	Egypt	67 (2.1)	▼
	Tunisia	59 (1.9)	▼
	Ghana	55 (1.8)	▼
	South Africa	52 (1.7)	▼
¶	England	95 (1.0)	▲
	Benchmarking Participants		
	Basque Country, Spain	84 (2.1)	
	Indiana State, US	90 (1.5)	▲
	Ontario Province, Can.	86 (1.6)	
	Quebec Province, Can.	87 (1.5)	

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

4.4 Performance at the grade 8 mathematics international benchmarks

Exhibit 4.49 shows how England performed against the international benchmarks for grade 8 mathematics.

Exhibit 4.49 Proportions of pupils reaching each benchmark, grade 8 mathematics

	Advanced International Benchmark	High International Benchmark	Intermediate International Benchmark	Low International Benchmark
England 2003	5%	26%	61%	90%
International Average	6%	24%	51%	75%
Comparison Group Average	13%	41%	72%	93%
England 1999	6%	25%	60%	88%
England 1995	6%	27%	61%	87%

In England 5 per cent of pupils attained the advanced benchmark in grade 8 mathematics, around the international average, 6 per cent. The proportion of pupils reaching the high benchmark was again similar to the international, average, but for the lowest two benchmarks England did better than the international average. Against the average for the comparison group countries, England's performance was lower at the advanced, high and intermediate benchmarks. The comparison group averages for the grade 8 mathematics benchmarks are influenced by the exceptional performance of Singapore, Hong Kong and Japan. The percentages reaching the advanced benchmark were 44, 31 and 24 respectively, while the next highest comparison group country was Hungary, with 11 per cent.

Given the similarity of England's overall scores for 1995, 1999 and 2003, significant changes over time here would be unlikely and none were found.

England's overall performance in grade 8 mathematics was above the international average but below that of the comparison group countries. In broad terms this was also true of England's performance on the sample items (see Exhibits 4.54 to 4.63), but there were some large differences between items. (England's average success rate on these seven items was 53 per cent against the comparison group average of 60 per cent.) Items 1 and 2, from the advanced

Advanced International Benchmark – 625

Students can organize information, make generalizations, solve non-routine problems, and draw and justify conclusions from data. They can compute percent change and apply their knowledge of numeric and algebraic concepts and relationships to solve problems. Students can solve simultaneous linear equations and model simple situations algebraically. They can apply their knowledge of measurement and geometry in complex problem situations. They can interpret data from a variety of tables and graphs, including interpolation and extrapolation.

High International Benchmark – 550

Students can apply their understanding and knowledge in a wide variety of relatively complex situations. They can order, relate, and compute with fractions and decimals to solve word problems, operate with negative integers, and solve multi-step word problems involving proportions with whole numbers. Students can solve simple algebraic problems including evaluating expressions, solving simultaneous linear equations, and using a formula to determine the value of a variable. Students can find areas and volumes of simple geometric shapes and use knowledge of geometric properties to solve problems. They can solve probability problems and interpret data in a variety of graphs and tables.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. They can add, subtract, or multiply to solve one-step word problems involving whole numbers and decimals. They can identify representations of common fractions and relative sizes of fractions. They understand simple algebraic relationships and solve linear equations with one variable. They demonstrate understanding of properties of triangles and basic geometric concepts including symmetry and rotation. They recognize basic notions of probability. They can read and interpret graphs, tables, maps, and scales.

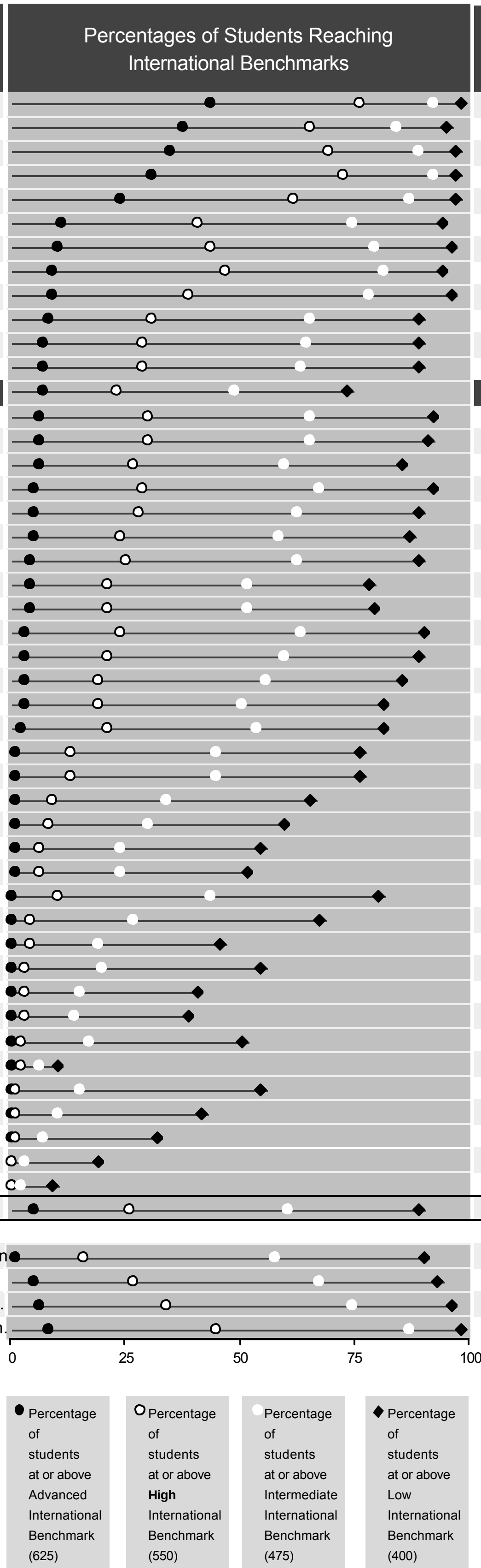
Low International Benchmark – 400

Students have some basic mathematical knowledge.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.51 Percentages of Students Reaching TIMSS 2003 International Benchmarks of Mathematics Achievement

8th grade Mathematics TIMSS 2003



Countries	Advanced International Benchmark (625)	High International Benchmark (550)	Intermediate International Benchmark (475)	Low International Benchmark (400)
Singapore	44 (2.0)	77 (2.0)	93 (1.0)	99 (0.2)
Chinese Taipei	38 (2.0)	66 (1.8)	85 (1.2)	96 (0.6)
¿ Korea, Rep. of	35 (1.3)	70 (1.0)	90 (0.5)	98 (0.3)
† Hong Kong, SAR	31 (1.6)	73 (1.8)	93 (1.3)	98 (0.6)
Japan	24 (1.0)	62 (1.2)	88 (0.6)	98 (0.2)
Hungary	11 (1.0)	41 (1.9)	75 (1.6)	95 (0.8)
† Netherlands	10 (1.5)	44 (2.5)	80 (2.0)	97 (0.8)
Belgium (Flemish)	9 (0.9)	47 (1.9)	82 (1.2)	95 (0.9)
Estonia	9 (0.8)	39 (1.9)	79 (1.4)	97 (0.5)
Slovak Republic	8 (0.8)	31 (1.7)	66 (1.7)	90 (1.1)
Australia	7 (1.1)	29 (2.4)	65 (2.3)	90 (1.4)
‡ United States	7 (0.7)	29 (1.6)	64 (1.6)	90 (1.0)
International Avg.	7 (0.1)	23 (0.2)	49 (0.2)	74 (0.2)
Malaysia	6 (1.0)	30 (2.4)	66 (2.1)	93 (0.9)
Russian Federation	6 (0.8)	30 (1.8)	66 (1.8)	92 (0.9)
Israel	6 (0.6)	27 (1.5)	60 (1.8)	86 (1.2)
Latvia	5 (0.7)	29 (1.5)	68 (1.7)	93 (0.8)
Lithuania	5 (0.6)	28 (1.2)	63 (1.4)	90 (0.8)
⚐ New Zealand	5 (1.3)	24 (2.7)	59 (2.5)	88 (1.7)
† Scotland	4 (0.6)	25 (2.1)	63 (2.4)	90 (1.1)
Romania	4 (0.6)	21 (1.8)	52 (2.2)	79 (1.7)
Serbia	4 (0.4)	21 (1.1)	52 (1.4)	80 (0.9)
Sweden	3 (0.5)	24 (1.2)	64 (1.5)	91 (1.0)
Slovenia	3 (0.5)	21 (1.0)	60 (1.3)	90 (0.9)
Italy	3 (0.6)	19 (1.5)	56 (1.7)	86 (1.2)
Bulgaria	3 (0.7)	19 (1.8)	51 (2.1)	82 (1.6)
Armenia	2 (0.3)	21 (1.3)	54 (1.5)	82 (1.0)
Cyprus	1 (0.2)	13 (0.7)	45 (1.0)	77 (1.0)
Moldova, Rep. of	1 (0.3)	13 (1.2)	45 (2.1)	77 (1.7)
Macedonia, Rep. of	1 (0.2)	9 (1.0)	34 (1.7)	66 (1.7)
Jordan	1 (0.2)	8 (1.0)	30 (1.9)	60 (1.9)
Indonesia	1 (0.2)	6 (0.7)	24 (1.7)	55 (2.4)
Egypt	1 (0.2)	6 (0.5)	24 (1.2)	52 (1.7)
Norway	0 (0.2)	10 (0.6)	44 (1.6)	81 (1.2)
Lebanon	0 (0.1)	4 (0.6)	27 (1.8)	68 (1.9)
Palestinian Nat'l Auth.	0 (0.1)	4 (0.4)	19 (1.2)	46 (1.5)
Iran, Islamic Rep. of	0 (0.2)	3 (0.4)	20 (1.1)	55 (1.4)
Chile	0 (0.1)	3 (0.4)	15 (1.2)	41 (1.8)
Philippines	0 (0.1)	3 (0.6)	14 (1.7)	39 (2.7)
Bahrain	0 (0.0)	2 (0.2)	17 (0.7)	51 (1.1)
South Africa	0 (0.1)	2 (0.6)	6 (1.3)	10 (1.8)
Tunisia	0 (0.0)	1 (0.3)	15 (1.1)	55 (1.6)
‡ Morocco	0 (0.0)	1 (0.2)	10 (0.9)	42 (1.6)
Botswana	0 (0.0)	1 (0.2)	7 (0.7)	32 (1.5)
Saudi Arabia	0 (0.1)	0 (0.1)	3 (0.6)	19 (1.7)
Ghana	0 (0.0)	0 (0.0)	2 (0.5)	9 (1.3)
⚐ ¶ England	5 (1.0)	26 (2.8)	61 (2.9)	90 (1.5)
Benchmarking Participants				
Basque Country, Spain	1 (0.3)	16 (1.5)	58 (2.2)	91 (1.0)
Indiana State, US	5 (1.5)	27 (3.2)	68 (2.5)	94 (1.0)
Ontario Province, Can.	6 (0.7)	34 (1.8)	75 (1.7)	97 (0.5)
Quebec Province, Can.	8 (1.4)	45 (2.2)	88 (1.1)	99 (0.2)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.

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

¶ Did not satisfy guidelines for sample participation rates, ⚐ Shows where England's result would be if the sample participation rates had been satisfied

1 National Desired Population does not cover all of International Desired Population, 2 National Defined Population covers less than 90% of National Desired Population.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.52

Trends in Percentages of Students Reaching the TIMSS 2003 International Benchmarks of Mathematics Achievement in 1995, 1999, and 2003

8th grade · TIMSS 2003 · Mathematics

Countries	Advanced International Benchmark (625)			High International Benchmark (550)		
	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Singapore	44 (2.0)	42 (3.5)	40 (2.9)	77 (2.0)	77 (2.6)	84 (1.8) ▼
Chinese Taipei	38 (2.0)	37 (1.6)	' '	66 (1.8)	67 (1.5)	' '
Korea, Rep. of	35 (1.3)	32 (0.9)	31 (1.1) ▲	70 (1.0)	70 (1.0)	67 (1.0)
Hong Kong, SAR	31 (1.6)	28 (2.1)	23 (2.4) ▲	73 (1.8)	70 (2.3)	65 (3.2) ▲
Japan	24 (1.0)	29 (0.9) ▼	29 (1.0) ▼	62 (1.2)	66 (1.0) ▼	67 (0.8) ▼
Hungary	11 (1.0)	13 (1.2)	10 (0.8)	41 (1.9)	43 (1.9)	40 (1.6)
Netherlands	10 (1.5)	11 (2.0)	9 (1.9)	44 (2.5)	47 (4.1)	41 (3.1)
Belgium (Flemish)	9 (0.9)	19 (1.5) ▼	15 (1.5) ▼	47 (1.9)	57 (1.7) ▼	54 (3.0) ▼
Slovak Republic	8 (0.8)	11 (1.2) ▼	11 (1.2) ▼	31 (1.7)	42 (2.3) ▼	43 (1.6) ▼
Australia	7 (1.1)	– –	7 (1.0)	29 (2.4)	– –	33 (1.8)
United States	7 (0.7)	7 (1.0)	4 (0.7) ▲	29 (1.6)	30 (1.6)	26 (2.0)
Russian Federation	6 (0.8)	12 (1.6) ▼	9 (1.2) ▼	30 (1.8)	39 (2.8) ▼	38 (3.1) ▼
Israel	6 (0.6)	4 (0.5) ▲	– –	27 (1.5)	19 (1.3) ▲	– –
Malaysia	6 (1.0)	10 (1.2) ▼	' '	30 (2.4)	36 (2.4)	' '
Lithuania	5 (0.6)	3 (0.6) ▲	2 (0.5) ▲	28 (1.2)	18 (2.0) ▲	17 (1.5) ▲
¶ England						
New Zealand	5 (1.3)	6 (1.1)	6 (1.0)	24 (2.7)	26 (2.4)	28 (2.2)
Latvia (LSS)	5 (0.9)	6 (0.8)	4 (0.7)	27 (1.7)	28 (1.8)	22 (1.4) ▲
Romania	4 (0.6)	4 (0.9)	4 (0.6)	21 (1.8)	20 (2.0)	21 (1.6)
Scotland	4 (0.6)	' '	5 (1.4)	25 (2.1)	' '	24 (2.7)
Bulgaria	3 (0.7)	9 (2.1) ▼	17 (2.0) ▼	19 (1.8)	32 (3.0) ▼	40 (2.8) ▼
Sweden	3 (0.5)	' '	12 (1.1) ▼	24 (1.2)	' '	46 (2.4) ▼
Slovenia	3 (0.5)	– –	4 (0.7)	21 (1.0)	– –	22 (1.3)
Italy	3 (0.6)	4 (0.6)	– –	19 (1.5)	21 (1.5)	– –
Cyprus	1 (0.2)	2 (0.4) ▼	3 (0.4) ▼	13 (0.7)	19 (0.9) ▼	19 (1.0) ▼
Moldova, Rep. of	1 (0.3)	3 (0.6) ▼	' '	13 (1.2)	18 (1.6) ▼	' '
Macedonia, Rep. of	1 (0.2)	2 (0.4) ▼	' '	9 (1.0)	13 (1.0) ▼	' '
Jordan	1 (0.2)	3 (0.5) ▼	' '	8 (1.0)	12 (1.0) ▼	' '
Indonesia	1 (0.2)	2 (0.3) ▼	' '	6 (0.7)	8 (0.9)	' '
Norway	0 (0.2)	' '	4 (0.4) ▼	10 (0.6)	' '	26 (1.3) ▼
Iran, Islamic Rep. of	0 (0.2)	1 (0.2)	0 (0.2)	3 (0.4)	6 (0.9) ▼	4 (0.6)
Chile	0 (0.1)	1 (0.4)	' '	3 (0.4)	4 (1.1)	' '
South Africa	0 (0.1)	0 (0.1)	– –	2 (0.6)	1 (0.5)	– –
Philippines	0 (0.1)	0 (0.1)	' '	3 (0.6)	1 (0.6)	' '
Tunisia	0 (0.0)	0 (0.1)	' '	1 (0.3)	5 (0.5) ▼	' '
¶ England	5 (1.0)	6 (0.8)	6 (1.0)	26 (2.8)	25 (2.0)	27 (1.5)
International Avg.	8 (0.2)	10 (0.2) ▼	11 (0.3) ▼	28 (0.3)	31 (0.3) ▼	37 (0.4) ▼
Benchmarking Participants						
Indiana State, US	5 (1.5)	7 (1.6)	' '	27 (3.2)	32 (3.9)	' '
Ontario Province, Can.	6 (0.7)	6 (0.8)	3 (0.4) ▲	34 (1.8)	32 (1.8)	26 (1.7) ▲
Quebec Province, Can.	8 (1.4)	18 (4.4) ▼	14 (2.8)	45 (2.2)	60 (3.5) ▼	54 (4.2)

▲ 2003 significantly higher

▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.
Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 4.52 Trends in Percentages of Students Reaching the TIMSS 2003 International Benchmarks of Mathematics Achievement in 1995, 1999, and 2003

Countries	Intermediate International Benchmark (475)			Low International Benchmark (400)		
	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Singapore	93 (1.0)	94 (1.2)	98 (0.4) ▼	99 (0.2)	99 (0.3)	100 (0.0) ▼
Chinese Taipei	85 (1.2)	85 (1.0)	' '	96 (0.6)	95 (0.5)	' '
Korea, Rep. of	90 (0.5)	91 (0.5)	89 (0.7) ▲	98 (0.3)	99 (0.2)	97 (0.4)
Hong Kong, SAR	93 (1.3)	92 (1.3)	88 (2.1)	98 (0.6)	98 (0.6)	96 (1.1)
Japan	88 (0.6)	90 (0.5) ▼	91 (0.5) ▼	98 (0.2)	98 (0.2)	98 (0.2)
Hungary	75 (1.6)	75 (1.5)	74 (1.6)	95 (0.8)	93 (1.0)	94 (0.9)
Netherlands	80 (2.0)	82 (3.4)	78 (2.9)	97 (0.8)	96 (1.5)	95 (1.6)
Belgium (Flemish)	82 (1.2)	86 (1.2) ▼	85 (2.7)	95 (0.9)	97 (0.6) ▼	96 (1.2)
Slovak Republic	66 (1.7)	79 (1.7) ▼	79 (1.3) ▼	90 (1.1)	96 (0.6) ▼	96 (0.6) ▼
Australia	65 (2.3)	– –	68 (1.7)	90 (1.4)	– –	90 (1.0)
United States	64 (1.6)	62 (1.8)	61 (2.4)	90 (1.0)	87 (1.1) ▲	86 (1.5) ▲
Russian Federation	66 (1.8)	73 (2.7) ▼	73 (2.4) ▼	92 (0.9)	93 (1.4)	93 (1.1)
Israel	60 (1.8)	49 (1.9) ▲	– –	86 (1.2)	76 (2.0) ▲	– –
Malaysia	66 (2.1)	70 (2.1)	' '	93 (0.9)	93 (0.9)	' '
Lithuania	63 (1.4)	53 (2.3) ▲	50 (2.3) ▲	90 (0.8)	85 (1.8) ▲	81 (1.7) ▲
¶ England						
New Zealand	59 (2.5)	57 (2.5)	64 (2.2)	88 (1.7)	84 (1.5)	89 (1.4)
Latvia (LSS)	66 (2.2)	65 (1.9)	57 (1.8) ▲	92 (1.1)	91 (0.9)	87 (1.4) ▲
Romania	52 (2.2)	51 (2.6)	52 (2.2)	79 (1.7)	79 (2.1)	79 (1.6)
Scotland	63 (2.4)	' '	60 (2.6)	90 (1.1)	' '	87 (1.4)
Bulgaria	51 (2.1)	67 (2.5) ▼	69 (2.4) ▼	82 (1.6)	90 (1.2) ▼	90 (1.1) ▼
Sweden	64 (1.5)	' '	81 (1.8) ▼	91 (1.0)	' '	96 (0.8) ▼
Slovenia	60 (1.3)	– –	60 (1.8)	90 (0.9)	– –	90 (0.9)
Italy	56 (1.7)	53 (2.1)	– –	86 (1.2)	82 (1.6)	– –
Cyprus	45 (1.0)	53 (1.2) ▼	51 (1.3) ▼	77 (1.0)	82 (0.9) ▼	77 (1.0)
Moldova, Rep. of	45 (2.1)	47 (2.1)	' '	77 (1.7)	79 (1.7)	' '
Macedonia, Rep. of	34 (1.7)	40 (1.9) ▼	' '	66 (1.7)	70 (1.8)	' '
Jordan	30 (1.9)	33 (1.6)	' '	60 (1.9)	61 (1.4)	' '
Indonesia	24 (1.7)	23 (1.4)	' '	55 (2.4)	50 (2.1)	' '
Norway	44 (1.6)	' '	64 (1.3) ▼	81 (1.2)	' '	90 (0.9) ▼
Iran, Islamic Rep. of	20 (1.1)	26 (1.9) ▼	24 (1.9) ▼	55 (1.4)	61 (1.6) ▼	59 (1.8) ▼
Chile	15 (1.2)	16 (1.9)	' '	41 (1.8)	46 (1.9)	' '
South Africa	6 (1.3)	6 (1.1)	– –	10 (1.8)	13 (2.0)	– –
Philippines	14 (1.7)	9 (1.5) ▲	' '	39 (2.7)	29 (2.5) ▲	' '
Tunisia	15 (1.1)	34 (1.5) ▼	' '	55 (1.6)	78 (1.2) ▼	' '
¶ England	61 (2.9)	60 (2.2)	61 (1.5)	90 (1.5)	88 (1.2)	87 (1.0)
International Avg.	56 (0.3)	57 (0.3) ▼	69 (0.4) ▼	80 (0.3)	80 (0.2) ▲	89 (0.3) ▼
Benchmarking Participants						
Indiana State, US	68 (2.5)	71 (3.5)	' '	94 (1.0)	93 (1.4)	' '
Ontario Province, Can.	75 (1.7)	72 (1.6)	65 (1.7) ▲	97 (0.5)	96 (0.6)	91 (1.0) ▲
Quebec Province, Can.	88 (1.1)	93 (1.1) ▼	90 (2.6)	99 (0.2)	99 (0.4)	99 (0.5)

▲ 2003 significantly higher

▼ 2003 significantly higher

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.
Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

Advanced International Benchmark – 625

Summary

Students can organize information, make generalizations, solve non-routine problems, and draw and justify conclusions from data. They can compute percent change and apply their knowledge of numeric and algebraic concepts and relationships to solve problems. Students can solve simultaneous linear equations and model simple situations algebraically. They can apply their knowledge of measurement and geometry in complex problem situations. They can interpret data from a variety of tables and graphs, including interpolation and extrapolation.

Students can organize information, make generalizations, and solve non-routine problems. Students can solve multi-step problems involving computations with whole numbers, decimals, and rounding. They can use the distributive property of the product to identify different representations of a number. They can compute with integers using order of operations.

Students can solve problems involving operations with proper and improper fractions, including fractions with unlike denominators. Given two points on a number line representing unspecified fractions, students can identify the point that represents their product. They can convert mixed numbers to decimal fractions. They can solve word problems involving inverse operations, decimal place value, and a fraction of a whole number of currency units. They can order integers, decimals, and common fractions.

Given a number and the ratio of two of its parts, students can find the value of one part. They can, given the dimensions of two rectangles, express the ratio of their areas. They can identify equivalent ratios and determine the ratio of two parts of a whole. They can find the percent change, given the original and final quantities, and, given the original and reduced prices, determine the percent reduction. They also can solve a multi-step non-routine problem involving percents.

Students can extend number patterns to identify the numbers common to two different arithmetic sequences and identify the row in a table whose entries are used to solve a problem. Students can make generalizations to find terms in number patterns and can explain the process used to find those terms.

They can add three simple rational expressions with unlike numerical denominators, identify the sum of three consecutive whole numbers given the middle number in general terms, and evaluate an algebraic equation by using an equivalent form and substituting given values. They can identify algebraic expressions that model situations, a diagram that models an addition of two like algebraic terms, and what the variable represents in an equation for a given situation. They can solve a pair of linear simultaneous equations, and given a linear equation in which y is expressed in terms of x, they can solve for x.

Students can apply their knowledge of measurement in complex problem situations. They can solve area problems in which they have to find the length of a side, the perimeter of a figure, the area between two rectangles when one is inside the other, and the area of a trapezoid inscribed in a rectangle. They can draw a new rectangle based on a given rectangle and find its area. They can use their knowledge of the area of a circle and of average rate to solve a problem. They can apply their knowledge of number of milliliters in a liter to solve a word problem and solve a problem that involves filling a rectangular prism with spheres. Students can combine information about lengths of segments on a line to solve a distance problem. They can solve multi-step problems involving time, distance, and speed, and can relate different units of time to solve a problem. They can use knowledge of time, clocks, and angles to solve a problem.

Students can combine knowledge of geometric figures to solve problems that involve more than one step. This knowledge involves congruent triangles, the sum of angles in a triangle, interior and exterior angles, angle bisectors, and regular hexagons. They recognize that arcs of equal radius generate an equilateral triangle. Students can select coordinates on a line in a plane given the coordinates of two other points on the line. Students can justify that a triangle is a right triangle using the Pythagorean relationship.

Students can predict outcomes from data and use their understanding of probability to draw a spinner that could have produced the data in a given table. Students can interpret data from a variety of tables and graphs, including interpolation and extrapolation. They can derive information from given timetables to complete a table for a specified journey and check that it meets given conditions. They can draw and justify conclusions based on data.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Content Area: Algebra

Description: Part C–Generalizing from the first several terms of a sequence growing in two dimensions, explains a way to find a specified term, e.g. the 50th.

The three figures below are divided into small congruent triangles.

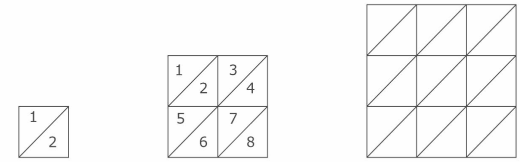


Figure 1 Figure 2 Figure 3

A. Complete the table below. First, fill in how many small triangles make up Figure 3. Then, find the number of small triangles that would be needed for the 4th figure if the sequence of figures is extended.

Figure	Number of Small Triangles
1	2
2	8
3	18
4	32

B. The sequence of figures is extended to the 7th figure. How many small triangles would be needed for Figure 7?

Answer: 98 $7^2 \times 2$ 49×2

C. The sequence of figures is extended to the 50th figure. Explain a way to find the number of small triangles in the 50th figure that does not involve drawing it and counting the number of triangles.

$50^2 \times 2$
2500×2
5000

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Chinese Taipei	49 (2.0)	▲
¿ Korea, Rep. of	48 (1.8)	▲
† Hong Kong, SAR	45 (2.0)	▲
Singapore	44 (2.0)	▲
Japan	44 (2.1)	▲
† Netherlands	36 (2.4)	▲
Comparison group	28	
Australia	26 (2.7)	▲
Hungary	24 (2.1)	▲
† Scotland	22 (2.2)	▲
Belgium (Flemish)	21 (1.3)	▲
¶ England		▲
‡ United States	19 (1.5)	▲
Sweden	17 (1.6)	
New Zealand	16 (2.1)	
Estonia	15 (1.3)	
Slovak Republic	14 (1.5)	
International Avg.	14 (0.2)	
Italy	14 (1.5)	
Latvia	13 (1.5)	
Slovenia	13 (1.6)	
Serbia	11 (1.2)	▼
Lithuania	11 (1.3)	▼
Romania	11 (1.6)	▼
Malaysia	10 (1.0)	▼
Israel	10 (1.3)	▼
Cyprus	10 (1.1)	▼
Norway	9 (1.3)	▼
Russian Federation	9 (1.2)	▼
Armenia	8 (1.2)	▼
Indonesia	7 (0.9)	▼
Chile	6 (0.8)	▼
Jordan	5 (0.9)	▼
Egypt	5 (0.8)	▼
Palestinian Nat'l Auth.	5 (0.7)	▼
Macedonia, Rep. of	4 (0.9)	▼
Philippines	4 (0.9)	▼
Bulgaria	4 (0.8)	▼
Bahrain	4 (0.8)	▼
Iran, Islamic Rep. of	3 (0.6)	▼
‡ Morocco	2 (0.8)	▼
Botswana	2 (0.5)	▼
South Africa	1 (0.5)	▼
Tunisia	1 (0.3)	▼
Lebanon	1 (0.3)	▼
Ghana	1 (0.3)	▼
Saudi Arabia	0 (0.1)	▼
Moldova, Rep. of	0 (0.1)	▼
¶ England	20 (2.0)	▲
Benchmarking Participants		
Basque Country, Spain	16 (2.0)	
Indiana State, US	16 (1.9)	
Ontario Province, Can.	26 (2.3)	▲
Quebec Province, Can.	28 (2.7)	▲

▲ Country average significantly higher than international average
▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* The item was answered fully correctly by a majority of students reaching this benchmark.
† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Content Area: Data

Description: Interpret data from a table, draws and justifies conclusions.

Betty, Frank, and Darlene have just moved to Zedland. They each need to get phone service. They received the following information from the telephone company about the two different phone plans it offers.

They must pay a set fee each month and there are different rates for each minute they talk. These rates depend on the time of the day or night they use the phone, and on which payment plan they choose. Both plans include time for which phone calls are free. Details of the two plans are shown in the table below.

Plan	Monthly Fee	Rate per minute		Free minutes per month
		Day (8 am – 6 pm)	Night (6 pm – 8 am)	
Plan A	20 zeds	3 zeds	1 zed	180
Plan B	15 zeds	2 zeds	2 zeds	120

Betty talks for less than 2 hours per month. Which plan would be less expensive for her?

Less expensive plan Plan B

Explain your answer in terms of both the monthly fee and free minutes.

she talks for less than 2 hours and Plan B has less monthly fees

The answer shown illustrates the type of student response that was given full credit.

Country	Percent Full Credit	
Japan	49 (2.2)	▲
¶ England		▲
Australia	44 (2.2)	▲
Estonia	44 (2.1)	▲
¿ Korea, Rep. of	40 (1.7)	▲
Singapore	40 (1.7)	▲
Hungary	39 (2.2)	▲
Belgium (Flemish)	38 (1.9)	▲
Lithuania	37 (1.7)	▲
‡ United States	37 (1.7)	▲
Comparison group	36	
† Scotland	36 (2.7)	▲
Israel	33 (2.1)	▲
New Zealand	30 (2.4)	▲
† Netherlands	28 (2.5)	▲
† Hong Kong, SAR	28 (2.0)	▲
Slovenia	27 (2.2)	▲
Sweden	27 (1.9)	▲
Malaysia	27 (1.7)	▲
Chinese Taipei	27 (1.8)	▲
Slovak Republic	26 (2.0)	▲
Italy	23 (1.8)	
Latvia	22 (1.8)	
International Avg.	21 (0.3)	
Jordan	20 (1.8)	
Bahrain	18 (1.4)	▼
Norway	18 (1.4)	▼
Romania	16 (1.8)	▼
Russian Federation	15 (2.0)	▼
Egypt	14 (1.2)	▼
Cyprus	13 (1.4)	▼
Indonesia	12 (1.4)	▼
Serbia	12 (1.3)	▼
Chile	12 (1.1)	▼
Bulgaria	12 (1.7)	▼
Lebanon	11 (1.4)	▼
Philippines	11 (1.2)	▼
Macedonia, Rep. of	10 (1.5)	▼
Saudi Arabia	8 (1.8)	▼
‡ Morocco	7 (1.2)	▼
South Africa	6 (1.2)	▼
Palestinian Nat'l Auth.	5 (0.7)	▼
Iran, Islamic Rep. of	4 (0.7)	▼
Tunisia	4 (0.6)	▼
Ghana	3 (1.0)	▼
Botswana	2 (0.8)	▼
Armenia	2 (0.6)	▼
Moldova, Rep. of	1 (0.5)	▼
¶ England	45 (2.5)	▲
Benchmarking Participants		
Basque Country, Spain	19 (2.1)	
Indiana State, US	34 (3.3)	▲
Ontario Province, Can.	36 (2.4)	▲
Quebec Province, Can.	24 (2.1)	

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.

1 National Desired Population does not cover all of International Desired Population.

2 National Defined Population covers less than 90% of National Desired Population.

¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

High International Benchmark – 550

Summary

Students can apply their understanding and knowledge in a wide variety of relatively complex situations. They can order, relate, and compute with fractions and decimals to solve word problems, operate with negative integers, and solve multi-step word problems involving proportions with whole numbers. Students can solve simple algebraic problems including evaluating expressions, solving simultaneous linear equations, and using a formula to determine the value of a variable. Students can find areas and volumes of simple geometric shapes and use knowledge of geometric properties to solve problems. They can solve probability problems and interpret data in a variety of graphs and tables.

Students can apply their understanding and knowledge in wide variety of relatively complex situations. Students can solve word problems by determining a number between two given numbers that is divisible by only one of two other numbers, and by estimating the product of whole numbers. They can identify the prime factorization of a given number. Students can solve word problems by using the patterns in a two-column table to determine the number in the second column that corresponds to a number midway between two entries in the first column. They demonstrate understanding of the effects of operations involving negative integers by identifying the largest number produced. They can identify the number that gives a specified result when divided by a given negative integer.

Students demonstrate some facility with fractions and decimals through computation, ordering, rounding, and use in word problems. They can identify the fraction of an hour representing a given time interval and three fractions with denominator less than 10. Students can solve one-step word problems involving division of a whole number by a unit fraction and multi-step word problems involving multiplication of whole numbers by fractions. They can select a fraction representing the comparison of parts to a whole, given each of two parts, and identify the percent equivalent of a given fraction with a denominator that is a factor of 100. They can round four-place decimals to the nearest hundredth. They can multiply two-place decimal numbers by three-place decimal numbers without calculators.

Students can identify one proportional share of an amount divided into three unequal parts. They can solve word problems by finding the missing term in a proportion. They can select the statement that describes the effect of adding the same amount to both terms of a ratio, and can determine the simplified ratio of the shaded to unshaded parts of a shape. They can calculate the new price of an item given the percent increase in price.

Given the first several terms of a sequence in numeric and pictorial form, students can extend the sequence to find specified terms. Students can solve simple algebraic problems. They can simplify an algebraic expression by combining like terms, and can find the value of an expression involving multiplication of negative integers. Students can identify an algebraic expression that corresponds to a situation, subtract algebraic expressions with the same numeric denominators, and recognize the product of two algebraic expressions in one variable that involves exponents.

Students can solve a linear equation with parentheses, solve simple simultaneous linear equations, and identify the quantity that satisfies two inequalities represented using a balance. They can identify the linear equation that describes the relationship between the first and second terms in a set of ordered pairs. They can use a formula to determine the value of one variable given the value of the other.

Students can compare volumes by visualizing and counting cubes, find the number of cubes needed to a fill a hole in a given shape, and calculate the volume of a rectangular prism given its net. Students can solve a variety of problems involving area. For example, they can find the perimeter of a square given its area, find the area of a rectangle enclosing two touching circles with given radius, find the area of an irregular figure formed by rectangles, and find the area of a triangle, on the same base and with the same height as a square, when the length of a side of the square is known. From a set of times expressed variously in days, hours, minutes, and seconds, students can determine which is least. Given the start time and the duration of an event expressed as a fraction of an hour, students can determine the end time. They can solve word problems involving average speed, distance, and time.

Students can use properties of lines and angles to solve routine problems that involve supplementary, adjacent, and vertical angles and measures of angles. They can use properties of triangles to find the measure of an angle. Students can produce a drawing that meets specific angle specifications. They can identify a pair of similar triangles given the length of their sides and identify a false statement about congruent triangles. They show understanding of transformations (rotations and reflections) in a plane. They can select a center of rotation when given a figure and its image. Students can visualize a figure cut from a folded piece of paper.

Students understand elementary concepts of probability, including estimating outcomes from sample data. They can solve simple problems involving the relationship between successful and unsuccessful outcomes and probabilities. They also recognize that when outcomes are expressed as fractions of a whole, the least likely outcome corresponds to a smallest fraction. They can read and interpret data in pie graphs, line graphs, and frequency tables to solve problems. They can compare and integrate several sets of data to determine which meet given conditions.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.57 TIMSS 2003 High International Benchmark (550) of Mathematics Achievement – Example Item 3

An Item that Students Reaching the High International Benchmark are Likely to Answer Correctly

Content Area: Number

Description: Solves a one-step word problem involving division of a whole number by a unit fraction.

A scoop holds $\frac{1}{5}$ kg of flour. How many scoops of flour are needed to fill a bag with 6 kg of flour?

Answer: $6 \div \frac{1}{5}$

6×5

30 scoops

The answer shown illustrates the type of student response that was given full credit.

	Country	Percent Full Credit	
	Singapore	79 (1.9)	▲
†	Hong Kong, SAR	76 (1.8)	▲
	Chinese Taipei	75 (1.9)	▲
†	Netherlands	74 (2.1)	▲
¿	Korea, Rep. of	68 (1.5)	▲
	Japan	62 (1.8)	▲
	Belgium (Flemish)	62 (2.2)	▲
	Sweden	60 (1.9)	▲
	Comparison group	58	
	Australia	53 (2.6)	▲
‡	United States	52 (1.7)	▲
†	Scotland	51 (2.7)	▲
	Estonia	51 (2.0)	▲
	Latvia	51 (2.7)	▲
	Hungary	51 (2.1)	▲
¶	England		▲
	Russian Federation	49 (2.7)	▲
	Israel	48 (2.3)	▲
	Malaysia	47 (2.2)	▲
	New Zealand	46 (3.2)	▲
	Slovenia	46 (2.1)	▲
	Armenia	45 (2.2)	▲
	Lithuania	43 (2.3)	▲
	Slovak Republic	43 (2.0)	▲
	Norway	39 (2.1)	
	Romania	39 (2.8)	
	International Avg.	38 (0.3)	
	Serbia	38 (2.0)	
	Bulgaria	38 (3.0)	
	Cyprus	37 (1.8)	
	Moldova, Rep. of	37 (2.7)	
	Italy	34 (2.1)	▼
	Indonesia	26 (1.5)	▼
	Macedonia, Rep. of	22 (2.0)	▼
	Iran, Islamic Rep. of	20 (1.9)	▼
	Tunisia	18 (1.4)	▼
	Egypt	17 (1.4)	▼
	Jordan	16 (1.5)	▼
	Lebanon	15 (1.4)	▼
	Chile	13 (1.1)	▼
	Philippines	13 (1.3)	▼
	Bahrain	11 (1.3)	▼
	Botswana	11 (1.1)	▼
	Palestinian Nat'l Auth.	10 (1.2)	▼
‡	Morocco	8 (1.5)	▼
	South Africa	7 (1.3)	▼
	Saudi Arabia	7 (1.9)	▼
	Ghana	6 (1.0)	▼
¶	England	50 (3.1)	▲
	Benchmarking Participants		
	Basque Country, Spain	42 (2.5)	
	Indiana State, US	56 (4.0)	▲
	Ontario Province, Can.	53 (2.2)	▲
	Quebec Province, Can.	61 (2.9)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

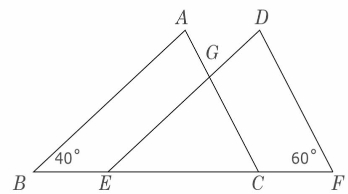
▼ Country average significantly lower than international average

¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Content Area: Geometry

Description: Uses properties of congruent triangles to find the measure of an angle.

In this figure, triangles ABC and DEF are congruent with $BC = EF$.



What is the measure of angle EGC ?

- (A) 20°
- (B) 40°
- (C) 60°
- (D) [filled] 80°
- (E) 100°

	Country	Percent Full Credit	
¿	Korea, Rep. of	84 (1.4)	▲
†	Hong Kong, SAR	81 (1.6)	▲
	Japan	80 (1.4)	▲
	Singapore	79 (1.6)	▲
	Chinese Taipei	73 (1.9)	▲
	Estonia	67 (2.0)	▲
	Belgium (Flemish)	66 (1.7)	▲
	Latvia	63 (2.2)	▲
	Bulgaria	60 (2.6)	▲
	Israel	57 (2.7)	▲
	Comparison group	56	
	Russian Federation	55 (2.7)	▲
	Lebanon	55 (2.2)	▲
†	Scotland	54 (2.7)	▲
	Slovak Republic	54 (2.5)	▲
	Lithuania	51 (2.3)	▲
	Hungary	50 (2.4)	
	Australia	47 (2.1)	
¶	England		
	Egypt	47 (1.7)	
	Malaysia	47 (2.4)	
	International Avg.	46 (0.3)	
	Armenia	45 (2.4)	
	Moldova, Rep. of	45 (3.0)	
	Cyprus	44 (2.2)	
†	Netherlands	44 (2.5)	
	Serbia	43 (1.9)	
	New Zealand	42 (3.6)	
	Jordan	42 (1.8)	▼
	Italy	42 (2.3)	
	Tunisia	41 (1.6)	▼
	Bahrain	41 (2.4)	▼
	Sweden	40 (2.1)	▼
	Palestinian Nat'l Auth.	39 (1.7)	▼
	Iran, Islamic Rep. of	37 (2.1)	▼
	Slovenia	37 (2.5)	▼
‡	United States	36 (1.7)	▼
	Macedonia, Rep. of	33 (2.4)	▼
	Norway	32 (2.1)	▼
	Indonesia	31 (1.7)	▼
‡	Morocco	31 (2.2)	▼
	Chile	30 (1.8)	▼
	Saudi Arabia	26 (2.5)	▼
	South Africa	21 (1.5)	▼
	Ghana	20 (1.6)	▼
	Botswana	20 (1.5)	▼
	Romania	18 (1.7)	▼
	Philippines	15 (1.3)	▼
¶	England	47 (2.8)	
	Benchmarking Participants		
	Basque Country, Spain	32 (2.5)	▼
	Indiana State, US	30 (2.6)	▼
	Ontario Province, Can.	50 (2.6)	
	Quebec Province, Can.	69 (1.8)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Intermediate International Benchmark – 475

Summary

Students can apply basic mathematical knowledge in straightforward situations. They can add, subtract, or multiply to solve one-step word problems involving whole numbers and decimals. They can identify representations of common fractions and relative sizes of fractions. They understand simple algebraic relationships and solve linear equations with one variable. They demonstrate understanding of properties of triangles and basic geometric concepts including symmetry and rotation. They recognize basic notions of probability. They can read and interpret graphs, tables, maps, and scales.

Students can apply basic mathematical knowledge in straightforward situations. They can arrange four given digits in descending and ascending order to form the largest and smallest possible numbers, and find the difference between those two numbers. They can solve word problems involving addition and multiplication of two-digit whole numbers. Students can approximate the quantity remaining after an amount is reduced by a given percent. They can select the statement that describes the effect of adding the same amount to both terms of a ratio. They can use knowledge of exponent notation to select approximations to two squared whole numbers.

Students show some understanding of decimals and fractions. They can solve word problems involving addition of numbers with up to three decimal places, and subtraction with up to two decimal places. They can select a two-place decimal closest to a given whole number and round two-place decimals to whole numbers. Students can identify the decimal number that is equivalent to the sum of two fractions whose denominators are powers of 10. They can select the smallest fraction from a set of commonly used fractions and can also write a fraction less than a given fraction. They can identify a circular model of a fraction that best approximates a given rectangular model of the same fraction.

Students at this level know the meaning of simple algebraic expressions involving multiplication and addition and can identify the expression that represents a situation. They can solve linear equations with one variable. Using the properties of a balance, they can reason to find an unknown weight. Students are able to recognize and extend number patterns. Given two straight line graphs, they can select the one that models a situation described in words, and interpret the graphs and use their intersection to solve a problem.

Students can identify a value of unlabeled marks on circular and linear scales. They can solve problems by comparing distances on a map drawn to scale.

Students can use knowledge of basic geometric properties to identify corresponding parts of congruent figures and to divide an isosceles triangle into congruent triangles. They can use properties of triangles to locate points on a grid. They can relate two-dimensional representations to three-dimensional objects and identify a three-dimensional figure after a rotation. Students can use the concept of line symmetry to complete geometric patterns and they can locate points in the Cartesian plane.

Students can locate and interpret data presented in bar graphs, pie graphs, and line graphs. They can construct a pie chart representing given data. Given a table of values for two variables, they can select the graph that represents the given data. They can calculate and compare averages, and have some understanding of the likelihood of an event.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.60

TIMSS 2003 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 5

An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer Correctly*

8th grade Mathematics TIMSS 2003

Content Area: Number

Description: Solves a word problem involving subtraction of a two-place decimal number from another.

Alice ran a race in 49.86 seconds. Betty ran the same race in 52.30 seconds. How much longer did it take Betty to run the race than Alice?

- (A) 2.44 seconds (correct answer, filled in)
- (B) 2.54 seconds
- (C) 3.56 seconds
- (D) 3.76 seconds

Country	Percent Full Credit	
Singapore	88 (1.0)	▲
¿ Korea, Rep. of	87 (1.1)	▲
Malaysia	81 (1.4)	▲
† Netherlands	81 (2.0)	▲
Hungary	80 (1.9)	▲
Chinese Taipei	80 (1.6)	▲
Japan	78 (1.6)	▲
Russian Federation	76 (1.8)	▲
† Hong Kong, SAR	75 (1.6)	▲
Slovak Republic	74 (2.1)	▲
‡ United States	74 (1.7)	▲
Slovenia	73 (2.3)	▲
Estonia	72 (1.8)	▲
Belgium (Flemish)	71 (1.8)	▲
† Scotland	71 (2.0)	▲
Comparison group	71	
Moldova, Rep. of	69 (2.3)	▲
Serbia	68 (2.1)	▲
Latvia	67 (2.4)	▲
Bulgaria	66 (2.5)	
Lithuania	65 (2.3)	
Romania	64 (2.4)	
Tunisia	63 (2.0)	
Australia	63 (2.4)	
Sweden	63 (2.0)	
Italy	62 (2.1)	
Botswana	61 (1.7)	
International Avg.	61 (0.3)	
Lebanon	61 (2.3)	
Armenia	60 (2.2)	
Macedonia, Rep. of	59 (2.1)	
Cyprus	59 (1.8)	
Egypt	58 (1.7)	
Israel	58 (1.9)	
Indonesia	55 (2.0)	▼
¶ England		▼
New Zealand	53 (2.4)	▼
Jordan	46 (2.2)	▼
Norway	46 (2.5)	▼
Philippines	45 (2.2)	▼
‡ Morocco	45 (2.6)	▼
Bahrain	45 (2.0)	▼
Iran, Islamic Rep. of	44 (1.9)	▼
Chile	42 (1.8)	▼
Palestinian Nat'l Auth.	37 (1.7)	▼
Ghana	32 (2.0)	▼
South Africa	29 (1.8)	▼
Saudi Arabia	19 (2.3)	▼
¶ England	54 (2.5)	▼
Benchmarking Participants		
Basque Country, Spain	64 (3.0)	
Indiana State, US	77 (2.2)	▲
Ontario Province, Can.	73 (2.4)	▲
Quebec Province, Can.	76 (1.9)	▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 4.61 TIMSS 2003 Intermediate International Benchmark (475) of Mathematics Achievement – Example Item 6

An Item that Students Reaching the Intermediate International Benchmark are Likely to Answer

Content Area: Algebra

Description: Solves equation for missing number in a proportion.

If $\frac{12}{n} = \frac{36}{21}$, then n equals

Ⓐ 3

● 7

Ⓒ 36

Ⓓ 63

Country	Percent Full Credit	
Singapore	93 (0.7)	▲
¿ Korea, Rep. of	89 (0.9)	▲
† Hong Kong, SAR	88 (1.2)	▲
Belgium (Flemish)	86 (1.4)	▲
† Netherlands	85 (1.8)	▲
Malaysia	83 (1.5)	▲
Chinese Taipei	83 (1.5)	▲
‡ United States	80 (1.1)	▲
Comparison group	79	
Japan	79 (1.6)	▲
Hungary	79 (1.7)	▲
† Scotland	79 (1.9)	▲
Australia	76 (1.9)	▲
Slovak Republic	74 (2.0)	▲
¶ England		▲
Slovenia	72 (2.3)	▲
Israel	72 (2.0)	▲
Lebanon	71 (2.6)	▲
Russian Federation	71 (1.9)	▲
Estonia	71 (2.2)	▲
Latvia	70 (2.1)	▲
New Zealand	68 (2.3)	
Sweden	66 (2.1)	
Iran, Islamic Rep. of	66 (1.7)	
Italy	65 (2.1)	
Cyprus	65 (1.8)	
International Avg.	65 (0.3)	
Tunisia	64 (1.7)	
Lithuania	64 (2.1)	
Serbia	63 (2.1)	
Moldova, Rep. of	61 (2.5)	
Romania	61 (2.2)	▼
Bulgaria	59 (2.0)	▼
Norway	59 (2.1)	▼
Indonesia	58 (1.9)	▼
Egypt	58 (2.2)	▼
Armenia	54 (2.6)	▼
‡ Morocco	54 (3.0)	▼
Jordan	53 (1.9)	▼
Palestinian Nat'l Auth.	52 (1.6)	▼
Philippines	52 (2.1)	▼
Macedonia, Rep. of	50 (2.3)	▼
Bahrain	44 (2.2)	▼
Chile	44 (2.0)	▼
Botswana	41 (1.7)	▼
Saudi Arabia	30 (2.2)	▼
Ghana	28 (1.6)	▼
South Africa	26 (1.5)	▼
¶ England	74 (2.6)	▲
Benchmarking Participants		
Basque Country, Spain	77 (2.3)	▲
Indiana State, US	83 (1.7)	▲
Ontario Province, Can.	86 (1.8)	▲
Quebec Province, Can.	88 (1.4)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Low International Benchmark – 400

Summary

Students have some basic mathematical knowledge.

The few items at this level provide some evidence that students can do basic computations with whole numbers without a calculator. They can select the two-place decimal closest to a whole number. They can multiply two-place decimal numbers by three-place decimal numbers with calculators available. They recognize some basic terminology and read information from a line on a graph.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 4.63

TIMSS 2003 Low International Benchmark (400) of Mathematics Achievement – Example Item 7

An Item that Students Reaching the Low International Benchmark are Likely to Answer Correctly*

8th grade Mathematics TIMSS 2003

Content Area: Number

Description: Selects two-place decimal closest to a given whole number.

Which of these numbers is closest to 10?

Ⓐ 0.10

● (B) 9.99

Ⓒ 10.10

Ⓓ 10.90

Country	Percent Full Credit	
† Netherlands	97 (1.0)	▲
Sweden	96 (1.1)	▲
Estonia	96 (1.2)	▲
Singapore	95 (1.1)	▲
Lithuania	95 (1.0)	▲
Belgium (Flemish)	94 (1.4)	▲
¿ Korea, Rep. of	94 (1.2)	▲
Malaysia	93 (1.4)	▲
Japan	92 (1.4)	▲
Serbia	91 (1.6)	▲
Norway	91 (1.3)	▲
Russian Federation	91 (1.2)	▲
Latvia	90 (1.9)	▲
Slovak Republic	90 (2.0)	▲
Italy	90 (1.9)	▲
Comparison group	90	
† Hong Kong, SAR	89 (1.6)	▲
† Scotland	89 (2.0)	▲
Chinese Taipei	89 (1.5)	▲
Cyprus	88 (2.0)	▲
Hungary	88 (2.0)	▲
Australia	88 (1.8)	▲
‡ United States	87 (1.1)	▲
Slovenia	87 (2.2)	▲
New Zealand	86 (2.0)	▲
Bulgaria	85 (2.7)	▲
¶ England		▲
Moldova, Rep. of	82 (2.5)	
Israel	81 (2.3)	
Romania	79 (2.5)	
Macedonia, Rep. of	78 (2.7)	
International Avg.	77 (0.3)	
Tunisia	76 (2.3)	
‡ Morocco	75 (3.1)	
Indonesia	74 (2.7)	
Iran, Islamic Rep. of	69 (2.4)	▼
Chile	67 (1.9)	▼
Lebanon	67 (2.7)	▼
Armenia	66 (2.6)	▼
Jordan	55 (2.7)	▼
Palestinian Nat'l Auth.	50 (2.7)	▼
Bahrain	49 (3.2)	▼
Egypt	48 (2.5)	▼
Philippines	42 (2.8)	▼
Botswana	40 (2.6)	▼
Saudi Arabia	35 (2.6)	▼
South Africa	30 (2.7)	▼
Ghana	24 (2.4)	▼
¶ England	82 (2.5)	▲
Benchmarking Participants		
Basque Country, Spain	92 (2.0)	▲
Indiana State, US	84 (3.2)	▲
Ontario Province, Can.	91 (1.8)	▲
Quebec Province, Can.	91 (1.8)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

benchmark demonstrate this variation well. For both items England scored significantly better than the international average, but in item 1 scored 8 per cent less than the comparison group average but 9 per cent higher on item 2. The context of the latter, mobile phone charges, may be particularly familiar to pupils in England. Items where England's performance was least good were sample item 4, on finding unknown angles, where performance was similar to the international average, and item 5, a non-calculator subtraction of decimals. In the latter students in England, as those in New Zealand, performed at a level below the international average.

4.5 The distribution of performance in England

For some years there has been discussion about whether or not England has a "long tail" of low achievers. This has been examined in TIMSS in two ways. Firstly there is the evidence already discussed here, the proportion of pupils reaching each of the international benchmarks, and, in particular, the low benchmark. If there were a long tail of low achievement it might be expected that this would be evident in the proportion of pupils attaining the low international benchmark being lower than, say, the mean for the comparison group countries. Exhibit 4.64 brings the information on this together.

Exhibit 4.64 Percentage of pupils in comparison group countries attaining the low international benchmark

Comparison Group Countries	Proportion of Pupils Reaching the Low International Benchmark (%)				
	Grade 4		Grade 8		
	Science	Maths	Science	Maths	Average
Hong Kong	98	99	98	98	**98**
Netherlands	99	99	98	97	**98**
Japan	95	98	98	98	**97**
Belgium (Fl)	98	99	94	95	**97**
Singapore	95	97	95	99	**97**
Hungary	94	94	97	95	**95**
England	**94**	**93**	**96**	**90**	**93**
United States	94	93	93	90	**93**
Australia	92	88	95	90	**91**
Scotland	90	88	92	90	**90**
New Zealand	91	86	94	88	**90**
Italy	91	89	87	86	**88**
Average	**94**	**94**	**95**	**93**	**94**

Some interesting patterns are revealed. Some countries are very consistent across grade and subject, notably Hong Kong and the Netherlands with 97 per cent or more attaining this benchmark in all four assessments. Others show different patterns. Belgium (Flemish), for example, has higher proportions achieving the benchmark at grade 4 than at grade 8. Singapore, overall the highest scoring country, does less well on this particular criterion, while the Netherlands does particularly well in both grades and subjects.

England's performance is about average for the group at grade 4 and in grade 8 science but does less well in grade 8 mathematics. Even here, though, the proportion of pupils achieving the benchmark, 90 per cent, is similar to the United States, Australia and Scotland, all countries which, overall, perform at a similar level to England. The exhibit provides no evidence for a long tail of low achievement relative to the comparison group as a whole, but does provide another view on England's performance in grade 8 mathematics.

Another approach to comparing England's distribution of achievement with the other comparison group countries has been to plot the distributions of achievement for the comparison group countries for each subject. This showed that for science and for grade 4 mathematics the distribution of performance in England was similar in shape to that in the other comparison group countries. Their means differed but the shape was similar. England's distribution of performance in grade 8 mathematics showed two main differences from the majority of the other comparison group counters. The distribution for England was flatter, less peaked, than for other countries and the mode, the most frequent scores, was below the mean, rather than above it as in the other comparison group countries.

5 Performance by content area

In this section several aspects of performance at topic level are investigated. The first analysis shows each country's scores on the topic areas defined in the TIMSS assessment framework for each grade and subject. This is followed by a graphical display of the pattern of strengths and weaknesses for each country, allowing similar patterns in different countries to be identified easily. For grade 8 there is then a section looking at performance by content area over time.

5.1 Performance by content area in grade 4 science

Exhibit 5.1 shows the scores for each country in the three content areas for grade 4 science. England performed above the international average in all three, with its highest performance in physical science, rather than life science or earth science. This pattern of performance is shown visually in Exhibit 5.2, where the performance of each country in the three topic areas is compared with that country's overall level of performance. When compared with the comparison group countries, England's profile of performance across topics is similar to that of Hong Kong, Japan and Singapore, all also high scoring countries in grade 4 science.

5.2 Performance by content area in grade 4 mathematics

Exhibits 5.3 and 5.4 show the same information for mathematics. In grade 4 mathematics there were five topic areas: number; patterns and relationships (pre-algebra); measurement; geometry; and data. England's performance, as shown clearly in exhibit 5.4, was relatively weakest in number and patterns and relationships, strongest in data and geometry and at about the same level as its overall performance in measurement. This pattern was also apparent in the performance of Australia, New Zealand and the USA, all countries outperformed by England. In all content areas England scored above the international average.

Exhibit 5.1 | Average Achievement in Science Content Areas | 4th grade TIMSS 2003 Science

Countries	Average Scale Scores for Science Content Areas		
	Life Science	Physical Science	Earth Science
Armenia	435 (4.4) ▼	429 (4.3) ▼	450 (3.6) ▼
† Australia	523 (3.8) ▲	518 (3.9) ▲	518 (4.1) ▲
Belgium (Flemish)	524 (1.7) ▲	507 (2.3) ▲	522 (1.7) ▲
Chinese Taipei	540 (1.6) ▲	554 (2.0) ▲	559 (2.6) ▲
Cyprus	482 (2.1) ▼	479 (2.3) ▼	487 (2.5)
† England	532 (3.1) ▲	546 (3.2) ▲	535 (3.5) ▲
† Hong Kong, SAR	535 (2.6) ▲	548 (2.7) ▲	536 (2.7) ▲
Hungary	536 (2.5) ▲	526 (2.7) ▲	526 (3.7) ▲
Iran, Islamic Rep. of	424 (4.6) ▼	419 (4.5) ▼	428 (3.0) ▼
Italy	521 (3.5) ▲	512 (3.5) ▲	519 (3.7) ▲
Japan	530 (1.3) ▲	557 (1.7) ▲	535 (1.9) ▲
Latvia	531 (2.3) ▲	532 (2.6) ▲	534 (2.9) ▲
Lithuania	516 (2.0) ▲	512 (2.5) ▲	503 (3.2) ▲
Moldova, Rep. of	504 (3.9) ▲	489 (3.9)	505 (4.9) ▲
Morocco	300 (6.1) ▼	308 (7.0) ▼	311 (6.1) ▼
† Netherlands	547 (1.8) ▲	505 (1.9) ▲	503 (2.3) ▲
New Zealand	520 (2.3) ▲	516 (2.3) ▲	522 (2.3) ▲
Norway	480 (2.2) ▼	456 (2.3) ▼	473 (2.8) ▼
Philippines	330 (9.0) ▼	343 (9.6) ▼	324 (9.2) ▼
Russian Federation	526 (4.7) ▲	527 (5.2) ▲	527 (6.0) ▲
† Scotland	506 (3.1) ▲	503 (2.6) ▲	498 (2.6) ▲
Singapore	558 (5.0) ▲	577 (5.9) ▲	538 (5.2) ▲
Slovenia	489 (2.9)	497 (2.3) ▲	490 (2.7)
Tunisia	290 (5.9) ▼	324 (5.3) ▼	336 (4.8) ▼
† United States	537 (2.2) ▲	531 (2.3) ▲	535 (2.5) ▲
International Avg.	489 (0.7)	489 (0.8)	489 (0.8)
Benchmarking Participants			
Indiana State, US	554 (2.9) ▲	546 (3.5) ▲	552 (3.6) ▲
Ontario Province, Can.	541 (3.6) ▲	537 (3.5) ▲	539 (3.8) ▲
Quebec Province, Can.	503 (2.2) ▲	497 (2.4) ▲	507 (2.7) ▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

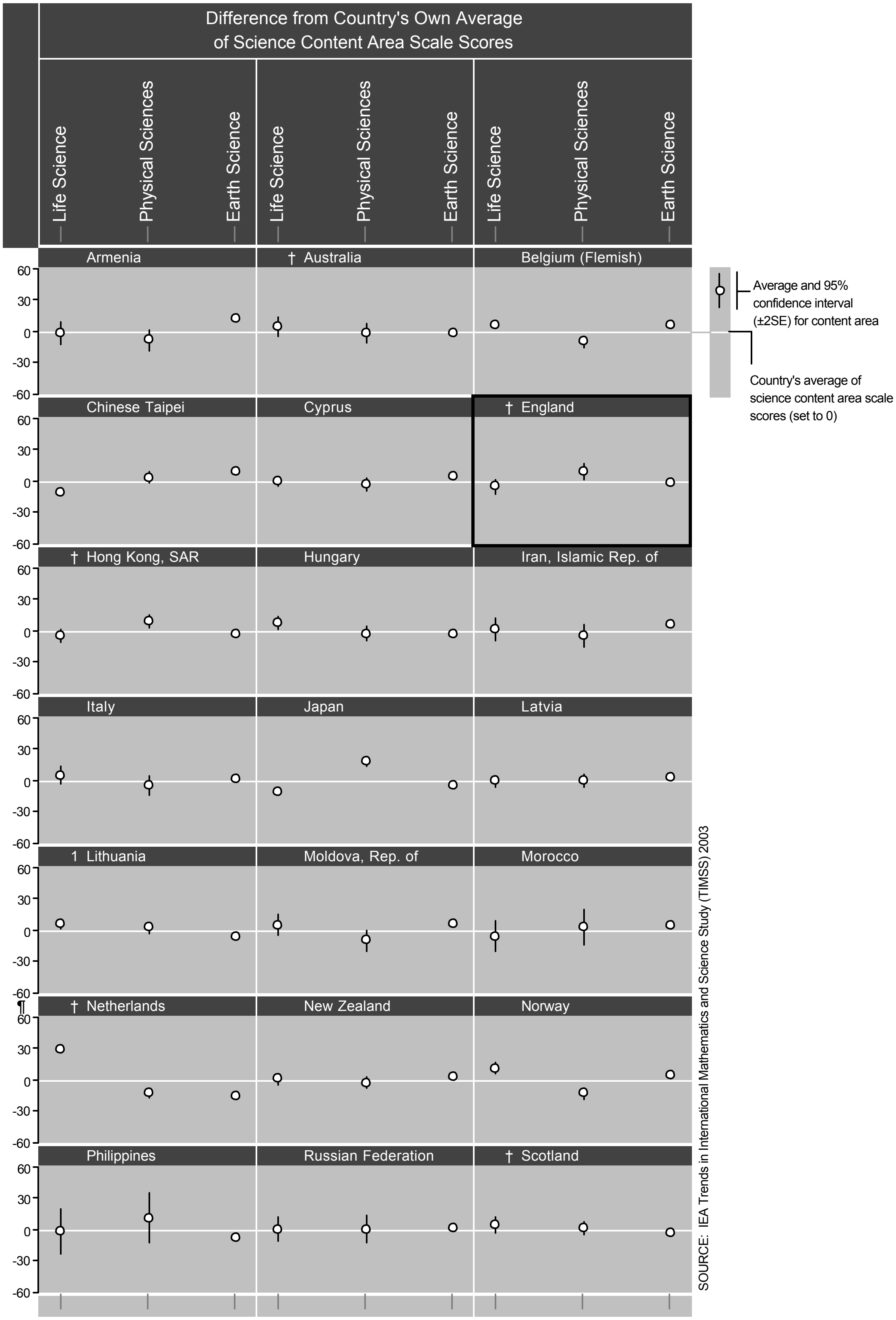
▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

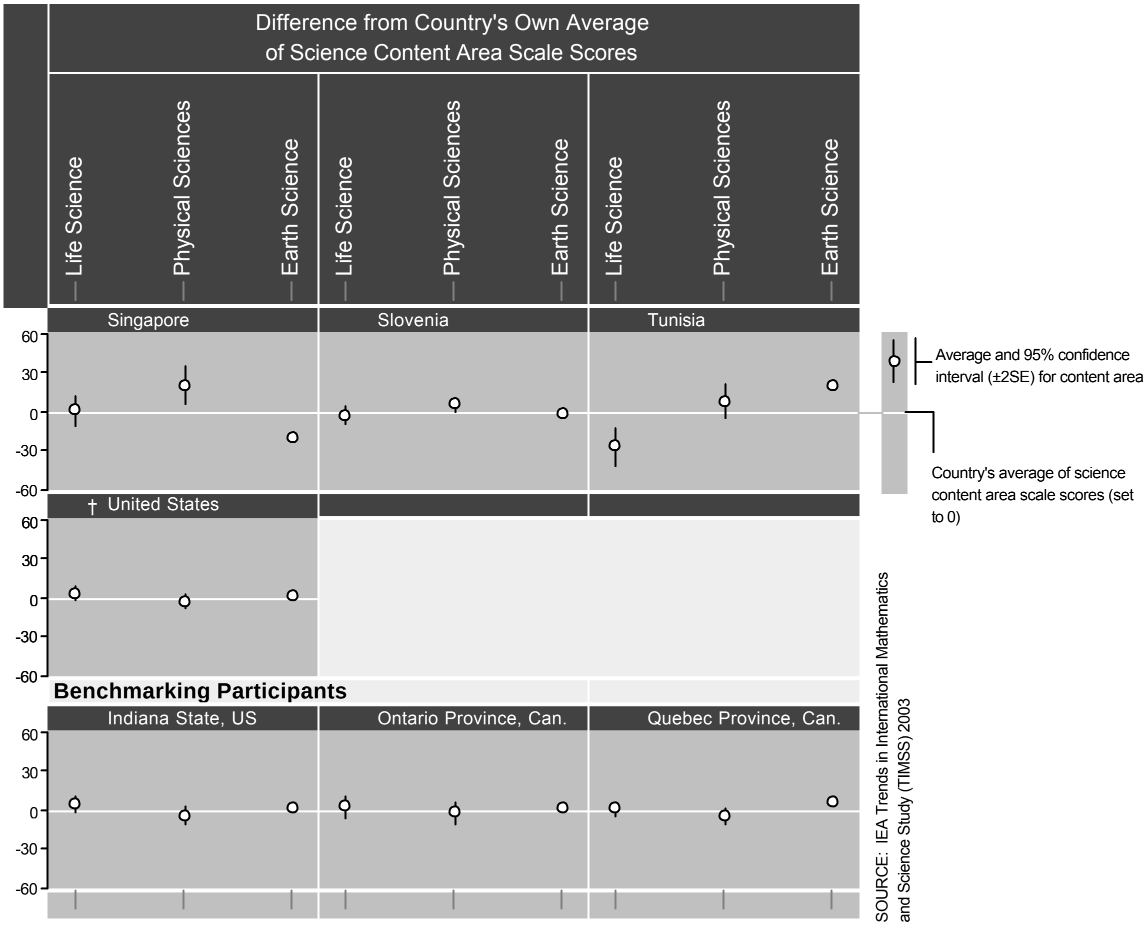
† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 5.2 Profiles of Within-Country Relative Performance in Science Content Areas

4th grade TIMSS 2003 Science



† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population



† Met guidelines for sample participation rates only after replacement schools were included.

Exhibit 5.3 Average Achievement in Mathematics Content Areas

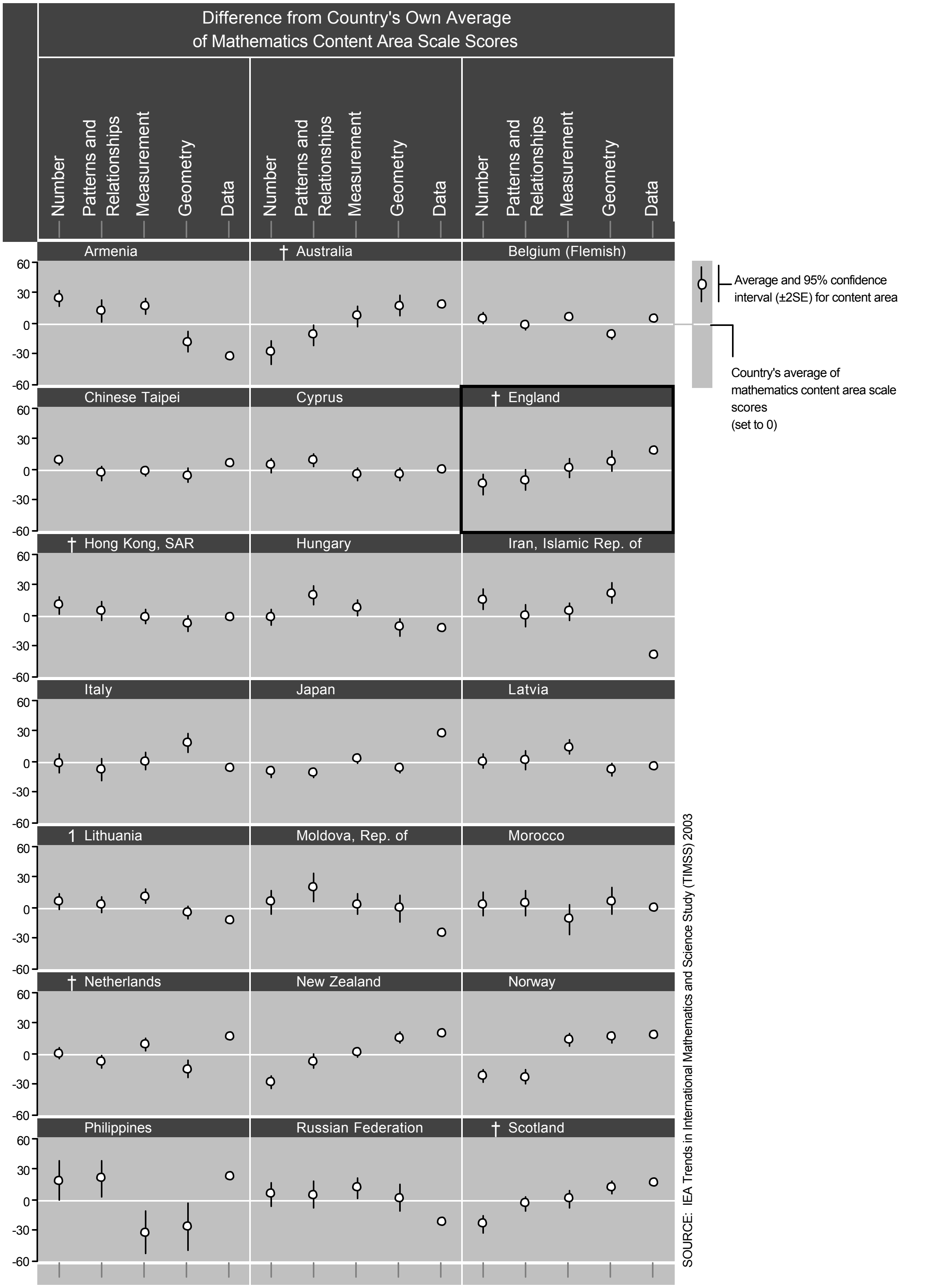
Countries	Average Scale Scores for Mathematics Content Areas				
	Number	Patterns and Relationships	Measurement	Geometry	Data
Armenia	473 (3.0) ▼	461 (4.1) ▼	465 (3.1) ▼	431 (3.8) ▼	417 (3.6) ▼
† Australia	479 (4.3) ▼	495 (3.7)	514 (3.7) ▲	524 (3.7) ▲	525 (3.6) ▲
Belgium (Flemish)	549 (1.9) ▲	542 (1.9) ▲	550 (1.4) ▲	533 (1.8) ▲	548 (2.2) ▲
Chinese Taipei	568 (1.8) ▲	555 (2.4) ▲	557 (1.6) ▲	553 (2.5) ▲	564 (2.3) ▲
Cyprus	514 (2.7) ▲	519 (2.4) ▲	506 (2.3) ▲	505 (2.3) ▲	509 (2.3) ▲
† England	519 (4.1) ▲	523 (3.9) ▲	535 (3.3) ▲	542 (3.7) ▲	552 (3.4) ▲
† Hong Kong, SAR	574 (3.3) ▲	568 (3.5) ▲	563 (2.7) ▲	557 (2.9) ▲	562 (2.3) ▲
Hungary	524 (2.9) ▲	545 (3.7) ▲	532 (2.7) ▲	514 (3.3) ▲	513 (3.2) ▲
Iran, Islamic Rep. of	410 (3.7) ▼	394 (3.9) ▼	398 (3.2) ▼	416 (3.9) ▼	356 (4.4) ▼
Italy	502 (3.6) ▲	496 (4.3)	504 (3.4) ▲	522 (3.5) ▲	497 (3.0)
Japan	556 (2.0) ▲	554 (1.4) ▲	568 (1.6) ▲	559 (1.9) ▲	593 (1.6) ▲
Latvia	531 (2.6) ▲	532 (3.4) ▲	545 (2.6) ▲	523 (2.2) ▲	526 (2.7) ▲
Lithuania	535 (2.9) ▲	531 (3.0) ▲	540 (2.7) ▲	524 (2.2) ▲	517 (2.5) ▲
Moldova, Rep. of	507 (4.7) ▲	521 (5.1) ▲	505 (4.0) ▲	501 (4.9)	477 (4.3) ▼
Morocco	359 (4.7) ▼	360 (4.7) ▼	345 (5.5) ▼	362 (4.9) ▼	355 (5.0) ▼
† Netherlands	536 (2.2) ▲	527 (2.4) ▲	545 (2.2) ▲	521 (3.2) ▲	553 (2.4) ▲
New Zealand	475 (2.3) ▼	495 (2.9)	503 (2.0) ▲	517 (1.8) ▲	522 (2.0) ▲
Norway	440 (2.2) ▼	439 (2.7) ▼	475 (2.2) ▼	478 (2.2) ▼	479 (2.3) ▼
Philippines	380 (7.4) ▼	382 (7.0) ▼	330 (7.8) ▼	335 (8.8) ▼	384 (7.5) ▼
Russian Federation	532 (4.6) ▲	531 (5.0) ▲	538 (3.8) ▲	528 (4.8) ▲	505 (4.1) ▲
† Scotland	475 (3.3) ▼	495 (2.9)	499 (3.1)	511 (2.5) ▲	516 (2.7) ▲
Singapore	612 (6.0) ▲	579 (5.4) ▲	566 (4.6) ▲	570 (5.5) ▲	575 (3.9) ▲
Slovenia	461 (2.7) ▼	490 (2.7) ▼	497 (2.8)	498 (2.2)	486 (2.7) ▼
Tunisia	360 (4.1) ▼	330 (4.7) ▼	308 (5.5) ▼	346 (5.1) ▼	308 (4.7) ▼
† United States	516 (2.6) ▲	524 (2.7) ▲	500 (2.1)	518 (2.2) ▲	549 (2.0) ▲
International Avg.	495 (0.7)	495 (0.7)	495 (0.7)	495 (0.7)	495 (0.6)
Benchmarking Participants					
Indiana State, US	531 (3.4) ▲	535 (3.4) ▲	515 (3.0) ▲	525 (3.5) ▲	557 (2.9) ▲
Ontario Province, Can.	494 (5.0)	513 (3.4) ▲	512 (3.8) ▲	535 (3.8) ▲	544 (3.5) ▲
Quebec Province, Can	508 (2.5) ▲	499 (2.6)	504 (2.1) ▲	522 (2.3) ▲	506 (2.3) ▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

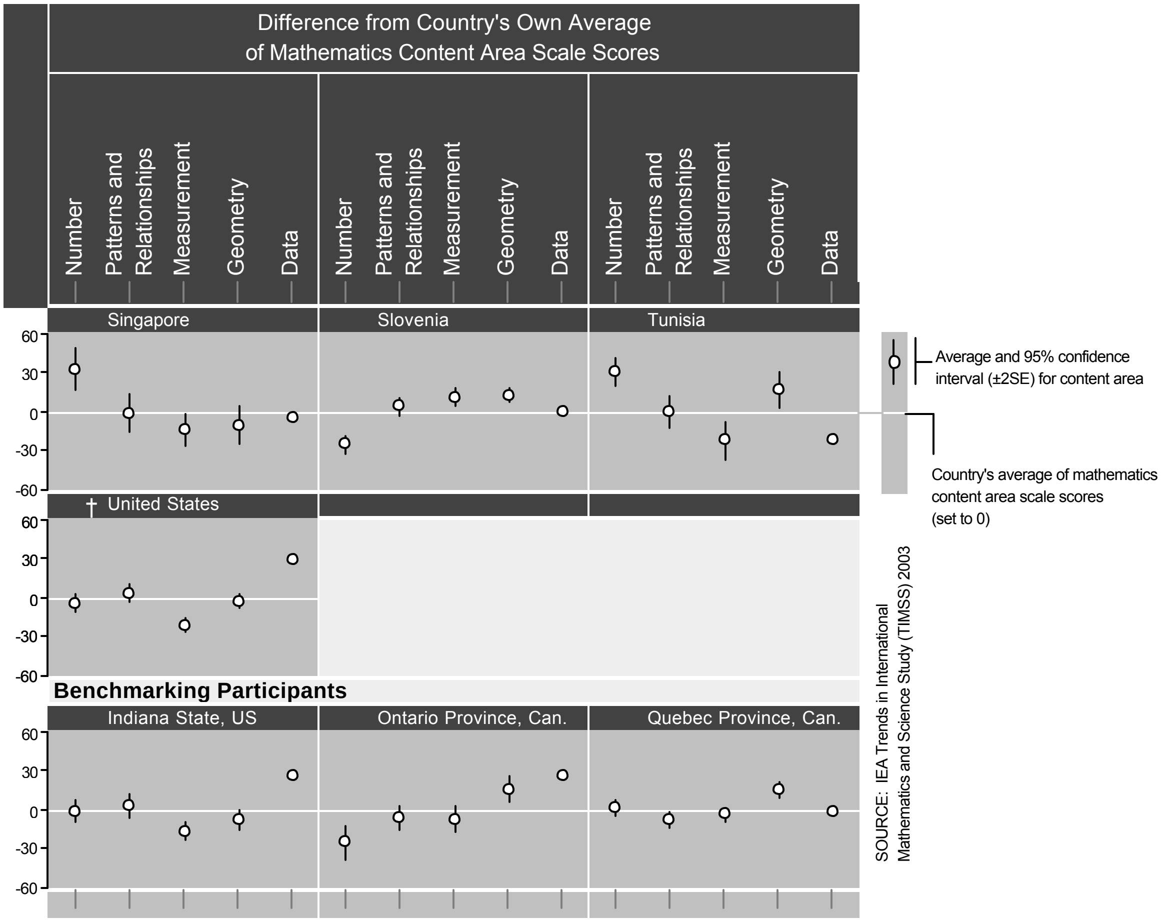
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.



† Met guidelines for sample participation rates only after replacement schools were included.

1 National Desired Population does not cover all of International Desired Population.

Exhibit 5.4 Profiles of Within-Country Relative Performance in Mathematics Content Areas



† Met guidelines for sample participation rates only after replacement schools were included.

Exhibit 5.5	Average Achievement in Science Content Areas

8th grade · TIMSS 2003 · Science

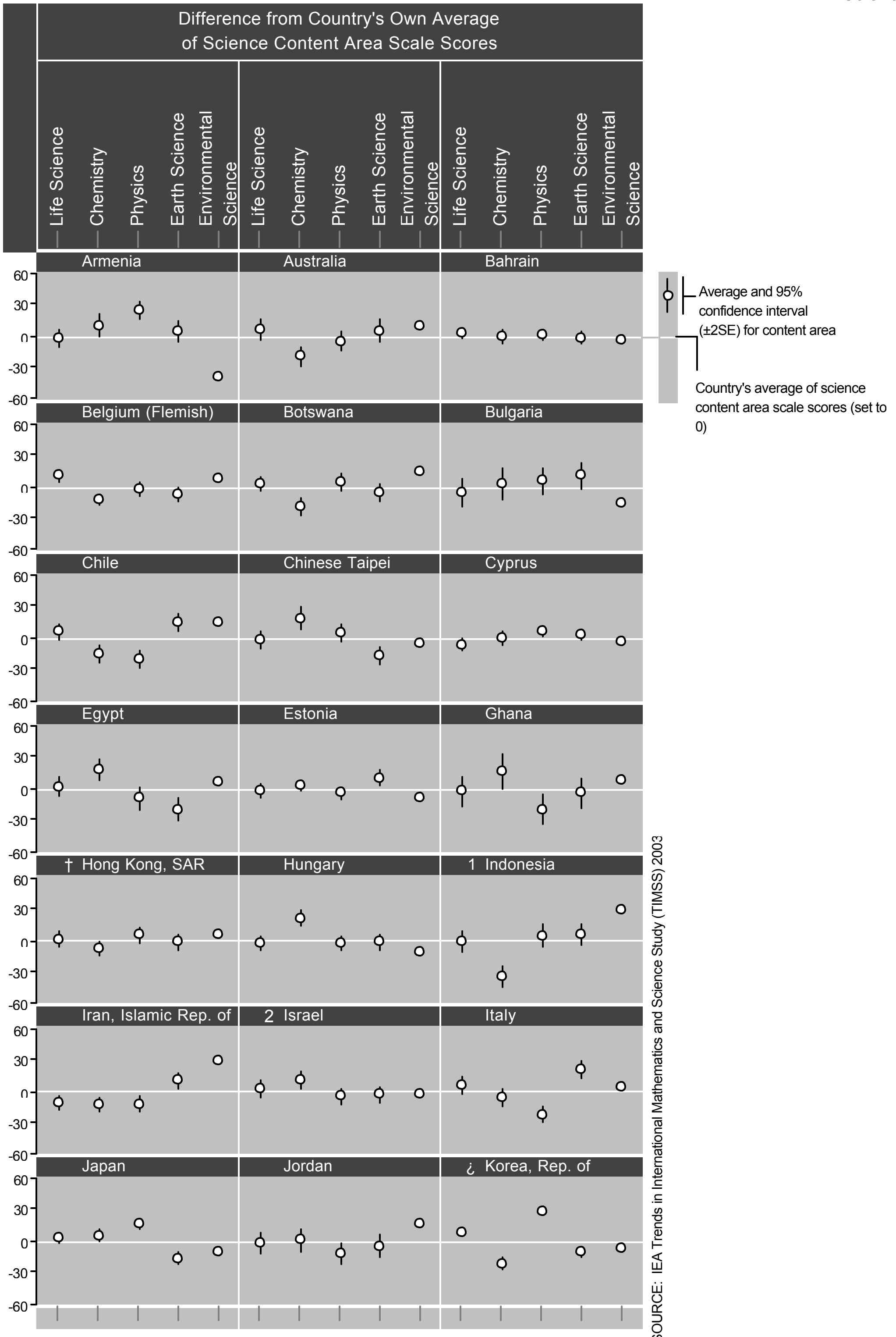
Countries	Average Scale Scores for Science Content Areas				
	Life Science	Chemistry	Physics	Earth Science	Environmental Science
Armenia	453 (3.3) ▼	466 (4.2) ▼	479 (3.2)	460 (3.7) ▼	417 (4.4) ▼
Australia	532 (3.8) ▲	506 (3.8) ▲	521 (3.7) ▲	531 (4.2) ▲	536 (3.4) ▲
Bahrain	445 (1.9) ▼	441 (2.6) ▼	443 (2.0) ▼	440 (2.4) ▼	439 (3.1) ▼
Belgium (Flemish)	526 (2.4) ▲	503 (2.0) ▲	514 (2.5) ▲	508 (2.5) ▲	523 (2.7) ▲
Botswana	370 (2.7) ▼	348 (3.1) ▼	371 (3.2) ▼	361 (3.1) ▼	381 (3.3) ▼
Bulgaria	474 (5.2)	482 (5.7)	485 (5.0) ▲	491 (4.9) ▲	464 (5.0) ▼
Chile	427 (2.7) ▼	405 (3.3) ▼	401 (3.1) ▼	435 (3.1) ▼	436 (2.9) ▼
Chinese Taipei	563 (3.1) ▲	584 (4.0) ▲	569 (3.3) ▲	548 (3.1) ▲	560 (3.1) ▲
Cyprus	437 (2.2) ▼	443 (2.6) ▼	450 (1.7) ▼	447 (2.1) ▼	441 (2.3) ▼
Egypt	425 (3.7) ▼	442 (3.8) ▼	414 (4.1) ▼	403 (4.4) ▼	430 (4.0) ▼
Estonia	547 (2.4) ▲	552 (2.1) ▲	544 (2.4) ▲	558 (2.9) ▲	540 (2.2) ▲
Ghana	256 (5.6) ▼	276 (6.6) ▼	239 (5.4) ▼	254 (5.6) ▼	267 (6.2) ▼
† Hong Kong, SAR	551 (2.9) ▲	542 (2.6) ▲	555 (2.8) ▲	549 (2.9) ▲	555 (2.6) ▲
Hungary	536 (2.7) ▲	560 (3.1) ▲	536 (2.7) ▲	537 (3.1) ▲	528 (2.9) ▲
Indonesia	424 (3.9) ▼	391 (3.8) ▼	430 (4.0) ▼	431 (3.8) ▼	454 (3.4) ▼
Iran, Islamic Rep. of	447 (2.6) ▼	445 (2.7) ▼	445 (3.0) ▼	468 (2.9) ▼	487 (2.1) ▲
Israel	491 (3.0) ▲	499 (3.4) ▲	484 (2.9) ▲	485 (3.0) ▲	486 (2.9) ▲
Italy	498 (3.2) ▲	487 (3.3) ▲	470 (3.2)	513 (3.2) ▲	497 (3.0) ▲
Japan	549 (2.0) ▲	552 (2.1) ▲	564 (1.9) ▲	530 (2.1) ▲	537 (2.0) ▲
Jordan	475 (4.0)	478 (4.4)	465 (3.8) ▲	472 (4.0)	492 (3.2) ▲
¿ Korea, Rep. of	558 (1.6) ▲	529 (2.5) ▲	579 (1.6) ▲	540 (1.9) ▲	544 (1.4) ▲
Latvia	511 (2.5) ▲	514 (3.2) ▲	512 (2.4) ▲	514 (2.8) ▲	508 (3.3) ▲
Lebanon	360 (5.0) ▼	433 (4.9) ▼	419 (4.0) ▼	395 (4.0) ▼	374 (5.1) ▼
Lithuania	517 (2.4) ▲	534 (2.3) ▲	519 (2.7) ▲	512 (2.7) ▲	507 (2.0) ▲
Macedonia, Rep. of	448 (3.8) ▼	467 (3.9) ▼	458 (3.1) ▼	440 (4.3) ▼	442 (3.7) ▼
Malaysia	504 (3.7) ▲	514 (3.8) ▲	519 (3.6) ▲	502 (3.8) ▲	513 (3.2) ▲
Moldova, Rep. of	466 (3.7) ▼	479 (3.9)	479 (3.7)	475 (4.0)	454 (3.8) ▼
‡ Morocco	390 (2.6) ▼	402 (2.7) ▼	410 (2.7) ▼	397 (3.4) ▼	396 (3.3) ▼
† Netherlands	536 (3.3) ▲	514 (2.6) ▲	538 (3.4) ▲	534 (3.2) ▲	539 (2.8) ▲
New Zealand	523 (5.1) ▲	501 (5.6) ▲	515 (4.7) ▲	525 (4.8) ▲	525 (3.9) ▲
Norway	496 (2.5) ▲	485 (3.0) ▲	488 (2.6) ▲	517 (2.7) ▲	496 (2.2) ▲
Palestinian Nat'l Auth.	435 (3.6) ▼	444 (3.9) ▼	432 (3.6) ▼	439 (3.0) ▼	444 (3.7) ▼
Philippines	387 (5.8) ▼	342 (6.1) ▼	380 (4.7) ▼	377 (5.7) ▼	403 (5.4) ▼
Romania	471 (4.8)	474 (4.9)	473 (4.1)	469 (5.2)	472 (4.7)
Russian Federation	514 (3.3) ▲	527 (4.0) ▲	511 (3.4) ▲	518 (3.3) ▲	491 (3.2) ▲
Saudi Arabia	412 (3.9) ▼	382 (4.8) ▼	394 (3.9) ▼	394 (4.0) ▼	410 (3.8) ▼
† Scotland	512 (3.3) ▲	499 (3.2) ▲	515 (3.0) ▲	515 (3.8) ▲	511 (3.5) ▲
Serbia	468 (2.6) ▼	474 (3.2)	471 (2.6)	471 (3.0)	457 (2.4) ▼
Singapore	569 (4.0) ▲	582 (4.2) ▲	579 (3.4) ▲	549 (3.9) ▲	568 (3.8) ▲
Slovak Republic	514 (2.9) ▲	519 (3.6) ▲	519 (2.9) ▲	523 (3.3) ▲	509 (2.8) ▲
Slovenia	521 (2.2) ▲	532 (2.6) ▲	509 (1.8) ▲	523 (2.2) ▲	515 (2.2) ▲
South Africa	250 (6.0) ▼	285 (5.9) ▼	244 (6.2) ▼	247 (6.3) ▼	261 (6.6) ▼
Sweden	528 (2.7) ▲	526 (2.6) ▲	525 (2.9) ▲	532 (3.3) ▲	499 (2.6) ▲
Tunisia	417 (2.0) ▼	413 (2.5) ▼	386 (2.5) ▼	408 (2.0) ▼	436 (2.2) ▼
‡ United States	537 (3.0) ▲	513 (3.2) ▲	515 (2.9) ▲	532 (2.9) ▲	533 (2.9) ▲
¶ England	543 (3.9) ▲	527 (4.2) ▲	545 (3.5) ▲	544 (4.1) ▲	540 (4.2) ▲
International Avg.	474 (0.5)	474 (0.5)	474 (0.5)	474 (0.5)	474 (0.5)
Benchmarking Participants					
Basque Country, Spain	492 (2.6) ▲	472 (3.1)	483 (3.4) ▲	506 (2.9) ▲	494 (2.7) ▲
Indiana State, US	540 (4.5) ▲	516 (5.4) ▲	516 (4.4) ▲	536 (5.2) ▲	538 (4.0) ▲
Ontario Province, Can.	537 (2.9) ▲	507 (3.0) ▲	530 (3.1) ▲	533 (3.2) ▲	542 (2.4) ▲
Quebec Province, Can.	525 (3.2) ▲	517 (2.8) ▲	524 (2.6) ▲	550 (2.8) ▲	531 (2.9) ▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

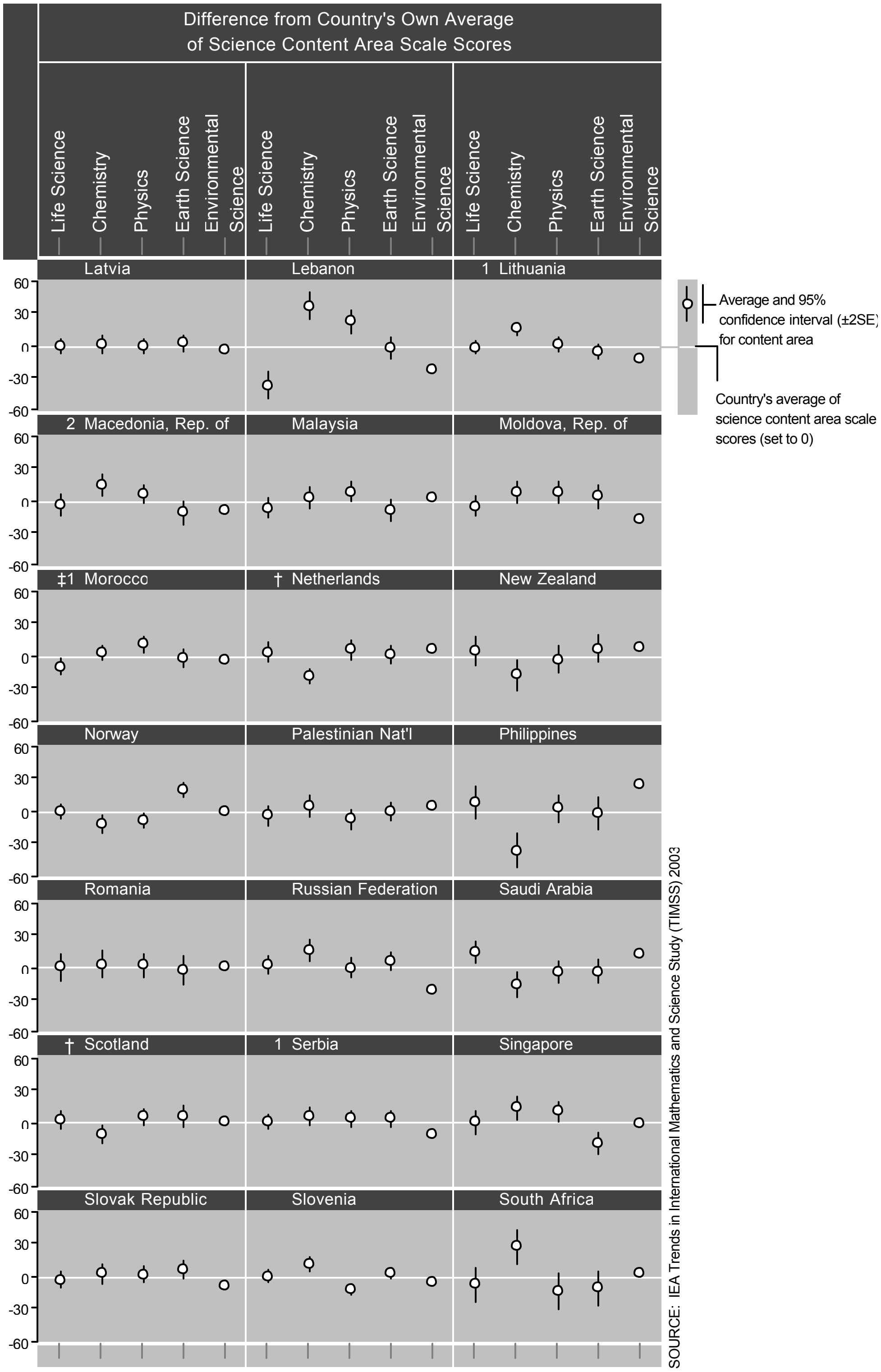
† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.



† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year

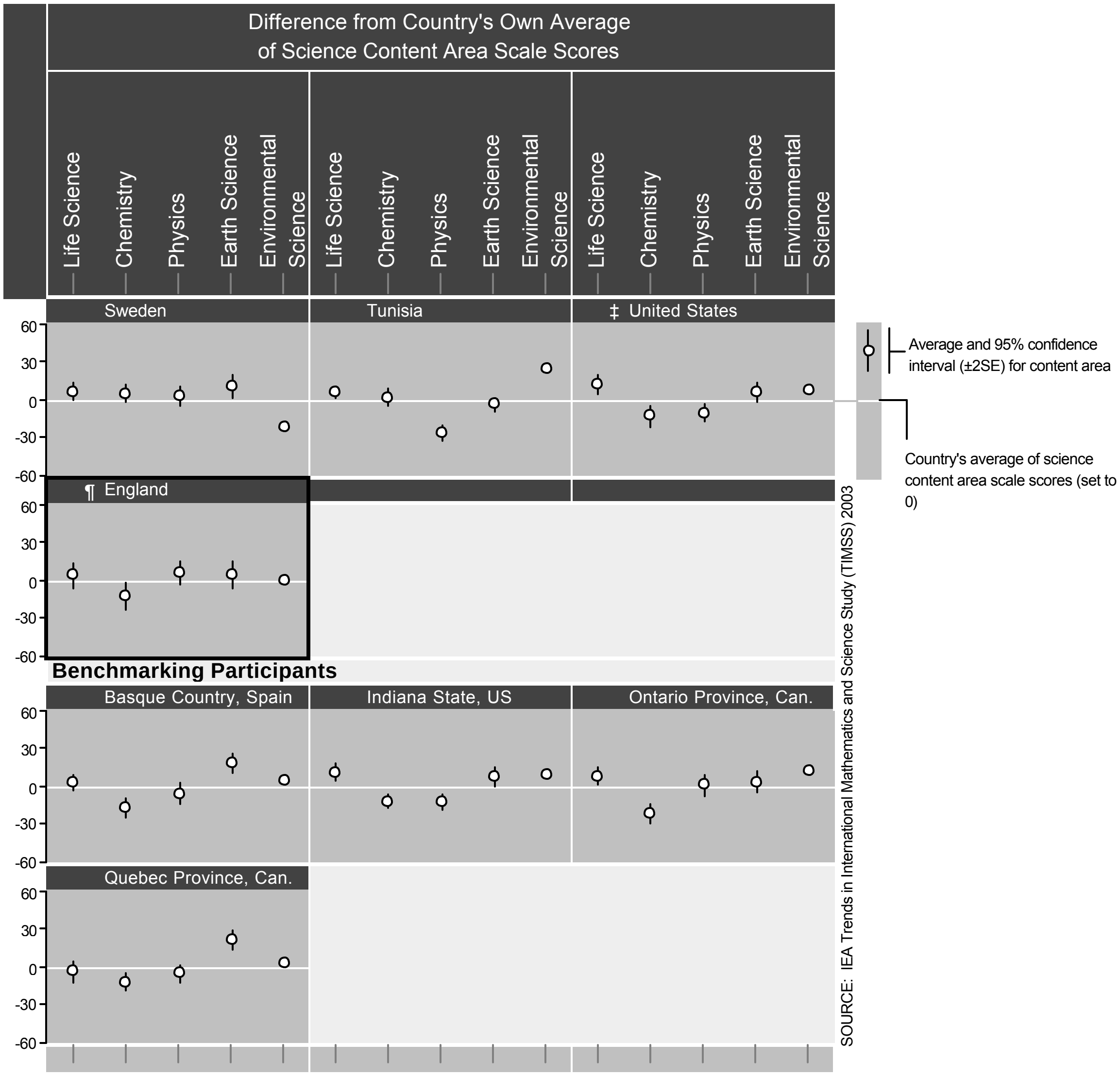
Exhibit 5.6 Profiles of Within-Country Relative Performance in Science Content Areas

8th grade Science TIMSS 2003



† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.

Exhibit 5.6 Profiles of Within-Country Relative Performance in Science Content Areas



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

¶ Did not satisfy guidelines for sample participation rates.

5.3 Performance by content area in grade 8 science

For grade 8 science there were five topics: life science; chemistry; physics; earth science; and environmental science. Exhibits 5.5 and 5.6 show England's performance, which was similar to its overall performance in four of the topic areas but at a lower level in the fifth, chemistry. This relative weakness in chemistry was common amongst comparison group countries, similar patterns being observed in Australia, Belgium (Flemish), Hong Kong, the Netherlands, New Zealand and Scotland.

At grade 8, it is also possible to look at trends over time by content area. There were sufficient items in common with the 1999 survey for this to be achieved using average percentage correct as the criterion for comparison. Exhibit 5.7 shows the results.

There was no overall trend for England in grade 8 science, and this was mirrored by each of the five content areas. This exhibit also provides a view of how the different levels of performance in different countries compare. For all 74 trend items the highest percentage correct was for Singapore, 67 per cent. England scored 61 per cent and Italy 53 per cent, close to the international average of 52 per cent.

5.4 Performance by content area in grade 8 mathematics

Exhibits 5.8 and 5.9 show England's performance in the five topic areas for grade 8 mathematics. These were: number; algebra; measurement; geometry; and data, very similar to those used at grade 4. England's performance followed a similar profile to that in grade 4 mathematics with the exception of geometry. Performance was strongest in data, about the same as England's average performance in measurement and relatively weakest in number. Geometry was not above average, unlike grade 4. Similar patterns are noticeable for Australia, New Zealand and Scotland, comparison group countries which overall scored at a level similar to England.

As for science it is possible to look at trends over time by content area in mathematics. Exhibit 5.10 shows the results.

There was no overall trend for England in grade 8 mathematics, and this was replicated in four of the five content areas. The exception was geometry, where England's performance in 2003 was significantly higher than in 1999, 50 per cent as opposed to 47 per cent. As for science, this exhibit also provides a view of how the different levels of performance in different countries compare. For all 79 trend items the highest percentage correct was again for Singapore, 74 per

Exhibit 5.7 Trends in Average Percent Correct in Science Content Areas*

Countries	Average Percent Correct for Science Content Areas					
	Total Science Trend Items (74 items)		Life Science Trend Items (17 items)		Chemistry Trend Items (14 items)	
	2003	1999	2003	1999	2003	1999
Australia	57 (0.7)	– –	61 (0.8)	– –	53 (0.9)	– –
Belgium (Flemish)	56 (0.5)	60 (0.5) ▼	61 (0.6)	64 (0.5) ▼	49 (0.5)	51 (1.0) ▼
Bulgaria	50 (1.1)	57 (1.1) ▼	50 (1.2)	58 (1.3) ▼	53 (1.2)	62 (1.1) ▼
Chile	40 (0.5)	38 (0.7) ▲	43 (0.6)	41 (0.8) ▲	41 (0.7)	38 (0.7) ▲
Chinese Taipei	66 (0.7)	67 (0.6)	62 (0.6)	64 (0.6)	71 (0.9)	72 (0.8)
Cyprus	42 (0.4)	46 (0.3) ▼	41 (0.5)	49 (0.6) ▼	42 (0.5)	47 (0.7) ▼
Hong Kong, SAR	61 (0.7)	59 (0.7)	61 (0.6)	59 (0.8) ▲	57 (0.7)	56 (0.7)
Hungary	62 (0.5)	63 (0.7)	61 (0.7)	61 (0.8)	66 (0.7)	67 (0.8)
Indonesia	39 (0.6)	40 (0.6)	38 (0.6)	38 (0.7)	31 (0.4)	32 (0.6)
Iran, Islamic Rep. of	44 (0.5)	44 (0.7)	39 (0.6)	40 (0.7)	46 (0.6)	48 (0.7) ▼
Israel	53 (0.6)	49 (0.8) ▲	56 (0.7)	50 (0.9) ▲	56 (0.8)	51 (0.9) ▲
Italy	53 (0.6)	53 (0.7)	55 (0.8)	54 (0.8)	52 (0.8)	53 (1.0)
Japan	61 (0.5)	63 (0.4) ▼	61 (0.5)	63 (0.5) ▼	59 (0.6)	61 (0.6)
Jordan	48 (0.7)	47 (0.6)	50 (0.9)	46 (0.7) ▲	51 (0.8)	52 (0.8)
Korea, Rep. of	63 (0.4)	64 (0.4)	64 (0.5)	62 (0.5)	54 (0.5)	61 (0.5) ▼
Latvia (LSS)	54 (0.7)	53 (0.6)	53 (0.8)	50 (0.8)	54 (1.0)	53 (0.8)
Lithuania	58 (0.6)	50 (0.8) ▲	57 (0.7)	48 (0.9) ▲	60 (0.7)	53 (0.9) ▲
Macedonia, Rep. of	45 (0.7)	46 (0.7)	45 (0.8)	47 (0.8)	52 (0.9)	52 (1.1)
Malaysia	53 (0.8)	52 (0.8)	49 (1.0)	51 (1.0)	52 (0.9)	49 (0.7) ▲
Moldova, Rep. of	48 (0.7)	47 (0.8)	46 (1.0)	48 (0.9)	50 (0.8)	46 (1.0) ▲
Netherlands	61 (0.7)	61 (1.4)	66 (0.8)	63 (1.5)	53 (0.8)	53 (1.2)
New Zealand	56 (1.0)	54 (1.0)	59 (1.0)	56 (1.1)	50 (1.2)	50 (1.1)
Philippines	35 (0.8)	33 (0.9)	38 (1.0)	34 (1.0) ▲	31 (0.7)	34 (0.8) ▼
Romania	48 (1.0)	48 (0.9)	50 (1.1)	48 (1.1)	49 (1.1)	52 (1.2)
Russian Federation	56 (0.6)	57 (1.3)	55 (0.5)	54 (1.5)	61 (1.0)	64 (1.5)
Singapore	67 (0.9)	67 (1.4)	65 (0.9)	66 (1.5)	70 (1.1)	65 (1.6) ▲
Slovak Republic	56 (0.7)	58 (0.7) ▼	57 (0.8)	59 (0.8)	57 (0.9)	61 (0.8) ▼
Slovenia	57 (0.5)	– –	54 (0.8)	– –	61 (0.7)	– –
South Africa	23 (0.7)	24 (0.7)	23 (0.7)	24 (0.9)	27 (0.6)	29 (0.6) ▼
Tunisia	35 (0.5)	41 (0.4) ▼	34 (0.6)	39 (0.5) ▼	40 (0.4)	45 (0.5) ▼
United States	58 (0.6)	57 (0.7)	63 (0.7)	61 (0.9)	55 (0.7)	55 (0.9)
¶ England	61 (0.9)	61 (1.0)	63 (1.0)	64 (0.9)	57 (1.1)	56 (1.2)
International Avg.	52 (0.1)	52 (0.1)	52 (0.1)	52 (0.2)	52 (0.1)	52 (0.2)
Benchmarking Participants						
Indiana State, US	59 (1.0)	60 (1.4)	64 (1.0)	66 (1.4)	56 (1.3)	57 (1.5)
Ontario Province, Can.	59 (0.6)	56 (0.6) ▲	65 (0.7)	61 (0.8) ▲	51 (0.8)	51 (0.9)
Quebec Province, Can.	60 (0.7)	61 (1.9)	60 (0.8)	61 (1.9)	55 (0.8)	57 (1.1)

▲ 2003 significantly higher than 1999

▼ 2003 significantly lower than 1999

* Applies only to items that appeared on both the 1999 and 2003 assessments. Fourth grade data are not available.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia. Korea tested later in 2003 than in 1999 at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 5.7 Trends in Average Percent Correct in Science Content Areas*

Countries	Average Percent Correct for Science Content Areas: Physics Trend Items (22 items) 2003	Physics Trend Items (22 items) 1999	Earth Science Trend Items (12 items) 2003	Earth Science Trend Items (12 items) 1999	Environmental Science Trend Items (9 items) 2003	Environmental Science Trend Items (9 items) 1999
Australia	59 (0.9)	– –	57 (1.0)	– –	56 (1.0)	– –
Belgium (Flemish)	61 (0.6)	64 (0.8) ▼	56 (0.7)	59 (1.0) ▼	49 (0.8)	54 (0.7) ▼
Bulgaria	48 (1.1)	52 (1.4) ▼	57 (1.3)	63 (1.2) ▼	43 (1.3)	50 (1.3) ▼
Chile	40 (0.5)	37 (0.7) ▲	41 (0.6)	38 (0.7) ▲	33 (0.6)	37 (0.8) ▼
Chinese Taipei	62 (0.8)	64 (0.7)	69 (0.8)	71 (0.7)	70 (0.9)	69 (0.8)
Cyprus	46 (0.6)	47 (0.5)	43 (0.6)	46 (0.6) ▼	35 (0.6)	42 (0.7) ▼
Hong Kong, SAR	61 (0.7)	62 (0.8)	64 (0.8)	65 (0.9)	62 (1.0)	55 (1.0) ▲
Hungary	62 (0.7)	63 (0.8)	66 (0.7)	70 (0.9) ▼	52 (1.0)	53 (1.0)
Indonesia	42 (0.7)	43 (0.7)	43 (0.8)	45 (0.9)	40 (0.8)	46 (0.9) ▼
Iran, Islamic Rep. of	41 (0.6)	42 (0.7)	54 (0.8)	53 (0.9)	42 (0.7)	40 (0.8)
Israel	53 (0.8)	48 (0.9) ▲	54 (0.7)	50 (1.1) ▲	42 (0.9)	42 (1.0)
Italy	49 (0.7)	50 (0.8)	61 (0.9)	58 (1.0)	47 (0.9)	49 (0.9)
Japan	65 (0.5)	68 (0.4) ▼	62 (0.6)	66 (0.6) ▼	54 (0.9)	50 (0.7) ▲
Jordan	42 (0.8)	42 (0.6)	53 (0.8)	52 (0.7)	44 (1.0)	44 (0.8)
Korea, Rep. of	68 (0.5)	67 (0.4)	67 (0.6)	67 (0.7)	58 (0.8)	58 (0.7)
Latvia (LSS)	57 (0.9)	57 (0.8)	54 (1.0)	51 (1.0) ▲	49 (1.2)	48 (1.0)
Lithuania	61 (0.6)	55 (0.9) ▲	59 (0.8)	49 (1.0) ▲	46 (0.8)	38 (1.0) ▲
Macedonia, Rep. of	45 (0.7)	45 (0.9)	47 (0.9)	45 (1.1)	34 (1.0)	35 (0.9)
Malaysia	55 (0.8)	53 (0.8)	56 (1.0)	56 (1.0)	51 (1.1)	50 (1.0)
Moldova, Rep. of	49 (0.9)	47 (0.9) ▲	53 (0.9)	52 (1.0)	38 (1.1)	38 (1.2)
Netherlands	65 (0.7)	64 (1.5)	62 (0.9)	61 (1.5)	58 (1.3)	59 (2.0)
New Zealand	60 (1.0)	57 (1.0) ▲	53 (1.1)	53 (1.0)	52 (1.4)	54 (1.1)
Philippines	35 (0.8)	33 (0.8)	36 (1.0)	35 (1.0)	33 (1.3)	26 (1.1) ▲
Romania	47 (0.9)	47 (1.0)	51 (1.2)	52 (1.1)	44 (1.2)	42 (1.2)
Russian Federation	56 (0.7)	58 (1.1)	61 (0.7)	60 (1.4)	45 (1.0)	46 (1.5)
Singapore	68 (0.7)	69 (1.3)	65 (0.8)	63 (1.5)	68 (1.1)	73 (1.8) ▼
Slovak Republic	56 (0.7)	59 (0.9) ▼	60 (0.9)	57 (1.0) ▲	50 (1.0)	53 (0.9) ▼
Slovenia	56 (0.6)	– –	63 (0.7)	– –	51 (1.0)	– –
South Africa	23 (0.8)	24 (0.7)	24 (0.7)	23 (0.6)	19 (1.0)	20 (0.9)
Tunisia	33 (0.6)	39 (0.5) ▼	38 (0.7)	44 (0.7) ▼	30 (0.7)	38 (0.5) ▼
United States	57 (0.6)	54 (0.7) ▲	60 (0.7)	58 (0.8) ▲	55 (0.9)	54 (0.7)
¶ England	63 (0.9)	61 (1.2)	64 (1.0)	63 (0.9)	54 (1.3)	56 (1.4)
International Avg.	53 (0.1)	52 (0.2)	55 (0.2)	54 (0.2) ▲	47 (0.2)	47 (0.2)
Benchmarking Participants						
Indiana State, US	56 (1.2)	55 (1.4)	60 (1.1)	63 (1.6)	57 (1.2)	60 (2.3)
Ontario Province, Can.	61 (0.6)	58 (0.8) ▲	60 (0.8)	54 (0.7) ▲	58 (1.0)	57 (1.0)
Quebec Province, Can	63 (0.7)	63 (2.6)	65 (1.1)	65 (1.8)	54 (1.0)	60 (2.8) ▼

▲ 2003 significantly higher than 1999

▼ 2003 significantly lower than 1999

* Applies only to items that appeared on both the 1999 and 2003 assessments. Fourth grade data are not available.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia. Korea tested later in 2003 than in 1999 at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

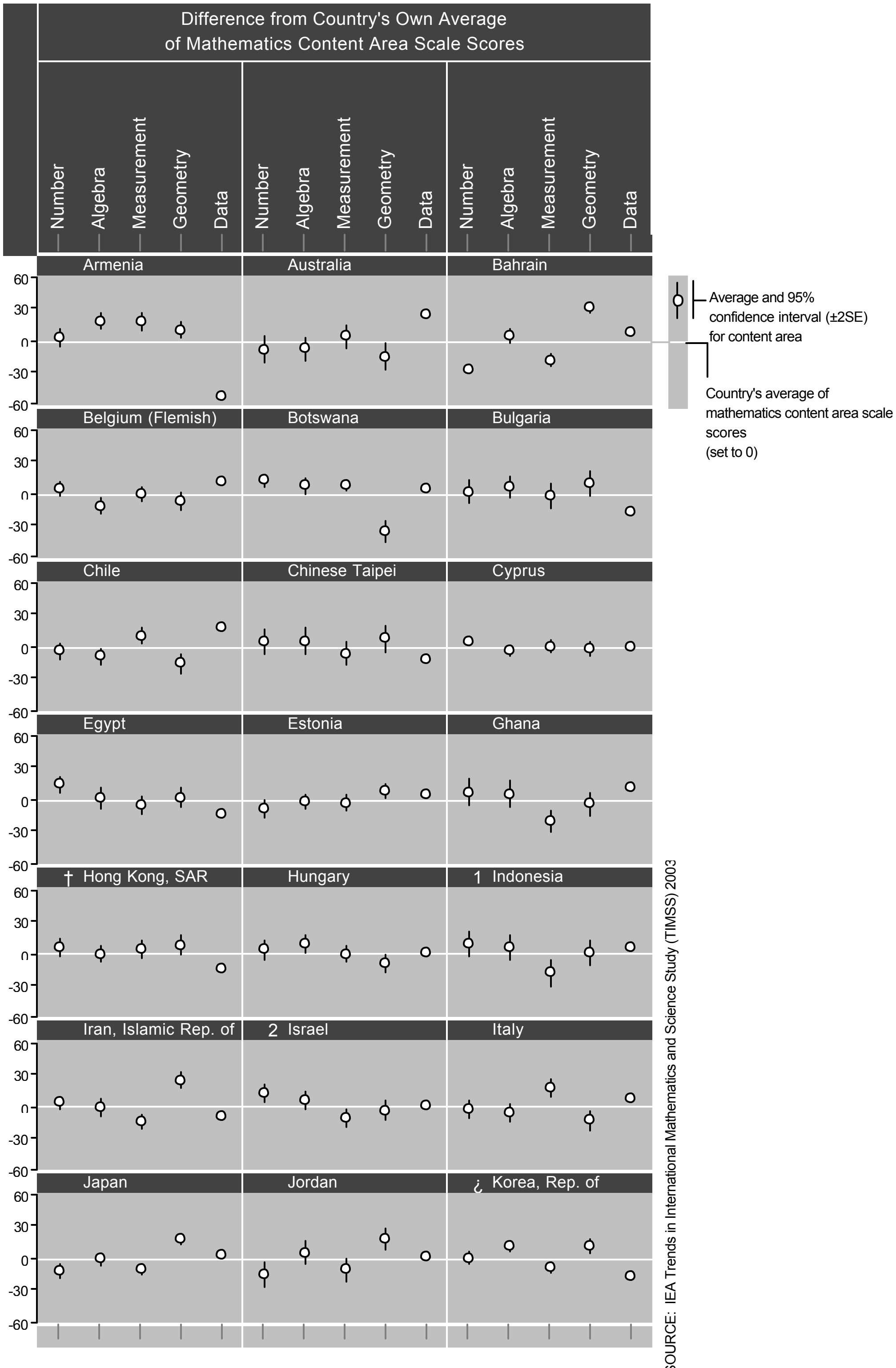
Countries	Average Scale Scores for Mathematics Content Areas				
	Number	Algebra	Measurement	Geometry	Data
Armenia	473 (3.1) ▲	489 (2.6) ▲	488 (3.3) ▲	481 (3.1) ▲	419 (2.7) ▼
Australia	498 (4.6) ▲	499 (4.4) ▲	511 (4.3) ▲	491 (4.8) ▲	531 (3.8) ▲
Bahrain	380 (1.9) ▼	411 (2.5) ▼	388 (2.1) ▼	438 (2.1) ▼	414 (2.1) ▼
Belgium (Flemish)	539 (2.7) ▲	523 (2.8) ▲	535 (2.5) ▲	527 (3.1) ▲	546 (2.9) ▲
Botswana	382 (2.2) ▼	377 (2.7) ▼	377 (2.0) ▼	335 (3.9) ▼	375 (2.7) ▼
Bulgaria	477 (4.1) ▲	481 (4.0) ▲	473 (4.6)	484 (4.5) ▲	458 (3.9) ▼
Chile	390 (3.1) ▼	384 (3.1) ▼	404 (2.9) ▼	378 (3.3) ▼	412 (3.4) ▼
Chinese Taipei	585 (4.6) ▲	585 (4.9) ▲	574 (4.4) ▲	588 (5.1) ▲	568 (3.4) ▲
Cyprus	464 (1.5) ▼	455 (1.7) ▼	459 (2.2) ▼	457 (2.4) ▼	458 (1.7) ▼
Egypt	421 (3.0) ▼	408 (3.9) ▼	401 (3.3) ▼	408 (3.6) ▼	393 (3.2) ▼
Estonia	523 (3.1) ▲	528 (2.6) ▲	528 (3.0) ▲	540 (2.6) ▲	535 (2.8) ▲
Ghana	289 (5.1) ▼	288 (4.8) ▼	262 (3.7) ▼	278 (4.3) ▼	293 (4.1) ▼
† Hong Kong, SAR	586 (3.2) ▲	580 (3.2) ▲	584 (3.3) ▲	588 (3.6) ▲	566 (3.0) ▲
Hungary	529 (3.6) ▲	534 (3.1) ▲	525 (3.1) ▲	515 (3.1) ▲	526 (2.9) ▲
Indonesia	421 (4.6) ▼	418 (4.5) ▼	394 (4.9) ▼	413 (4.6) ▼	418 (4.0) ▼
Iran, Islamic Rep. of	416 (2.3) ▼	412 (3.1) ▼	399 (2.6) ▼	437 (3.1) ▼	404 (2.6) ▼
Israel	504 (3.3) ▲	498 (3.2) ▲	480 (3.4) ▲	488 (3.7) ▲	492 (3.3) ▲
Italy	480 (3.2) ▲	477 (3.4) ▲	500 (3.2) ▲	469 (3.5)	490 (3.0) ▲
Japan	557 (2.3) ▲	568 (2.0) ▲	559 (2.0) ▲	587 (2.1) ▲	573 (1.9) ▲
Jordan	413 (4.4) ▼	434 (4.4) ▼	418 (4.4) ▼	446 (4.0) ▼	430 (3.5) ▼
¿ Korea, Rep. of	586 (2.1) ▲	597 (2.2) ▲	577 (2.0) ▲	598 (2.6) ▲	569 (2.0) ▲
Latvia	507 (3.2) ▲	508 (3.2) ▲	500 (3.0) ▲	515 (3.3) ▲	506 (3.8) ▲
Lebanon	430 (3.3) ▼	448 (3.1) ▼	430 (3.7) ▼	459 (3.0) ▼	394 (4.0) ▼
Lithuania	500 (2.7) ▲	501 (2.4) ▲	492 (3.0) ▲	506 (2.5) ▲	502 (2.5) ▲
Macedonia, Rep. of	438 (3.5) ▼	442 (3.6) ▼	434 (3.6) ▼	442 (3.7) ▼	419 (3.6) ▼
Malaysia	524 (4.0) ▲	495 (3.9) ▲	504 (4.5) ▲	495 (4.8) ▲	505 (3.2) ▲
Moldova, Rep. of	463 (3.8)	464 (4.2)	468 (4.0)	463 (4.7)	428 (3.4) ▼
‡ Morocco	384 (2.7) ▼	400 (2.8) ▼	376 (3.4) ▼	415 (2.3) ▼	374 (2.5) ▼
† Netherlands	539 (3.6) ▲	514 (4.0) ▲	549 (3.7) ▲	513 (4.1) ▲	560 (3.1) ▲
New Zealand	481 (6.0) ▲	490 (5.2) ▲	500 (4.8) ▲	488 (4.6) ▲	526 (5.1) ▲
Norway	456 (2.3) ▼	428 (2.7) ▼	481 (2.9) ▲	461 (2.8) ▼	498 (2.5) ▲
Palestinian Nat'l Auth.	385 (3.6) ▼	392 (3.5) ▼	386 (2.8) ▼	423 (3.1) ▼	390 (2.8) ▼
Philippines	393 (5.1) ▼	400 (5.2) ▼	372 (4.8) ▼	344 (5.3) ▼	390 (4.5) ▼
Romania	474 (4.9)	480 (4.7) ▲	485 (4.7) ▲	476 (4.9) ▲	445 (4.6) ▼
Russian Federation	505 (4.0) ▲	516 (3.2) ▲	507 (3.9) ▲	515 (4.2) ▲	484 (3.2) ▲
Saudi Arabia	307 (5.3) ▼	331 (4.7) ▼	338 (3.4) ▼	382 (4.3) ▼	339 (3.8) ▼
† Scotland	484 (4.2) ▲	488 (3.9) ▲	508 (3.6) ▲	491 (3.3) ▲	531 (3.7) ▲
Serbia	477 (2.8) ▲	488 (2.5) ▲	475 (2.5) ▲	471 (3.0)	456 (2.6) ▼
Singapore	618 (3.5) ▲	590 (3.5) ▲	611 (3.6) ▲	580 (3.7) ▲	579 (3.2) ▲
Slovak Republic	514 (3.3) ▲	505 (3.3) ▲	508 (3.7) ▲	501 (3.6) ▲	495 (2.9) ▲
Slovenia	498 (2.0) ▲	487 (2.3) ▲	496 (2.3) ▲	483 (2.5) ▲	494 (2.3) ▲
South Africa	274 (5.4) ▼	275 (5.1) ▼	298 (4.7) ▼	247 (5.4) ▼	296 (5.3) ▼
Sweden	496 (2.6) ▲	480 (3.0) ▲	512 (2.6) ▲	467 (3.4)	539 (2.9) ▲
Tunisia	419 (2.3) ▼	405 (2.4) ▼	407 (2.2) ▼	427 (2.0) ▼	387 (2.2) ▼
‡ United States	508 (3.4) ▲	510 (3.1) ▲	495 (3.2) ▲	472 (3.1)	527 (3.2) ▲
¶ England	485 (5.0) ▲	492 (4.5) ▲	505 (4.3) ▲	492 (4.5) ▲	535 (4.1) ▲
International Avg.	467 (0.5)	467 (0.5)	467 (0.5)	467 (0.5)	467 (0.5)
Benchmarking Participants					
Basque Country, Spain	490 (2.6) ▲	490 (2.7) ▲	488 (2.4) ▲	456 (3.2) ▼	499 (2.7) ▲
Indiana State, US	516 (5.8) ▲	510 (5.3) ▲	503 (5.5) ▲	468 (5.1)	528 (4.9) ▲
Ontario Province, Can.	516 (3.4) ▲	515 (2.6) ▲	520 (2.8) ▲	513 (3.2) ▲	538 (2.7) ▲
Quebec Province, Can.	546 (3.4) ▲	529 (3.2) ▲	541 (3.6) ▲	542 (3.3) ▲	544 (2.6) ▲

▲ Country average significantly higher than international average

▼ Country average significantly lower than international average

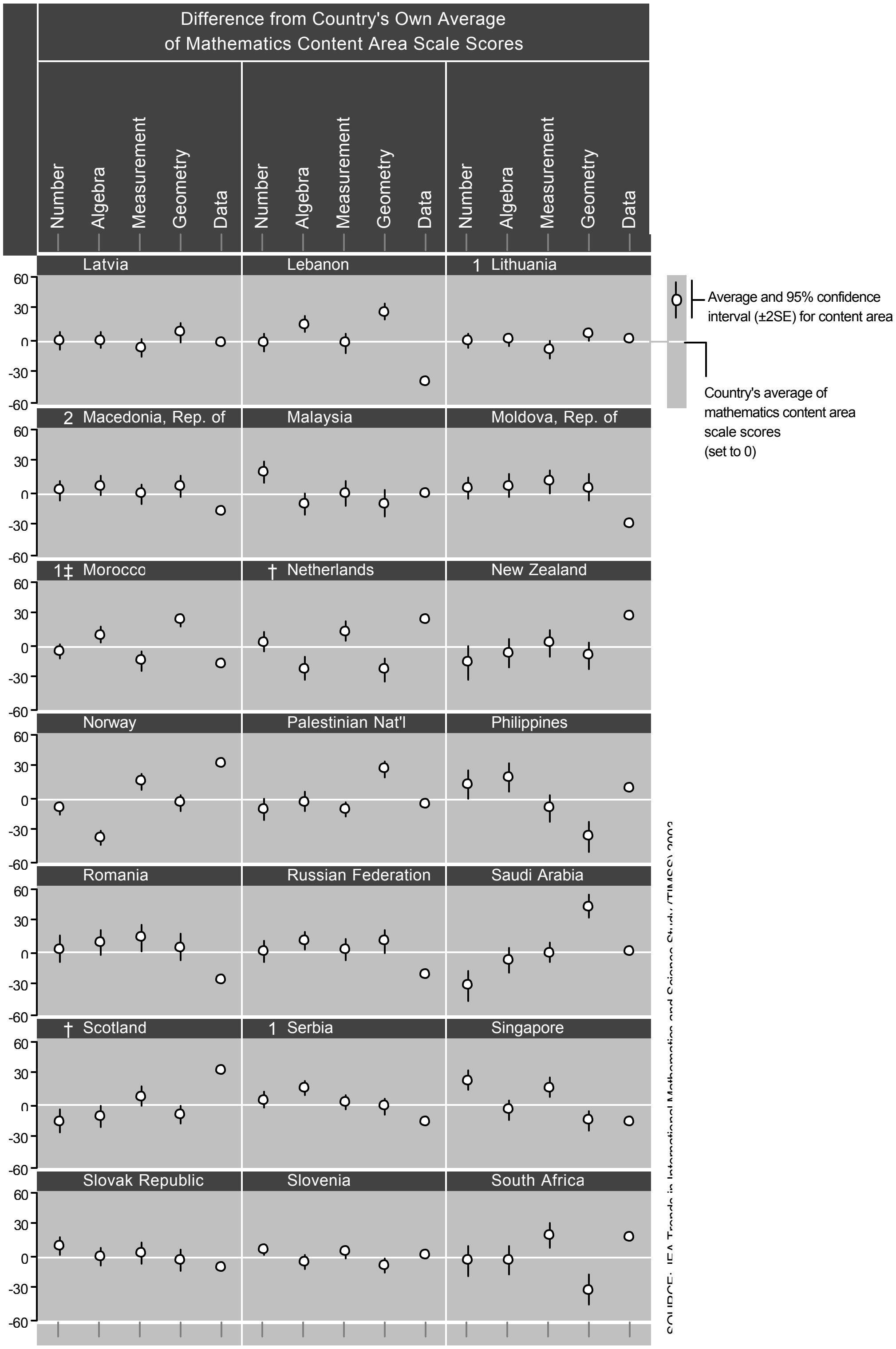
SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

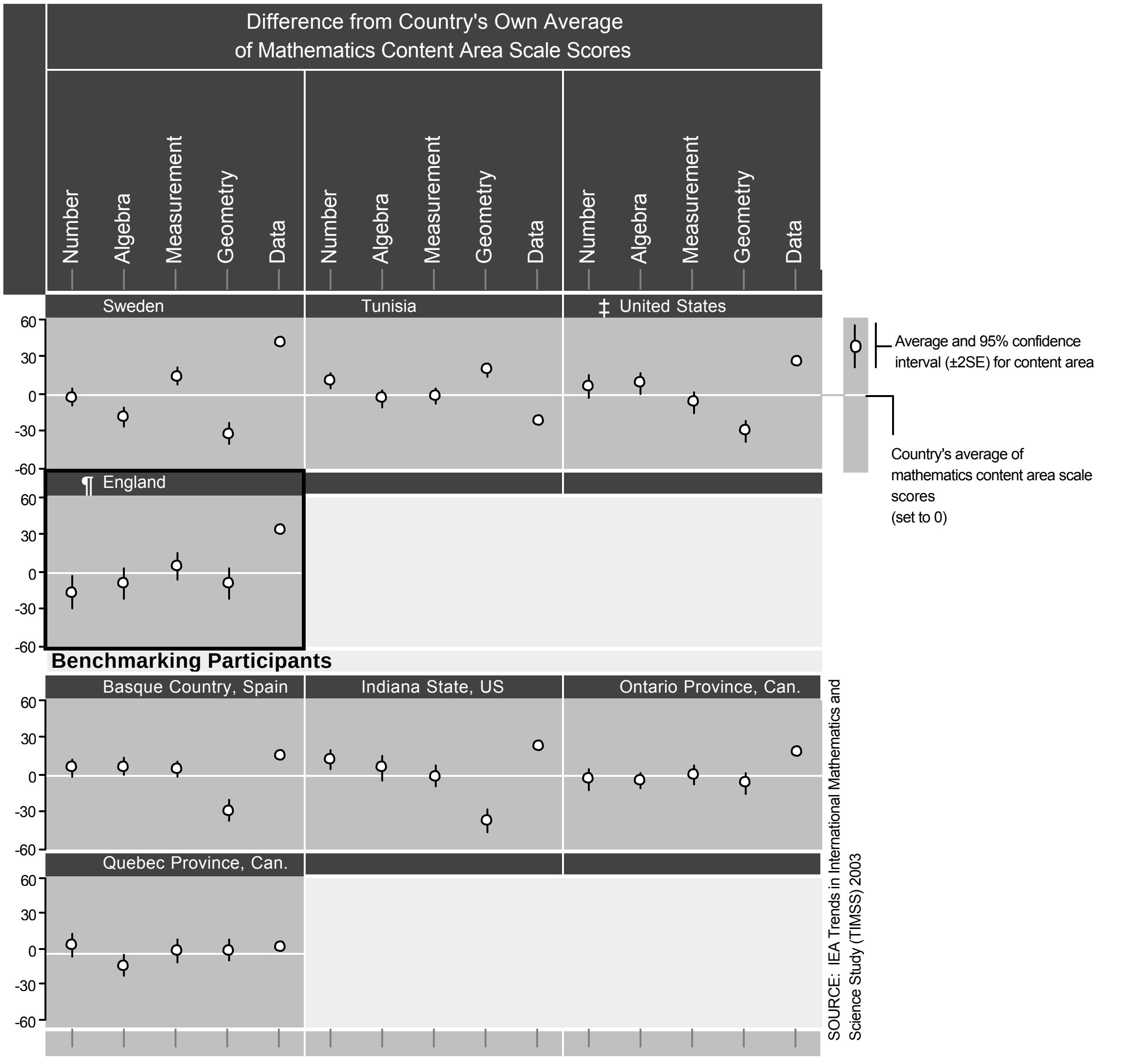


† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year

Exhibit 5.9 | Profiles of Within-Country Relative Performance in Mathematics Content Areas | 8th grade Mathematics | TIMSS 2003



† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.



‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.

cent. Countries which outscored England overall in 2003 scored between 74 per cent and 58 per cent (Hungary) on these trend items. England scored 49 per cent and countries performing at a similar level to England scored between 53 per cent and 48 per cent. The international average was 48 per cent, close to England's score. On these 79 trend items England's performance was closer to the international average than when all items used in 2003 are the basis on which performance is compared, see exhibits 2.7 and 2.8 for details.

Exhibit 5.10 Trends in Average Percent Correct in Mathematics Content Areas*

8th grade Mathematics — TIMSS 2003

Countries	Average Percent Correct for Mathematics Content Areas					
	Total Mathematics Trend Items (79 items)		Number Trend Items (25 items)		Algebra Trend Items (16 items)	
	2003	1999	2003	1999	2003	1999
Australia	52 (1.0)	– –	53 (1.0)	– –	47 (1.3)	– –
Belgium (Flemish)	60 (0.7)	64 (0.8) ▼	61 (0.8)	64 (1.0) ▼	52 (0.8)	56 (1.0) ▼
Bulgaria	45 (1.0)	53 (1.5) ▼	47 (1.0)	54 (1.5) ▼	43 (1.1)	53 (1.6) ▼
Chile	29 (0.6)	29 (0.8)	31 (0.6)	32 (0.9)	23 (0.7)	24 (0.9)
Chinese Taipei	69 (1.0)	70 (0.9)	70 (1.1)	73 (0.9)	66 (1.2)	68 (1.1)
Cyprus	43 (0.4)	46 (0.4) ▼	46 (0.5)	49 (0.5) ▼	38 (0.6)	40 (0.7)
Hong Kong, SAR	70 (0.7)	71 (1.1)	69 (0.8)	71 (1.2)	68 (0.9)	69 (1.3)
Hungary	57 (0.9)	59 (0.8)	59 (1.0)	60 (0.9)	56 (1.0)	57 (0.9)
Indonesia	32 (0.8)	34 (0.8)	35 (0.9)	36 (0.8)	30 (0.8)	32 (0.9)
Iran, Islamic Rep. of	32 (0.5)	35 (0.7) ▼	36 (0.5)	39 (0.7) ▼	29 (0.6)	31 (0.8) ▼
Israel	50 (0.9)	43 (0.9) ▲	52 (0.9)	44 (0.9) ▲	48 (0.9)	42 (1.1) ▲
Italy	47 (0.9)	48 (0.9)	48 (0.9)	49 (0.9)	42 (1.1)	41 (0.9)
Japan	66 (0.6)	70 (0.5) ▼	65 (0.7)	70 (0.6) ▼	64 (0.7)	69 (0.7) ▼
Jordan	33 (0.8)	36 (0.6) ▼	35 (0.8)	38 (0.7) ▼	31 (0.9)	33 (0.8) ▼
Korea, Rep. of	72 (0.5)	71 (0.5)	73 (0.6)	72 (0.5)	71 (0.6)	68 (0.7) ▲
Latvia (LSS)	51 (1.0)	51 (0.8)	53 (1.1)	53 (0.9)	48 (1.2)	47 (0.9)
Lithuania	50 (0.7)	47 (1.0) ▲	51 (0.7)	50 (1.1)	46 (0.8)	44 (1.2)
Macedonia, Rep. of	36 (0.7)	38 (0.8)	38 (0.8)	37 (0.9)	35 (0.9)	38 (1.0) ▼
Malaysia	52 (1.1)	56 (1.2) ▼	57 (1.1)	62 (1.2) ▼	42 (1.0)	46 (1.0) ▼
Moldova, Rep. of	43 (0.9)	44 (1.0)	47 (1.0)	46 (1.1)	40 (1.0)	41 (1.0)
Netherlands	60 (1.0)	58 (2.0)	60 (1.0)	58 (2.1)	51 (1.1)	51 (2.3)
New Zealand	48 (1.2)	47 (1.3)	47 (1.2)	47 (1.3)	43 (1.4)	43 (1.4)
Philippines	27 (0.8)	25 (0.7) ▲	31 (0.8)	30 (0.8)	27 (1.0)	20 (0.9) ▲
Romania	45 (1.2)	46 (1.3)	46 (1.1)	46 (1.4)	44 (1.4)	44 (1.5)
Russian Federation	53 (1.0)	55 (1.3)	54 (1.1)	57 (1.4) ▼	52 (1.0)	54 (1.3)
Singapore	74 (1.0)	76 (1.4)	78 (0.9)	80 (1.2)	69 (1.1)	69 (1.6)
Slovak Republic	52 (0.9)	59 (1.1) ▼	55 (1.0)	62 (1.2) ▼	49 (1.0)	55 (1.3) ▼
Slovenia	50 (0.7)	– –	53 (0.7)	– –	45 (0.9)	– –
South Africa	18 (0.7)	19 (0.7)	20 (0.7)	22 (0.7)	14 (0.7)	15 (0.7)
Tunisia	30 (0.4)	39 (0.5) ▼	33 (0.5)	41 (0.5) ▼	26 (0.5)	33 (0.6) ▼
United States	51 (0.9)	50 (0.9)	54 (0.9)	54 (1.0)	50 (1.0)	47 (1.0) ▲
¶ England	49 (1.1)	47 (1.1)	49 (1.1)	47 (1.1)	43 (1.2)	42 (1.2)
International Avg.	48 (0.2)	50 (0.2) ▼	50 (0.2)	51 (0.2) ▼	45 (0.2)	46 (0.2) ▼
Benchmarking Participants						
Indiana State, US	52 (1.3)	52 (1.7)	56 (1.4)	56 (1.8)	49 (1.3)	49 (1.8)
Ontario Province, Can.	55 (0.8)	53 (0.8)	55 (0.9)	56 (1.0)	51 (0.9)	48 (0.9)
Quebec Province, Can.	61 (0.8)	65 (1.5) ▼	62 (0.9)	65 (1.8)	56 (1.0)	60 (1.2) ▼

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher than 1999

▼ 2003 significantly lower than 1999

* Applies only to items that appeared on both the 1999 and 2003 assessments. Fourth grade data are not available.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia. Korea tested later in 2003 than in 1999, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

Countries	Average Percent Correct for Mathematics Content Areas					
	Measurement Trend Items (16 items)		Geometry Trend Items (12 items)		Data Trend Items (10 items)	
	2003	1999	2003	1999	2003	1999
Australia	47 (1.2)	– –	50 (1.1)	– –	71 (1.1)	– –
Belgium (Flemish)	54 (0.8)	60 (0.8) ▼	61 (0.9)	64 (1.0) ▼	79 (0.7)	81 (0.8)
Bulgaria	35 (1.2)	45 (1.5) ▼	50 (0.9)	58 (1.6) ▼	58 (1.1)	62 (1.6) ▼
Chile	21 (0.6)	19 (0.8)	30 (0.7)	32 (0.9)	44 (1.0)	45 (1.0)
Chinese Taipei	61 (1.1)	64 (1.0)	71 (1.0)	72 (0.9)	79 (0.8)	80 (0.7)
Cyprus	34 (0.6)	40 (0.6) ▼	45 (0.5)	47 (0.6) ▼	61 (0.7)	61 (1.0)
Hong Kong, SAR	66 (0.9)	66 (1.2)	73 (0.8)	72 (1.1)	76 (0.6)	78 (0.9)
Hungary	51 (1.0)	53 (1.0)	55 (1.0)	55 (1.1)	69 (1.0)	71 (0.9)
Indonesia	21 (0.8)	22 (0.8)	36 (0.8)	37 (1.0)	47 (1.1)	47 (1.1)
Iran, Islamic Rep. of	20 (0.5)	22 (0.8)	36 (0.6)	39 (0.8) ▼	46 (0.8)	49 (1.0) ▼
Israel	39 (0.9)	32 (0.9) ▲	51 (1.1)	44 (0.9) ▲	65 (1.1)	59 (1.1) ▲
Italy	43 (1.0)	44 (1.0)	46 (1.0)	47 (1.0)	64 (0.9)	64 (1.2)
Japan	58 (0.7)	63 (0.7) ▼	74 (0.6)	75 (0.6) ▼	76 (0.5)	79 (0.5) ▼
Jordan	23 (0.8)	27 (0.8) ▼	37 (0.8)	41 (0.7) ▼	46 (1.1)	49 (0.7)
Korea, Rep. of	63 (0.7)	64 (0.6)	75 (0.6)	74 (0.6)	80 (0.4)	82 (0.4) ▼
Latvia (LSS)	38 (1.0)	40 (1.1)	57 (1.2)	59 (1.0)	67 (1.4)	63 (1.0) ▲
Lithuania	38 (0.8)	34 (1.2) ▲	54 (0.8)	49 (1.3) ▲	68 (0.8)	64 (1.2) ▲
Macedonia, Rep. of	27 (0.9)	29 (1.0)	39 (0.7)	42 (1.0) ▼	49 (1.0)	48 (1.0)
Malaysia	45 (1.3)	51 (1.4) ▼	51 (1.2)	53 (1.3)	67 (1.0)	68 (1.0)
Moldova, Rep. of	36 (1.1)	37 (1.3)	46 (1.3)	47 (1.2)	49 (1.0)	50 (1.1)
Netherlands	58 (1.2)	56 (2.0)	57 (1.2)	58 (1.7)	79 (1.0)	75 (2.4)
New Zealand	42 (1.5)	42 (1.5)	49 (1.3)	48 (1.3)	66 (1.4)	65 (1.4)
Philippines	18 (0.8)	15 (0.6) ▲	25 (0.7)	25 (0.8)	40 (0.9)	39 (0.9)
Romania	39 (1.4)	40 (1.4)	45 (1.3)	48 (1.3)	55 (1.4)	54 (1.3)
Russian Federation	44 (1.2)	47 (1.6)	56 (1.1)	58 (1.5)	64 (1.2)	65 (1.3)
Singapore	74 (1.1)	76 (1.6)	71 (1.1)	73 (1.6)	79 (0.8)	81 (1.2)
Slovak Republic	44 (1.1)	53 (1.5) ▼	53 (1.0)	61 (1.2) ▼	64 (1.0)	71 (1.1) ▼
Slovenia	42 (0.9)	– –	50 (0.9)	– –	67 (0.9)	– –
South Africa	12 (0.7)	13 (0.6)	19 (0.8)	21 (0.8)	29 (1.1)	30 (0.9)
Tunisia	20 (0.5)	32 (0.7) ▼	34 (0.6)	46 (0.6) ▼	39 (0.6)	52 (0.7) ▼
United States	42 (1.0)	40 (1.1)	45 (0.9)	44 (1.0)	72 (0.8)	68 (0.9) ▲
¶ England	45 (1.3)	43 (1.3)	50 (1.3)	47 (1.3) ▲	69 (1.3)	66 (1.4)
International Avg.	41 (0.2)	42 (0.2) ▼	50 (0.2)	51 (0.2) ▼	62 (0.2)	62 (0.2)
Benchmarking Participants						
Indiana State, US	42 (1.7)	43 (2.0)	44 (1.7)	44 (1.9)	72 (1.3)	72 (1.9)
Ontario Province, Can.	47 (0.9)	45 (1.1)	56 (1.1)	52 (1.0) ▲	75 (0.8)	71 (0.9) ▲
Quebec Province, Can	54 (1.1)	60 (2.0) ▼	64 (0.9)	68 (2.0)	74 (0.6)	77 (1.4) ▼

▲ 2003 significantly higher than 1999

▼ 2003 significantly lower than 1999

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

* Applies only to items that appeared on both the 1999 and 2003 assessments. Fourth grade data are not available.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia. Korea tested later in 2003 than in 1999, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

6 Gender differences

In this section gender differences are examined both overall and for the content areas from the TIMSS framework. In both cases any trends over time are also looked at.

6.1 Performance by gender in grade 4 science

Exhibit 6.1 shows overall performance in science at grade 4 analysed by gender. In England there was no significant difference between boys and girls, but this was not true of all comparison group countries. In the United States, the Netherlands and Scotland, boys outperformed girls, but the converse did not occur in any comparison group country.

Exhibit 6.2 indicates trends over time in gender differences. England's performance shows an interesting pattern. Overall England's results improved from 1995 to 2003, but only the performance of girls showed a significant change. Girls, rather than boys, were mostly responsible for the improved performance in science. This pattern was unusual, only four of the 15 countries showed a trend over time for one gender but not the other.

Exhibit 6.3 shows how boys and girls performed in the three content areas. Each one mirrored overall performance in science, there being no gender differences apparent for England. Of the comparison group countries this was also the case only for Belgium and Singapore. The countries produced a variety of patterns of gender differences which are difficult to generalise from.

6.2 Performance by gender in grade 4 mathematics

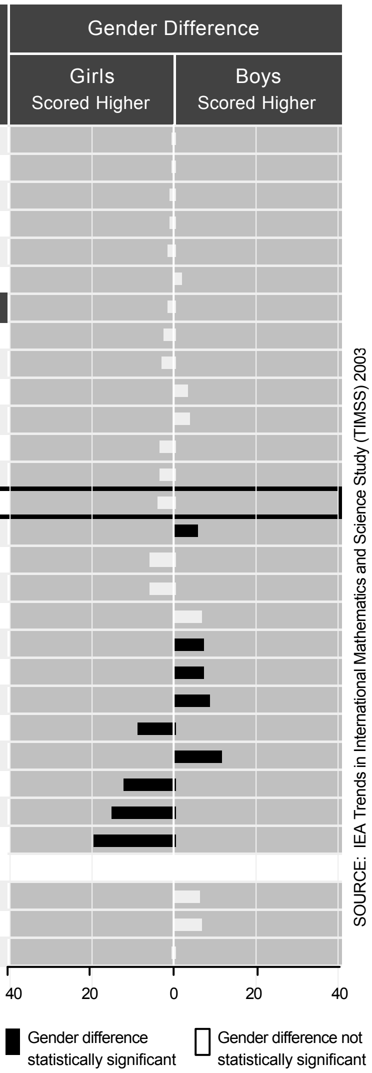
The same set of exhibits are presented as for grade 4 science.

Exhibit 6.4 shows that at grade 4 in England, as in science, there was no significant difference between boys and girls. Again this was not true of all comparison group countries. In the United States, the Netherlands and Scotland, boys outperformed girls as they did in science, and, in addition, this was true for Italy in mathematics. In Singapore, however, girls outperformed boys.

Exhibit 6.5 indicates trends over time in gender differences. Given England's large increase in performance from 1995 to 2003 significant increases in performance by both genders would be expected and were found. Both genders also improved their performance in Hong Kong and New Zealand.

Exhibit 6.1 Average Science Achievement by Gender

Countries	Girls: Percent of Students	Girls: Average Scale Score	Boys: Percent of Students	Boys: Average Scale Score	Difference (Absolute Value)
Lithuania	49 (0.9)	513 (3.0)	51 (0.9)	513 (2.9)	0 (2.5)
Singapore	49 (1.4)	565 (5.4)	51 (1.4)	565 (6.4)	1 (4.2)
Slovenia	48 (1.1)	491 (3.0)	52 (1.1)	490 (3.2)	1 (3.7)
Norway	50 (0.8)	467 (3.2)	50 (0.8)	466 (2.9)	1 (3.1)
Russian Federation	50 (0.7)	527 (5.9)	50 (0.7)	526 (4.9)	1 (3.3)
Belgium (Flemish)	50 (1.0)	518 (1.9)	50 (1.0)	519 (2.3)	1 (2.3)
International Avg.	49 (0.2)	489 (1.1)	51 (0.2)	488 (0.9)	1 (0.8)
Morocco	49 (1.1)	306 (7.9)	51 (1.1)	303 (6.8)	2 (6.0)
† Hong Kong, SAR	47 (1.1)	544 (3.3)	53 (1.1)	541 (3.2)	3 (2.3)
Italy	48 (0.8)	514 (4.2)	52 (0.8)	517 (3.8)	3 (2.8)
Japan	49 (0.6)	542 (1.8)	51 (0.6)	545 (2.0)	3 (2.4)
† Australia	50 (1.0)	522 (3.8)	50 (1.0)	519 (5.5)	4 (4.3)
Tunisia	48 (0.9)	316 (6.1)	52 (0.9)	312 (6.0)	4 (4.3)
† England	50 (0.9)	542 (3.3)	50 (0.9)	538 (4.6)	4 (3.3)
† United States	50 (0.5)	533 (2.5)	50 (0.5)	538 (2.8)	5 (1.7)
Latvia	49 (0.9)	534 (2.6)	51 (0.9)	529 (3.2)	6 (3.2)
New Zealand	50 (1.1)	523 (3.3)	50 (1.1)	517 (2.5)	6 (3.1)
Hungary	50 (0.9)	527 (3.7)	50 (0.9)	533 (3.2)	6 (3.7)
Chinese Taipei	48 (0.5)	548 (2.0)	52 (0.5)	555 (2.2)	7 (2.5)
Cyprus	49 (0.7)	477 (2.5)	51 (0.7)	484 (2.9)	7 (2.6)
† Netherlands	49 (1.1)	521 (2.2)	51 (1.1)	529 (2.2)	8 (2.1)
Armenia	49 (0.8)	441 (4.5)	51 (0.8)	432 (4.7)	9 (3.4)
† Scotland	51 (1.0)	496 (3.1)	49 (1.0)	508 (4.0)	11 (4.2)
Moldova, Rep. of	50 (0.8)	503 (4.8)	50 (0.8)	490 (4.9)	12 (3.3)
Philippines	51 (1.0)	339 (10.8)	49 (1.0)	324 (8.8)	15 (6.3)
Iran, Islamic Rep. of	39 (4.2)	426 (7.0)	61 (4.2)	406 (4.7)	20 (8.4)
Benchmarking Participants					
Indiana State, US	52 (1.1)	550 (3.9)	48 (1.1)	556 (4.5)	6 (4.0)
Ontario Province, Can.	48 (1.1)	537 (4.0)	52 (1.1)	543 (4.6)	6 (4.3)
Quebec Province, Can.	50 (0.9)	501 (2.7)	50 (0.9)	500 (3.1)	1 (2.9)



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.2	Trends in Average Science Achievement by Gender	4th grade Science	TIMSS 2003

Countries	Girls			Boys		
	2003 Average Scale Score	1995 to 2003 Difference		2003 Average Scale Score	1995 to 2003 Difference	
Australia	522 (3.8)	4 (5.2)		519 (5.5)	-5 (7.2)	
Cyprus	477 (2.5)	32 (3.9)	▲	484 (2.9)	29 (4.9)	▲
England	542 (3.3)	17 (4.8)	▲	538 (4.6)	8 (6.0)	
Hong Kong, SAR	544 (3.3)	43 (4.8)	▲	541 (3.2)	27 (5.1)	▲
Hungary	527 (3.7)	26 (5.2)	▲	533 (3.2)	17 (5.0)	▲
Iran, Islamic Rep. of	426 (7.0)	48 (8.8)	▲	406 (4.7)	23 (8.6)	▲
Japan	542 (1.8)	-5 (2.7)	▼	545 (2.0)	-14 (2.8)	▼
Latvia (LSS)	534 (3.0)	46 (6.4)	▲	526 (3.7)	40 (6.5)	▲
Netherlands	521 (2.2)	3 (3.9)		529 (2.2)	-14 (4.2)	▼
New Zealand	526 (3.2)	15 (5.7)	▲	521 (2.3)	22 (7.4)	▲
Norway	467 (3.2)	-30 (4.9)	▼	466 (2.9)	-43 (5.8)	▼
Scotland	496 (3.1)	-16 (5.6)	▼	508 (4.0)	-9 (6.7)	
Singapore	565 (5.4)	45 (8.0)	▲	565 (6.4)	39 (8.3)	▲
Slovenia	491 (3.0)	33 (4.6)	▲	490 (3.2)	21 (5.3)	▲
United States	533 (2.5)	-3 (4.6)		538 (2.8)	-10 (4.3)	▼
International Avg.	514 (1.1)	17 (1.4)	▲	514 (1.1)	9 (1.6)	▲
Benchmarking Participants						
Ontario Province, Ca	537 (4.0)	24 (5.8)	▲	543 (4.6)	25 (6.2)	▲
Quebec Province, Ca	501 (2.7)	-24 (5.7)	▼	500 (3.1)	-32 (7.1)	▼

▲ 2003 significantly higher than 1995

▼ 2003 significantly lower than 1995

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.3 Average Achievement in Science Content Areas by Gender

Countries	Average Scale Scores for Science Content Areas					
	Life Science		Physical Science		Earth Science	
	Girls	Boys	Girls	Boys	Girls	Boys
Armenia	443 (4.5) ▲	428 (5.0)	430 (4.5)	428 (4.9)	455 (3.9) ▲	445 (4.1)
† Australia	527 (3.5) ▲	520 (4.9)	518 (3.8)	518 (5.1)	519 (4.0)	518 (5.7)
Belgium (Flemish)	523 (1.9)	524 (2.3)	507 (2.6)	507 (2.5)	521 (2.2)	524 (2.4)
Chinese Taipei	539 (1.6)	542 (2.0)	551 (2.2)	557 (2.6) ▲	553 (2.9)	565 (2.8) ▲
Cyprus	479 (2.7)	485 (2.7)	475 (2.5)	483 (3.0) ▲	485 (2.6)	489 (3.0)
† England	532 (3.0)	531 (3.8)	549 (3.3)	544 (4.1)	535 (3.8)	536 (4.2)
† Hong Kong, SAR	536 (2.8)	533 (2.7)	551 (3.2) ▲	544 (2.8)	537 (3.4)	536 (3.0)
Hungary	537 (3.2)	536 (2.8)	522 (3.5)	530 (3.2)	520 (5.0)	531 (4.1) ▲
Iran, Islamic Rep. of	437 (6.6) ▲	415 (5.3)	432 (7.4) ▲	410 (5.2)	437 (5.2) ▲	423 (3.7)
Italy	521 (3.9)	521 (3.7)	510 (4.1)	513 (3.6)	514 (4.5)	523 (3.6) ▲
Japan	529 (2.0)	530 (2.0)	557 (2.2)	557 (2.4)	530 (2.5)	539 (2.3) ▲
Latvia	535 (2.4) ▲	527 (2.9)	536 (3.1) ▲	528 (3.1)	534 (3.4)	534 (3.3)
Lithuania	518 (2.4)	517 (2.5)	514 (2.8)	513 (3.2)	503 (4.2)	507 (3.8)
Moldova, Rep. of	511 (4.2) ▲	497 (4.5)	495 (4.1) ▲	483 (4.4)	511 (5.2) ▲	499 (5.6)
Morocco	303 (7.6)	297 (6.0)	311 (7.9)	305 (7.4)	313 (7.5)	308 (6.1)
† Netherlands	545 (2.2)	549 (2.2)	501 (2.2)	509 (2.2) ▲	496 (2.9)	509 (2.9) ▲
New Zealand	524 (2.9) ▲	516 (2.7)	519 (2.9) ▲	513 (2.6)	523 (3.1)	522 (2.3)
Norway	483 (2.6)	477 (2.8)	457 (3.0)	454 (2.6)	473 (3.4)	472 (3.5)
Philippines	339 (10.4) ▲	322 (8.1)	349 (10.6) ▲	337 (9.3)	331 (10.7) ▲	317 (8.6)
Russian Federation	528 (5.5)	525 (4.5)	527 (5.8)	526 (5.2)	528 (6.9)	527 (5.7)
† Scotland	500 (3.5)	511 (3.9) ▲	499 (3.0)	507 (3.7)	492 (2.9)	505 (3.6) ▲
Singapore	559 (4.9)	557 (5.7)	580 (5.8)	574 (6.6)	534 (5.0)	541 (6.1)
Slovenia	490 (3.6)	488 (3.8)	499 (2.8)	496 (3.2)	489 (3.0)	492 (4.1)
Tunisia	294 (6.5)	285 (6.3)	326 (5.9)	322 (5.5)	337 (5.5)	336 (5.8)
† United States	536 (2.1)	538 (2.6)	529 (2.1)	533 (2.7) ▲	531 (2.6)	539 (2.9) ▲
International Avg.	491 (0.8) ▲	487 (0.8)	490 (0.9) ▲	488 (0.8)	488 (0.9)	490 (0.8) ▲
Benchmarking Participants						
Indiana State, US	551 (2.6)	558 (4.3)	544 (3.3)	548 (4.5)	547 (3.5)	557 (4.6) ▲
Ontario Province, Can.	540 (3.7)	542 (4.7)	534 (3.6)	539 (4.6)	531 (4.0)	547 (5.1) ▲
Quebec Province, Can.	506 (2.3)	500 (3.1)	496 (2.5)	497 (3.0)	505 (2.7)	510 (3.8)

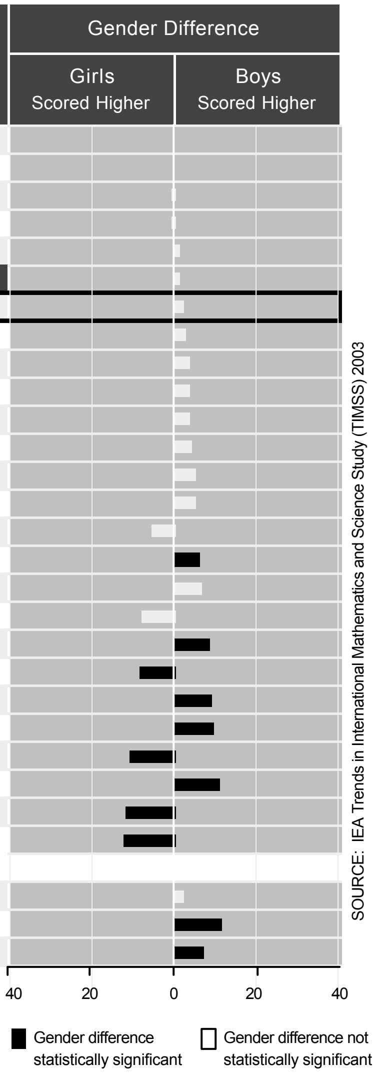
▲ Significantly higher than other gender

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 6.4	Average Mathematics Achievement by Gender	4th grade Mathematics	TIMSS 2003

Countries	Girls		Boys		Difference (Absolute Value)
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	
† Hong Kong, SAR	47 (1.1)	575 (3.4)	53 (1.1)	575 (3.4)	0 (2.3)
New Zealand	50 (1.1)	493 (2.7)	50 (1.1)	494 (2.4)	0 (2.9)
Chinese Taipei	48 (0.5)	564 (1.7)	52 (0.5)	564 (2.1)	1 (1.7)
Latvia	49 (0.9)	536 (2.9)	51 (0.9)	536 (3.5)	1 (2.9)
Lithuania	49 (0.9)	535 (3.5)	51 (0.9)	536 (3.2)	1 (2.8)
International Avg.	49 (0.2)	495 (0.8)	51 (0.2)	496 (0.8)	1 (0.7)
† England	50 (0.9)	530 (3.9)	50 (0.9)	532 (4.5)	2 (4.0)
Belgium (Flemish)	50 (1.0)	549 (1.8)	50 (1.0)	552 (2.5)	2 (2.5)
Hungary	50 (0.9)	527 (3.8)	50 (0.9)	530 (3.3)	3 (3.4)
† Australia	50 (1.0)	497 (4.5)	50 (1.0)	500 (4.3)	3 (4.0)
Japan	49 (0.6)	563 (1.8)	51 (0.6)	566 (2.1)	4 (2.3)
Russian Federation	50 (0.7)	530 (5.4)	50 (0.7)	534 (4.7)	4 (3.5)
Norway	50 (0.8)	449 (2.7)	50 (0.8)	454 (2.7)	5 (2.8)
Slovenia	48 (1.1)	477 (3.0)	52 (1.1)	481 (3.5)	5 (3.8)
Tunisia	48 (0.9)	342 (5.0)	52 (0.9)	337 (4.9)	5 (2.8)
† Netherlands	49 (1.1)	537 (2.7)	51 (1.1)	543 (2.2)	6 (2.4)
Morocco	49 (1.1)	344 (6.1)	51 (1.1)	350 (5.1)	6 (4.7)
Iran, Islamic Rep. of	39 (4.2)	394 (6.5)	61 (4.2)	386 (5.5)	8 (8.8)
† United States	50 (0.5)	514 (2.4)	50 (0.5)	522 (2.7)	8 (1.6)
Singapore	49 (1.4)	599 (5.5)	51 (1.4)	590 (6.2)	8 (3.9)
Italy	48 (0.8)	498 (4.1)	52 (0.8)	507 (3.7)	9 (2.6)
Cyprus	49 (0.7)	505 (2.7)	51 (0.7)	514 (2.9)	9 (2.8)
Moldova, Rep. of	50 (0.8)	510 (5.2)	50 (0.8)	499 (5.1)	11 (3.5)
† Scotland	51 (1.0)	485 (3.2)	49 (1.0)	496 (4.4)	11 (4.1)
Philippines	51 (1.0)	364 (9.2)	49 (1.0)	352 (7.0)	12 (4.6)
Armenia	49 (0.8)	462 (3.7)	51 (0.8)	450 (3.8)	12 (2.9)
Benchmarking Participants					
Indiana State, US	52 (1.1)	532 (3.1)	48 (1.1)	534 (3.4)	2 (3.3)
Ontario Province, Can.	48 (1.1)	505 (3.6)	52 (1.1)	517 (4.7)	11 (3.7)
Quebec Province, Can.	50 (0.9)	502 (2.7)	50 (0.9)	509 (2.8)	7 (2.7)



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.5 Trends in Average Mathematics Achievement by Gender

Countries	Girls			Boys		
	2003 Average Scale Score	1995 to 2003 Difference		2003 Average Scale Score	1995 to 2003 Difference	
Australia	497 (4.5)	4 (5.9)		500 (4.3)	4 (6.0)	
Cyprus	505 (2.7)	34 (4.5)	▲	514 (2.9)	35 (4.8)	▲
England	530 (3.9)	51 (5.7)	▲	532 (4.5)	44 (5.7)	▲
Hong Kong, SAR	575 (3.4)	17 (5.1)	▲	575 (3.4)	18 (5.5)	▲
Hungary	527 (3.8)	8 (5.5)		530 (3.3)	6 (5.1)	
Iran, Islamic Rep. of	394 (6.5)	15 (8.9)		386 (5.5)	-8 (9.7)	
Japan	563 (1.8)	-1 (2.6)		566 (2.1)	-5 (3.3)	
Latvia (LSS)	535 (3.2)	30 (5.9)	▲	531 (3.9)	38 (6.9)	▲
Netherlands	537 (2.7)	-6 (4.4)		543 (2.2)	-13 (4.2)	▼
New Zealand	495 (2.8)	22 (5.1)	▲	496 (2.4)	31 (6.6)	▲
Norway	449 (2.7)	-25 (5.0)	▼	454 (2.7)	-24 (4.5)	▼
Scotland	485 (3.2)	-8 (5.2)		496 (4.4)	3 (6.5)	
Singapore	599 (5.5)	4 (7.8)		590 (6.2)	4 (7.8)	
Slovenia	477 (3.0)	19 (4.8)	▲	481 (3.5)	15 (4.9)	▲
United States	514 (2.4)	-2 (3.8)		522 (2.7)	3 (4.1)	
International Avg.	512 (0.9)	11 (1.4)	▲	515 (1.0)	10 (1.5)	▲
Benchmarking Participants						
Ontario Province, Can.	505 (3.6)	19 (4.9)	▲	517 (4.7)	26 (6.4)	▲
Quebec Province, Can.	502 (2.7)	-46 (6.1)	▼	509 (2.8)	-42 (5.6)	▼

▲ 2003 significantly higher than 1995

▼ 2003 significantly lower than 1995

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. Data for Latvia in this exhibit include Latvian-speaking schools only. To be comparable with 1995, 2003 data for New Zealand in this exhibit include students in English medium instruction only (98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.6 Average Achievement in Mathematics Content Areas by Gender

Countries	Average Scale Scores for Mathematics Content Areas					
	Number		Patterns and Relationships		Measurement	
	Girls	Boys	Girls	Boys	Girls	Boys
Armenia	480 (3.3) ▲	467 (3.2)	468 (4.6) ▲	453 (4.6)	468 (3.3)	463 (3.9)
† Australia	476 (5.1)	481 (5.0)	493 (4.5)	497 (4.3)	510 (4.4)	517 (4.1)
Belgium (Flemish)	547 (2.1)	550 (2.5)	542 (2.7)	543 (2.2)	547 (1.7)	552 (2.1) ▲
Chinese Taipei	568 (2.5)	567 (2.1)	555 (2.4)	555 (2.9)	556 (2.0)	558 (1.9)
Cyprus	510 (3.1)	517 (3.0) ▲	516 (3.4)	522 (2.9)	498 (2.4)	513 (3.1) ▲
† England	520 (4.4)	518 (4.8)	523 (4.1)	524 (4.5)	531 (3.5)	539 (3.8) ▲
† Hong Kong, SAR	575 (3.5)	573 (3.6)	568 (4.4)	568 (3.6)	561 (3.0)	564 (2.9)
Hungary	522 (3.5)	525 (3.4)	550 (4.1) ▲	539 (4.9)	527 (3.5)	538 (2.8) ▲
Iran, Islamic Rep. of	415 (6.1)	407 (5.0)	402 (6.5)	389 (5.3)	401 (5.5)	397 (4.3)
Italy	499 (4.0)	506 (3.7) ▲	496 (5.3)	496 (5.3)	496 (3.8)	512 (3.8) ▲
Japan	553 (2.5)	558 (2.3)	551 (1.9)	557 (2.0) ▲	567 (2.0)	569 (2.0)
Latvia	532 (3.1)	530 (3.3)	533 (3.9)	530 (3.8)	542 (3.1)	548 (3.0)
Lithuania	536 (3.5)	536 (3.6)	531 (3.5)	533 (4.1)	539 (2.9)	544 (3.7)
Moldova, Rep. of	513 (5.0) ▲	501 (4.8)	527 (5.6) ▲	515 (5.3)	506 (4.4)	504 (4.3)
Morocco	355 (6.0)	363 (4.8)	356 (5.9)	365 (5.2)	336 (6.5)	353 (5.7) ▲
† Netherlands	531 (2.6)	541 (2.8) ▲	527 (3.6)	528 (2.5)	540 (2.6)	549 (2.3) ▲
New Zealand	473 (3.4)	477 (2.6)	496 (4.0)	493 (3.7)	501 (3.2)	505 (2.1)
Norway	437 (3.2)	444 (2.4) ▲	439 (3.0)	438 (3.0)	469 (2.9)	480 (2.9) ▲
Philippines	388 (8.9) ▲	372 (6.3)	384 (8.2)	380 (6.7)	332 (9.4)	328 (7.4)
Russian Federation	532 (5.1)	531 (4.7)	531 (5.6)	531 (5.3)	533 (4.3)	544 (4.0) ▲
† Scotland	471 (3.6)	479 (4.5)	492 (2.7)	498 (4.2)	492 (3.2)	507 (3.9) ▲
Singapore	617 (5.9) ▲	608 (6.7)	583 (5.4)	575 (6.0)	569 (4.5)	564 (5.2)
Slovenia	458 (3.4)	465 (3.4)	487 (3.0)	493 (4.9)	493 (3.1)	501 (3.5) ▲
Tunisia	361 (4.8)	360 (4.1)	331 (5.4)	329 (5.4)	311 (6.3)	306 (5.5)
† United States	513 (2.5)	520 (3.2) ▲	521 (2.7)	526 (3.1) ▲	494 (2.0)	505 (2.7) ▲
International Avg.	495 (0.8)	496 (0.8)	496 (0.8)	495 (0.8)	493 (0.8)	498 (0.7) ▲
Benchmarking Participants						
Indiana State, US	529 (3.5)	532 (4.5)	535 (3.4)	536 (4.6)	515 (3.8)	515 (3.7)
Ontario Province, Can.	490 (4.2)	498 (6.7)	508 (4.0)	517 (4.3) ▲	506 (3.6)	517 (4.8) ▲
Quebec Province, Can.	503 (2.9)	514 (3.0) ▲	499 (3.5)	499 (3.1)	499 (2.7)	508 (2.9) ▲

▲ Significantly higher than other gender

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 6.6 Average Achievement in Mathematics Content Areas by Gender

Countries	Average Scale Scores for Mathematics Content Areas			
	Geometry		Data	
	Girls	Boys	Girls	Boys
Armenia	437 (3.9) ▲	425 (4.4)	424 (4.0) ▲	411 (4.0)
† Australia	529 (3.6) ▲	519 (4.9)	529 (4.3)	521 (4.7)
Belgium (Flemish)	534 (2.0)	531 (2.3)	547 (2.8)	549 (2.9)
Chinese Taipei	554 (2.6)	552 (2.7)	568 (2.1) ▲	560 (3.3)
Cyprus	506 (2.5)	504 (2.7)	506 (2.4)	513 (3.1) ▲
† England	545 (4.4)	538 (4.4)	554 (4.3)	549 (4.3)
† Hong Kong, SAR	559 (3.8)	555 (2.9)	563 (2.6)	561 (2.7)
Hungary	515 (4.1)	513 (3.7)	515 (4.6)	512 (3.8)
Iran, Islamic Rep. of	430 (5.9) ▲	407 (4.7)	360 (7.3)	354 (5.4)
Italy	523 (4.2)	521 (3.4)	495 (3.9)	499 (3.5)
Japan	562 (1.9)	557 (2.7)	595 (2.4)	591 (2.4)
Latvia	525 (2.0) ▲	520 (2.9)	529 (3.2)	522 (3.5)
Lithuania	525 (2.7)	526 (2.7)	519 (3.3)	518 (3.3)
Moldova, Rep. of	505 (5.5) ▲	496 (4.8)	483 (4.9) ▲	470 (4.3)
Morocco	362 (7.3)	362 (5.2)	356 (6.2)	354 (4.9)
† Netherlands	522 (4.1)	519 (3.1)	552 (2.8)	554 (3.1)
New Zealand	521 (2.4) ▲	514 (2.5)	524 (2.9)	519 (2.9)
Norway	482 (2.7) ▲	473 (2.9)	480 (2.8)	478 (3.0)
Philippines	336 ####	334 (7.8)	393 (8.8) ▲	374 (7.2)
Russian Federation	528 (5.2)	528 (4.9)	502 (4.8)	508 (4.3)
† Scotland	513 (2.8)	509 (3.3)	513 (3.2)	519 (3.6)
Singapore	573 (5.4)	566 (6.1)	579 (3.8) ▲	571 (4.4)
Slovenia	502 (3.1)	495 (2.5)	486 (3.6)	487 (3.9)
Tunisia	351 (6.2)	342 (5.4)	311 (5.3)	305 (5.0)
† United States	517 (2.5)	519 (2.4)	546 (1.9)	551 (2.5) ▲
International Avg.	498 (0.8) ▲	493 (0.8)	497 (0.8) ▲	494 (0.7)
Benchmarking Participants				
Indiana State, US	524 (3.4)	526 (5.0)	557 (4.4)	558 (3.6)
Ontario Province, Can.	532 (3.6)	537 (5.2)	542 (4.4)	546 (4.5)
Quebec Province, Can.	525 (2.1)	519 (3.6)	505 (3.0)	508 (3.4)

▲ Significantly higher than other gender

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
1 National Desired Population does not cover all of International Desired Population.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.6 shows how boys and girls performed in the five content areas. Only one content area, measurement, showed a gender difference, in favour of boys. The remaining four areas mirrored the overall performance, showing no gender differences. This was also the case for Scotland, but, as in science, the other comparison countries showed a range of patterns of gender differences. Only Hong Kong showed none.

6.3 Performance by gender in grade 8 science

Exhibit 6.7 to 6.9 show the same information as for grade 4, but for grade 8 science. In this case England did show a gender difference, in favour of boys. Of the comparison group countries only Singapore and New Zealand did not show a significant difference in favour of boys. The difference in England was 12 points, higher than the international average, 6 points, but lower than that for the comparison group countries, 14 points. The difference in favour of boys in Scotland was also 12 points, but the largest differences in comparison group countries were 20 points or more , in Australia, Belgium and Hungary. This gender difference was evident in 29 of the participating countries, but seven countries, either from eastern Europe or the Arab world, showed significant differences in favour of girls.

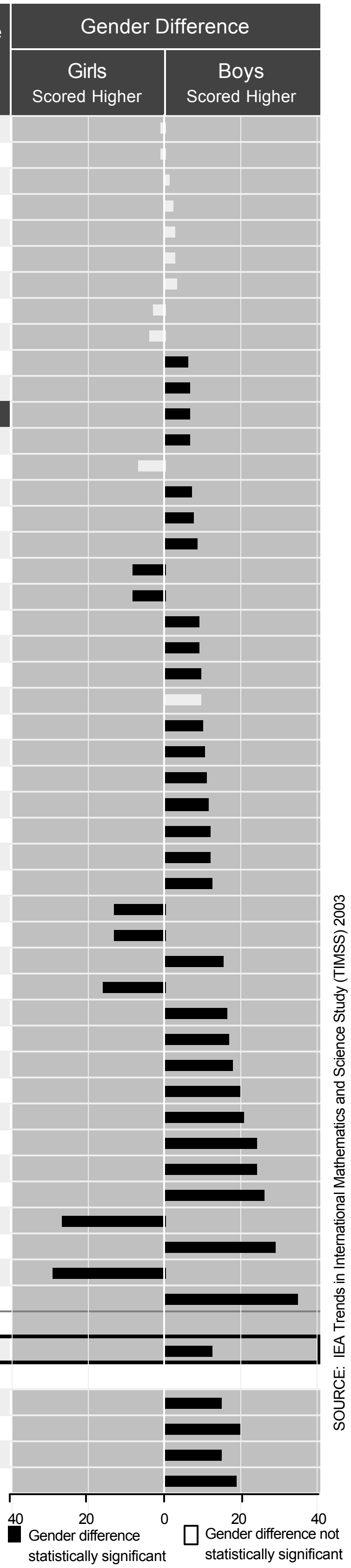
Exhibit 6.8 indicates trends over time in gender differences. England's performance shows an interesting pattern. Overall England's results did not improve from 1995 or 1999 to 2003, but at grade 8 the performance of girls showed a significant improvement from both previous surveys. Girls improved their performance relative to boys but still scored less highly than boys. Had boys' performance improved in a similar way to that of girls, England's performance overall would have improved.

Exhibit 6.9 shows how boys and girls performed in the five content areas. In four: chemistry, physics, earth science and environmental science, boys outperformed girls in England. In the fifth content area, life science, there was no significant difference in performance by gender. In the comparison group countries as a whole, life science, produced fewer gender differences than other content areas, but the patterns of difference again varied considerably between countries.

Exhibit 6.7 | Average Science Achievement by Gender

8th grade TIMSS 2003 Science

Countries	Girls: Percent of Students	Girls: Average Scale Score	Boys: Percent of Students	Boys: Average Scale Score	Difference (Absolute Value)
Egypt	46 (2.7)	422 (4.8)	54 (2.7)	421 (5.5)	1 (6.8)
Iran, Islamic Rep. of	40 (4.1)	454 (3.9)	60 (4.1)	453 (3.7)	1 (6.1)
Chinese Taipei	48 (1.0)	571 (3.8)	52 (1.0)	572 (3.8)	1 (3.1)
Botswana	51 (0.7)	364 (3.2)	49 (0.7)	366 (3.4)	2 (3.3)
South Africa	51 (0.9)	242 (7.2)	49 (0.9)	244 (7.7)	2 (6.1)
Lebanon	57 (1.8)	392 (4.8)	43 (1.8)	395 (6.0)	3 (6.4)
Singapore	49 (0.8)	576 (4.0)	51 (0.8)	579 (5.0)	3 (3.1)
Estonia	50 (1.0)	554 (2.8)	50 (1.0)	551 (2.9)	3 (2.8)
Cyprus	49 (0.6)	443 (2.3)	51 (0.6)	440 (2.8)	4 (3.0)
Lithuania	50 (0.9)	516 (2.7)	50 (0.9)	522 (2.4)	6 (2.5)
Serbia	49 (0.8)	465 (2.9)	51 (0.8)	471 (2.6)	6 (2.5)
International Avg.	50 (0.2)	471 (0.7)	50 (0.2)	477 (0.7)	6 (0.6)
Slovenia	50 (0.9)	517 (2.4)	50 (0.9)	524 (2.3)	7 (3.0)
Philippines	58 (0.9)	380 (5.9)	42 (0.9)	374 (6.4)	7 (4.1)
Latvia	49 (0.8)	509 (2.6)	51 (0.8)	516 (3.0)	7 (2.4)
Sweden	51 (0.9)	521 (3.2)	49 (0.9)	528 (2.7)	8 (2.5)
Norway	50 (0.8)	490 (2.2)	50 (0.8)	498 (3.0)	8 (2.9)
Macedonia, Rep. of	49 (0.9)	454 (3.7)	51 (0.9)	445 (4.2)	8 (3.3)
Moldova, Rep. of	51 (0.8)	477 (3.5)	49 (0.8)	468 (3.7)	8 (2.6)
Romania	52 (0.9)	465 (5.5)	48 (0.9)	474 (4.9)	9 (3.5)
† Hong Kong, SAR	50 (2.4)	552 (3.4)	50 (2.4)	561 (3.8)	9 (3.9)
Japan	49 (1.2)	548 (3.0)	51 (1.2)	557 (2.7)	9 (4.5)
New Zealand	52 (1.7)	515 (4.8)	48 (1.7)	525 (6.7)	9 (5.7)
Malaysia	50 (1.8)	505 (4.3)	50 (1.8)	515 (4.0)	10 (4.0)
Italy	50 (0.9)	486 (2.7)	50 (0.9)	496 (3.8)	10 (2.5)
Russian Federation	49 (1.2)	508 (3.7)	51 (1.2)	519 (4.2)	11 (3.1)
‡ Morocco	50 (1.8)	392 (3.2)	50 (1.8)	403 (3.8)	11 (4.6)
Indonesia	50 (0.7)	415 (3.9)	50 (0.7)	426 (4.6)	11 (2.7)
† Scotland	50 (1.3)	506 (4.0)	50 (1.3)	517 (3.5)	12 (3.6)
¿ Korea, Rep. of	48 (2.8)	552 (2.1)	52 (2.8)	564 (1.9)	12 (2.5)
Armenia	53 (0.7)	468 (4.0)	47 (0.7)	455 (3.4)	13 (2.8)
Palestinian Nat'l Auth.	55 (2.4)	441 (3.7)	45 (2.4)	428 (5.2)	13 (6.2)
† Netherlands	49 (1.2)	528 (3.3)	51 (1.2)	543 (3.8)	15 (3.5)
Saudi Arabia	43 (2.3)	407 (6.2)	57 (2.3)	391 (5.4)	16 (8.2)
Bulgaria	48 (1.3)	470 (6.3)	52 (1.3)	487 (5.2)	16 (5.2)
‡ United States	52 (0.7)	519 (3.2)	48 (0.7)	536 (3.4)	16 (2.1)
Slovak Republic	48 (1.3)	508 (3.8)	52 (1.3)	525 (3.4)	18 (3.1)
Israel	52 (1.6)	479 (3.2)	48 (1.6)	498 (4.1)	20 (4.2)
Australia	51 (2.2)	517 (4.6)	49 (2.2)	537 (4.6)	20 (5.6)
Belgium (Flemish)	54 (2.1)	505 (3.0)	46 (2.1)	528 (3.4)	24 (4.2)
Tunisia	53 (0.7)	392 (2.3)	47 (0.7)	416 (2.6)	24 (2.6)
Hungary	50 (1.0)	530 (3.4)	50 (1.0)	556 (3.0)	26 (3.0)
Jordan	49 (1.7)	489 (4.5)	51 (1.7)	462 (5.6)	27 (6.9)
Chile	48 (1.6)	398 (3.2)	52 (1.6)	427 (3.6)	29 (4.0)
Bahrain	50 (0.4)	453 (2.7)	50 (0.4)	423 (2.3)	29 (3.5)
Ghana	45 (0.9)	236 (6.4)	55 (0.9)	271 (6.5)	35 (4.7)
¶ England	50 (2.4)	538 (4.7)	50 (2.4)	550 (5.1)	12 (5.3)
Benchmarking Participants					
Basque Country, Spain	49 (1.7)	481 (3.0)	51 (1.7)	496 (3.3)	15 (3.6)
Indiana State, US	49 (1.2)	521 (4.7)	51 (1.2)	540 (5.3)	19 (3.1)
Ontario Province, Can.	51 (0.9)	526 (3.1)	49 (0.9)	540 (2.8)	15 (2.6)
Quebec Province, Can.	50 (1.6)	522 (3.7)	50 (1.6)	540 (3.2)	18 (3.1)



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.8 Trends in Average Science Achievement by Gender

Countries	Girls			Boys		
	2003 Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	2003 Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference
Australia	517 (4.6)	– –	10 (6.0)	537 (4.6)	– –	18 (7.1) ▲
Belgium (Flemish)	505 (3.0)	-21 (5.4) ▼	-19 (9.2) ▼	528 (3.4)	-16 (7.9) ▼	-14 (9.7)
Bulgaria	470 (6.3)	-41 (8.6) ▼	-78 (8.8) ▼	487 (5.2)	-38 (8.3) ▼	-56 (7.6) ▼
Chile	398 (3.2)	-11 (5.6)	' '	427 (3.6)	-5 (6.2)	' '
Chinese Taipei	571 (3.8)	10 (5.5)	' '	572 (3.8)	-6 (6.6)	' '
Cyprus	443 (2.3)	-11 (4.2) ▼	-11 (3.6) ▼	440 (2.8)	-26 (4.2) ▼	-11 (3.8) ▼
Hong Kong, SAR	552 (3.4)	29 (5.7) ▲	60 (7.4) ▲	561 (3.8)	24 (6.2) ▲	36 (7.4) ▲
Hungary	530 (3.4)	-10 (5.5)	5 (4.8)	556 (3.0)	-10 (5.4)	7 (4.7)
Indonesia	415 (3.9)	-12 (7.7)	' '	426 (4.6)	-18 (6.7) ▼	' '
Iran, Islamic Rep. of	454 (3.9)	24 (6.9) ▲	6 (7.0)	453 (3.7)	-7 (5.7)	-22 (5.8) ▼
Israel	479 (3.2)	18 (6.8) ▲	– –	498 (4.1)	23 (7.0) ▲	– –
Italy	486 (2.7)	1 (4.9)	– –	496 (3.8)	-7 (7.2)	– –
Japan	548 (3.0)	5 (4.0)	3 (3.5)	557 (2.7)	0 (4.1)	-7 (3.6) ▼
Jordan	489 (4.5)	29 (6.8) ▲	' '	462 (5.6)	20 (8.3) ▲	' '
Korea, Rep. of	552 (2.1)	14 (4.4) ▲	22 (3.2) ▲	564 (1.9)	5 (4.0)	6 (3.4)
Latvia (LSS)	511 (3.2)	16 (5.9) ▲	48 (5.0) ▲	515 (3.3)	5 (6.0)	25 (5.4) ▲
Lithuania	516 (2.7)	38 (5.2) ▲	64 (5.2) ▲	522 (2.4)	23 (5.6) ▲	45 (5.1) ▲
Macedonia, Rep. of	454 (3.7)	-4 (7.1)	' '	445 (4.2)	-13 (6.6) ▼	' '
Malaysia	505 (4.3)	17 (7.1) ▲	' '	515 (4.0)	18 (7.1) ▲	' '
Moldova, Rep. of	477 (3.5)	22 (5.7) ▲	' '	468 (3.7)	3 (6.2)	' '
Netherlands	528 (3.3)	-8 (8.0)	0 (6.5)	543 (3.8)	-11 (8.2)	-11 (8.3)
New Zealand	515 (4.8)	9 (7.0)	18 (7.5) ▲	525 (6.7)	11 (9.7)	1 (9.0)
Norway	490 (2.2)	' '	-16 (3.4) ▼	498 (3.0)	' '	-25 (4.8) ▼
Philippines	380 (5.9)	29 (10.2) ▲	' '	374 (6.4)	35 (11.3) ▲	' '
Romania	465 (5.5)	-3 (8.0)	2 (7.7)	474 (4.9)	-1 (8.0)	-4 (7.5)
Russian Federation	508 (3.7)	-11 (8.0)	-7 (5.9)	519 (4.2)	-21 (7.3) ▼	-12 (6.4)
Scotland	506 (4.0)	' '	19 (6.6) ▲	517 (3.5)	' '	3 (7.5)
Singapore	576 (4.0)	19 (8.8) ▲	3 (7.8)	579 (5.0)	1 (10.9)	-8 (8.6)
Slovak Republic	508 (3.8)	-17 (5.0) ▼	-12 (5.7) ▼	525 (3.4)	-21 (5.6) ▼	-20 (4.7) ▼
Slovenia	517 (2.4)	– –	13 (3.8) ▲	524 (2.3)	– –	0 (4.0)
South Africa	242 (7.2)	8 (11.6)	– –	244 (7.7)	-9 (10.8)	– –
Sweden	521 (3.2)	' '	-26 (6.0) ▼	528 (2.7)	' '	-31 (5.5) ▼
Tunisia	392 (2.3)	-25 (3.9) ▼	' '	416 (2.6)	-26 (4.5) ▼	' '
United States	519 (3.2)	14 (5.8) ▲	14 (6.3) ▲	536 (3.4)	11 (6.3)	16 (6.9) ▲
¶ England	538 (4.7)	16 (7.9) ▲	15 (6.3) ▲	550 (5.1)	-4 (7.3)	7 (8.0)
International Avg.	486 (0.7)	7 (1.2) ▲	3 (1.3) ▲	495 (0.8)	0 (1.2) ▲	-5 (1.4) ▼
Benchmarking Participants						
Indiana State, US	521 (4.7)	-3 (8.4)	' '	540 (5.3)	-5 (9.3)	' '
Ontario Province, Can.	526 (3.1)	17 (4.7) ▲	38 (4.7) ▲	540 (2.8)	13 (4.3) ▲	35 (5.5) ▲
Quebec Province, Can.	522 (3.7)	-14 (7.7)	16 (8.5)	540 (3.2)	-5 (5.6)	26 (8.1) ▲

▲ 2003 significantly higher

▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 6.9 Average Achievement in Science Content Areas by Gender

Countries	Life Science Girls	Life Science Boys	Chemistry Girls	Chemistry Boys	Physics Girls	Physics Boys
Armenia	462 (4.1) ▲	444 (3.1)	474 (5.0) ▲	456 (4.1)	481 (3.9)	478 (3.3)
Australia	527 (4.6)	538 (4.5)	498 (5.1)	515 (4.9) ▲	510 (4.5)	532 (4.5) ▲
Bahrain	465 (2.8) ▲	424 (2.8)	458 (5.0) ▲	424 (2.3)	454 (2.8) ▲	432 (2.7)
Belgium (Flemish)	521 (3.3)	532 (3.3) ▲	497 (3.0)	509 (3.5) ▲	501 (3.0)	528 (3.1) ▲
Botswana	374 (3.0) ▲	366 (3.3)	350 (3.5)	346 (3.8)	361 (3.6)	382 (3.6) ▲
Bulgaria	472 (6.1)	477 (5.2)	476 (7.2)	488 (5.7) ▲	474 (5.6)	495 (5.4) ▲
Chile	419 (3.0)	434 (3.5) ▲	394 (4.2)	415 (4.0) ▲	382 (3.4)	418 (3.6) ▲
Chinese Taipei	563 (3.6)	562 (3.4)	589 (4.3) ▲	579 (4.6)	568 (3.6)	571 (3.8)
Cyprus	448 (2.9) ▲	427 (3.2)	446 (3.2) ▲	439 (2.9)	448 (2.2)	451 (2.3)
Egypt	429 (4.6)	422 (5.2)	442 (4.6)	441 (6.0)	412 (4.7)	415 (6.1)
Estonia	543 (2.8)	550 (2.9) ▲	552 (2.4)	551 (2.8)	551 (3.3) ▲	538 (2.3)
Ghana	240 (7.1)	269 (6.1) ▲	267 (7.4)	283 (7.9) ▲	213 (7.0)	260 (6.9) ▲
† Hong Kong, SAR	550 (3.2)	552 (3.7)	541 (3.2)	543 (3.4)	549 (3.6)	561 (3.6) ▲
Hungary	531 (3.4)	542 (3.2) ▲	551 (3.4)	569 (3.7) ▲	522 (3.5)	551 (3.3) ▲
Indonesia	422 (4.0)	425 (4.3)	393 (4.3)	389 (4.4)	417 (4.2)	443 (4.6) ▲
Iran, Islamic Rep. of	454 (4.5) ▲	442 (3.5)	449 (5.4)	442 (4.5)	440 (4.6)	449 (4.2)
Israel	486 (3.3)	497 (4.2) ▲	496 (4.3)	503 (4.1)	475 (3.3)	494 (3.9) ▲
Italy	496 (3.1)	499 (4.1)	486 (3.4)	487 (4.2)	459 (3.0)	481 (3.8) ▲
Japan	547 (3.1)	551 (3.0)	549 (3.8)	555 (2.4)	560 (3.3)	568 (2.9)
Jordan	493 (4.8) ▲	458 (5.3)	496 (5.2) ▲	460 (6.2)	474 (4.8) ▲	457 (5.5)
¿ Korea, Rep. of	555 (1.9)	562 (2.1) ▲	527 (3.0)	531 (2.8)	575 (2.7)	582 (1.8) ▲
Latvia	515 (3.0) ▲	508 (2.8)	513 (5.0)	514 (4.9)	503 (3.1)	520 (2.9) ▲
Lebanon	366 (5.6) ▲	352 (6.4)	436 (5.6)	430 (5.9)	413 (4.6)	426 (5.4) ▲
Lithuania	518 (2.9)	515 (2.9)	531 (2.8)	537 (3.3)	515 (2.7)	523 (3.2) ▲
Macedonia, Rep. of	460 (4.1) ▲	436 (4.5)	475 (4.2) ▲	459 (4.5)	457 (3.5)	458 (3.7)
Malaysia	504 (4.3)	504 (4.2)	513 (4.9)	514 (4.9)	512 (4.3)	527 (3.9) ▲
Moldova, Rep. of	475 (4.2) ▲	456 (3.9)	482 (4.5)	475 (4.6)	479 (4.1)	478 (4.1)
‡ Morocco	388 (3.8)	392 (3.4)	399 (3.8)	405 (3.6)	400 (3.3)	422 (3.9) ▲
† Netherlands	534 (3.4)	539 (4.7)	510 (3.3)	519 (3.4) ▲	529 (3.8)	548 (3.8) ▲
New Zealand	525 (5.1)	521 (6.8)	496 (5.7)	506 (7.3)	512 (4.7)	519 (5.9)
Norway	497 (2.6)	494 (3.1)	479 (3.4)	490 (3.5) ▲	483 (2.9)	492 (3.1) ▲
Palestinian Nat'l Auth.	443 (3.7) ▲	426 (6.0)	454 (3.9) ▲	433 (6.7)	436 (4.1)	427 (5.6)
Philippines	395 (5.9) ▲	377 (6.5)	348 (6.2)	334 (8.2)	377 (4.9)	385 (5.3) ▲
Romania	473 (5.3)	470 (4.9)	477 (5.4)	471 (5.3)	465 (4.5)	481 (4.2) ▲
Russian Federation	515 (3.6)	513 (3.8)	526 (4.4)	529 (4.4)	502 (3.8)	520 (3.8) ▲
Saudi Arabia	419 (6.7)	406 (4.8)	398 (8.9) ▲	370 (6.1)	405 (7.2) ▲	385 (4.9)
† Scotland	511 (4.1)	514 (3.7)	497 (4.2)	501 (3.4)	509 (4.0)	521 (3.4) ▲
Serbia	468 (3.2)	469 (3.3)	477 (4.2)	471 (4.2)	463 (3.5)	478 (2.6) ▲
Singapore	571 (3.7)	566 (4.8)	584 (4.0)	581 (5.1)	578 (3.4)	579 (4.0)
Slovak Republic	512 (3.6)	515 (3.1)	514 (4.5)	524 (3.6) ▲	506 (3.3)	531 (3.2) ▲
Slovenia	522 (2.8)	519 (3.6)	531 (3.7)	533 (2.8)	502 (2.4)	515 (2.5) ▲
South Africa	249 (6.8)	249 (7.0)	282 (6.6)	287 (6.4)	237 (7.3)	251 (7.4)
Sweden	531 (3.2) ▲	524 (2.9)	524 (3.1)	528 (2.8)	517 (3.5)	532 (2.9) ▲
Tunisia	412 (2.2)	423 (2.4) ▲	405 (2.5)	422 (3.3) ▲	371 (2.9)	402 (3.2) ▲
‡ United States	534 (3.2)	540 (3.3) ▲	506 (3.4)	519 (3.5) ▲	509 (3.5)	523 (3.0) ▲
¶ England	545 (4.3)	541 (5.2)	521 (5.3)	533 (5.1) ▲	537 (4.1)	552 (4.6) ▲
International Avg.	476 (0.6) ▲	473 (0.6)	474 (0.6)	474 (0.6)	468 (0.6)	480 (0.6) ▲
Benchmarking Participants						
Basque Country, Spain	490 (3.2)	494 (3.5)	466 (3.4)	478 (4.7) ▲	474 (4.1)	492 (3.5) ▲
Indiana State, US	534 (4.7)	545 (5.1) ▲	508 (5.1)	525 (6.7) ▲	505 (4.6)	526 (5.4) ▲
Ontario Province, Can.	533 (3.3)	542 (3.5) ▲	501 (3.3)	514 (3.6) ▲	524 (3.4)	536 (3.7) ▲
Quebec Province, Can.	520 (3.9)	530 (3.6) ▲	511 (3.4)	523 (3.0) ▲	514 (2.8)	534 (3.5) ▲

(Average Scale Scores for Science Content Areas)

▲ Significantly higher than other gender

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.9 Average Achievement in Science Content Areas by Gender

8th grade — TIMSS 2003 — Science

Countries	Average Scale Scores for Science Content Areas			
	Earth Science		Environmental Science	
	Girls	Boys	Girls	Boys
Armenia	464 (4.2) ▲	455 (3.8)	425 (5.1) ▲	408 (4.3)
Australia	516 (4.8)	547 (4.9) ▲	528 (4.4)	543 (4.0) ▲
Bahrain	445 (1.9)	436 (4.6)	452 (2.7) ▲	425 (5.6)
Belgium (Flemish)	494 (2.9)	525 (3.8) ▲	512 (3.4)	536 (3.5) ▲
Botswana	354 (4.7)	367 (4.1) ▲	385 (3.5) ▲	376 (4.1)
Bulgaria	477 (5.7)	503 (5.3) ▲	455 (6.4)	471 (4.9) ▲
Chile	413 (3.4)	455 (3.5) ▲	424 (3.0)	446 (3.8) ▲
Chinese Taipei	542 (3.2)	554 (3.9) ▲	561 (3.5)	558 (3.2)
Cyprus	442 (2.8)	452 (3.3) ▲	442 (2.8)	439 (3.0)
Egypt	397 (4.7)	409 (6.9)	435 (5.0)	426 (5.4)
Estonia	560 (4.4)	556 (3.2)	540 (2.7)	539 (2.7)
Ghana	230 (7.0)	274 (6.9) ▲	256 (6.7)	276 (7.1) ▲
† Hong Kong, SAR	539 (3.4)	558 (3.5) ▲	554 (3.0)	557 (3.6)
Hungary	520 (3.7)	555 (4.3) ▲	515 (3.4)	541 (3.4) ▲
Indonesia	424 (4.2)	438 (4.2) ▲	451 (4.1)	457 (4.0)
Iran, Islamic Rep. of	464 (4.2)	470 (4.1)	488 (3.1)	486 (3.1)
Israel	475 (3.2)	496 (3.9) ▲	476 (2.7)	497 (4.6) ▲
Italy	504 (3.1)	523 (4.2) ▲	494 (3.3)	500 (3.9)
Japan	524 (3.4)	536 (2.9) ▲	533 (2.8)	540 (2.9)
Jordan	479 (4.2) ▲	466 (5.5)	507 (4.1) ▲	479 (4.7)
¿ Korea, Rep. of	527 (2.0)	552 (2.4) ▲	538 (2.0)	548 (1.7) ▲
Latvia	504 (3.5)	524 (2.9) ▲	503 (3.4)	513 (4.0) ▲
Lebanon	389 (5.0)	402 (4.8) ▲	371 (6.2)	379 (7.0)
Lithuania	504 (3.4)	520 (3.1) ▲	504 (2.6)	509 (2.6)
Macedonia, Rep. of	438 (6.1)	443 (4.8)	443 (4.7)	442 (4.2)
Malaysia	494 (4.6)	510 (3.9) ▲	509 (3.6)	516 (3.8)
Moldova, Rep. of	474 (4.6)	475 (4.0)	461 (4.4) ▲	446 (4.5)
‡ Morocco	389 (4.6)	406 (3.6) ▲	394 (4.5)	401 (4.0)
† Netherlands	523 (3.3)	545 (4.1) ▲	529 (3.8)	548 (3.5) ▲
New Zealand	514 (5.1)	537 (6.3) ▲	519 (3.7)	532 (5.5) ▲
Norway	506 (2.4)	527 (3.9) ▲	494 (2.6)	498 (2.9)
Palestinian Nat'l Auth.	441 (3.4)	436 (4.5)	454 (3.9) ▲	432 (6.0)
Philippines	376 (6.0)	377 (7.4)	410 (5.4) ▲	394 (6.0)
Romania	461 (5.6)	477 (5.7) ▲	469 (5.0)	475 (5.1)
Russian Federation	508 (3.6)	527 (3.7) ▲	486 (3.6)	496 (3.9) ▲
Saudi Arabia	400 (6.5)	389 (5.6)	417 (5.7)	405 (5.2)
† Scotland	503 (4.9)	527 (3.6) ▲	505 (4.1)	517 (3.6) ▲
Serbia	463 (3.5)	480 (3.2) ▲	453 (3.2)	461 (2.6) ▲
Singapore	542 (4.1)	556 (4.4) ▲	566 (3.7)	569 (4.5)
Slovak Republic	508 (4.9)	537 (3.7) ▲	498 (3.6)	518 (2.8) ▲
Slovenia	515 (3.3)	532 (3.4) ▲	512 (3.1)	519 (2.4) ▲
South Africa	245 (6.9)	248 (7.5)	260 (8.4)	260 (7.7)
Sweden	525 (3.5)	539 (4.3) ▲	494 (3.0)	505 (2.8) ▲
Tunisia	391 (2.3)	426 (2.3) ▲	427 (2.5)	445 (2.9) ▲
‡ United States	519 (3.2)	546 (3.1) ▲	527 (3.4)	539 (3.1) ▲
¶ England	535 (5.2)	553 (5.3) ▲	532 (4.5)	547 (5.1) ▲
International Avg.	466 (0.6)	482 (0.6) ▲	472 (0.6)	476 (0.6) ▲
Benchmarking Participants				
Basque Country, Spain	497 (3.0)	516 (3.4) ▲	490 (3.5)	497 (3.6)
Indiana State, US	523 (5.5)	549 (5.4) ▲	530 (4.5)	545 (4.7) ▲
Ontario Province, Can.	522 (3.3)	544 (3.7) ▲	538 (3.2)	545 (3.1)
Quebec Province, Can.	539 (3.6)	562 (3.1) ▲	523 (3.9)	540 (2.9) ▲

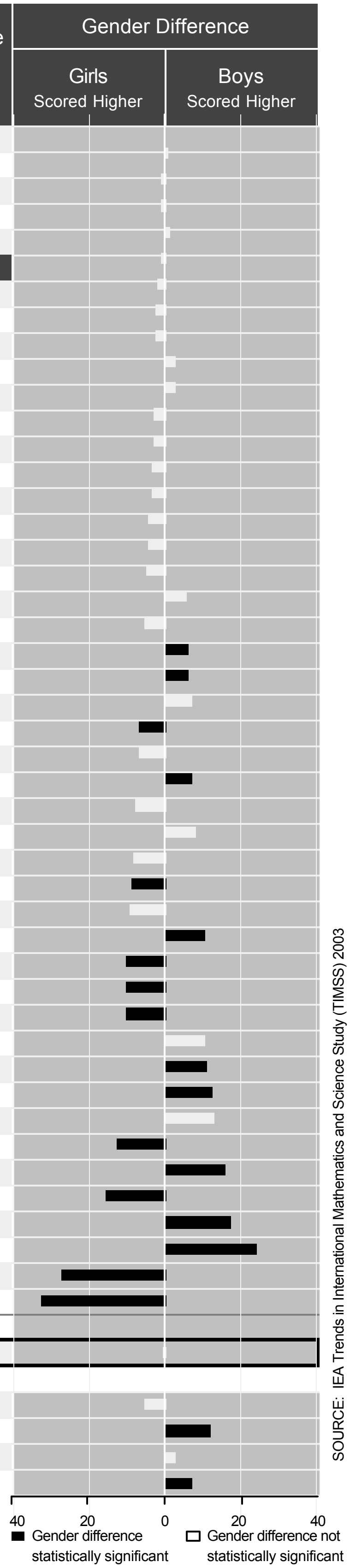
▲ Significantly higher than other gender

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 6.10 Average Mathematics Achievement by Gender

Countries	Girls: Percent of Students	Girls: Average Scale Score	Boys: Percent of Students	Boys: Average Scale Score	Difference (Absolute Value)
Slovak Republic	48 (1.3)	508 (3.4)	52 (1.3)	508 (4.0)	0 (3.5)
Sweden	51 (0.9)	499 (3.0)	49 (0.9)	499 (2.7)	1 (2.2)
Indonesia	50 (0.7)	411 (4.9)	50 (0.7)	410 (5.3)	1 (3.0)
Egypt	46 (2.7)	407 (4.4)	54 (2.7)	406 (5.0)	1 (6.4)
Bulgaria	48 (1.3)	476 (5.5)	52 (1.3)	477 (4.3)	1 (4.7)
International Avg.	50 (0.2)	467 (0.6)	50 (0.2)	466 (0.6)	1 (0.6)
† Hong Kong, SAR	50 (2.4)	587 (3.8)	50 (2.4)	585 (4.6)	2 (5.1)
Estonia	50 (1.0)	532 (3.4)	50 (1.0)	530 (3.3)	2 (3.0)
New Zealand	52 (1.7)	495 (4.8)	48 (1.7)	493 (7.0)	3 (5.7)
Japan	49 (1.2)	569 (4.0)	51 (1.2)	571 (3.6)	3 (6.4)
South Africa	51 (0.9)	262 (6.2)	49 (0.9)	264 (6.4)	3 (5.8)
Norway	50 (0.8)	463 (2.7)	50 (0.8)	460 (3.0)	3 (2.8)
Russian Federation	49 (1.2)	510 (3.5)	51 (1.2)	507 (4.4)	3 (2.8)
Slovenia	50 (0.9)	495 (2.6)	50 (0.9)	491 (2.6)	3 (2.8)
Botswana	51 (0.7)	368 (2.6)	49 (0.7)	365 (2.9)	3 (1.8)
Romania	52 (0.9)	477 (5.1)	48 (0.9)	473 (5.0)	4 (3.3)
Lithuania	50 (0.9)	503 (2.9)	50 (0.9)	499 (3.0)	5 (2.9)
† Scotland	50 (1.3)	500 (4.3)	50 (1.3)	495 (3.8)	5 (3.5)
¿ Korea, Rep. of	48 (2.8)	586 (2.7)	52 (2.8)	592 (2.6)	5 (3.1)
Latvia	49 (0.8)	511 (3.3)	51 (0.8)	506 (3.7)	6 (2.9)
‡ United States	52 (0.7)	502 (3.4)	48 (0.7)	507 (3.5)	6 (1.9)
Italy	50 (0.9)	481 (3.0)	50 (0.9)	486 (3.9)	6 (2.8)
† Netherlands	49 (1.2)	533 (4.1)	51 (1.2)	540 (4.5)	7 (3.6)
Serbia	49 (0.8)	480 (2.9)	51 (0.8)	473 (2.9)	7 (2.8)
Chinese Taipei	48 (1.0)	589 (4.9)	52 (1.0)	582 (5.2)	7 (4.2)
Hungary	50 (1.0)	526 (3.7)	50 (1.0)	533 (3.5)	7 (3.2)
Malaysia	50 (1.8)	512 (4.7)	50 (1.8)	505 (4.5)	8 (4.2)
Israel	52 (1.6)	492 (3.3)	48 (1.6)	500 (4.5)	8 (4.0)
Palestinian Nat'l Auth.	55 (2.4)	394 (3.9)	45 (2.4)	386 (4.7)	8 (5.9)
Macedonia, Rep. of	49 (0.9)	439 (4.0)	51 (0.9)	431 (3.9)	9 (3.5)
Iran, Islamic Rep. of	40 (4.1)	417 (4.3)	60 (4.1)	408 (4.2)	9 (7.2)
Lebanon	57 (1.8)	429 (3.6)	43 (1.8)	439 (3.9)	10 (4.0)
Armenia	53 (0.7)	483 (3.3)	47 (0.7)	473 (3.4)	10 (3.0)
Moldova, Rep. of	51 (0.8)	465 (4.1)	49 (0.8)	455 (4.8)	10 (3.5)
Singapore	49 (0.8)	611 (3.3)	51 (0.8)	601 (4.3)	10 (2.9)
Saudi Arabia	43 (2.3)	326 (7.9)	57 (2.3)	336 (5.5)	10 (9.7)
Belgium (Flemish)	54 (2.1)	532 (3.5)	46 (2.1)	542 (3.8)	11 (4.8)
‡ Morocco	50 (1.8)	381 (2.8)	50 (1.8)	393 (3.0)	12 (3.1)
Australia	51 (2.2)	499 (5.8)	49 (2.2)	511 (5.8)	13 (7.0)
Philippines	58 (0.9)	383 (5.2)	42 (0.9)	370 (5.8)	13 (3.4)
Chile	48 (1.6)	379 (3.5)	52 (1.6)	394 (4.3)	15 (4.5)
Cyprus	49 (0.6)	467 (1.9)	51 (0.6)	452 (2.3)	16 (2.7)
Ghana	45 (0.9)	266 (5.1)	55 (0.9)	283 (4.9)	17 (3.1)
Tunisia	53 (0.7)	399 (2.6)	47 (0.7)	423 (2.2)	24 (1.9)
Jordan	49 (1.7)	438 (4.6)	51 (1.7)	411 (5.8)	27 (6.8)
Bahrain	50 (0.4)	417 (2.4)	50 (0.4)	385 (2.4)	33 (3.3)
¶ England	50 (2.4)	499 (5.3)	50 (2.4)	498 (5.8)	0 (6.0)
Benchmarking Participants					
Basque Country, Spain	49 (1.7)	490 (2.5)	51 (1.7)	484 (3.7)	6 (3.1)
Indiana State, US	49 (1.2)	502 (5.1)	51 (1.2)	514 (5.8)	12 (3.4)
Ontario Province, Can.	51 (0.9)	520 (3.4)	49 (0.9)	522 (3.4)	2 (2.8)
Quebec Province, Can.	50 (1.6)	540 (3.7)	50 (1.6)	546 (3.3)	7 (3.3)



SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	Girls			Boys		
	2003 Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference	2003 Average Scale Score	1999 to 2003 Difference	1995 to 2003 Difference
Australia	499 (5.8)	– –	-13 (7.1)	511 (5.8)	– –	4 (7.5)
Belgium (Flemish)	532 (3.5)	-28 (7.7) ▼	-21 (8.9) ▼	542 (3.8)	-13 (9.0)	-4 (9.5)
Bulgaria	476 (5.5)	-35 (8.1) ▼	-57 (8.0) ▼	477 (4.3)	-34 (8.2) ▼	-45 (7.5) ▼
Chile	379 (3.5)	-9 (5.4)	' '	394 (4.3)	-3 (7.0)	' '
Chinese Taipei	589 (4.9)	5 (6.2)	' '	582 (5.2)	-5 (7.4)	' '
Cyprus	467 (1.9)	-11 (2.7) ▼	-4 (3.3)	452 (2.3)	-23 (3.6) ▼	-13 (4.2) ▼
Hong Kong, SAR	587 (3.8)	4 (6.1)	28 (7.9) ▲	585 (4.6)	4 (7.5)	8 (8.5)
Hungary	526 (3.7)	-3 (5.4)	-1 (5.2)	533 (3.5)	-2 (5.6)	6 (5.1)
Indonesia	411 (4.9)	10 (7.2)	' '	410 (5.3)	5 (7.3)	' '
Iran, Islamic Rep. of	417 (4.3)	9 (6.0)	12 (7.5)	408 (4.2)	-24 (6.4) ▼	-21 (6.3) ▼
Israel	492 (3.3)	33 (5.4) ▲	– –	500 (4.5)	25 (6.7) ▲	– –
Italy	481 (3.0)	6 (5.3)	– –	486 (3.9)	2 (5.8)	– –
Japan	569 (4.0)	-6 (4.7)	-8 (4.5)	571 (3.6)	-11 (4.2) ▼	-14 (4.2) ▼
Jordan	438 (4.6)	7 (6.7)	' '	411 (5.8)	-14 (8.3)	' '
Korea, Rep. of	586 (2.7)	2 (4.1)	15 (4.1) ▲	592 (2.6)	2 (3.2)	3 (3.8)
Latvia (LSS)	509 (4.0)	6 (5.3)	22 (5.5) ▲	502 (4.4)	-6 (6.0)	11 (6.1)
Lithuania	503 (2.9)	23 (5.4) ▲	32 (5.5) ▲	499 (3.0)	16 (5.8) ▲	27 (5.5) ▲
Macedonia, Rep. of	439 (4.0)	-7 (6.5)	' '	431 (3.9)	-16 (5.8) ▼	' '
Malaysia	512 (4.7)	-9 (6.7)	' '	505 (4.5)	-12 (7.4)	' '
Moldova, Rep. of	465 (4.1)	-3 (5.8)	' '	455 (4.8)	-16 (6.7) ▼	' '
Netherlands	533 (4.1)	-4 (8.6)	11 (7.8)	540 (4.5)	-3 (8.4)	5 (7.9)
New Zealand	495 (4.8)	0 (7.4)	-1 (7.2)	493 (7.0)	5 (10.2)	-12 (9.3)
Norway	463 (2.7)	' '	-35 (3.8) ▼	460 (3.0)	' '	-39 (4.1) ▼
Philippines	383 (5.2)	31 (8.4) ▲	' '	370 (5.8)	34 (8.7) ▲	' '
Romania	477 (5.1)	2 (8.0)	5 (6.8)	473 (5.0)	3 (8.0)	-2 (7.3)
Russian Federation	510 (3.5)	-16 (6.9) ▼	-15 (6.1) ▼	507 (4.4)	-20 (7.7) ▼	-16 (7.5) ▼
Scotland	500 (4.3)	' '	14 (6.8) ▲	495 (3.8)	' '	-5 (7.9)
Singapore	611 (3.3)	7 (7.0)	1 (5.9)	601 (4.3)	-5 (8.6)	-7 (6.4)
Slovak Republic	508 (3.4)	-24 (5.3) ▼	-25 (4.7) ▼	508 (4.0)	-28 (6.0) ▼	-28 (5.3) ▼
Slovenia	495 (2.6)	– –	3 (3.9)	491 (2.6)	– –	-6 (4.4)
South Africa	262 (6.2)	-6 (9.4)	– –	264 (6.4)	-19 (9.7)	– –
Sweden	499 (3.0)	' '	-43 (5.5) ▼	499 (2.7)	' '	-39 (5.4) ▼
Tunisia	399 (2.6)	-37 (3.7) ▼	' '	423 (2.2)	-37 (3.8) ▼	' '
United States	502 (3.4)	3 (5.2)	12 (5.8) ▲	507 (3.5)	2 (5.9)	12 (6.3) ▲
¶ England	499 (5.3)	12 (7.6)	4 (6.7)	498 (5.8)	-7 (7.7)	-2 (7.9)
International Avg.	486 (0.7)	0 (1.2)	-5 (1.3) ▼	485 (0.8)	-6 (1.4) ▼	-9 (1.4) ▼
Benchmarking Participants						
Indiana State, US	502 (5.1)	-8 (8.6)	' '	514 (5.8)	-6 (10.0)	' '
Ontario Province, Ca	520 (3.4)	6 (4.7)	20 (4.5) ▲	522 (3.4)	3 (4.7)	18 (4.8) ▲
Quebec Province, Ca	540 (3.7)	-27 (6.8) ▼	-20 (7.7) ▼	546 (3.3)	-19 (6.5) ▼	-6 (7.2)

▲ 2003 significantly higher

▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and Slovenia, and 1995 data are not shown for Israel, Italy, and South Africa. Korea tested later in 2003 than in 1999 and 1995, at the beginning of the next school year. Similarly, Lithuania tested later in 1999 than in 2003 and 1995. Data for Latvia in this exhibit include Latvian-speaking schools only.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 6.12 Average Achievement in Mathematics Content Areas by Gender

8th grade TIMSS 2003 Mathematics

Countries	Number		Algebra		Measurement	
	Girls	Boys	Girls	Boys	Girls	Boys
Armenia	478 (3.5) ▲	468 (3.6)	496 (3.0) ▲	482 (3.8)	489 (3.5)	488 (4.1)
Australia	490 (5.5)	507 (5.9) ▲	496 (5.5)	501 (5.4)	504 (5.3)	518 (5.7) ▲
Bahrain	392 (3.6) ▲	369 (2.8)	434 (3.2) ▲	387 (3.3)	394 (3.2) ▲	383 (2.5)
Belgium (Flemish)	532 (3.1)	547 (3.6) ▲	521 (3.5)	526 (4.2)	529 (3.2)	541 (3.6) ▲
Botswana	386 (2.3) ▲	378 (3.2)	382 (3.2) ▲	371 (2.8)	376 (2.8)	379 (3.0)
Bulgaria	477 (5.2)	476 (4.3)	485 (4.8)	477 (4.3)	471 (5.9)	474 (4.7)
Chile	381 (3.7)	398 (3.9) ▲	380 (3.7)	389 (3.9) ▲	393 (3.7)	414 (3.6) ▲
Chinese Taipei	588 (5.1)	582 (5.2)	592 (5.4) ▲	579 (5.3)	573 (5.1)	576 (4.7)
Cyprus	471 (2.2) ▲	457 (2.5)	469 (2.1) ▲	442 (2.6)	463 (3.1)	455 (2.9)
Egypt	420 (3.8)	421 (4.5)	413 (4.7)	403 (5.6)	396 (4.3)	405 (4.7)
Estonia	525 (3.5)	520 (3.5)	529 (3.1)	528 (3.2)	530 (3.9)	526 (3.7)
Ghana	282 (5.3)	295 (5.4) ▲	281 (4.7)	293 (5.8) ▲	256 (4.8)	267 (5.4)
† Hong Kong, SAR	587 (3.7)	585 (4.3)	582 (3.5)	578 (4.3)	583 (3.9)	585 (4.4)
Hungary	524 (4.1)	533 (4.0) ▲	535 (3.7)	532 (3.5)	517 (3.6)	532 (3.6) ▲
Indonesia	424 (4.9)	418 (5.2)	422 (5.1)	414 (4.7)	394 (5.3)	394 (5.4)
Iran, Islamic Rep. of	420 (4.2)	414 (3.9)	429 (4.3) ▲	400 (4.4)	393 (5.0)	402 (3.8)
Israel	498 (3.9)	509 (4.3) ▲	499 (3.4)	496 (4.2)	473 (3.3)	488 (4.7) ▲
Italy	477 (3.3)	483 (4.0)	478 (3.4)	475 (3.9)	494 (3.0)	506 (3.9) ▲
Japan	554 (4.5)	560 (4.0)	570 (3.9)	566 (3.4)	559 (4.0)	559 (3.3)
Jordan	426 (5.5) ▲	401 (6.3)	452 (4.8) ▲	417 (6.4)	426 (5.7) ▲	410 (5.5)
¿ Korea, Rep. of	582 (2.9)	589 (2.5) ▲	596 (3.3)	598 (2.9)	575 (3.1)	579 (2.1)
Latvia	508 (3.3)	506 (3.7)	515 (3.1) ▲	501 (3.8)	497 (3.6)	504 (3.6)
Lebanon	427 (3.7)	434 (4.3)	448 (3.7)	447 (4.2)	420 (4.1)	442 (4.6) ▲
Lithuania	500 (3.0)	497 (3.2)	508 (2.6) ▲	494 (3.0)	490 (4.1)	493 (3.9)
Macedonia, Rep. of	441 (3.8) ▲	434 (3.7)	452 (4.5) ▲	432 (4.5)	433 (4.0)	435 (4.1)
Malaysia	529 (4.7) ▲	519 (4.4)	501 (4.6) ▲	488 (4.2)	505 (5.7)	503 (4.9)
Moldova, Rep. of	468 (3.8) ▲	457 (4.4)	473 (4.4) ▲	455 (4.8)	468 (4.4)	468 (4.4)
‡ Morocco	377 (3.6)	394 (3.4) ▲	400 (3.0)	402 (4.1)	369 (3.1)	385 (7.1)
† Netherlands	534 (4.0)	544 (4.1) ▲	515 (4.4)	513 (4.7)	542 (4.0)	555 (4.3) ▲
New Zealand	480 (5.5)	483 (7.6)	494 (4.5)	485 (7.4)	498 (4.6)	503 (6.2)
Norway	457 (2.8)	455 (3.2)	432 (2.8) ▲	424 (3.9)	479 (3.6)	483 (3.2)
Palestinian Nat'l Auth	387 (4.4)	383 (5.7)	404 (4.5) ▲	378 (5.4)	380 (3.9)	392 (4.4) ▲
Philippines	401 (5.2) ▲	384 (5.6)	408 (5.4) ▲	390 (5.7)	373 (5.1)	370 (5.7)
Romania	477 (5.3)	472 (5.1)	487 (5.1) ▲	473 (5.1)	484 (5.1)	487 (5.0)
Russian Federation	506 (4.0)	504 (4.5)	522 (3.0) ▲	510 (4.0)	505 (4.2)	510 (4.2)
Saudi Arabia	293 (8.9)	318 (5.9) ▲	333 (8.0)	329 (6.1)	326 (4.4)	347 (4.9) ▲
† Scotland	486 (4.9)	482 (4.5)	493 (4.5) ▲	484 (4.3)	508 (4.4)	508 (3.8)
Serbia	480 (3.5)	475 (2.8)	496 (3.1) ▲	480 (2.9)	474 (3.2)	476 (3.2)
Singapore	623 (3.3) ▲	612 (4.2)	597 (3.4) ▲	583 (4.3)	613 (3.8)	608 (4.2)
Slovak Republic	514 (3.3)	514 (4.1)	510 (3.3) ▲	500 (3.9)	504 (3.7)	511 (4.5) ▲
Slovenia	499 (2.5)	498 (2.5)	494 (3.1) ▲	479 (2.5)	493 (2.7)	499 (3.6)
South Africa	273 (6.4)	274 (6.0)	273 (6.0)	275 (6.0)	296 (5.5)	301 (5.6)
Sweden	495 (2.9)	497 (2.7)	482 (3.9)	478 (3.1)	509 (3.3)	515 (2.8)
Tunisia	408 (2.3)	432 (2.8) ▲	398 (3.1)	412 (2.5) ▲	394 (2.7)	421 (3.4) ▲
‡ United States	504 (3.5)	512 (3.6) ▲	510 (3.2)	509 (3.3)	489 (3.4)	501 (3.3) ▲
¶ England	484 (5.8)	486 (6.1)	494 (5.3)	490 (5.6)	504 (5.1)	506 (5.2)
International Avg.	467 (0.6)	467 (0.6)	471 (0.6) ▲	462 (0.6)	464 (0.6)	470 (0.6) ▲
Benchmarking Participants						
Basque Country	489 (2.7)	490 (3.5)	499 (3.2) ▲	482 (3.6)	490 (3.0)	487 (3.3)
Indiana State	508 (5.7)	524 (6.6) ▲	510 (5.4)	509 (5.8)	493 (5.7)	512 (6.5) ▲
Ontario Province	514 (3.8)	518 (3.9)	517 (3.0)	512 (3.0)	517 (2.9)	523 (3.7)
Quebec Province	542 (4.2)	550 (3.5) ▲	527 (3.7)	531 (3.7)	535 (4.2)	548 (3.8) ▲

Column group heading: Average Scale Scores for Mathematics Content Areas

▲ Significantly higher than other gender

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	Average Scale Scores for Mathematics Content Areas			
	Geometry		Data	
	Girls	Boys	Girls	Boys
Armenia	485 (3.4) ▲	476 (3.5)	425 (3.6) ▲	412 (3.3)
Australia	485 (5.7)	497 (6.1)	527 (4.8)	536 (4.3)
Bahrain	453 (2.4) ▲	422 (2.8)	427 (2.2) ▲	401 (2.7)
Belgium (Flemish)	522 (3.7)	533 (5.0)	541 (3.8)	552 (4.2) ▲
Botswana	328 (4.9)	343 (4.2) ▲	375 (3.6)	374 (3.3)
Bulgaria	483 (5.4)	486 (4.8)	454 (4.8)	462 (5.0)
Chile	369 (3.9)	386 (4.6) ▲	405 (3.9)	419 (4.1) ▲
Chinese Taipei	595 (5.9) ▲	581 (5.6)	570 (3.6)	566 (4.0)
Cyprus	464 (3.2) ▲	451 (2.7)	465 (2.5) ▲	451 (2.0)
Egypt	407 (4.9)	409 (5.3)	393 (4.2)	394 (4.7)
Estonia	539 (3.0)	540 (3.2)	538 (3.2) ▲	532 (3.2)
Ghana	259 (6.0)	293 (4.2) ▲	286 (4.5)	299 (4.6) ▲
† Hong Kong, SAR	587 (4.3)	589 (4.8)	568 (3.3)	564 (4.1)
Hungary	510 (4.0)	521 (3.5) ▲	523 (3.6)	528 (3.3)
Indonesia	408 (4.5)	419 (5.8) ▲	417 (4.8)	420 (4.6)
Iran, Islamic Rep. of	446 (4.8)	432 (4.7)	407 (4.5)	403 (4.4)
Israel	487 (3.8)	488 (4.8)	486 (3.7)	497 (4.4) ▲
Italy	466 (3.4)	472 (4.0) ▲	484 (3.0)	496 (3.6) ▲
Japan	588 (3.9)	585 (3.5)	570 (3.4)	575 (2.3)
Jordan	455 (4.4) ▲	438 (5.8)	441 (3.7) ▲	420 (4.7)
¿ Korea, Rep. of	593 (3.9)	601 (2.4) ▲	564 (2.8)	574 (2.7) ▲
Latvia	518 (3.9)	512 (3.6)	513 (3.7) ▲	500 (4.5)
Lebanon	453 (3.2)	467 (4.2) ▲	391 (5.2)	398 (4.6)
Lithuania	508 (3.2)	505 (4.8)	501 (3.2)	503 (3.0)
Macedonia, Rep. of	445 (4.2)	438 (4.4)	421 (4.8)	416 (4.9)
Malaysia	494 (6.0)	495 (5.2)	507 (3.8)	503 (3.6)
Moldova, Rep. of	467 (4.6) ▲	458 (5.5)	431 (3.7)	425 (4.2)
‡ Morocco	408 (3.9)	423 (3.6) ▲	364 (3.8)	384 (3.8) ▲
† Netherlands	512 (4.3)	514 (5.1)	556 (3.6)	564 (4.0)
New Zealand	490 (4.5)	486 (5.8)	530 (4.7)	522 (6.7)
Norway	463 (3.9)	459 (3.7)	500 (2.8)	497 (3.4)
Palestinian Nat'l Auth.	426 (4.2)	419 (4.8)	397 (3.9) ▲	382 (5.2)
Philippines	344 (5.4)	346 (6.3)	395 (4.2) ▲	384 (5.7)
Romania	474 (5.3)	479 (5.5)	445 (5.2)	445 (4.9)
Russian Federation	517 (4.2)	513 (4.7)	483 (3.4)	485 (3.9)
Saudi Arabia	381 (7.2)	382 (4.9)	345 (5.9)	334 (5.3)
† Scotland	493 (4.4)	488 (3.6)	533 (4.3)	529 (3.9)
Serbia	475 (3.2) ▲	467 (3.7)	454 (3.1)	458 (3.4)
Singapore	584 (3.8) ▲	575 (4.5)	581 (3.0)	578 (4.0)
Slovak Republic	497 (3.9)	505 (4.8)	488 (3.5)	502 (3.9) ▲
Slovenia	486 (4.0)	480 (3.6)	495 (2.9)	492 (3.0)
South Africa	246 (6.0)	245 (6.4)	297 (6.2)	294 (5.7)
Sweden	469 (4.0)	465 (3.3)	540 (3.6)	539 (3.6)
Tunisia	419 (2.4)	437 (2.4) ▲	373 (2.1)	402 (3.5) ▲
‡ United States	469 (3.0)	475 (3.8) ▲	526 (3.3)	527 (3.5)
¶ England	490 (5.6)	494 (5.9)	535 (4.7)	535 (5.4)
International Avg.	466 (0.6)	467 (0.6)	467 (0.5)	467 (0.6)
Benchmarking Participants				
Basque Country	457 (3.2)	454 (4.2)	500 (3.6)	498 (3.4)
Indiana State	462 (5.9)	474 (5.5) ▲	526 (4.9)	530 (5.8)
Ontario Province	511 (3.5)	514 (3.7)	536 (3.1)	540 (3.3)
Quebec Province	538 (3.9)	545 (3.7) ▲	541 (3.0)	546 (3.2)

▲ Significantly higher than other gender

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

† Met guidelines for sample participation rates only after replacement schools were included.
‡ Nearly satisfied guidelines for sample participation rates only after replacement schools were included.
¶ Did not satisfy guidelines for sample participation rates.
1 National Desired Population does not cover all of International Desired Population.
2 National Defined Population covers less than 90% of National Desired Population.
¿ Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

6.4 Performance by gender in grade 8 mathematics

Exhibits 6.10 to 6.12 show the same information for grade 8 mathematics. As for grade 4 mathematics, there was no overall difference in performance by gender. The comparison group countries varied in respect to this. In Singapore girls outscored boys, but the reverse was true in the United States, Italy and Belgium. The remaining countries, like England, showed no overall gender difference.

Exhibit 6.11 indicates trends over time in gender differences. Overall England's results did not change from 1995 or 1999 to 2003, and this was mirrored by the performance of both genders.

Exhibit 6.12 shows how boys and girls performed in the five content areas. For grade 8 mathematics there were no gender differences in any of the five content areas, number, algebra, measurement, geometry and data. Of the comparison group countries, this was also true of Hong Kong, New Zealand and Japan.

6.5 Performance on different types of item by gender

In the TIMSS tests there are sufficient of both multiple choice items and constructed response items for performance on these to be analysed by gender. This has allowed past work on gender differences and item types to be followed up. Exhibit 6.13 shows how boys and girls fared in terms of overall percentage correct. This involves complex analysis because for each grade a pupil took one of 12 different booklets.

Exhibit 6.13 Responses to multiple choice and constructed response items by gender

Grade 4	Mathematics			Science		
	Multiple Choice	**Constructed Response**	**Difference**	**Multiple Choice**	**Constructed Response**	**Difference**
Girls	64.17	52.52	-11.65	66.45	56.55	-9.90
Boys	64.74	52.61	-12.13	67.11	53.78	-13.33
Difference	0.57	0.09	***-0.48***	0.66	-2.77	***-3.43***
Grade 8	**Mathematics**			**Science**		
	Multiple Choice	**Constructed Response**	**Difference**	**Multiple Choice**	**Constructed Response**	**Difference**
Girls	53.27	39.10	-14.17	58.87	49.80	-9.07
Boys	54.63	38.96	-15.67	62.59	52.19	-10.40
Difference	1.36	-0.14	***-1.50***	3.72	2.39	***-1.33***

As can be seen, multiple choice items were easier than constructed response ones. This reflects the fact that more demanding aspects of the TIMSS assessment framework, particularly the problem solving and enquiry tasks, are more likely to be assessed using the constructed response format.

At grade 4, science items showed a tendency for boys to be better at multiple choice items and for girls to score more highly on constructed response ones. This pattern was absent from grade 4 mathematics.

In grade 8 the overall gender difference found in science was reflected in both types of item, boys scoring more highly in multiple choice and constructed response items than girls. In grade 8 mathematics small differences were found, but with a tendency for boys to score more highly on multiple choice items than girls.

The pattern of differences shown in exhibit 6.13 is complex and was followed up using a regression approach. This involved deriving a measure for each pupil describing their relative performance on multiple choice and constructed response items. This was then used in regression analysis in two phases. Firstly this was done with total performance in mathematics and science and a variety of background factors, including gender, involved and then with only the background factors. Exhibits 6.14 to 6.20 give the results for both grades and subjects. Each pair of exhibits is followed by a brief commentary on the findings.

These exhibits show the results, in terms of coefficients which are significant at the 5 per cent level using ordinary linear regression. The tables also show the ‘beta’ coefficient or partial correlation, which is a measure of the strength of the relationship, as well as the level of significance.

Results for grade 4 science

Exhibit 6.14 Significant coefficients for grade 4 science (performance included)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Overall mathematics performance	0.108	0.144	0.0%
Overall science performance	-0.105	-0.132	0.0%
Gender (boys v. girls)	-11.881	-0.096	0.0%

Exhibit 6.15: Significant Coefficients for Grade 4 Science (Performance excluded)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Gender (boys v. girls)	-11.170	-0.090	0.0%

To summarise, for grade 4 science :

- Pupils with higher mathematics and lower science performance overall tend to do better at constructed response compared with multiple choice items in science.
- Allowing for this, girls tend to do better at constructed response compared with multiple choice items.
- The above remains true when overall performance is not taken into account.

Results for grade 4 mathematics

Exhibit 6.16 Significant coefficients for grade 4 mathematics (performance included)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Overall Science performance	-0.044	-0.060	1.1%
Number of people in the home	-1.556	-0.036	3.7%
Age	7.926	0.044	1.0%
Books in the home	1.940	0.040	2.6%

Exhibit 6.17 Significant coefficients for grade 4 mathematics (performance excluded)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Age	6.821	0.038	2.7%

These results may be interpreted as follows:

- Pupils with higher science scores tend to do better at multiple choice items in mathematics, compared with constructed response items.
- Allowing for this, those with more people living in the home also do better at multiple choice compared with constructed response, while older pupils and those with more books in the home do better at constructed response compared with multiple choice.
- When overall performance is not included, the only significant effect is that older pupils tend to do better at constructed response compared with multiple choice.
- Gender is not a factor associated with differential performance by item type in grade 4 mathematics.

Results for grade 8 science

Exhibit 6.18 Significant coefficients for grade 8 science (performance included)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Gender (boys v. girls)	-6.710	-0.065	0.1%

Results are the same whether or not performance is included in the analysis, and can be summarised as below.

- Girls tend to do better at constructed response items compared with multiple choice items.

Results for grade 8 mathematics

Exhibit 6.19 Significant coefficients for grade 8 mathematics (performance included)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Overall Science performance	-0.035	-0.049	1.1%
Gender (boys v. girls)	-6.338	-0.062	0.1%
Born outside the UK	-8.384	-0.039	4.4%
Age	7.260	0.047	1.5%

Exhibit 6.20 Significant coefficients for grade 8 mathematics (performance excluded)

Background factor	Coefficient	Partial Correlation (Beta)	Significance
Gender (boys v. girls)	-6.985	-0.069	0.0%
Age	6.595	0.043	2.7%

To summarise:

- Pupils with higher science scores tend to do better at multiple choice items in mathematics, compared with constructed response items.
- Allowing for this, boys and those born outside the UK tend to do better in multiple choice compared with constructed response items, while older pupils tend to do better in constructed response rather than multiple choice items.
- When overall performance is not included, the effects of boys and older pupils remain as above.

These results show that a range of background factors, not just gender, are associated with differential item performance in multiple choice and constructed response items. These are not necessarily the same for mathematics and science, and are not necessarily consistent over time. Further analysis, particularly with item type looked at more closely, would help to clarify the relationships involved.

6.6 Gender differences in TIMSS compared with other assessments

The previous sections of section 6 illustrate that gender differences are complex and vary between subjects, across ages and within subject by content area. It has also been shown that simple examination of success rates can hide more complex relationships.

The key stage 2 results for national curriculum tests in mathematics and science do not show large differences by gender if the proportions of pupils gaining level 4 or above are examined, differing by at most 1 per cent. Nor have large gender differences been noted in key stage 3 results in these subjects. The TIMSS results are broadly consistent, but one large difference was found in grade 8 (year 9) science. This result was also found in 1999 and is consistent across a range of countries. The results here, showing variation by content area and item type, suggest that the national curriculum results need to be analysed at item level using large samples in order to establish whether the same factors are at work.

7 Pupils' attitudes

Positive attitudes to mathematics and science are acknowledged as relevant to learning, in the National Curriculum (1999). Of science, the curriculum document says:

> *Science stimulates and excites pupils' curiosity about phenomena and events in the world around them. It also satisfies this curiosity with knowledge. Because science links direct practical experience with ideas, it can engage learners at many levels.*

Similarly, of mathematics it says:

> *Mathematics is a creative discipline. It can stimulate moments of pleasure and wonder when a pupil solves a problem for the first time, discovers a more elegant solution to that problem, or suddenly sees hidden connections.*

Given this, it is clearly desirable to see pupils' achievements in mathematics and science accompanied by positive attitudes to these subjects. In order to probe the extent of such attitudes, questionnaires asked pupils to rate their experience of science and mathematics and to judge how frequently they carried out certain types of activity in each. Their responses are summarised in the international report, where they are compared with those of pupils in all participating countries. The outcomes in relation to pupils' attitudes in England in particular are discussed here. In this section the tables focus on comparison group countries only, but reference to other countries is made in the text where appropriate.

As in previous sections of this report, the outcomes for grade 4 pupils are discussed first, followed by those for grade 8; science is reported first in each case, followed by mathematics. In the section for a particular grade and subject, the results for particular aspects of attitude are presented first. Then the relationships between these aspects are examined, using the results of factor analysis, to establish coherent factors. The relationships between these factors and performance can then be examined. At the end of the section, in section 7.5, the relationships found are examined and discussed. These were found using multilevel modelling of performance and its relationship with background variables. Further information on this mode of analysis can be found in Section 10.

7.1 Pupils' attitudes towards grade 4 science

Just over half (54 per cent) of England's pupils are highly self-confident in their abilities in science (see Exhibit 7.1). Almost a third fall into the 'medium' self-confidence category, giving a total of 86 per cent of England's pupils feeling a reasonable level of confidence in their ability to learn science. Of the comparison group countries, only Singapore achieved significantly more highly than England and it is noticeable that Singapore has more than a quarter of pupils in the low confidence category. In fact several of the countries with mean science achievement scores similar to England at grade 4, had high proportions of pupils in the low self-confidence category. By and large, pupils in the lower achieving countries showed more confidence. This suggests an inverse relationship between achievement and self-confidence (although the direction of causality, if any, is not clear). In view of this, it is a positive outcome that the vast majority of England's pupils at grade 4 are confident about their scientific abilities.

Pupils were asked to respond to six statements on attitude to science: 'I usually do well in science', 'I would like to do more science at school', 'Science is harder for me than for many of my classmates', 'I enjoy learning science', 'I am just not good at science' and 'I learn things quickly in science'.

Responses to the statement 'I enjoy learning science' are summarised in Exhibit 7.2. Sixty-eight per cent of England's pupils agreed with this statement, a significant decrease since 1995 when 80 per cent agreed. In this instance, England had the highest proportion of pupils disagreeing that they enjoy science. Despite this, it is noteworthy that the proportion agreeing 'a lot' with the statement has not changed significantly since 1995. The movement has come from those agreeing 'a little' and those disagreeing.

A further statement asked pupils to indicate whether they 'would like to do more science at school'. Almost half (49 per cent) indicated that they would, with the lowest achievers being most enthusiastic.

The majority of pupils (80 per cent) believe that they usually do well in science. In the 1995 survey the equivalent percentage was 83, a small difference. It is noticeable, however, that the distribution of responses has changed significantly: whereas 61 per cent 'agreed' in 1995, only 51 per cent 'agreed' in 2003. However, the percentage 'agreeing strongly' increased from 21 per cent in 1995 to 30 per cent in 2003.

Factor analysis showed that pupils' responses to these attitude statements were strongly correlated, enabling them to be used as a coherent factor in a multilevel model (see section 7.5).

7.2 Pupils' attitudes towards grade 4 mathematics

The level of confidence in learning mathematics was marginally higher for mathematics, compared with science: 59 per cent showed high self-confidence and 30 per cent had a medium level of self-confidence (see Exhibit 7.3). A similar international pattern was obtained for mathematics as was seen for science: many of the countries achieving higher than or at a similar level to England had equal or higher proportions of pupils in the low self-confidence category.

These attitudinal findings reported here are based on pupils' responses to six statements: 'I usually do well in maths', 'I would like to do more maths at school', 'Maths is harder for me than for many of my classmates', 'I enjoy learning maths', 'I am just not good at maths' and 'I learn things quickly in maths'.

Seventy per cent of grade 4 pupils in England reported that they enjoy mathematics (Exhibit 7.4), down from the 84 per cent reporting so in 1995. This is similar to the decline found for science. Again, some of the highest achieving countries showed the greatest proportion of pupils failing to enjoy learning mathematics, although the pattern was less clear cut than for science. The pattern of significant differences also varied. In England and Hong Kong, both 'agreement' categories decreased significantly, while in Singapore and Japan, only the 'agree a little' category decreased. In contrast, there was no change in the Netherlands.

A further statement asked pupils to indicate whether they 'would like to do more mathematics at school'. Almost half (47 per cent) indicated that they would. As was found for science, the mean score of those agreeing 'a lot' was lower than that of the pupils disagreeing.

The majority of pupils, even more than for science, considered that they usually do well in mathematics: 89 per cent agreed with this statement to some extent. Again, this was a small difference, against the comparable proportion in 1995, and the change in responses was similar. While 57 per cent 'agreed' with the statement in 1995, only 50 per cent did so in 2003. However, the percentage 'strongly agreeing' increased from 33 per cent to 39 per cent. These changes were statistically significant.

Factor analysis of responses to the six statements about mathematics showed a different pattern from that found for science. Whilst enjoyment of and confidence in learning science were correlated strongly as one factor, the equivalent statements in mathematics formed two separate factors: Enjoyment of mathematics and self-confidence in mathematics. Given that percentages of pupils reporting Self-confidence and enjoyment of science and mathematics were similar, it is interesting that the two do not appear to go hand in hand for both subjects. The two grade 4 science factors were entered into the multilevel model, with the outcomes reported in section 7.5.

7.3 Pupils' attitudes towards grade 8 science

As with grade 4 science, a large proportion of England's grade 8 students (85 per cent) showed high or medium confidence in learning science (see Exhibit 7.5). Once again, there was a trend towards the higher scoring countries having a greater proportion of pupils showing low self-confidence.

Enjoyment of learning science was reported by 68 per cent (Exhibit 7.6), as was the case at grade 4. While the 32 per cent stating that they do not enjoy science is an increase on previous years, it is only the 'agree a little' category that has seen a significant decrease in England. The percentage of English students agreeing 'a lot' that they enjoy learning science has not changed significantly across the three TIMSS cycles. Once again, several of the highest scoring countries have high percentages of students reporting not enjoying science.

Despite almost one third of English students indicating that they do not enjoy science, an appetite for science still exists: 52 per cent indicated that they would like to study more science.

While these outcomes were based on questions similar to those asked at grade 4, additional questions were asked at grade 8. Students were also asked to rate statements about: needing science to help in daily life; with learning other school subjects; with getting into the university or college of their choice; and with getting the job of their choice. A final statement asked them to indicate whether they would like a job that involved using science. Responses to these statements were combined with two others ('I enjoy learning science' and 'I would like to spend more time studying science in school') into an index indicating the value which students place upon learning science (see Exhibit 7.7). Seventy-nine per cent of students score at the high or medium levels on this index. It is noticeable that Hong Kong and Singapore, the two comparison group countries which achieved significantly more highly than England, have lower proportions of pupils placing a low value on science. Despite the fact that a high proportion of their pupils show low self-confidence and lack enjoyment of the subject, they nevertheless value it.

When asked if they would like a job that involved using science, 43 per cent of England's grade 8 pupils showed some level of agreement that they would. This was a little lower than the percentages found in previous years, and is accounted for mainly by differences in the 'agree' category (down from 31 per cent in 1995 and 30 per cent in 1999, to 23 per cent in 2003). The 'strongly agree' category showed a small increase from 16 and 18 per cent in 1995 and 1999 respectively, to 19 per cent in 2003. There were larger differences in the 'disagree' categories, with those 'strongly disagreeing' increasing from 17 and 13 per cent to 28 per cent. These changes were statistically significant. A similar trend was observed for the statement 'I need to do well in science to get the job I want'. These findings, both relating to employment, may reflect the fact that only 35 per cent of pupils reported feeling that the majority of their science lessons were relevant to their daily lives (see Section 8).

Getting into university or college was a motivating factor for some, and showed different changes over time. Again, the percentage agreeing that science was necessary in order to get into the desired college or university fell across the three surveys but, in the case of this statement, percentages rose in both disagreement categories: 'strong disagreement' increased from six per cent and five per cent in 1995 and 1999, to 10 per cent in 2003, while 'disagreement' rose from 19 and 20 per cent to 23 per cent. While each individual change seems relatively small, the overall pattern of responses was significantly different from that previously observed. These changes may, in part, be related to the increase in numbers going on to university over the period of the three surveys, and the associated increase in the breadth of courses on offer and there may also be some effect from the different perceptions of the extent to which science is perceived to be made relevant to pupils.

Outcomes of factor analysis were similar for grade 8 and grade 4 science. Responses to questions about enjoyment and confidence in learning science were correlated, as were responses to questions about the motivating factors in learning science. Two attitude factors were, therefore, used in the multilevel modelling (see section 7.5): Enjoyment and confidence in science, and Motivation in science.

7.4 Pupils' attitudes towards grade 8 mathematics

Once again, levels of confidence were high. Even though fewer grade 8 students reported confidence in mathematics, when compared with those reporting confidence in science, the figure giving a high or medium level of confidence in mathematics was 81 per cent. Just under half of the grade 8 sample reported a high level of confidence in mathematics (see Exhibit 7.8).

Exhibit 7.1 Index of Students' Self-Confidence in Learning Science (SCS)

Countries	High SCS		Medium SCS		Low SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Netherlands	71 (1.2)	535 (2.1)	22 (0.8)	507 (2.7)	7 (0.6)	496 (4.6)
Hungary	70 (1.1)	546 (2.7)	23 (0.9)	496 (4.6)	7 (0.6)	498 (6.5)
Italy	69 (1.1)	529 (3.8)	26 (1.0)	493 (4.6)	5 (0.4)	481 (7.5)
Australia	66 (1.2)	535 (3.8)	27 (1.1)	501 (6.2)	7 (0.5)	491 (5.8)
United States	66 (0.9)	553 (2.5)	25 (0.7)	512 (3.3)	9 (0.4)	501 (3.6)
Hong Kong, SAR	60 (1.4)	556 (2.9)	32 (1.1)	523 (3.3)	8 (0.5)	525 (5.2)
Belgium (Flemish)	58 (1.0)	530 (1.7)	30 (0.9)	507 (2.7)	12 (0.7)	492 (3.1)
Scotland	58 (1.3)	514 (3.3)	30 (1.1)	490 (3.7)	12 (0.6)	480 (4.6)
England	54 (1.1)	560 (3.8)	32 (0.9)	522 (4.6)	14 (0.7)	514 (5.0)
New Zealand	51 (1.0)	545 (2.5)	40 (0.9)	499 (3.3)	9 (0.5)	493 (5.0)
Japan	46 (1.0)	562 (1.9)	41 (0.9)	531 (2.0)	13 (0.7)	529 (3.7)
Singapore	32 (0.9)	592 (5.3)	41 (0.8)	554 (6.2)	27 (0.8)	552 (5.8)
International Avg.	59 (0.2)	508 (1.0)	32 (0.2)	469 (1.1)	9 (0.1)	459 (1.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 7.2 Trends in "I Enjoy Learning Science"

Countries	Agree A Lot		Agree A Little		Disagree	
	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students
Australia	64 (1.3)	39 (1.2) ▲	23 (0.9)	42 (1.0) ▼	14 (0.9)	19 (0.9) ▼
Belgium (Flemish)	31 (1.1)	' '	38 (0.9)	' '	31 (1.2)	' '
England	39 (1.4)	41 (1.1)	29 (1.1)	39 (1.1) ▼	32 (1.2)	21 (1.0) ▲
Hong Kong, SAR	50 (1.2)	43 (1.4) ▲	36 (0.9)	44 (1.3) ▼	14 (0.9)	13 (1.6)
Hungary	54 (1.2)	36 (1.3) ▲	26 (0.9)	41 (1.1) ▼	20 (0.9)	24 (1.4) ▼
Italy	50 (1.0)	– –	37 (0.9)	– –	13 (0.8)	– –
Japan	45 (1.2)	38 (1.1) ▲	36 (0.8)	50 (0.9) ▼	19 (1.0)	12 (0.8) ▲
Netherlands	40 (1.5)	29 (1.4) ▲	37 (1.1)	42 (1.3) ▼	23 (1.3)	29 (1.4) ▼
New Zealand	60 (1.0)	47 (1.4) ▲	26 (0.8)	36 (1.5) ▼	14 (0.7)	17 (1.1) ▼
Scotland	57 (1.6)	– –	24 (1.1)	– –	19 (1.0)	– –
Singapore	51 (0.9)	41 (1.3) ▲	28 (0.6)	47 (1.1) ▼	21 (0.7)	12 (0.6) ▲
United States	62 (0.9)	48 (1.0) ▲	21 (0.6)	35 (0.8) ▼	16 (0.7)	17 (0.9)
International Avg.	55 (0.3)	44 (0.4) ▲	27 (0.2)	39 (0.3) ▼	18 (0.2)	17 (0.3) ▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

Background data provided by students.

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. 1995 data for New Zealand in this exhibit include students in English medium instruction only (>98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

It is noticeable that, across both age groups and both subjects, within country pupils' achievement is higher when their confidence is higher. This pattern should be interpreted with care, however, as the direction of causality, if any, cannot be ascertained from this data. In other words, it is not possible to say whether it is high confidence that leads to high achievement, high achievement that leads to high confidence or, indeed, whether other factors cause both high achievement and high confidence.

Enjoyment of learning mathematics was reported by 53 per cent of grade 8 students (Exhibit 7.9). This is lower than the levels of enjoyment reported for mathematics at grade 4 (70 per cent) and for science at both grades (68 per cent in each case). Whereas, for science, the percentage of pupils who 'agree a lot' that they enjoy science has not changed significantly between surveys, there has been a significant decline for both agreement categories at both grades for mathematics. Once again, however, England is not alone in this decline. Of the six comparison group countries achieving significantly more highly than England, only Hungary shows an increase in both agreement categories. Two other countries (Hong Kong and the Netherlands), like England, show a decline in both agreement categories, while the remaining three countries show a significant decrease in one or both agreement categories. Furthermore, as observed in other areas, the greatest proportions of disagreement with the statement 'I enjoy learning mathematics' came from two of the highest achieving countries: Japan (61 per cent disagreement) and the Netherlands (69 per cent disagreement). Singapore, notably, showed an increase in the percentage of pupils agreeing 'a lot' that they enjoy mathematics (a rise to 33 per cent) as well as an increase in those saying they do not enjoy it (an increase to 25 per cent). These different patterns suggest that there is no easy lesson to be learned about how to encourage enjoyment of learning in mathematics. To emphasise this point, it is worth noting that the countries where most pupils (more than 50 per cent) agreed 'a lot' that they enjoy learning mathematics are among the lowest achieving TIMSS countries. Clearly, the relationship between enjoyment and achievement is anything but straightforward.

At grade 4, despite the decrease in those reporting enjoyment of mathematics, almost half reported that they would like to do more mathematics at school. A smaller but, even so, sizeable effect was found at grade 8, with roughly one third of pupils (34 per cent) saying that they would like to study more mathematics. It is possible that the appetite for more mathematics, despite falling levels of enjoyment, reflects a recognition by pupils that their understanding of mathematics is weaker than it might be and could be improved by more time to explore and strengthen their areas of weakness. Similarly, 36 per cent say that, if they do not understand a new mathematics topic straight away, they feel they will never really understand it. Despite being a relatively high proportion, this implies that a substantial proportion feel that, with more teaching, they will be able to grasp an initially difficult concept. This is encouraging. The findings

Exhibit 7.3	Index of Students' Self-Confidence in Learning Mathematics (SCM)	4th grade Mathematics TIMSS 2003

Countries	High SCM		Medium SCM		Low SCM	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Netherlands	67 (1.0)	556 (2.3)	22 (0.9)	516 (2.8)	11 (0.6)	498 (4.4)
United States	64 (0.7)	541 (2.3)	25 (0.5)	486 (2.8)	11 (0.4)	475 (2.7)
Hungary	64 (0.8)	556 (3.1)	26 (0.8)	487 (3.8)	9 (0.5)	473 (5.2)
Australia	64 (0.9)	522 (3.7)	25 (0.9)	471 (5.2)	11 (0.8)	436 (8.1)
Scotland	64 (0.8)	508 (3.5)	26 (0.9)	468 (3.7)	11 (0.6)	451 (5.8)
Belgium (Flemish)	62 (0.8)	569 (1.8)	26 (0.7)	526 (2.7)	13 (0.6)	510 (3.1)
Italy	62 (1.0)	523 (3.9)	29 (0.8)	479 (5.0)	9 (0.5)	458 (6.1)
England	59 (1.1)	556 (4.1)	30 (0.9)	505 (4.3)	11 (0.6)	480 (5.3)
New Zealand	54 (1.1)	526 (2.5)	36 (1.0)	464 (2.9)	9 (0.5)	446 (4.3)
Singapore	49 (1.6)	629 (5.0)	35 (1.1)	573 (5.3)	16 (0.9)	540 (6.2)
Hong Kong, SAR	40 (1.1)	601 (3.1)	42 (0.9)	562 (3.6)	19 (0.8)	548 (3.7)
Japan	39 (0.9)	600 (2.2)	40 (0.9)	550 (2.3)	21 (0.8)	532 (2.2)
International Avg.	55 (0.2)	522 (0.9)	33 (0.2)	472 (0.9)	11 (0.1)	453 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 7.4 Trends in "I Enjoy Learning Mathematics"

Countries	Agree A Lot		Agree A Little		Disagree	
	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students
Australia	52 (1.4)	41 (1.1) ▲	27 (1.2)	42 (0.9) ▼	20 (0.9)	17 (0.7) ▲
Belgium (Flemish)	27 (0.8)	' '	38 (0.7)	' '	35 (1.2)	' '
England	43 (1.2)	53 (1.4) ▼	27 (0.8)	31 (1.0) ▼	30 (1.3)	16 (1.0) ▲
Hong Kong, SAR	30 (1.2)	34 (1.6) ▼	42 (0.8)	49 (1.2) ▼	28 (1.0)	17 (1.0) ▲
Hungary	49 (1.3)	32 (1.3) ▲	27 (0.9)	45 (1.2) ▼	24 (1.2)	23 (1.5)
Italy	40 (1.2)	– –	41 (0.9)	– –	19 (1.0)	– –
Japan	29 (1.0)	16 (0.8) ▲	36 (0.8)	56 (1.0) ▼	35 (1.2)	28 (1.1) ▲
Netherlands	30 (1.3)	28 (1.2)	39 (1.0)	40 (1.3)	31 (1.4)	32 (1.5)
New Zealand	52 (1.1)	45 (1.4) ▲	29 (1.0)	37 (1.2) ▼	19 (0.7)	18 (1.0)
Scotland	50 (1.3)	– –	26 (1.0)	– –	24 (1.1)	– –
Singapore	57 (0.8)	48 (1.0) ▲	27 (0.5)	44 (0.8) ▼	15 (0.6)	8 (0.6) ▲
United States	54 (0.9)	47 (1.6) ▲	25 (0.5)	38 (1.0) ▼	20 (0.6)	15 (0.9) ▲
International Avg.	50 (0.2)	46 (0.4) ▲	28 (0.2)	38 (0.3) ▼	22 (0.2)	16 (0.3) ▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher ▼ 2003 significantly lower

Background data provided by students.
Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. 1995 data for New Zealand in this exhibit include students in English medium instruction only (>98% of the estimated population).
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

described here may simply reflect a feeling among some pupils that the pace of lessons is too fast for them and that greater time for reflection and reinforcement may be beneficial to their enjoyment of and achievement in mathematics.

Another key finding, which may reinforce the hypothesis, is that grade 8 students appear to understand the value of mathematics. On an index derived from responses to seven statements, 85 per cent showed either a high or medium level of valuing mathematics (Exhibit 7.10). The statements were: ‘I would like to spend more time studying maths in school’; ‘I enjoy learning maths’; ‘I think learning maths will help me in my everyday life’; ‘I need maths to learn other school subjects’; ‘I need to do well in maths to get into the college or university I want’; ‘I would like a job that involved using maths’; and ‘I need to do well in maths to get the job I want’. These reflect an essentially pragmatic view of the value of mathematics. However, students’ responses showed that their sense of the value of mathematics was not purely pragmatic, being related to their enjoyment of it and their confidence in learning it (see section 7.5). It is also worth noting that, of the seven highest achieving countries at grade 8 mathematics, five have higher proportions of students placing a low value on mathematics. Conversely, several of those countries where the greatest percentages of students place high value on mathematics are those where achievement internationally is lowest (for example, Botswana, Ghana and South Africa). In these countries, success in mathematics may be seen as a means to a better life to a sharper extent than in more prosperous countries. Once again, complex factors are at play in evaluating pupils’ attitudes to their mathematics and science education.

When asked if they would like a job that involved using mathematics, 37 per cent of England’s grade 8 pupils showed some level of agreement that they would. This was a decrease on the percentage found in previous years (50 per cent in 1995 and 49 per cent in 1999) and is accounted for by decreases in both the ‘agree’ and ‘strongly agree’ categories. A complementary increase was found in the ‘strongly disagree’ category, up from 15 and 13 per cent respectively in 1995 and 1999, to 29 per cent in 2003.

Similar trends were observed for the statement ‘I need to do well in mathematics to get the job I want’. Both ‘agreement’ categories drew fewer responses than in previous years, while both ‘disagreement’ categories increased (from 20 and 22 per cent in 1995 and 1999 to 30 per cent in 2003). These findings, both relating to employment, may reflect the fact that only 27 per cent of pupils reported feeling that the majority of their mathematics lessons were relevant to their daily lives (see Section 8).

Obtaining entry to university or college was a motivating factor for some students. The percentage disagreeing that mathematics would help them into the university or college of their choice increased in both relevant categories (a total

Index of Students' Self-Confidence in Learning Science (SCS)

Index based on students' responses to four statements about science:1) I usually do well in science; 2) Science is more difficult for me than for many of my classmates (Reversed); 3) Science is not one of my strengths (Reversed); 4) I learn things quickly in science

Average is computed across the four items based on a 4-point scale: 1. Agree a lot; 2. Agree a little; 3. Disagree a little; 4. Disagree a lot. Students agreeing a little or a lot on average across the four statements are assigned to the high level. Students disagreeing a little or a lot on average are assigned to the low level. All other students are assigned to the middle level.

Countries	High SCS		Medium SCS		Low SCS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
General/ Integrated Science						
Scotland	59 (1.5)	539 (3.3)	28 (1.1)	481 (3.5)	14 (0.9)	459 (3.9)
Italy	57 (1.1)	509 (3.2)	32 (1.0)	471 (4.1)	11 (0.6)	459 (5.2)
United States	56 (0.9)	548 (3.4)	31 (0.7)	507 (3.4)	13 (0.6)	495 (3.4)
¶ England						
Australia	49 (1.4)	550 (4.0)	34 (1.1)	513 (3.6)	17 (0.9)	499 (4.8)
Singapore	45 (0.8)	601 (4.4)	37 (0.6)	562 (4.9)	18 (0.6)	553 (5.0)
New Zealand	41 (1.4)	548 (5.7)	41 (0.9)	509 (5.2)	19 (1.2)	489 (5.4)
Hong Kong, SAR	32 (1.1)	582 (3.3)	47 (0.8)	546 (3.6)	21 (1.0)	540 (2.9)
Japan	20 (0.9)	595 (2.7)	46 (0.8)	551 (1.8)	34 (1.0)	529 (2.3)
¶ England	53 (1.5)	569 (4.9)	32 (1.3)	525 (5.2)	15 (0.9)	513 (6.3)
International Avg.	48 (0.2)	490 (0.8)	38 (0.2)	445 (0.9)	13 (0.1)	430 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Trends in "I Enjoy Learning Science"

Countries	Agree A Lot			Agree A Little			Disagree		
	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
General/ Integrated Science									
Australia	29 (1.2)	– –	16 (0.6) ▲	38 (0.9)	– –	50 (0.9) ▼	33 (1.2)	– –	35 (0.9)
Hong Kong, SAR	21 (0.8)	17 (0.7) ▲	15 (0.8) ▲	48 (1.0)	56 (0.9) ▼	53 (1.0) ▼	31 (1.1)	27 (1.2) ▲	32 (1.3)
Italy	23 (0.9)	22 (1.0)	– –	50 (1.0)	52 (0.9)	– –	27 (1.0)	26 (1.1)	– –
Japan	19 (1.0)	8 (0.4) ▲	8 (0.5) ▲	40 (0.8)	42 (1.2)	45 (1.0) ▼	41 (1.4)	49 (1.3) ▼	47 (1.2) ▼
New Zealand	33 (1.5)	22 (1.0) ▲	21 (1.1) ▲	38 (1.3)	50 (0.9) ▼	51 (0.9) ▼	29 (1.3)	27 (1.2)	29 (1.1)
Scotland	37 (1.0)	' '	30 (1.2) ▲	37 (0.8)	' '	51 (1.0) ▼	26 (1.0)	' '	19 (1.1) ▲
Singapore	42 (0.9)	33 (1.1) ▲	31 (1.4) ▲	41 (0.7)	54 (0.9) ▼	59 (1.1) ▼	17 (0.6)	13 (1.1) ▲	10 (0.8) ▲
United States	35 (0.8)	25 (0.8) ▲	24 (1.0) ▲	37 (0.6)	50 (0.8) ▼	50 (0.8) ▼	27 (0.9)	25 (0.8)	27 (1.2)
¶ England	28 (1.4)	29 (1.1)	27 (1.3)	41 (1.1)	56 (1.0) ▼	55 (1.4) ▼	32 (1.5)	15 (0.8) ▲	18 (1.1) ▲
International Avg.	44 (0.2)	32 (0.2) ▲	23 (0.3) ▲	33 (0.2)	47 (0.2) ▼	49 (0.3) ▼	23 (0.2)	21 (0.2) ▲	28 (0.3) ▼

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and 1995 data are not shown for Italy.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 7.7 Index of Students' Valuing Science (SVS)

8th grade Science | TIMSS 2003

Index of Students' Valuing Science (SVS)

Index based on students' responses to seven statements about science: 1) I would like to take more science in school; 2) I enjoy learning science; 3) I think learning science will help me in my daily life; 4) I need science to learn other school subjects; 5) I need to do well in science to get into the university of my choice; 6) I would like a job that involved using science; 7) I need to do well in science to get the job I want. Average is computed across the seven items based on a 4-point scale: 1. Agree a lot; 2. Agree a little; 3. Disagree a little; 4. Disagree a lot.

Students agreeing a little or a lot on average across the seven statements are assigned to the high level. Students disagreeing a little or a lot on average are assigned to the low level. All other students are assigned to the middle level.

Countries	High SVS		Medium SVS		Low SVS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
General/ Integrated Science						
Singapore	62 (1.0)	599 (3.9)	33 (0.9)	551 (4.6)	6 (0.4)	505 (7.3)
Scotland	49 (1.0)	528 (3.5)	33 (0.9)	506 (3.8)	17 (0.9)	479 (5.0)
United States	47 (0.8)	543 (3.6)	37 (0.6)	520 (3.2)	16 (0.6)	503 (3.8)
New Zealand	40 (1.5)	535 (6.5)	40 (1.1)	517 (5.0)	21 (1.0)	502 (4.4)
Hong Kong, SAR	40 (0.9)	574 (3.1)	51 (0.8)	549 (3.3)	9 (0.5)	523 (4.9)
¶ England						
Australia	36 (1.2)	551 (3.7)	37 (1.0)	522 (4.1)	27 (1.0)	506 (5.0)
Italy	29 (0.9)	507 (4.0)	55 (0.8)	488 (3.5)	16 (0.7)	473 (4.2)
Japan	17 (0.8)	586 (3.3)	56 (0.8)	555 (1.8)	27 (1.0)	526 (2.8)
¶ England	38 (1.5)	562 (6.3)	41 (1.1)	544 (5.0)	22 (1.4)	522 (4.8)
International Avg.	57 (0.2)	477 (0.8)	31 (0.2)	450 (1.0)	12 (0.1)	463 (1.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Index of Students' Self-Confidence in Learning Mathematics (SCM)

Index based on students' responses to four statements about mathematics:1) I usually do well in mathematics; 2) Mathematics is more difficult for me than for many of my classmates (Reversed); 3) Mathematics is not one of my strengths (Reversed); 4) I learn things quickly in mathematics.

Average is computed across the four items based on a 4-point scale: 1. Agree a lot; 2. Agree a little; 3. Disagree a little; 4. Disagree a lot.

Students agreeing a little or a lot on average across the four statements are assigned to the high level. Students disagreeing a little or a lot on average are assigned to the low level. All other students are assigned to the middle level.

Countries	High SCM		Medium SCM		Low SCM	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Scotland	52 (1.5)	524 (3.9)	32 (1.0)	477 (3.8)	15 (0.9)	456 (5.0)
United States	51 (0.8)	534 (3.3)	29 (0.6)	483 (3.5)	20 (0.6)	461 (3.6)
Australia	50 (1.7)	542 (4.5)	31 (1.1)	483 (3.7)	19 (1.2)	451 (6.4)
¶ England						
Italy	46 (0.9)	521 (3.3)	29 (0.9)	466 (3.6)	25 (1.0)	439 (3.4)
Belgium (Flemish)	45 (0.9)	556 (3.2)	30 (0.7)	526 (3.0)	25 (0.8)	518 (3.5)
Netherlands	45 (1.4)	557 (4.4)	33 (1.0)	527 (4.7)	23 (1.0)	511 (4.8)
Hungary	44 (1.0)	574 (3.3)	32 (1.0)	507 (3.9)	24 (0.8)	479 (3.9)
New Zealand	43 (1.4)	534 (6.4)	36 (1.1)	475 (5.4)	21 (0.9)	452 (4.1)
Singapore	39 (0.8)	639 (3.0)	34 (0.7)	594 (3.9)	27 (0.7)	571 (4.6)
Hong Kong, SAR	30 (0.9)	627 (2.9)	38 (0.7)	581 (4.1)	33 (0.9)	556 (4.0)
Japan	17 (0.6)	634 (3.1)	38 (0.7)	580 (2.7)	45 (0.8)	538 (2.3)
¶ England	47 (1.5)	526 (5.8)	34 (1.2)	485 (4.7)	19 (1.1)	468 (5.5)
International Avg.	40 (0.2)	504 (0.6)	38 (0.1)	453 (0.6)	22 (0.1)	433 (0.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	Agree A Lot			Agree A Little			Disagree		
	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Australia	18 (1.2)	– –	13 (0.7) ▲	39 (1.0)	– –	52 (0.6) ▼	42 (1.4)	– –	35 (0.9) ▲
Belgium (Flemish)	20 (0.9)	14 (0.6) ▲	14 (1.0) ▲	37 (0.9)	37 (0.8)	41 (1.2) ▼	43 (1.3)	49 (1.0) ▼	45 (1.3)
Hong Kong, SAR	15 (0.7)	19 (0.7) ▼	15 (0.8)	45 (1.0)	50 (0.8) ▼	50 (1.1) ▼	41 (1.1)	31 (1.1) ▲	35 (1.3) ▲
Hungary	17 (0.9)	8 (0.5) ▲	8 (0.7) ▲	36 (0.9)	30 (1.1) ▲	31 (1.2) ▲	47 (1.2)	62 (1.2) ▼	61 (1.3) ▼
Italy	16 (0.8)	21 (0.9) ▼	– –	43 (1.2)	45 (1.1)	– –	41 (1.2)	34 (1.3) ▲	– –
Japan	9 (0.6)	6 (0.4) ▲	5 (0.3) ▲	30 (0.8)	33 (1.0) ▼	41 (1.3) ▼	61 (1.1)	61 (1.1)	54 (1.5) ▲
Netherlands	6 (0.5)	14 (1.1) ▼	10 (1.1) ▼	26 (1.2)	44 (1.4) ▼	46 (1.9) ▼	69 (1.4)	43 (1.8) ▲	44 (2.4) ▲
New Zealand	23 (1.2)	20 (1.0) ▲	20 (1.0) ▲	38 (1.1)	53 (0.9) ▼	54 (0.9) ▼	39 (1.3)	27 (1.1) ▲	26 (1.0) ▲
Scotland	18 (0.8)	' '	– –	40 (1.2)	' '	– –	42 (1.5)	' '	– –
Singapore	33 (0.7)	28 (0.9) ▲	25 (1.0) ▲	42 (0.7)	52 (0.9) ▼	53 (0.8) ▼	25 (0.8)	20 (1.0) ▲	22 (1.0) ▲
United States	22 (0.6)	22 (0.9)	20 (0.7) ▲	38 (0.7)	47 (0.6) ▼	50 (0.9) ▼	40 (0.8)	31 (1.1) ▲	30 (0.9) ▲
¶ England	14 (1.1)	25 (1.1) ▼	22 (1.1) ▼	39 (1.2)	54 (1.2) ▼	59 (1.5) ▼	47 (1.5)	21 (1.0) ▲	20 (1.3) ▲
International Avg.	29 (0.1)	25 (0.2) ▲	17 (0.2) ▲	36 (0.1)	44 (0.2) ▼	46 (0.3) ▼	35 (0.2)	31 (0.2) ▲	37 (0.3) ▼

▲ 2003 significantly higher ▼ 2003 significantly lower

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and 1995 data are not shown for Italy.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An inverted comma (') indicates the country did not participate in the assessment.

Index of Students' Valuing Mathematics (SVM)

Index based on students' responses to seven statements about mathematics: 1) I would like to take more mathematics in school; 2) I enjoy learning mathematics; 3) I think learning mathematics will help me in my daily life; 4) I need mathematics to learn other school subjects; 5) I need to do well in mathematics to get into the university of my choice; 6) I would like a job that involved using mathematics; 7) I need to do well in mathematics to get the job I want.

Average is computed across the seven items based on a 4-point scale: 1. Agree a lot; 2. Agree a little; 3. Disagree a little; 4. Disagree a lot.

Students agreeing a little or a lot on average across the four statements are assigned to the high level. Students disagreeing a little or a lot on average are assigned to the low level. All other students are assigned to the middle level.

Countries	High SVM		Medium SVM		Low SVM	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore	63 (0.8)	616 (3.4)	32 (0.6)	592 (4.0)	5 (0.3)	558 (7.9)
United States	58 (0.8)	512 (3.6)	34 (0.7)	498 (3.4)	8 (0.4)	485 (4.6)
New Zealand	56 (1.3)	499 (5.3)	36 (1.2)	493 (6.0)	8 (0.7)	480 (6.9)
Scotland	54 (1.3)	503 (4.1)	37 (1.0)	497 (3.9)	9 (0.7)	479 (6.6)
Australia	51 (1.3)	517 (4.9)	37 (1.0)	499 (4.9)	12 (0.6)	481 (7.4)
Hungary	47 (1.0)	540 (3.8)	44 (0.9)	519 (3.7)	9 (0.6)	527 (5.3)
¶ England						
Hong Kong, SAR	35 (1.0)	607 (3.4)	55 (0.8)	581 (3.4)	10 (0.5)	544 (6.1)
Italy	32 (1.0)	505 (3.9)	52 (0.9)	480 (3.4)	16 (0.8)	454 (3.7)
Belgium (Flemish)	29 (1.0)	557 (3.7)	47 (0.8)	535 (2.7)	24 (0.9)	521 (3.7)
Japan	17 (0.6)	597 (3.1)	61 (0.8)	574 (2.2)	22 (0.8)	539 (3.3)
Netherlands	16 (1.0)	526 (7.9)	59 (1.3)	540 (4.1)	25 (1.2)	534 (4.3)
¶ England	39 (1.5)	508 (6.2)	46 (1.3)	500 (4.8)	15 (0.8)	486 (6.7)
International Avg.	55 (0.2)	479 (0.6)	35 (0.1)	458 (0.6)	10 (0.1)	458 (1.0)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

of 25 per cent in 1995 and 1999, to 33 per cent in 2003), while the percentage agreeing fell from 86 and 85 per cent to 81 per cent. Once again, these changes were statistically significant. As was the case with grade 8 science, the individual changes seem small, but, the overall change in the distribution of responses was statistically significant. The changes may, in part, be related to the increase in numbers going on to university over the period of the three surveys, and the associated increase in the breadth of courses on offer, and there may also be some effect from the different perceptions of the extent to which mathematics is perceived to be made relevant to pupils.

As with grade 8 science, factor analysis was carried out to establish whether any patterns of response existed. For grade 8 mathematics, the observed pattern was similar to that found for grade 4 mathematics and differed from that observed for science at both grades. For mathematics, pupils' responses to statements relating to the value of mathematics were correlated, as were their responses to statements about their level of confidence in mathematics, and their enjoyment of learning the subject. Thus, at grade 8, three mathematics factors were entered into the multilevel models: Enjoyment of mathematics, Confidence in mathematics, and Motivation in mathematics.

7.5 Pupils' attitudes and multilevel model outcomes

Multilevel modelling enables predictions to be made regarding the value of one variable given the value of another. The factors discussed in sections 7.1 to 7.4 above, along with other relevant background information about the pupils, teachers and schools, were fed into the multilevel models. Section 10 gives further information about the modelling process and the factors used. This section reports the main findings regarding pupils' attitudes to mathematics and sciences at grades 4 and 8.

At each grade, three attitude models were run, relating to pupils' enjoyment and confidence in science, enjoyment of mathematics and confidence in mathematics. The variables were grouped in this way based on the results of factor analysis (reported earlier). Although enjoyment and confidence in mathematics correlated separately from each other to form two separate factors, each was, nevertheless, a strong predictor of the other at both grades.

Confidence, enjoyment, motivation and performance

At grade 8, the only grade at which pupils were asked to comment on the extent to which they valued mathematics and science, their value rating (or 'motivation' factor for each subject) was a significant predictor of the extent to which they would enjoy and be confident in the subject. This was particularly the case for grade 8 science, where motivation in science was the strongest predictor of enjoyment and confidence in science. As discussed in section 7.3, the statements from which the motivation factors were derived reflect an essentially pragmatic view of the subjects: their main focus is on each subject as a route to a university place or desired job, or to a better understanding of other subjects studied at school. The multilevel modelling outcomes suggest, nevertheless, that pupils are not studying these subjects grudgingly as a means to an end. Rather, the value placed on the subject is related to levels of enjoyment and confidence: as the value placed on the subject increases, so do levels of enjoyment and confidence in studying it.

It should be stressed, however, that the models do not indicate the direction of causality of this effect. They simply state that, from the numerical value of the 'motivation' factor, a prediction of the value of the 'enjoyment' and 'confidence' factors can be estimated. They cannot account for whether motivation causes enjoyment and confidence, for whether the reverse is true, or for whether a third factor causes the effect.

Some gender differences were observed. At grade 8, boys were more confident and had higher enjoyment levels in both mathematics and science. At grade 4, the same was true of mathematics only: there were no effects in science.

Interestingly, these observed effects did not necessarily translate into increased scores on the tests, despite the fact that, in all four areas, self-confidence in the subject was a strong positive predictor of score. As will be recalled from Section 6, science at grade 8 was the only area where significant differences in the achievement of boys and girls were seen in England. In grade 8 science, boys had higher enjoyment, were more confident and outperformed girls in all areas except life science. In grade 4 science and in mathematics at both grades, boys did not perform significantly differently from girls, despite their higher levels of confidence. Further investigation into this area would be worthwhile.

Interactions between attitudes and performance in science and mathematics

Attitudes to mathematics and science also appear to interact with performance in the other subject, but not always in the ways one might expect. For example, at grade 8, confidence in mathematics was a significant positive predictor of science score in all areas: as confidence in mathematics increased, so did performance in science. This may seem logical, as a good grounding in mathematics is helpful in understanding many areas of science. However, the fact that this variable impacted on all science areas may imply that some deeper effect is at work. Enjoyment of mathematics at grade 8, however, worked in the opposite direction: as enjoyment of mathematics increased, performance in science fell. It is not clear why this should be.

In comparison, enjoyment and confidence in science at grade 8 was seen to have an impact on mathematics performance in two areas only: algebra (for which it was a negative predictor) and geometry (for which it was a positive predictor). However, motivation in science had a positive effect on mathematics achievement overall and a specific, positive effect on two areas: algebra and measurement.

At grade 4, the picture was similar. Self-confidence in mathematics was a positive predictor of performance in all areas of science, while enjoyment of mathematics was a negative predictor in all areas. Enjoyment and self-confidence in science impacted on only one area of mathematics achievement: geometry.

Classroom factors which relate to attitudes

These findings relate to the impact of attitudes on performance. Other factors were found to impact on the attitudes themselves and are, therefore, worthy of attention, since it is possible that they influence performance indirectly. As time spent in grade 4 on the practice of computation without a calculator (according to pupils' estimates) increased, so too did their confidence in and enjoyment of mathematics. Interestingly, however, a similar effect was found for time spent on activities other than computation: as this time increased, so did enjoyment of mathematics. This suggests that pupils respond to breadth as well as depth in their learning experiences. However, it is also worth noting that, as time spent on these other activities increased, confidence in mathematics decreased. It is possible that an inappropriate balance of depth and breadth may have caused this anomaly. Similar effects in grade 8 were not obtained because the factors fed into the grade 8 models were different from those at grade 4: it was not possible to isolate computation from other classroom activities at grade 8. Even so, other evidence at grade 8 may point towards a similar conclusion, as discussed in section 7.4.

Pupils' enjoyment and confidence in science and their enjoyment of mathematics were also related to their perceptions of the school climate. If they felt that their school was a positive place to be, that other students tried hard and that teachers had positive attitudes towards their pupils (see Section 8), they were more likely to report confidence and enjoyment in science and enjoyment of mathematics. This was true at both grades although, at grade 4, this assessment of school climate impacted negatively on confidence in mathematics, for reasons that are not clear. The overall suggestion, however, seems to be that pupils at both grades respond better to a positive climate where they feel valued.

Other classroom factors are also important. In science at both grades, the frequency of investigation, observation and explanation of phenomena are implicated in enjoyment and confidence in the subject. This is an interesting outcome, given the emphasis on Scientific Enquiry in the National Curriculum at all stages of schooling. The key thing to remember here is that this outcome relates to pupils' perceptions of the extent to which they carry out such activities, rather than to the objective amount of time actually dedicated to them. As discussed in section 8 below, pupils' and teachers' perceptions of the amount of time devoted to certain activities differed. It would appear to be important to ensure that investigative activities are carried out frequently enough to ensure that they impact on pupils' attitudes and perhaps, therefore, on their achievement.

The approach to class work also has an impact. At grade 4, as the amount of time spent on pupils working on their own or listening to a lecture-style presentation from their teachers increased, so did their confidence in mathematics. Similarly, at grade 8, as the time in such class-based and individual activities increased, so did confidence in and enjoyment of science. In the case of these findings, it is not clear whether increased confidence flows from these modes of working, or whether the mode of working follows from the pupils' abilities (that is, perhaps more confident pupils are more frequently taught in this way). The latter may particularly be the case where pupils are placed in sets for mathematics, as occurs frequently in secondary schools. Additionally, setting is becoming more commonplace in primary schools. The numeracy hour may also have had some impact in this regard.

Resourcing and attitudes

A further set of variables impacting on pupils' attitudes relates to resourcing. Access to more resources at home (see Section 9 for a description of the resources about which students were asked) was a positive predictor of enjoyment and confidence in science, and confidence in mathematics. It was not necessarily a predictor of enjoyment of mathematics, however (this aspect was not significant at grade 8 and was a negative predictor of enjoyment of mathematics at grade 4).

The use of computers for schoolwork (see Section 9) was also significant. At grade 4, a higher frequency of using a computer for looking up information for mathematics or science, or using a computer for working on school projects, was predictive of higher enjoyment and confidence in science and greater enjoyment of mathematics. Grade 8 pupils using computers for these purposes showed similar trends. However, grade 4 pupils were likely to show lower levels of confidence in mathematics as their use of a computer for schoolwork increased. This apparent anomaly may be explained by prior attainment: it is possible that weaker pupils are given more opportunities to use a computer than are able pupils, perhaps for further practice of particular skills. This may be why those spending more time using the computer for schoolwork show less confidence.

Language of the home and attitudes

Finally, the language used at home (see Section 9) has an impact on enjoyment and confidence in mathematics and science. If English was never or only sometimes used in the home, grade 4 pupils said that they enjoyed maths more and showed more enjoyment and confidence in science. The same was true at grade 8 for enjoyment of mathematics only. It is not clear why this should be. It is possible that the abstract nature of some aspects of mathematics minimises the effects of a language barrier for some pupils but, of course, that could not provide a full explanation for this finding. The need to communicate verbally is as important in mathematics as in other areas of the curriculum. It is also not a foregone conclusion that pupils who speak another language at home are not fluent or almost fluent when using English at school. Some families use another language at home from choice, patriotism or pragmatism (perhaps because older relatives in the household do not speak English) rather than because they cannot speak English fluently. These findings may, therefore, be spurious.

In summary, the multilevel models show that attitudes to mathematics and science are predictive of performance in these subjects, and that other factors impact on these attitudes. It would, therefore, seem wise to consider trying to change some of these factors, in order to encourage positive attitudes among pupils and, perhaps therefore, maximise the chances of pupils performing to the best of their ability.

8 The teachers and the schools

The National Curriculum, as described in Section 7, cites the relevance of attitudes to learning. However, positive attitudes, though important, are not sufficient for success. Other factors related to pupils as well as factors related to their teachers and schools also play a role in learning outcomes and, thus, several such factors were considered as part of TIMSS 2003. Outcomes are reported in the international report. This national report considers some of the teacher- and school-level variables, notably those where there may be some observable correlation with achievement (Section 8). Section 9 looks at pupil-level variables that may have a similar impact.

In this section, the pattern of reporting follows that used in previous sections: factors relating to grade 4 science are discussed first, followed by grade 4 mathematics, grade 8 science and grade 8 mathematics. As in section 7, in each section individual background variables are discussed first, followed by examination of the relationships between these in order to establish coherent factors for further analysis. The relationships between these factors and performance are discussed in section 8.5.

8.1 The teachers and the schools: grade 4 science

A measure of school climate was devised, using data provided by headteachers and the teachers of the TIMSS classes. These members of staff rated their school in relation to several perceptions (teachers' job satisfaction, their understanding of the school's curricular goals, their success in implementing the curriculum, their expectations for pupil achievement, levels of parental support and involvement, pupils' regard for school property and pupils' desire to do well). From the resulting data, two indices of school climate, one based on headteachers' responses and one based on teachers' responses were derived (see Exhibits 8.1 and 8.2). These show that England's schools, at grade 4, are concentrated at the high and medium end of the scale.

The distribution of responses obtained from headteachers was different from that given by other teachers. While 34 per cent of grade 4 pupils were taught in schools where the headteachers' ratings gave a high perception of school climate (PPSC), only 29 per cent of grade 4 pupils were taught in schools where the teachers' ratings gave a high perception of school climate (TPSC). Proportions giving a medium PPSC and TPSC rating were similar, while two per cent and eight per cent of pupils respectively were in schools with low ratings. This difference was not peculiar to England, however; rather, it was repeated across the comparison group. The only exceptions were that the difference in Belgium

(Flemish) was minimal and the trend was reversed in Hungary, where more 'high' ratings were recorded by teachers than by headteachers. The difference in headteachers' and teachers' ratings was particularly marked in Singapore (32 per cent of pupils taught in high PPSC schools, compared with 20 per cent in high TPSC schools), Hong Kong (30 per cent compared with 11 per cent) and the Netherlands (20 per cent against eight per cent). Note, however, that these figures describe the percentage of pupils whose teachers reported a particular type of climate, rather than percentages of teachers and headteachers who gave such responses (a subtle but important difference). Hong Kong and Singapore both report average class sizes greater than those of the other comparison group countries (Exhibit 8.3) and this may have affected the calculation of the climate indices.

Interestingly, although the 'climate' indices derived from the ratings of headteachers and other teachers gave different distributions of response, the internal patterns in their answers were similar. In both cases, there was a correlation between their responses to each of the four statements about teachers and to each of the four statements about parents and children. These correlations were used to create two factors for each group of respondents, and these factors were then entered into the multilevel model (see section 8.5).

On a similar theme, teachers were asked to rate their schools in terms of the safety of the school's neighbourhood, their sense of their own physical safety at school and the school's security policies and practices. These were combined into an index of teachers' perceptions of safety in the schools (TPSS, see Exhibit 8.4). At grade 4, 98 per cent of pupils were taught in schools where teachers' perceptions of safety were at the high or medium level, a positive outcome, given that these schools can be considered a typical cross-section of English schools.

Pupils were asked a series of questions leading to the production of a comparable index (students' perceptions of being safe in the schools, or SPBSS). They were asked to say whether or not each of five listed events had happened to them at school in the last month. The events were: having something stolen, being hit or hurt by other children, being made to do something they did not want to do, being made fun of or being called names, and being left out by other children. On this index, 32 per cent of pupils were placed on the high SPBSS, 42 per cent at the medium level and 26 per cent at the low level; at all three levels, close to the international average. This suggests that there may be some differences between teachers' and pupils' perceptions of safety at school.

The third set of indices derived from headteachers' responses relates to school resources. Headteachers rated 19 resource areas according to whether the school's capacity to provide education was affected by a shortage or inadequacy of each one. The areas covered related to the teaching of mathematics and science, computer software and hardware for each subject, audio-visual resources, general resources such as teaching materials and supplies, adaptive equipment for pupils with disabilities, the infrastructure of the school (buildings, grounds and heating/lighting systems), and staffing (teaching and support). The international report identified two indices at each grade: availability of school resources for mathematics instruction (ASRMI) and availability of school resources for science instruction (ASRSI). For grade 4, the outcomes for science are reported in Exhibit 8.5 below. Those for mathematics are reported in section 8.2.

At grade 4, all pupils are taught in schools resourced at the high or medium level, according to the ratings given by their headteachers. The 45 per cent of pupils whose schools achieve the 'high' rating is a significant increase on the 26 per cent obtained in the 1995 survey, while the zero per cent achieving a low ASRSI rating is a decrease on the 8 per cent observed in 1995. England is not alone in this trend, however. Seven of the comparison group countries have also made gains in resourcing. The greatest gain was observed in Singapore, the highest achieving country, where the 'high' ASRSI rating has increased from 47 per cent to 85 per cent since 1995.

Those aspects of resourcing not included in the international ASRSI and ASRMI indices are included in the further analysis of England's results. Factor analysis led to the creation of three 'resourcing' factors and two separate variables (the provision of teachers and IT support staff), which were entered into the multilevel model (see section 8.5 below). For grade 4, response patterns led to the creation of three resourcing factors: Infrastructure (incorporating buildings, grounds, teaching space, and heating and lighting systems); IT support (incorporating computers, software, and calculators for mathematics and science work); and General resources for mathematics and science (incorporating teaching materials and budget for supplies, special equipment for disabled pupils, science equipment, and library and audio-visual materials for mathematics and science).

Additional school factors entered into the model were derived from questions about pupils' behaviour and teacher vacancies. It was noted earlier that teachers' responses to the question about school climate fell into two factors (School climate: teachers, and School climate: parents and children). Headteachers answered a further set of questions about pupil behaviour, and these were also incorporated into the model. Headteachers were asked to rate several pupil behaviours: absenteeism, late arrival, truancy, breaching the uniform code, classroom disturbance, cheating, swearing, vandalism, theft, and abuse and injury to staff or other pupils. Their answers to all statements were correlated and all but the first two statements were formed into an additional factor (Problem behaviour), which was fed into the model. It emerged that late arrival and absenteeism were more strongly correlated with the ‘School climate: parents and children’ factor, and so were incorporated into that factor.

The final factor derived from headteachers’ responses concerned teacher vacancies. Headteachers rated the difficulty they had experienced in recruiting teachers for the current school year, and stated whether or not incentives had been used. Their responses were correlated and formed the final factor used in the multilevel model. Outcomes are reported in section 8.5 below.

As well as information about the school and classroom contexts, information was also collected about classroom activities. England’s teachers report a far more ‘hands-on’ approach (see Exhibit 8.6) than is seen internationally. Teachers’ reports show that 61 per cent of grade 4 students carry out investigations ‘about half of the lessons or more’, compared with an international average of 39 per cent. Only four other countries internationally report higher percentages. The only one of these countries in the national comparison group is Japan, whose achievement score did not differ significantly from that of England. Singapore, in contrast, reports only 45 per cent of pupils having this level of investigative experience. A similar pattern is found as regards pupils planning and designing investigations (a key facet of England’s national curriculum in science). In England, 51 per cent of pupils plan and design investigations in half or more of their lessons, according to the reports of their teachers. In Singapore, the comparable figure is 10 per cent. Conversely, more Singaporean than English pupils were reported as watching teacher demonstrations in half or more of the lessons. Singapore appears to be offering its pupils a very different science experience from England.

Pupils’ reports of classroom activities were also collected although these were not directly comparable with those of the teachers. Nevertheless, they were useful in the modelling analysis and so factors derived from both pupils’ and teachers’ answers to this set of questions were entered into the multilevel model. A parallel set of questions was asked regarding pupils’ and teachers’ experiences of mathematics lessons. The factors used in the grade 4 multilevel model are described in section 8.2 below.

Thirty-seven per cent of England’s pupils are taught science without the use of a textbook (Exhibit 8.8). Most pupils use a textbook as a supplementary resource, with only 6 per cent using one as a primary resource, a figure that is much lower than that seen for most other countries.

Twelve per cent are taught science without access to computers, according to their teachers’ reports (Exhibit 8.9). This is lower than the international average, and also lower than the percentages for most of the comparison group countries.

Index of Principals' Perception of School Climate (PPSC)

Countries	High PPSC		Medium PPSC		Low PPSC	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Scotland	51 (5.0)	513 (4.2)	45 (4.9)	497 (4.5)	4 (1.8)	451 (14.3)
New Zealand	48 (3.3)	543 (3.1)	48 (3.3)	505 (4.6)	4 (1.5)	477 (14.4)
United States	48 (3.5)	564 (3.4)	45 (3.5)	521 (4.1)	7 (1.6)	475 (9.0)
Australia	38 (4.6)	538 (4.5)	55 (5.1)	514 (4.4)	7 (3.6)	468 (36.6)
England	34 (4.7)	556 (7.3)	64 (4.9)	533 (5.9)	2 (1.3)	~ ~
Singapore	32 (4.1)	583 (7.7)	63 (4.1)	558 (7.0)	5 (1.6)	519 (15.1)
Hong Kong, SAR	30 (4.6)	551 (5.2)	65 (4.8)	540 (3.4)	5 (2.1)	529 (5.8)
Belgium (Flemish)	21 (3.3)	527 (3.0)	77 (3.2)	518 (1.9)	3 (1.4)	479 (32.8)
Netherlands	20 (3.8)	528 (3.7)	79 (4.0)	526 (2.5)	2 (1.2)	~ ~
Japan	18 (3.1)	554 (3.7)	77 (3.3)	542 (1.8)	5 (1.8)	526 (6.4)
Italy	15 (2.8)	525 (9.0)	76 (3.4)	515 (4.4)	10 (2.4)	507 (12.7)
Hungary	8 (2.2)	559 (8.6)	85 (3.0)	526 (3.4)	7 (2.3)	532 (16.7)
International Avg.	23 (0.7)	510 (2.0)	66 (0.8)	486 (1.1)	11 (0.5)	457 (3.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by schools.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insuffcient data to report achievement.

Countries		High TPSC		Medium TPSC		Low TPSC	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
United States		42 (2.8)	557 (3.3)	47 (2.8)	531 (3.4)	12 (1.5)	486 (6.5)
Scotland	r	41 (5.1)	518 (4.9)	58 (5.0)	500 (4.2)	2 (1.1)	~ ~
New Zealand		37 (2.9)	533 (5.1)	57 (3.1)	516 (3.5)	5 (1.2)	461 (9.5)
Australia		31 (3.6)	532 (7.3)	59 (3.7)	526 (3.3)	11 (2.5)	466 (25.7)
England	r	29 (4.4)	552 (6.6)	63 (4.9)	533 (5.2)	8 (2.4)	539 (15.4)
Singapore		20 (3.5)	596 (9.5)	71 (3.9)	558 (6.5)	9 (2.1)	534 (20.7)
Belgium (Flemish)		19 (2.6)	518 (3.6)	75 (3.2)	521 (1.7)	6 (1.9)	490 (13.4)
Hungary		15 (2.8)	535 (7.9)	79 (3.2)	531 (3.1)	7 (2.1)	492 (15.8)
Japan		13 (2.8)	557 (4.6)	75 (3.5)	543 (1.8)	12 (2.8)	532 (3.3)
Hong Kong, SAR		11 (2.8)	555 (6.9)	76 (4.2)	540 (3.4)	13 (3.3)	544 (7.6)
Italy		8 (2.2)	522 (13.4)	73 (3.3)	520 (4.4)	19 (2.7)	495 (8.5)
Netherlands		8 (2.6)	538 (5.1)	84 (3.6)	527 (2.4)	8 (2.5)	504 (8.6)
International Avg.		20 (0.7)	506 (2.4)	66 (0.8)	488 (1.2)	14 (0.6)	467 (2.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insuffcient data to report achievement.

An "r" indicates data are available for at least 70 but less than 85% of the students.

Class Size for Science Instruction

Countries		Overall Average Class Size
Australia		26 (0.5)
Belgium (Flemish)		20 (0.3)
England	r	28 (0.8)
Hong Kong, SAR	r	34 (0.4)
Hungary		24 (0.5)
Italy		20 (0.3)
Japan		32 (0.3)
Netherlands		23 (0.4)
New Zealand	r	28 (0.3)
Scotland	s	26 (0.5)
Singapore		38 (0.2)
United States	r	23 (0.4)
International Avg.		26 (0.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries		High TPSS		Medium TPSS		Low TPSS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore		88 (2.5)	568 (5.6)	12 (2.5)	542 (17.4)	0 (0.0)	~ ~
Hungary		88 (3.0)	528 (3.2)	11 (2.8)	538 (12.6)	1 (1.0)	~ ~
New Zealand	r	88 (1.9)	524 (2.8)	12 (1.9)	484 (9.4)	0 (0.3)	~ ~
Netherlands		85 (2.2)	531 (2.0)	13 (2.1)	497 (7.7)	2 (1.5)	~ ~
United States		83 (2.1)	545 (2.5)	14 (1.9)	499 (7.6)	2 (0.7)	~ ~
Hong Kong, SAR		83 (3.8)	542 (3.5)	15 (3.6)	547 (6.1)	2 (1.3)	~ ~
Australia		79 (3.5)	529 (3.9)	20 (3.5)	494 (15.6)	1 (0.7)	~ ~
Scotland	r	77 (3.2)	513 (3.8)	22 (3.1)	486 (5.8)	1 (0.0)	~ ~
England	r	70 (4.0)	548 (4.4)	28 (4.0)	518 (7.6)	2 (1.2)	~ ~
Belgium (Flemish)		69 (2.9)	518 (1.8)	30 (2.8)	519 (3.7)	1 (0.4)	~ ~
Italy		65 (3.5)	520 (4.5)	24 (3.0)	505 (8.3)	12 (2.2)	513 (12.5)
Japan		57 (4.0)	548 (2.0)	36 (4.1)	538 (2.6)	7 (2.3)	539 (3.8)
International Avg.		76 (0.7)	492 (1.1)	20 (0.7)	478 (2.2)	4 (0.3)	446 (5.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An “r” indicates data are available for at least 70 but less than 85% of the students.

The most common use of computers in science lessons in England, as in most of the comparison group countries, is to look up ideas and information in science lessons.

8.2 The teachers and the schools: grade 4 mathematics

Because the grade 4 pupils in the TIMSS 2003 survey completed test booklets containing both mathematics and science questions, the pupil background data is identical across the two subjects. This applies also, in most cases, to the data obtained from headteachers and teachers. The only exceptions are where questions related specifically to mathematics or science. For that reason, only these specific areas are discussed in this section. See section 8.1 for a description of information pertaining to measures of school climate and safety, behaviour, and teacher vacancies. General resourcing of schools at grade 4 was also discussed in section 8.1, but specific resourcing of mathematics is detailed in this section, as are classroom activities and use of calculators and computers in mathematics.

Section 8.1 described the index derived from headteachers' reports of the availability of school resources for science instruction (ASRSI). A comparable index was compiled for mathematics (the availability of school resources for mathematics instruction (ASRMI). As might be expected, given that the same schools reported on mathematics provision as on science provision and given that the index includes aspects of general as well as specific resources, the same trend was observed for mathematics as for science: an increase in pupils in 'high ASRMI' schools and a decrease in 'low ASRMI' schools (see Exhibit 8.10). As with grade 4 science, the trend in the comparison group is towards similar increases and decreases in most countries, with Singapore having the greatest increase.

Factor analysis gave the resourcing factors previously outlined in section 8.1 and so details are not repeated here.

As was the case for grade 4 science, information was collected about classroom activities in mathematics (Exhibit 8.11). In regard to computation and working on fractions and decimals, England's pupils are fairly typical of pupils around the world, with their percentages being close to the international mean. In other respects, however, they differ, being less likely to engage in measuring, data handling and shape activities in half or more of the lessons. This does not necessarily highlight a problem in terms of curriculum coverage but may simply reflect a broader curriculum. Certainly, England is similar to most of the comparison group countries on this measure, with only Italy and Japan having noticeably greater proportions of pupils doing these activities in half or more of their lessons.

There were some differences in the perceptions of teachers and pupils regarding classroom activities in mathematics. Pupils were less likely than teachers to report that they carried out computation activities in half of their lessons or more (Exhibit 8.12). They were, however, more likely to report that they did the other types of activity (measuring, data-handling and shape activities) in half of the lessons or more. It could be that these activities are more memorable for the pupils and so they are likely to over-report them, or it could be that their computation activities are set in context and, hence, not identified as such by the pupils.

Even if such distortion has happened, the difference in perceptions is interesting and so factors derived from both pupils' and teachers' answers to this set of questions were entered into the multilevel model. Three factors were derived from pupils' answers, and three from teachers' answers, with some similarities in their factors. The pupils' factors were: Investigation and explanation in science, Content other than computation in mathematics, and a Lecture/exercise mode of working in mathematics and science. Computation and working in small groups with other children were entered into the model as separate variables (see Section 10 for more information about multilevel modelling). The teachers' factors were: Investigation in science, Explanation in maths and science, and Content other than computation with presentations in science. Observations and Science demonstrations were entered into the model as separate variables.

Just over a quarter of England's grade 4 pupils are taught mathematics using a textbook as the primary basis for lessons (Exhibit 8.13), with 11 per cent using no textbooks at all. The greatest percentages of lesson time are spent working on problems with or without the teacher's guidance and listening to lecture-style presentations (Exhibit 8.14). Twelve per cent of time is spent listening to teachers re-teach and clarify content. This balance is similar to that found in most of the comparison group countries, with the one exception that grade 4 pupils in Hong Kong spend more time listening to lecture-style presentations.

Calculators are common in England's grade 4 mathematics classrooms, as might be expected given the requirements of the National Curriculum. Only one per cent of pupils work without them. The most common use is for solving complex problems (Exhibit 8.15), followed by checking answers and exploring number concepts. This acceptance of calculators at grade 4 is unusual internationally, although New Zealand and Australia also have low percentages not permitting calculators. Nevertheless, there is clearly no simple link between calculator use and achievement, as England's achievement was higher than that of many countries whose pupils do not use calculators.

Computer use in mathematics lessons is less widespread than calculator use, and less common than in science (19 per cent do not have computers compared with 12 per cent for science). As with science, this is lower than the international average, and also lower than the percentages for most of the comparison group

Exhibit 8.5 Trends in Index of Availability of School Resources for Science Instruction (ASRSI)

Countries		High ASRMI 2003 Percent of Students	High ASRMI 1995 Percent of Students		Medium ASRMI 2003 Percent of Students	Medium ASRMI 1995 Percent of Students		Low ASRMI 2003 Percent of Students	Low ASRMI 1995 Percent of Students	
Singapore		85 (2.8)	47 (4.1)	▲	15 (2.8)	53 (4.1)	▼	1 (0.5)	0 (0.0)	
Scotland		51 (4.7)	– –		47 (4.9)	– –		1 (1.1)	– –	
Japan		48 (3.8)	25 (3.6)	▲	49 (3.9)	70 (3.8)	▼	3 (1.3)	5 (2.0)	
England	r	45 (4.9)	26 (4.5)	▲	55 (4.9)	66 (4.6)		0 (0.0)	8 (2.9)	▼
New Zealand		40 (3.3)	20 (3.8)	▲	59 (3.3)	72 (4.3)	▼	1 (0.8)	7 (2.5)	▼
Australia		38 (3.9)	24 (4.6)	▲	59 (4.0)	74 (4.5)	▼	3 (1.3)	2 (1.2)	
United States	r	36 (3.4)	24 (3.2)	▲	57 (3.5)	72 (2.7)	▼	6 (1.7)	4 (1.5)	
Belgium (Flemish)		36 (3.9)	' '		62 (4.2)	' '		3 (1.4)	' '	
Hong Kong, SAR		35 (4.5)	21 (4.3)	▲	65 (4.5)	75 (4.5)		0 (0.0)	3 (1.6)	
Hungary		34 (4.0)	22 (3.7)	▲	66 (4.0)	76 (3.8)		1 (0.5)	2 (1.1)	
Netherlands		29 (4.3)	28 (4.5)		67 (4.1)	69 (4.8)		3 (1.7)	3 (1.6)	
Italy		25 (3.3)	– –		72 (3.5)	– –		3 (1.3)	– –	
International Avg.		28 (0.7)	22 (1.0)	▲	62 (0.8)	72 (1.1)	▼	11 (0.6)	7 (0.6)	▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

Background data provided by schools.

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy.

1995 data for New Zealand in this exhibit include students in English medium instruction only (>98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An "r" indicates data are available for at least 70 but less than 85% of the students.

An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 8.6 | Teachers' Reports on Students Doing Science Investigations

4th grade Science TIMSS 2003

Countries	Percentage of Students Whose Teachers Reported Students Doing the Activity About Half of the Lessons or More					
	Watch Me Do a Science Experiment	Design or Plan Experiments or Investigations	Do Experiments or Investigations	Work Together in Small Groups on Experiments or Investigations	Write Explanations About Something They are Studying	Relate What Students are Learning in Science to Their Daily Lives
Australia	r 12 (3.0)	r 27 (4.2)	r 40 (4.4)	r 46 (4.8)	r 58 (4.8)	r 52 (4.8)
Belgium (Flemish)	12 (2.6)	3 (1.3)	7 (1.8)	16 (2.7)	42 (3.6)	46 (3.7)
England	r 13 (3.4)	r 51 (4.9)	r 61 (4.8)	r 64 (4.6)	r 78 (4.3)	r 75 (3.6)
Hong Kong, SAR	5 (2.0)	3 (2.1)	r 6 (2.4)	6 (2.5)	44 (5.0)	52 (4.9)
Hungary	15 (2.8)	2 (1.1)	5 (1.8)	6 (1.9)	83 (3.1)	84 (3.0)
Italy	18 (2.5)	25 (2.7)	30 (3.1)	24 (2.6)	79 (3.0)	44 (3.4)
Japan	37 (4.0)	64 (3.7)	85 (3.1)	85 (2.6)	76 (3.1)	55 (4.1)
Netherlands	8 (2.5)	5 (1.7)	15 (3.4)	16 (3.6)	32 (4.6)	49 (4.9)
New Zealand	r 11 (2.3)	r 36 (3.6)	r 49 (3.4)	r 69 (3.2)	r 69 (3.5)	r 64 (3.3)
Scotland	s 15 (3.4)	s 23 (3.8)	s 40 (4.8)	s 43 (4.9)	s 59 (4.9)	s 54 (4.6)
Singapore	29 (3.9)	10 (2.1)	45 (4.2)	46 (4.0)	51 (4.7)	65 (4.1)
United States	r 12 (1.9)	r 22 (2.7)	r 44 (3.2)	r 57 (2.9)	r 63 (2.5)	r 71 (2.7)
International Avg.	23 (0.7)	28 (0.7)	39 (0.8)	44 (0.8)	64 (0.8)	67 (0.8)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries	Percentage of Students Who Reported Doing the Activity Once or Twice a Month or More				
	Watch the Teacher Do a Science Experiment	Design or Plan a Science Experiment or Investigation	Do a Science Experiment or Investigation	Work with Other Students in a Small Group on a Science Experiment or Investigation	Write or Give an Explanation For Something I am Studying in Science
Australia	59 (1.9)	44 (1.9)	48 (1.8)	60 (2.1)	64 (1.9)
Belgium (Flemish)	57 (1.8)	35 (1.5)	29 (1.4)	40 (1.7)	52 (1.6)
England	78 (1.7)	73 (1.5)	79 (1.3)	83 (1.3)	84 (0.9)
Hong Kong, SAR	44 (1.8)	22 (1.0)	23 (1.1)	28 (1.5)	37 (1.0)
Hungary	85 (1.0)	37 (1.2)	23 (1.0)	29 (1.3)	81 (0.7)
Italy	69 (1.7)	47 (1.5)	49 (1.3)	42 (1.6)	78 (0.9)
Japan	88 (1.1)	78 (1.0)	76 (0.8)	89 (0.7)	82 (0.8)
Netherlands	60 (2.3)	53 (1.8)	39 (1.9)	50 (2.1)	50 (2.0)
New Zealand	55 (1.3)	46 (1.1)	47 (1.2)	62 (1.3)	65 (1.1)
Scotland	60 (2.6)	47 (2.0)	50 (2.4)	61 (2.0)	65 (2.1)
Singapore	81 (1.4)	34 (1.1)	48 (1.3)	66 (1.6)	64 (1.3)
United States	63 (1.1)	42 (0.9)	53 (1.0)	65 (1.1)	73 (0.7)
International Avg.	69 (0.3)	50 (0.3)	50 (0.3)	57 (0.3)	69 (0.3)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 8.8 Texbook Use in Teaching Science

Countries		Percentage of Students Taught by Teachers Reporting Textbook Use		
		Do Not Use Textbook to Teach Science	Use Textbook to Teach Science	
			As Primary Basis for Lessons	As Supplementary Resource
Australia		79 (4.1)	8 (3.4)	13 (2.8)
Belgium (Flemish)		51 (4.0)	28 (3.4)	21 (3.3)
England	r	37 (4.9)	6 (2.3)	58 (4.9)
Hong Kong, SAR	r	2 (1.1)	86 (3.7)	13 (3.7)
Hungary		0 (0.0)	81 (3.3)	19 (3.3)
Italy		7 (1.5)	32 (3.3)	61 (3.4)
Japan		1 (0.7)	76 (3.3)	23 (3.2)
Netherlands	r	13 (3.0)	75 (4.3)	12 (3.3)
New Zealand	r	83 (2.6)	4 (1.5)	13 (2.1)
Scotland	s	26 (4.2)	40 (4.6)	35 (4.7)
Singapore		0 (0.0)	75 (4.0)	25 (4.0)
United States	r	24 (2.5)	46 (3.2)	30 (3.0)
International Avg.		18 (0.5)	56 (0.8)	26 (0.8)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.9 Computer Use in Science Class

Countries	National Curriculum Contains Policies / Statements About the Use of Computers	Percentage of Students Whose Teachers Reported that Computers are Not Available	Percentage of Students Whose Teachers Reported on Computer Use About Half of the Lessons or More			
			Doing Scientific Procedures or Experiments	Studying Natural Phenomena Through Simulations	Practicing Skills and Procedures	Looking Up Ideas and Information
Australia	●	16 (3.0)	4 (1.8)	5 (2.4)	6 (2.5)	23 (3.8)
Belgium (Flemish)	o	37 (3.7)	2 (0.9)	1 (0.7)	4 (1.4)	12 (2.3)
England	●	r 12 (2.8)	r 4 (2.0)	r 3 (1.9)	r 4 (2.0)	r 15 (2.8)
Hong Kong, SAR	●	36 (4.8)	1 (0.8)	4 (1.9)	2 (1.4)	8 (2.2)
Hungary	o	76 (4.0)	1 (0.8)	1 (0.8)	1 (0.9)	1 (0.9)
Italy	o	81 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)
Japan	●	11 (2.8)	1 (0.0)	9 (2.5)	1 (1.0)	8 (2.4)
Netherlands	o	62 (4.9)	1 (0.0)	0 (0.0)	2 (1.4)	4 (2.0)
New Zealand	o	r 15 (2.6)	r 2 (1.2)	r 5 (1.4)	r 5 (1.7)	r 34 (3.3)
Scotland	●	s 21 (4.3)	s 1 (1.0)	s 0 (0.0)	s 4 (1.8)	s 19 (4.1)
Singapore	●	23 (3.5)	5 (1.8)	4 (1.7)	10 (2.7)	14 (2.9)
United States	o	32 (2.5)	3 (1.0)	2 (0.8)	6 (1.1)	19 (2.3)
International Avg.		54 (0.7)	2 (0.2)	2 (0.3)	3 (0.3)	9 (0.5)

● Yes

o No

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by National Research Coordinators and by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

countries (Exhibit 8.16). The most frequent use of computers in mathematics lessons in England, as in most of the comparison group countries, is for practising mathematical skills and procedures, although few countries, England included, report much use of a computer in half of mathematics lessons or more.

8.3 The teachers and the schools: grade 8 science

Teachers and headteachers at grade 8 rated their schools' climate using the same series of statements as reported for grade 4. From this data, three indices of school climate were derived: an index of headteachers' perceptions (PPSC), of grade 8 science teachers' perceptions, and of grade 8 mathematics teachers' perceptions (TPSC science and TPSC mathematics). The latter is discussed in section 8.4.

The PPSC outcomes at grade 8 show that, as was the case at grade 4, England's schools are concentrated at the high and medium end of the scale (see Exhibit 8.17).

Only five per cent of headteachers' gave responses that resulted in a 'low PPSC' rating. As was observed at grade 4, teachers' perceptions varied somewhat from those of headteachers (Exhibit 8.18). The effect, however, was rather more pronounced at grade 8, where 19 per cent of science teachers gave responses leading to a 'low TPSC' rating (14 percentage points higher than the equivalent rating from headteachers) and 12 per cent gave a 'high' rating (21 percentage points below the rating obtained from headteachers). Again, however, this was not an isolated finding: similar trends can be seen in all comparison group countries.

Interestingly, the patterns of response regarding grade 8 school climate differed from those in grade 4. For grade 8 science teachers, their responses to the four statements about teachers in the school were correlated, as were their responses to the four statements about parents and children. For headteachers, on the other hand, their answers to all eight questions were correlated. Thus, for teachers, two 'climate' factors derived from this set of questions were fed into the multilevel model, and for headteachers, one factor derived from this set of questions was used (see section 8.5).

On the safety measure, the vast majority of responses placed England's schools in the 'high' and 'medium' categories: 96 per cent of pupils were taught in schools where their science teachers' perceptions of safety were at the high or medium level (Exhibit 8.19). This is similar to the 98 per cent obtained at grade 4 and can, like that finding, be considered a positive outcome. Teachers' responses to the statements about safety and security in the school and its neighbourhood were correlated, and were entered into the multilevel model as a single factor. The condition of school buildings was entered into the model as a separate variable.

Countries	High ASRMI		Medium ASRMI		Low ASRMI	
	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students	2003 Percent of Students	1995 Percent of Students
Singapore	86 (2.7)	47 (4.0) ▲	14 (2.6)	53 (4.0) ▼	1 (0.5)	0 (0.0)
Scotland	62 (4.3)	– –	37 (4.2)	– –	1 (0.0)	– –
Japan	57 (3.8)	25 (3.7) ▲	41 (3.8)	70 (3.7) ▼	1 (1.0)	5 (1.8)
Belgium (Flemish)	53 (3.9)	' '	44 (4.1)	' '	3 (1.4)	' '
Hong Kong, SAR	51 (4.9)	33 (5.4) ▲	49 (4.9)	65 (5.5) ▼	0 (0.0)	2 (1.4)
New Zealand	49 (3.6)	28 (3.9) ▲	49 (3.7)	65 (4.2) ▼	1 (0.9)	8 (2.5) ▼
Australia	46 (4.1)	27 (4.7) ▲	53 (4.1)	71 (5.0) ▼	1 (0.8)	2 (1.4)
England r	**44 (4.9)**	**27 (4.5) ▲**	**56 (4.9)**	**66 (4.6)**	**0 (0.0)**	**7 (2.8) ▼**
United States r	43 (3.3)	32 (3.9) ▲	54 (3.4)	65 (3.7) ▼	3 (1.2)	3 (1.4)
Netherlands	39 (5.0)	35 (5.2)	58 (4.8)	61 (5.1)	3 (1.5)	4 (1.7)
Hungary	38 (4.5)	20 (3.5) ▲	61 (4.6)	78 (3.6) ▼	1 (1.0)	2 (1.2)
Italy	28 (3.6)	– –	70 (3.7)	– –	2 (1.2)	– –
International Avg.	33 (0.7)	26 (1.1) ▲	58 (0.9)	68 (1.2) ▼	10 (0.5)	6 (0.6) ▲

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

Background data provided by schools.

Trend notes: Because of differences between 1995 and 2003 in population coverage, 1995 data are not shown for Italy. 1995 data for New Zealand in this exhibit include students in English medium instruction only (>98% of the estimated population).

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An “r” indicates data are available for at least 70 but less than 85% of the students.

An inverted comma (') indicates the country did not participate in the assessment.

Grade 8 pupils were also asked to comment on their perceptions of safety at school, via the same set of questions used at grade 4. Their responses were closer to those given by their teachers than was the case at grade 4. Even so, some differences with teachers' ratings were found, with 51 per cent recording a 'high SPBSS' (students' perception of being safe in schools) compared with 62 per cent on the teachers' ratings. Conversely, 12 per cent of pupils recorded a 'low SPBSS' rating, against a figure of four per cent obtained from teachers. It is important to remember that the two measures are not directly comparable, having been derived from questions using different statements. The grade 8 pupils, nevertheless, seem to be reporting greater feelings of safety in school than were seen at grade 4. However, it does not necessarily follow that grade 4 environments are more dangerous than those found at grade 8. It may simply be that the difference in responses reflects pupils' greater social maturity at grade 8 and their earlier stage of social-emotional development at grade 4. These answers may, therefore, imply that more attention should be given to helping pupils develop emotionally and socially, particularly as perceptions of safety at school were seen to impact on pupils' attitudes and attainment (see section 8.5).

As at grade 4, headteachers rated 19 resource areas according to whether the school's capacity to provide education was affected by a shortage or inadequacy of each one. According to their ratings, most grade 8 pupils (93 per cent) are taught science in schools resourced at the high or medium level, and this is not significantly different from the position found during the 1999 and 1995 surveys (Exhibit 8.20). Several of the comparison group countries have made significant gains in resourcing, compared with the 1999 and 1995 surveys. As was the case with grade 4 science, Singapore has made the greatest gains, with an increase from 56 to 92 per cent of schools falling into the 'high' resourcing category.

As was the case at grade 4, those aspects of resourcing not included in the international indices were included in the further analysis of England's results. The outcomes of the factor analysis were similar to those obtained for grade 4, resulting in three factors: Infrastructure, IT support for maths and science, and Staff and equipment. These were entered into the multilevel model (see section 8.5).

Again as at grade 4, grade 8 headteachers were asked a series of questions about student behaviour and the extent to which particular types of behaviour were, or were not, a problem. The areas covered were the same as for grade 4 and, once again, headteachers' responses were correlated enabling two factors to be derived. The first 'problem behaviour' factor includes mainly school-specific behaviours: late arrival, absenteeism, truancy, uniform breaches, classroom disturbance, and physical injury to teachers or other staff. The second includes mainly wider behaviour issues: cheating, swearing, vandalism, theft, intimidation of staff or other students, and physical injury to other students. These factors were entered into the multilevel model (section 8.5).

Exhibit 8.11 Teachers' Reports on Mathematics Content Related Emphasis in Students' Classroom Activities

Countries	Percentage of Students Whose Teachers Reported Students Doing the Activity About Half of the Lessons or More				
	Practice Adding, Subtracting, Multiplying, and Dividing Without Using Calculator	Work on Fractions and Decimals	Measure Things in the Classroom and Around the School	Make Tables, Charts, or Graphs	Learn about Shapes such as Circles, Triangles, Rectangles, and Cubes
Australia	71 (4.6)	18 (2.9)	6 (1.9)	7 (2.0)	8 (2.1)
Belgium (Flemish)	89 (2.1)	42 (3.0)	5 (1.6)	9 (1.9)	6 (1.8)
England	r 82 (3.7)	r 21 (4.1)	r 5 (2.7)	r 6 (2.8)	r 4 (2.4)
Hong Kong, SAR	52 (4.6)	23 (3.9)	3 (1.6)	3 (1.4)	4 (1.6)
Hungary	97 (1.4)	8 (2.0)	5 (1.5)	2 (1.1)	5 (1.9)
Italy	76 (2.7)	42 (3.4)	7 (1.7)	18 (2.4)	21 (3.0)
Japan	90 (2.3)	53 (4.1)	18 (3.2)	35 (4.0)	37 (4.4)
Netherlands	90 (2.8)	33 (4.4)	3 (1.6)	5 (2.1)	0 (0.0)
New Zealand	88 (2.0)	20 (2.8)	3 (0.9)	7 (1.5)	4 (1.1)
Scotland	r 84 (3.7)	r 12 (3.3)	r 2 (1.1)	r 2 (1.1)	r 6 (2.1)
Singapore	87 (2.4)	58 (4.4)	4 (1.5)	6 (1.5)	7 (1.8)
United States	87 (1.7)	23 (2.7)	8 (1.4)	17 (2.3)	11 (1.8)
International Avg.	82 (0.7)	29 (0.7)	11 (0.5)	15 (0.6)	17 (0.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

Exhibit 8.12 Students' Reports on Mathematics Content Related Emphasis in Classroom Activities

Countries	Percentage of Students Who Reported Doing the Activity About Half of the Lessons or More				
	Practice Adding, Subtracting, Multiplying, and Dividing Without Using Calculator	Work on Fractions and Decimals	Measure Things in the Classroom and Around the School	Make Tables, Charts, or Graphs	Learn about Shapes such as Circles, Triangles, Rectangles, and Cubes
Australia	75 (1.1)	58 (1.7)	29 (1.2)	42 (1.4)	52 (1.6)
Belgium (Flemish)	74 (1.2)	60 (1.3)	14 (0.7)	23 (1.4)	51 (1.6)
England	63 (1.1)	42 (1.6)	12 (0.9)	36 (1.5)	33 (1.3)
Hong Kong, SAR	53 (1.6)	53 (1.1)	16 (1.0)	25 (1.0)	46 (1.1)
Hungary	72 (1.0)	32 (1.6)	12 (0.7)	16 (1.0)	53 (1.7)
Italy	61 (1.3)	60 (1.4)	21 (1.1)	49 (1.6)	72 (1.5)
Japan	80 (0.9)	74 (1.4)	27 (0.9)	50 (1.4)	57 (1.3)
Netherlands	74 (1.4)	36 (1.8)	9 (0.9)	29 (1.5)	15 (0.9)
New Zealand	74 (0.8)	58 (1.3)	31 (1.2)	48 (1.2)	52 (1.1)
Scotland	73 (1.0)	38 (1.7)	25 (1.3)	42 (1.5)	43 (1.5)
Singapore	77 (0.9)	73 (1.0)	14 (0.6)	29 (0.9)	47 (1.2)
United States	74 (0.7)	64 (1.1)	28 (0.8)	51 (1.0)	56 (1.0)
International Avg.	67 (0.3)	54 (0.3)	25 (0.3)	39 (0.3)	54 (0.3)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 8.13 Textbook Use in Teaching Mathematics

Countries		Percentage of Students Taught by Teachers Reporting Textbook Use		
		Do Not Use Textbook to Teach Mathematics	Use Textbook to Teach Mathematics: As Primary Basis for Lessons	Use Textbook to Teach Mathematics: As Supplementary Resource
Australia		29 (3.9)	16 (3.1)	56 (4.1)
Belgium (Flemish)		4 (1.4)	85 (2.8)	11 (2.6)
England	r	11 (2.9)	26 (3.9)	62 (4.5)
Hong Kong, SAR		0 (0.0)	81 (3.5)	19 (3.5)
Hungary		0 (0.0)	77 (3.8)	23 (3.8)
Italy		11 (2.0)	11 (2.0)	78 (2.5)
Japan		1 (0.0)	86 (3.0)	14 (2.9)
Netherlands		2 (1.4)	98 (1.4)	0 (0.4)
New Zealand		11 (2.2)	16 (2.8)	72 (3.0)
Scotland	s	0 (0.0)	82 (4.2)	18 (4.2)
Singapore		0 (0.0)	66 (4.0)	34 (4.0)
United States		11 (2.1)	60 (3.1)	29 (2.8)
International Avg.		5 (0.4)	66 (0.7)	29 (0.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.14 Percentage of Time in Mathematics Lessons Students Spend on Various Activities in a Typical Week

Countries		Listening to Teachers Re-teach and Clarify Content / Procedures		Taking Tests and Quizzes		Participating in Classroom Management Tasks not Related to the Lesson's Content/Purpose		Other Student Activities
Australia		13 (0.6)		7 (0.4)		5 (0.5)	r	5 (0.6)
Belgium (Flemish)		11 (0.6)		8 (0.3)		3 (0.2)		3 (0.3)
England	r	12 (0.6)	s	5 (0.4)	s	4 (0.3)	s	5 (0.7)
Hong Kong, SAR		9 (0.5)		6 (0.3)		4 (0.3)		6 (0.4)
Hungary	r	12 (0.6)	r	8 (0.6)	r	3 (0.3)	r	5 (0.6)
Italy		14 (0.4)		14 (0.5)		6 (0.3)		5 (0.4)
Japan		15 (0.7)		10 (0.4)		1 (0.2)		2 (0.6)
Netherlands	r	12 (0.7)	r	7 (0.8)	r	3 (0.3)	r	4 (0.6)
New Zealand		14 (0.7)		7 (0.3)		4 (0.2)		6 (0.6)
Scotland	s	9 (0.5)	s	5 (0.3)	s	4 (0.3)	s	4 (0.5)
Singapore		11 (0.4)		8 (0.4)		6 (0.3)		5 (0.5)
United States		11 (0.3)		9 (0.3)		5 (0.3)		5 (0.4)
International Avg.		12 (0.1)		10 (0.1)		4 (0.1)		5 (0.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.14 Percentage of Time in Mathematics Lessons Students Spend on Various Activities in a Typical Week

Countries		Reviewing Homework		Listening to Lecture-Style Presentations		Working Problems with Teacher's Guidance		Working Problems on Their Own Without Teacher's Guidance
Australia		6 (0.4)		12 (0.8)		27 (1.1)		25 (1.0)
Belgium (Flemish)		6 (0.4)		18 (0.6)		19 (0.6)		32 (1.1)
England	r	6 (0.4)	r	18 (1.2)	r	24 (1.2)	r	27 (1.1)
Hong Kong, SAR		7 (0.4)		37 (1.3)		17 (0.7)		15 (0.8)
Hungary	r	8 (0.4)	r	12 (0.8)	r	27 (0.8)	r	27 (0.8)
Italy		11 (0.4)		24 (0.6)		13 (0.4)		14 (0.4)
Japan		5 (0.3)		19 (0.9)		32 (1.1)		16 (1.0)
Netherlands	r	3 (0.3)	r	14 (0.9)	r	20 (1.2)	r	37 (1.4)
New Zealand		4 (0.3)		10 (0.5)		28 (1.1)		27 (0.9)
Scotland	s	6 (0.4)	s	21 (0.9)	s	20 (1.4)	s	31 (1.8)
Singapore		14 (0.6)		21 (1.0)		17 (0.8)		17 (0.7)
United States		10 (0.4)		16 (0.4)		23 (0.7)		22 (0.7)
International Avg.		8 (0.1)		16 (0.2)		22 (0.2)		23 (0.2)

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

Again, as with grade 4, headteachers were asked about teacher vacancies and two factors were derived from their responses: Difficulty in filling vacancies and Incentives to recruitment. These also were entered into the multilevel model.

Teachers were asked to rate a list of criteria to indicate to what extent each limited how they taught the TIMSS science class. The first six of these criteria (students with a wide range of academic abilities, students from a wide range of backgrounds, students with special needs, lack of interest among students, low morale among students, and disruptive students) were combined into an index of limiting factors (SCFL). On this index, most of England's pupils fell into the high and medium SCFL categories (a higher score indicates fewer limitations), a trend that was repeated across the comparison group countries (Exhibit 8.21). However, some countries had relatively high proportions of pupils in classes where greater limitations were felt to exist: Hong Kong, for example, had one third of its students in this category. It may be that teachers in different countries interpreted the concept of a limitation on their teaching differently. Even so, if a criterion identified by a teacher seems to that teacher to be a limiting one, then it is plausible to assume that it does, indeed, have some impact on his or her teaching.

Teachers' responses to the six statements in this index were correlated and so they were fed into the multilevel model as a single factor. A further two factors were derived from teachers' ratings of other statements: Limiting factors in science resources and Limiting factors in computer resources. Ratings of the final statement did not correlate and so were entered into the model as a separate variable: Student numbers. Outcomes are reported in section 8.5.

Complementing the information about school and classroom contexts, data was also collected about classroom activities. Grade 8 pupils were more likely than their international peers to carry out investigations 'in about half of the lessons or more' (66 per cent). This was 12 percentage points greater than the international average (see Exhibit 8.22). It may be affected by the fact that, at grade 8, many countries teach separate sciences. The international average shown in Exhibit 8.22, therefore, is derived only from the countries that teach integrated sciences. Interestingly, the international report shows that investigation is used less often in those countries where separate sciences are taught: the largest mean percentage is 30 per cent using investigation in half or more of physics lessons.

Another difference in England's data is that students at grade 8 are less likely than those at grade 4 to design and plan their own investigations: only 14 per cent of pupils are taught by teachers who report doing this in half or more of their lessons. This difference is not atypical, mirroring the trend in all but one of the comparison countries. A higher percentage of England's grade 8 students, compared with grade 4 students, also watch teacher demonstrations in half or

Exhibit 8.15 | Emphasis on Calculators in Mathematics Class

4th grade Mathematics | TIMSS 2003

Countries	National Curriculum Contains Policies / Statements About the Use of Calculators	Percentage of Students Whose Teachers Reported that Calculators are Not Permitted	Percentage of Students Whose Teachers Reported on Calculator Use About Half of the Lessons or More			
			Checking Answers	Doing Routine Computations	Solving Complex Problems	Exploring Number Concepts
Australia	•	6 (2.4)	15 (3.3)	5 (1.9)	13 (2.6)	11 (2.9)
Belgium (Flemish)	o	29 (3.8)	9 (2.1)	2 (0.7)	9 (2.2)	1 (0.5)
England	•	r 1 (0.6)	r 18 (4.2)	r 7 (2.7)	r 22 (4.4)	r 14 (3.7)
Hong Kong, SAR	o	87 (3.0)	0 (0.0)	1 (0.9)	1 (0.9)	2 (1.1)
Hungary	o	87 (2.9)	1 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Italy	•	88 (2.3)	1 (0.9)	2 (0.7)	1 (0.4)	1 (0.0)
Japan	•	32 (3.7)	0 (0.0)	1 (0.0)	3 (1.4)	1 (1.0)
Netherlands	•	61 (4.8)	1 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
New Zealand	•	4 (1.3)	11 (2.0)	3 (1.1)	13 (2.2)	7 (1.6)
Scotland	•	s 9 (2.4)	r 2 (1.6)	r 0 (0.0)	r 5 (2.0)	r 4 (1.7)
Singapore	o	97 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
United States	•	r 31 (2.6)	7 (1.4)	2 (0.8)	9 (1.8)	6 (1.4)
International Avg.		57 (0.6)	4 (0.3)	2 (0.2)	5 (0.4)	4 (0.3)

• Yes
o No

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by National Research Coordinators and by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.16 Computer Use in Mathematics Class

Countries	National Curriculum Contains Policies / Statements About the Use of Computers	Percentage of Students Whose Teachers Reported that Computers are Not Available	Percentage of Students Whose Teachers Reported on Computer Use About Half of the Lessons or More		
			Discovering Principles and Concepts	Practicing Skills and Procedures	Looking up Ideas and Information
Australia	•	24 (3.6)	5 (2.3)	8 (2.4)	3 (1.7)
Belgium (Flemish)	o	33 (3.4)	0 (0.3)	9 (2.2)	1 (0.2)
England	•	r 19 (3.4)	r 4 (1.9)	r 5 (2.3)	r 2 (1.4)
Hong Kong, SAR	o	47 (4.4)	1 (1.0)	1 (1.1)	0 (0.0)
Hungary	o	86 (3.3)	1 (0.9)	3 (1.4)	2 (1.1)
Italy	•	75 (3.1)	0 (0.0)	0 (0.3)	0 (0.0)
Japan	•	16 (3.2)	0 (0.0)	1 (0.7)	1 (0.7)
Netherlands	o	24 (3.5)	11 (3.0)	31 (4.4)	1 (0.0)
New Zealand	•	30 (3.1)	1 (0.5)	4 (1.4)	1 (0.6)
Scotland	•	r 19 (3.8)	r 0 (0.3)	r 2 (1.1)	r 0 (0.3)
Singapore	•	21 (3.3)	6 (1.9)	14 (3.0)	4 (1.5)
United States	o	40 (2.4)	3 (0.8)	7 (1.3)	3 (0.9)
International Avg.		58 (0.6)	2 (0.2)	4 (0.3)	2 (0.2)

• Yes

o No

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by National Research Coordinators and by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

Index of Principals' Perception of School Climate

Index based on principals' responses to eight questions about their schools: teachers' job satisfaction; teachers' understanding of the school's curricular goals; teachers' degree of success in implementing the school's curriculum; teachers' expectations for student achievement; parental support for student achievement; parental involvement in school activities; students' regard for school property; and students' desire to do well in school. Average is computed based on a 5-point scale: 1 = very high; 2 = high; 3 = medium; 4 = low; 5 = very low. High level indicates average is less than or equal to 2. Medium level indicates that average is greater than 2 and less or equal to 3. Low level indicates average is greater than 3.

Countries	High PPSC		Medium PPSC		Low PPSC	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
United States	43 (3.2)	560 (4.7)	49 (3.3)	512 (5.1)	8 (1.9)	492 (6.4)
Scotland	42 (4.3)	539 (6.7)	52 (4.7)	505 (7.1)	6 (2.6)	473 (30.2)
New Zealand	34 (4.7)	547 (7.8)	58 (4.7)	509 (7.5)	8 (3.2)	504 (11.7)
¶ England						
Australia	31 (4.3)	541 (7.0)	61 (4.8)	529 (5.3)	8 (2.7)	476 (19.9)
Singapore	30 (0.0)	628 (6.0)	65 (0.0)	559 (6.4)	5 (0.0)	520 (22.1)
Japan	29 (3.4)	563 (3.8)	69 (3.4)	548 (2.1)	3 (1.3)	533 (4.8)
Belgium (Flemish)	16 (2.7)	539 (6.5)	74 (3.8)	518 (3.5)	10 (2.6)	463 (19.3)
Italy	12 (2.7)	511 (8.3)	75 (3.6)	491 (3.7)	13 (2.3)	470 (8.5)
Hong Kong, SAR	12 (2.7)	576 (11.1)	70 (4.1)	556 (3.4)	18 (3.4)	533 (9.7)
Hungary	7 (2.1)	574 (12.3)	84 (3.3)	542 (3.4)	10 (2.6)	531 (11.5)
Netherlands	5 (2.1)	572 (10.5)	81 (3.7)	538 (3.4)	13 (3.2)	510 (13.9)
¶ England	33 (5.8)	568 (11.0)	63 (6.2)	539 (8.2)	5 (3.1)	503 (11.9)
International Avg.	15 (0.4)	499 (2.4)	67 (0.6)	473 (0.8)	18 (0.4)	455 (1.9)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by schools.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Index of Teachers' Perception of School Climate

Index based on teachers' responses to eight questions about their schools: teachers' job satisfaction; teachers' understanding of the school's curricular goals; teachers' degree of success in implementing the school's curriculum; teachers' expectations for student achievement; parental support for student achievement; parental involvement in school activities; students' regard for school property; and students' desire to do well in school. Average is computed based on a 5-point scale: 1 = very high; 2 = high; 3 = medium; 4 = low; 5 = very low. High level indicates average is less than or equal to 2. Medium level indicates that average is greater than 2 and less or equal to 3. Low level indicates average is greater than 3.

Countries		High TPSC		Medium TPSC		Low TPSC	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
United States		24 (2.6)	564 (5.5)	52 (3.0)	531 (4.0)	24 (2.6)	499 (5.8)
New Zealand		22 (4.3)	534 (6.6)	60 (5.3)	523 (6.6)	18 (4.1)	503 (12.0)
Australia	r	13 (2.1)	559 (7.2)	57 (3.9)	534 (5.5)	30 (3.9)	499 (6.6)
¶ England							
Scotland	s	12 (1.8)	536 (10.0)	60 (3.0)	522 (4.9)	28 (2.9)	493 (6.8)
Singapore		9 (1.5)	625 (16.2)	71 (2.6)	583 (5.3)	20 (2.0)	542 (9.4)
Japan		9 (2.2)	573 (13.4)	62 (4.0)	554 (2.7)	30 (3.7)	542 (3.2)
Belgium (Flemish)		7 (1.5)	551 (8.1)	68 (3.0)	525 (3.0)	25 (2.8)	482 (8.2)
Hong Kong, SAR		7 (2.3)	589 (15.0)	66 (4.7)	561 (4.1)	28 (4.5)	537 (7.4)
Hungary		5 (1.0)	570 (9.5)	79 (2.1)	545 (2.7)	17 (2.0)	518 (5.4)
Italy		4 (1.8)	499 (33.3)	49 (4.2)	497 (4.3)	48 (3.9)	484 (4.4)
Netherlands	r	1 (0.7)	~ ~	60 (3.1)	546 (4.3)	39 (3.0)	521 (4.9)
¶ England	s	12 (2.2)	606 (14.6)	70 (4.5)	546 (7.9)	19 (4.3)	537 (10.4)
International Avg.		10 (0.3)	496 (2.1)	60 (0.5)	477 (0.8)	30 (0.5)	460 (1.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insuffcient data to report achievement.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

more of their lessons, according to their teachers' reports. At 30 per cent, this is higher than the comparable figure for most comparison group countries.

Where England is most similar to the other comparison group countries is in relating learning to students' daily lives: 64 per cent of students do this in half or more of their lessons, according to their teachers. This is close to the percentages for the other countries.

Grade 8 pupils, like their grade 4 counterparts, were asked how often they carried out each of the activities rated by their teachers. Again, there were some differences in perceptions of frequency of each activity. Students were less likely than their teachers to report relating science to their daily lives in half or more of the lessons: the figure was 35 per cent by pupil report, compared with 64 per cent by teacher report. A similar difference was found regarding teacher demonstrations of an experiment: by student report, the percentage was 60 per cent, compared with the teacher report of 30 per cent doing this in half or more lessons. By far the largest discrepancy was found in relation to pupils designing investigations. According to teacher reports, 14 per cent do this in half the lessons or more; the pupils' reports give a figure of 54 per cent.

These differences are intriguing. In two respects, they suggest that pupils believe their science activities to be more 'hands-on' than the teachers' data would suggest. In another respect, however, they suggest that the lessons have less relevance to pupils' daily lives than the teachers believe is being indicated. These discrepancies could benefit from further research, particularly given that some relevant effects were found in the multilevel model (see section 8.5). The pupil factors derived from these questions are described in section 8.4 below. Three factors were derived from teachers' responses: Investigation and explanation in science, Demonstrations and planning investigations, and the Nature, impact and presentation of science. A fourth variable (the relevance of science to everyday life) was placed into the multilevel model separately.

Teachers were asked to rate their agreement with nine statements about science and science education. These were subjected to factor analysis and two factors were entered into the multilevel model: the Nature of science and learning science, and Natural phenomena. The former contained seven statements such as: more than one representation ... should be used in teaching a science topic; learning science mainly involves memorising; there are many ways to conduct scientific investigation; and scientific theories are subject to change. The second factor related to modelling and explaining natural phenomena, and contained two statements: science is taught primarily to give students the skills and knowledge to explain natural phenomena; and modelling natural phenomena is essential to teaching science.

Exhibit 8.19 Index of Science Teachers' Perception of Safety in the Schools (TPSS)

Index of Teachers' Perception of Safety in the Schools

Index based on teachers' responses to three statements about their schools: this school is located in a safe neighborhood; I feel safe at this school; this school's security policies and practices are sufficient. High level indicates that the teacher agrees a lot or agrees to all three statements. Low level indicates that teacher disagrees or disagrees a lot to all three statements. Medium level includes all other combinations of responses.

Countries		High TPSS		Medium TPSS		Low TPSS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore		91 (1.5)	578 (4.8)	8 (1.5)	574 (16.2)	1 (0.6)	~ ~
Hong Kong, SAR		88 (2.9)	559 (3.1)	12 (2.9)	535 (16.6)	0 (0.0)	~ ~
Hungary		84 (2.2)	543 (3.1)	14 (2.0)	538 (4.7)	2 (0.7)	~ ~
United States		80 (2.3)	538 (3.3)	18 (2.3)	506 (8.3)	2 (0.8)	~ ~
Belgium (Flemish)		80 (3.0)	517 (3.1)	18 (2.7)	512 (7.6)	2 (1.2)	~ ~
Netherlands	r	79 (2.4)	539 (3.4)	18 (2.1)	535 (8.0)	2 (1.2)	~ ~
New Zealand		78 (5.2)	522 (5.7)	18 (4.6)	523 (11.4)	3 (2.8)	515 (7.4)
Australia	r	70 (3.6)	527 (4.5)	26 (3.5)	529 (9.0)	3 (1.3)	501 (14.0)
Italy		68 (3.3)	499 (3.3)	23 (3.0)	473 (5.8)	9 (2.2)	480 (11.8)
¶ England							
Scotland	s	61 (3.1)	523 (5.0)	35 (3.0)	509 (6.1)	4 (1.4)	461 (27.1)
Japan		55 (3.9)	555 (2.7)	35 (3.5)	551 (3.1)	10 (2.3)	539 (6.0)
¶ England	s	62 (5.0)	563 (7.4)	34 (5.0)	536 (9.2)	4 (1.7)	494 (11.0)
International Avg.		70 (0.5)	479 (0.8)	24 (0.5)	468 (1.2)	6 (0.3)	447 (2.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Index of Availability of School Resources for Science Instruction

Index based on principals' average response to five questions about shortages that affect general capacity to provide instruction: instructional materials (e.g., textbook); budget for supplies (e.g., paper, pencils); school buildings and grounds; heating/cooling and lighting systems; and instructional space (e.g., classrooms); and the average response to six questions about shortages that affect science instruction: science laboratory equipment and materials; computers for science instruction; computer software for science instruction; calculators for science instruction; library materials relevant to science instruction; and audio-visual resources for science instruction. Average is computed based on a 4-point scale: 1 = none; 2 = a little; 3 = some; 4 = a lot. High level indicates that both shortages are on average lower than 2. Low level indicates that both shortages are on average greater than or equal to 3. Medium level includes all other possible combinations of responses.

Countries		High ASRSI 2003 Percent of Students	High ASRSI 1999 Percent of Students	High ASRSI 1995 Percent of Students	Medium ASRSI 2003 Percent of Students	Medium ASRSI 1999 Percent of Students	Medium ASRSI 1995 Percent of Students
Singapore		92 (0.0)	56 (3.9) ▲	62 (4.8) ▲	7 (0.0)	40 (4.1) ▼	37 (4.7) ▼
Hong Kong, SAR		66 (3.6)	19 (3.3) ▲	23 (5.4) ▲	32 (3.6)	73 (3.5) ▼	72 (5.7) ▼
Netherlands	r	59 (4.7)	37 (6.4) ▲	50 (7.5)	40 (4.8)	62 (6.4) ▼	50 (7.5)
Belgium (Flemish)		57 (4.9)	60 (4.5)	52 (5.8)	41 (4.8)	40 (4.5)	48 (5.8)
Australia	r	55 (3.8)	– –	42 (5.2) ▲	43 (3.8)	– –	52 (5.4)
United States	r	49 (3.8)	34 (3.3) ▲	16 (3.3) ▲	48 (3.8)	59 (3.2) ▼	77 (3.5) ▼
Japan		49 (4.0)	31 (3.8) ▲	25 (3.4) ▲	49 (4.0)	64 (4.1) ▼	67 (3.8) ▼
New Zealand		45 (4.8)	37 (4.1)	19 (3.3) ▲	52 (5.1)	62 (4.1)	74 (4.0) ▼
Scotland		36 (5.3)	' '	– –	62 (5.4)	' '	– –
¶ England							
Italy		31 (3.4)	22 (3.1)	– –	68 (3.5)	71 (3.8)	– –
Hungary		26 (3.9)	24 (3.6)	22 (3.3)	72 (3.9)	69 (3.9)	77 (3.4)
¶ England	s	34 (6.5)	26 (4.2)	24 (4.8)	59 (6.5)	69 (4.5)	72 (5.0)
International Avg.		26 (0.5)	19 (0.6) ▲	22 (0.9) ▲	63 (0.6)	63 (0.7)	66 (1.0) ▼

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

▲ 2003 significantly higher

▼ 2003 significantly lower

Background data provided by schools.
¶ Did not satisfy guidelines for sample participation rates.
Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and 1995 data are not shown for Italy.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.
An inverted comma (') indicates the country did not participate in the assessment.

Teachers were also asked to say what percentage of time students spent on each of a list of activities in a typical week of science lessons (Exhibit 8.23). The largest percentage of time was spent on working with the teacher's guidance (32 per cent of class time, on average), followed by working independently and listening to lecture-style presentations (19 per cent and 15 per cent respectively). Ten per cent of time was spent listening to teachers re-teach and clarify concepts. Similar distributions were seen in the other comparison countries. Six per cent of class time was spent, in a typical week, on taking tests; this is below the international average of ten per cent.

Two separate questions were asked about tests: their frequency and their format. Just over half of England's pupils were reported as taking tests about once a month; a further quarter a few times a year or less. A minority of 15 per cent takes a test every two weeks or more, well below the international average. There does not seem to be any clear relationship between frequency of tests and performance in TIMSS 2003 (Exhibit 8.24). Equally, the often-quoted idea that England's pupils are over-tested would appear not to stand up to scrutiny when compared with reports from other countries.

Most (nearly three-quarters) of England's pupils encounter only or mostly constructed-response tests. This is unusual (see Exhibit 8.25). The most common format internationally is to have tests that contain about half constructed response items and about half multiple-choice items. Only a quarter of England's pupils typically experiences this mixture.

Textbook use is more common at grade 8 than at grade 4. Even so, the proportion using them as a primary resource is relatively low at 18 per cent, and nine per cent of students are taught without use of a textbook (Exhibit 8.26).

Computer use in science lessons appears to be limited: 30 per cent of England's pupils are reported as not having computers available in their science lessons and, even where computers are available, they are rarely used in half of the lessons or more. Where they are used, the most common purpose, as was the case in grade 4, is for looking up ideas and information.

8.4 The teachers and the schools: grade 8 mathematics

Because the TIMSS 2003 test booklets included mathematics and science items, the same grade 8 pupils completed both. Therefore, the pupil background data relating to science (reported in section 8.3) applies equally to mathematics (reported in this section). This applies also to the data obtained from headteachers but, unlike grade 4, not to teachers. Mathematics and science is, for most grade 8 students, taught by different people. Hence, in this section, only

Exhibit 8.21 Index of Teachers' Reports on Teaching Science Classes With Few or No Limitations on Instruction Due to Student Factors (SCFL)

8th grade TIMSS 2003 Science

Index of Teachers' Reports on Teaching Science Classes With Few or No Limitations on Instruction Due to Student Factors

Index based on teachers' responses to six statements about student factors limiting science instruction: 1) Students with different academic abilities; 2) Students who come from a wide range of backgrounds; 3) Students with special needs; 4) Uninterested students ; 5) Low morale among students ; 6) Distruptive students. Average is computed across the six statements based on a 4-point scale: 1. Not at all/Not applicable; 2. A little; 3. Some; 4. A lot. High level indicates average is less than or equal to 2. Medium level indicates average is greater than 2 and less than 3. Low level indicates average is greater than or equal to 3.

Countries		High SCFL		Medium SCFL		Low SCFL	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Netherlands	r	76 (2.8)	548 (3.8)	21 (2.7)	505 (4.6)	3 (1.1)	486 (8.6)
Belgium (Flemish)		66 (3.2)	532 (2.8)	28 (3.3)	493 (7.1)	7 (1.5)	470 (19.6)
¶ England							
Japan		61 (3.0)	558 (2.4)	38 (3.2)	542 (2.9)	1 (1.0)	~ ~
Hungary		55 (2.7)	554 (3.2)	38 (2.6)	528 (3.4)	7 (1.1)	524 (5.7)
Australia	r	49 (3.6)	541 (5.2)	36 (3.1)	522 (6.4)	16 (2.4)	504 (7.4)
United States	r	44 (3.0)	541 (4.8)	38 (3.0)	528 (4.3)	18 (2.1)	510 (7.6)
Scotland	s	43 (2.9)	524 (5.5)	40 (2.8)	517 (5.0)	17 (2.4)	493 (10.6)
New Zealand		40 (4.7)	552 (8.8)	39 (4.6)	510 (3.6)	20 (3.3)	485 (8.2)
Singapore		36 (2.4)	619 (5.8)	40 (2.5)	574 (7.3)	23 (2.3)	524 (9.2)
Italy		34 (3.9)	511 (6.2)	43 (4.0)	482 (4.1)	23 (2.7)	479 (6.1)
Hong Kong, SAR		30 (4.0)	571 (5.3)	38 (4.3)	556 (5.2)	32 (4.3)	539 (7.4)
¶ England	s	64 (4.0)	573 (7.3)	25 (3.1)	514 (10.5)	11 (2.9)	508 (9.3)
International Avg.		38 (0.5)	486 (1.0)	40 (0.5)	469 (0.9)	21 (0.4)	457 (1.3)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insuffcient data to report achievement.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

Countries	Percentage of Students Whose Teachers Reported Students Doing the Activity About Half of the Lessons or More					
	Watch Me Demonstrate an Experiment or Investigation	Design or Plan Experiments or Investigations	Conduct Experiments or Investigations	Work Together in Small Groups on Experiments or Investigations	Write Explanations About What was Observed and Why It Happened	Relate What Students are Learning in Science to Their Daily Lives
General/ Integrated Science						
Australia	r 17 (2.9)	r 19 (3.4)	r 73 (3.7)	r 71 (3.7)	r 68 (3.7)	r 63 (4.0)
Hong Kong, SAR	20 (3.6)	13 (3.2)	77 (3.5)	75 (3.0)	70 (3.7)	62 (3.8)
Italy	7 (1.6)	10 (2.3)	6 (1.6)	7 (1.9)	23 (3.2)	64 (4.0)
Japan	39 (4.0)	35 (4.0)	77 (3.7)	81 (3.3)	69 (3.9)	54 (4.1)
New Zealand	17 (4.6)	16 (3.6)	61 (5.0)	66 (5.4)	61 (4.7)	71 (4.3)
Scotland	s 24 (2.9)	s 18 (2.2)	s 82 (2.3)	s 85 (2.4)	s 83 (2.6)	s 56 (3.5)
Singapore	13 (1.5)	6 (1.4)	53 (2.7)	51 (2.7)	49 (2.6)	60 (2.8)
United States	r 21 (2.8)	r 29 (2.5)	r 49 (3.0)	r 65 (3.2)	r 56 (3.4)	r 78 (2.7)
¶ England	s 30 (4.8)	s 14 (2.8)	s 66 (5.2)	s 68 (5.4)	s 69 (5.2)	s 64 (5.1)
International Avg.	38 (0.7)	31 (0.7)	54 (0.7)	57 (0.7)	61 (0.7)	76 (0.6)

Background data provided by teachers.

Does not include students whose teachers report that they do not teach the topic.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

data relating specifically to mathematics, or data relating to both mathematics and science but not covered in section 8.3 is reported here.

Headteachers' perceptions of their school climate were reported earlier, alongside science teachers' perceptions of the same. A comparable index was compiled for mathematics teachers, using their answers to the same questions, as described in section 8.2. The distribution of mathematics teachers' answers was similar to that of science teachers: most gave a 'medium' rating for school climate, while 13 and 14 per cent respectively gave high and low ratings (Exhibit 8.27). It appears, therefore, that headteachers gave more positive ratings than both science and mathematics teachers. Once again, the same trend is observed across the comparison group, to a greater or lesser extent.

The relationships between teachers' responses to the different statements about school climate, which were observed for grade 8 science, also emerged for mathematics: grade 8 teachers' responses to the four statements about teachers were correlated, as were their responses to the four statements about parents and students. These were, thus, entered into the multilevel model as two factors.

On measures of safety in school, mathematics teachers' responses were similar to those of science teachers, with a majority leading to ratings in the 'high' and 'medium' safety categories: 93 per cent of pupils were taught in schools where their mathematics teachers rated safety at these levels (Exhibit 8.28). Unlike the science teachers, however, mathematics teachers' responses to all four safety questions (about safety and security in the school and its neighbourhood, and the conditions of the school buildings) were correlated and were, therefore, entered into the multilevel model as a single factor.

Pupils' perceptions of their safety at school (SPBSS) differed from those of their science teachers and this was again the case for mathematics teachers (exhibit 8.29). The largest difference in opinion between pupils and their mathematics teachers related to the high SPBSS category: 51 per cent of students fell into this category according to their own ratings, compared with 69 per cent according to their teachers. Differences of opinion were observed, again, in most of the comparison group countries for which data was available, although the differences in some cases, such as Scotland, were minimal and unlikely to be significant.

England's index for availability of resources for mathematics instruction (ASRMI) gives similar outcomes to those found for science: 91 per cent of pupils taught in schools with resourcing in the 'high' or 'medium' categories (Exhibit 8.30). Unlike science, however, mathematics resourcing has seen one significant change since 1995: the percentage of students taught in schools in the 'medium' resourced category has dropped from its 1995 and 1999 level. Although both of the other categories appear to have increased from their 1995 and 1999 levels, neither change is statistically significant.

As was found for grade 8 science resourcing, several of the comparison group countries have made significant gains in resourcing since the previous TIMSS surveys and most of these countries had over half of their grade 8 students taught mathematics in highly resourced schools. As with science, the greatest gains in resourcing occurred in Hong Kong and Singapore.

Once again, those aspects of resourcing not included in the resources index were included in the further analysis of England's results. For mathematics resourcing, this was combined with the science outcomes and has been reported in section 8.3. The same applies to student behaviour and teacher vacancies.

Limitations on teaching mathematics because of student factors was analysed separately and resulted in three factors being identified for use in the multilevel model. These were similar to the three identified in science and were labelled: Student ability, needs and attitudes; the Range and number of students and resources; and Shortage of computer resources for mathematics.

Responses to some of the statements were also used, in the international report, to compile an index of limitations on teaching mathematics classes because of student factors (MCFL). For mathematics, 94 per cent of pupils (Exhibit 8.31) were taught in classes in the high or medium categories (a higher score indicates fewer limitations). It was true of most comparison group countries that their pupils mostly fell into the high and medium categories. However, some countries had relatively high proportions of pupils in classes where greater limitations were felt to exist: Hong Kong, SAR, for example, had one third of its students in this category, as it did for science also. As noted in section 8.4, it may be that teachers in different countries interpreted the concept of a limitation on their teaching differently. Even so, if a factor identified by a teacher is seen by that teacher to be a limiting factor, then it is plausible to assume that it does, indeed, have some impact on his or her teaching.

Mathematics teachers provided responses to questions about classroom activities, some of which were summarised in the international report, which showed that half of England's pupils practised basic computation in half or more of their mathematics lessons (Exhibit 8.32). The equivalent figures for the other countries in the comparison group ranged from 10 per cent for Hong Kong, SAR, to 75 per cent in Hungary, both countries with significantly higher performance than England. Wide differences were also apparent on the other activities measures reported.

Once again, pupils' assessment of the activities they engaged in during half or more of their lessons varied from that of their teachers, although the difference was more noticeable for the areas other than computation. Half thought they practised computation skills in half or more of the lessons, which is relatively close to the figure obtained from their teachers. However, approximately a third

Exhibit 8.23 Percentage of Time in Science Lessons Students Spend on Various Activities in a Typical Week

8th grade TIMSS 2003 Science

Countries		Listening to Teachers Re-teach and Clarify Content/Procedures		Taking Tests and Quizzes		Participating in Classroom Management Tasks not Related to the Lesson's Content/Purpose		Other Student Activities
Australia	r	10 (0.4)	r	7 (0.3)	r	8 (0.5)	r	12 (1.1)
Belgium (Flemish)	r	26 (1.2)	r	10 (0.4)	r	5 (0.4)	r	3 (0.6)
Hong Kong, SAR		8 (0.5)		9 (1.1)		5 (0.4)		9 (1.1)
Hungary		10 (0.3)		11 (0.3)		4 (0.2)		7 (0.3)
Italy		15 (0.5)		11 (0.5)		4 (0.4)		4 (0.5)
Japan		16 (0.9)		6 (0.4)		2 (0.3)		11 (1.2)
Netherlands	r	9 (0.4)	r	8 (0.3)	r	6 (0.4)	r	8 (0.6)
New Zealand		10 (0.9)		7 (0.4)		8 (0.8)		16 (1.8)
Scotland	s	11 (0.4)	s	5 (0.3)	s	8 (0.5)	s	4 (0.4)
Singapore		8 (0.4)		8 (0.3)		6 (0.5)		6 (0.5)
United States	r	11 (0.4)	r	8 (0.4)	r	7 (0.5)	r	10 (0.9)
¶ England	s	10 (0.5)	s	6 (0.7)	s	7 (0.6)	s	5 (0.6)
International Avg.		13 (0.1)		10 (0.1)		5 (0.1)		6 (0.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Percentage of Time in Science Lessons Students Spend on Various Activities in a Typical Week

Countries		Reviewing Homework		Listening to Lecture-Style Presentations		Working Problems with Teacher's Guidance		Working Problems on Their Own Without Teacher's Guidance
Australia	r	7 (0.4)	r	19 (1.3)	r	20 (0.7)	r	17 (0.9)
Belgium (Flemish)	r	5 (0.3)	r	20 (1.2)	r	21 (0.9)	r	12 (0.6)
Hong Kong, SAR		8 (0.6)		35 (1.6)		17 (0.9)		9 (0.6)
Hungary		8 (0.3)		24 (0.7)		21 (0.5)		16 (0.4)
Italy		12 (0.6)		31 (0.9)		13 (0.6)		9 (0.4)
Japan		3 (0.3)		41 (1.6)		16 (1.2)		6 (0.7)
Netherlands	r	16 (0.5)	r	19 (0.6)	r	16 (0.8)	r	19 (1.1)
New Zealand		8 (0.5)		17 (1.0)		20 (0.8)		14 (1.0)
Scotland	s	6 (0.3)	s	16 (0.8)	s	34 (1.3)	s	18 (1.2)
Singapore		12 (0.4)		36 (0.8)		14 (0.4)		11 (0.5)
United States	r	9 (0.4)	r	20 (1.0)	r	18 (0.6)	r	17 (0.8)
¶ England	s	7 (0.4)	s	15 (0.9)	s	32 (1.3)	s	19 (1.1)
International Avg.		10 (0.1)		24 (0.2)		19 (0.1)		14 (0.1)

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Science Study (TIMSS) 2003

Exhibit 8.24 Frequency of Science Tests

Countries		Percentage of Students Whose Teachers Give a Science Test or Examination		
		Every Two Weeks or More	About Once a Month	A Few Times a Year or Less
Australia	r	7 (1.9)	64 (3.6)	28 (3.1)
Belgium (Flemish)		43 (3.7)	49 (3.5)	8 (1.8)
Hong Kong, SAR		20 (3.1)	28 (4.0)	52 (3.8)
Hungary		38 (2.8)	51 (2.7)	11 (1.6)
Italy		17 (2.9)	52 (3.7)	30 (3.1)
Japan		11 (2.7)	35 (3.7)	54 (4.1)
Netherlands	r	25 (2.6)	69 (2.7)	6 (1.5)
New Zealand		10 (2.9)	79 (4.5)	11 (3.7)
Scotland	s	3 (1.2)	58 (3.9)	38 (3.9)
Singapore		25 (2.1)	61 (2.8)	15 (2.0)
United States	r	67 (3.4)	27 (3.3)	6 (1.5)
¶ England	s	15 (3.7)	57 (4.7)	28 (4.5)
International Avg.		32 (0.4)	43 (0.5)	25 (0.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.25 Item Formats Used by Teachers in Science Tests or Examinations

Countries		Only or Mostly Constructed-Response		About Half Constructed-Response and Half Multiple-Choice		Only or Mostly Multiple-Choice	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	r	22 (3.1)	520 (9.9)	74 (3.4)	531 (4.4)	5 (1.9)	501 (15.0)
Belgium (Flemish)		34 (3.1)	520 (5.5)	42 (3.1)	513 (5.0)	24 (2.6)	521 (5.4)
Hong Kong, SAR		39 (4.8)	556 (6.3)	60 (4.7)	558 (4.1)	1 (0.0)	~ ~
Hungary		47 (2.5)	545 (3.5)	50 (2.6)	537 (3.4)	3 (0.9)	562 (18.8)
Italy		33 (4.0)	498 (5.4)	61 (4.1)	488 (4.1)	6 (1.9)	488 (16.6)
Japan		26 (3.6)	552 (3.5)	67 (4.2)	550 (2.7)	7 (2.3)	562 (14.5)
Netherlands	r	32 (3.0)	549 (5.6)	57 (3.4)	532 (3.7)	11 (2.1)	527 (10.2)
New Zealand		49 (4.3)	508 (5.2)	45 (4.2)	538 (7.1)	5 (1.8)	506 (11.0)
Scotland	s	48 (4.4)	518 (6.0)	45 (4.3)	513 (6.9)	6 (2.4)	525 (18.2)
Singapore		30 (2.4)	592 (8.6)	68 (2.4)	573 (5.3)	2 (0.5)	~ ~
United States	r	10 (2.1)	535 (8.7)	74 (3.0)	530 (4.2)	16 (2.2)	531 (7.2)
¶ England	s	72 (4.0)	560 (6.1)	27 (4.0)	534 (13.3)	2 (1.2)	~ ~
International Avg.		28 (0.4)	475 (1.1)	60 (0.5)	475 (0.9)	13 (0.3)	463 (1.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insuffcient data to report achievement.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries		Percentage of Students Taught by Teachers Reporting Textbook Use: Do Not Use Textbook to Teach Science	Use Textbook to Teach Science: As Primary Basis for Lessons	Use Textbook to Teach Science: As Supplementary Resource
Australia	r	19 (3.1)	31 (4.4)	50 (3.8)
Belgium (Flemish)		14 (2.4)	43 (2.9)	43 (2.4)
Hong Kong, SAR		1 (0.9)	91 (2.8)	8 (2.6)
Hungary		0 (0.0)	66 (2.2)	34 (2.2)
Italy		1 (0.8)	63 (3.5)	36 (3.6)
Japan		2 (1.0)	62 (3.9)	37 (3.9)
Netherlands	r	1 (0.6)	92 (1.9)	7 (1.7)
New Zealand		15 (4.0)	11 (3.2)	74 (5.0)
Scotland	s	10 (2.0)	30 (4.3)	61 (4.1)
Singapore		0 (0.0)	73 (2.4)	27 (2.4)
United States	r	7 (1.7)	39 (3.4)	54 (3.7)
¶ England	s	9 (2.7)	18 (3.9)	72 (4.3)
International Avg.		5 (0.2)	56 (0.5)	39 (0.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

reported engaging in each of the other three areas reported, somewhat higher than the figures derived from their teachers. It is not clear why this might be.

Exhibits 8.33 and 8.34 show that pupils and teachers differed in their perceptions of other classroom activities. In particular, students were less likely than their teachers to report relating the mathematics they learn to their daily lives. According to their teachers, 46 per cent of pupils are in classes where this is done in half or more of the lessons. According to the pupils, only 27 per cent of them are.

Responses to the four statements reported and those not outlined in the international report were subjected to further analysis, which resulted in three factors being identified from the teachers' responses: Computation and fractions; Problem-solving and interpretation; and Relevance and individual/group work. These were entered into the multilevel model. The pupils' responses were combined with their responses to the parallel question for science, discussed in section 8.3 above. From this exercise, four groups of correlated responses were identified, resulting in four factors being derived: Content in mathematics; Class and individual activities in mathematics; Investigation and explanation in science; and Relevance, presentation, homework and tests in mathematics and science. Use of a calculator did not correlate with any other statement so was entered into the model as a separate variable.

Teachers also provided ratings of agreement with seven statements about mathematics and mathematics education. These were subjected to factor analysis and produced two clear sets of correlated items, which were entered into the multilevel model as two separate factors: Strategies in learning mathematics; and the Nature of mathematics. The former contained four statements, such as: more than one representation...should be used in teaching a mathematics topic; and there are different ways to solve most mathematical problems. The latter contained three statements, including: learning mathematics mainly involves memorising; and modelling real-world problems is essential to teaching mathematics.

Teachers also estimated the percentages of time spent on each of a list of activities in a typical week of science lessons (Exhibit 8.35). The largest percentage of time (almost a third, on average) was spent in working on problems with the teacher's guidance. This was followed by working independently without the teacher's guidance, and listening to lecture-style presentations (20 per cent and 15 per cent respectively). Eleven per cent of time was spent listening to teachers re-teach and clarify concepts. These figures match closely those obtained for science, despite being completed by different teachers. This may be coincidence, or may reflect structured, school-wide approaches to the organisation of teaching and learning.

As with science, similar distributions of response were seen in several other comparison group countries, although there were exceptions. Also similarly, only four per cent of time was given to taking tests, below the international average of ten per cent.

Specific questions about mathematics tests revealed that grade 8 pupils are tested less frequently in mathematics than they are in science: just over half receive a mathematics test a few times a year or less often, with a further 38 per cent receiving one about once a month. Only nine per cent receive one every two weeks or more often, well below the international average (Exhibit 8.36). The question used did not make a distinction between tests set by the teacher or school and externally set tests, and, as was the case with grade 8 science, the results give an interesting perspective on the issue of the amount of testing in England.

There is near uniformity in terms of type of test item encountered in mathematics: 97 per cent of England's pupils are tested in only or mostly constructed-response format (Exhibit 8.37). While this is the most common format internationally in mathematics (56 per cent), there are few countries where such a high proportion of students experiences this format to such an extent.

Use of a science textbook was more common at grade 8 than at grade 4. However, the same is not true of mathematics. Fourteen per cent of grade 8 students are taught mathematics without a textbook, similar to the 11 per cent at grade 4. Nevertheless, where textbooks are used, they are more likely to be a primary than a secondary basis for lessons: almost half use them as a primary resource, compared with a quarter at grade 4 (Exhibit 8.38).

Computer use in mathematics, in contrast, is less prevalent, with 34 per cent of teachers reporting that computers are not available. Where they are used in half the lessons or more, the most common usage appears to be for practising skills and procedures. However, the incidence of such frequent usage is very low, and this is true for most countries (Exhibit 8.39).

Calculator use is more common, with no schools reporting that pupils are not permitted calculators (Exhibit 8.40). The most common uses of calculators, in half of lessons or more, are for solving complex problems and checking answers. Usage for routine calculations is also quite common, at just over one third of pupils. This is by no means the highest percentage internationally, however. Indeed, using a calculator for routine computation is relatively common in some of the highest performing countries.

Index of Teachers' Perception of School Climate

Index based on teachers' responses to eight questions about their schools: teachers' job satisfaction; teachers' understanding of the school's curricular goals; teachers' degree of success in implementing the school's curriculum; teachers' expectations for student achievement; parental support for student achievement; parental involvement in school activities; students' regard for school property; and students' desire to do well in school. Average is computed based on a 5-point scale: 1 = very high; 2 = high; 3 = medium; 4 = low; 5 = very low. High level indicates average is less than or equal to 2. Medium level indicates that average is greater than 2 and less or equal to 3. Low level indicates average is greater than 3.

Countries	High TPSC		Medium TPSC		Low TPSC	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
United States	21 (2.8)	542 (6.6)	56 (3.2)	507 (3.8)	22 (2.6)	476 (7.3)
New Zealand	17 (3.1)	512 (8.6)	62 (4.3)	499 (6.8)	21 (3.7)	472 (9.7)
Australia	16 (2.6)	530 (9.1)	58 (4.4)	514 (7.6)	27 (4.0)	462 (7.9)
Scotland	15 (3.4)	534 (15.2)	60 (4.6)	502 (5.6)	25 (3.8)	481 (8.5)
Singapore	14 (1.2)	646 (9.4)	61 (2.1)	610 (3.9)	25 (2.0)	574 (7.1)
¶ England						
Hong Kong, SAR	7 (2.5)	625 (10.8)	58 (3.6)	596 (4.9)	35 (3.5)	557 (6.8)
Belgium (Flemish)	4 (1.3)	578 (7.9)	78 (2.8)	552 (4.0)	18 (2.5)	466 (10.0)
Italy	4 (1.8)	485 (29.2)	49 (4.2)	494 (4.7)	48 (3.9)	473 (4.5)
Netherlands	3 (2.7)	521 (59.9)	49 (4.6)	567 (6.9)	48 (4.7)	508 (7.0)
Hungary	3 (1.4)	563 (23.7)	83 (2.9)	532 (3.5)	14 (2.5)	502 (9.2)
¶ England r	13 (3.3)	525 (21.5)	73 (5.0)	511 (8.2)	14 (4.3)	467 (15.0)
International Avg.	10 (0.4)	486 (2.9)	60 (0.6)	471 (0.8)	30 (0.5)	450 (1.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An “r” indicates data are available for at least 70 but less than 85% of the students.

Index of Teachers' Perception of Safety in the Schools

Index based on teachers' responses to three statements about their schools: this school is located in a safe neighborhood; I feel safe at this school; this school's security policies and practices are sufficient. High level indicates that the teacher agrees a lot or agrees to all three statements. Low level indicates that teacher disagrees or disagrees a lot to all three statements. Medium level includes all other combinations of responses.

Countries		High TPSS		Medium TPSS		Low TPSS	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore		91 (1.5)	609 (3.7)	8 (1.5)	582 (16.6)	1 (0.5)	~ ~
New Zealand		90 (2.4)	501 (5.4)	7 (1.8)	460 (12.2)	3 (1.6)	454 (25.7)
Hungary		88 (2.5)	530 (3.5)	10 (2.0)	519 (12.8)	2 (1.3)	~ ~
Belgium (Flemish)		85 (2.7)	539 (3.5)	15 (2.6)	533 (11.5)	0 (0.0)	~ ~
United States		84 (2.2)	513 (3.2)	16 (2.2)	488 (10.0)	0 (0.3)	~ ~
Australia		81 (3.4)	508 (5.9)	15 (3.1)	489 (12.1)	4 (1.5)	467 (12.2)
Netherlands		81 (4.1)	541 (5.2)	19 (4.1)	518 (13.5)	0 (0.0)	~ ~
Hong Kong, SAR		79 (3.5)	588 (3.9)	21 (3.5)	580 (9.6)	0 (0.0)	~ ~
¶ England							
Italy		68 (3.3)	492 (3.6)	23 (3.0)	466 (6.5)	9 (2.2)	465 (8.8)
Scotland		59 (4.1)	510 (5.8)	34 (4.1)	488 (7.4)	7 (2.5)	508 (12.9)
Japan		54 (4.0)	574 (3.0)	34 (3.9)	569 (3.5)	12 (2.9)	555 (5.4)
¶ England	r	69 (7.0)	506 (8.9)	24 (5.9)	517 (13.9)	7 (3.5)	474 (22.1)
International Avg.		72 (0.5)	470 (0.8)	22 (0.5)	461 (1.3)	6 (0.3)	440 (3.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insuffcient data to report achievement.
An “r” indicates data are available for at least 70 but less than 85% of the students.

Index of Students' Perception of Being Safe in the Schools

Index based on students' responses to five statements about their schools (1 = yes, 2 = no): something of mine was stolen; I was hit or hurt by other student(s) (e.g., shoving, hitting, kicking); I was made to do things that I didn't want to do by other students; I was made fun of or called names; I was left out of activities by other students. High level indicates that the student answered NO to all five statements. Low level indicates that the student answered YES to three or more statements. Medium level includes all other possible combinations of responses.

Countries	High SPBSS		Medium SPBSS		Low SPBSS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Netherlands	66 (1.4)	540 (4.1)	29 (1.1)	533 (4.8)	5 (0.5)	519 (8.3)
Belgium (Flemish)	64 (1.1)	544 (2.9)	31 (1.0)	530 (3.2)	5 (0.4)	510 (6.7)
Hungary	61 (1.2)	534 (3.3)	32 (1.0)	530 (3.9)	7 (0.5)	508 (6.3)
Japan	61 (1.0)	571 (2.5)	31 (0.8)	573 (3.1)	8 (0.5)	554 (5.5)
Scotland	59 (1.2)	501 (4.1)	33 (1.0)	500 (4.1)	8 (0.6)	479 (8.3)
Italy	56 (1.1)	491 (3.3)	35 (0.9)	480 (3.5)	9 (0.6)	462 (5.6)
¶ England						
Hong Kong, SAR	46 (1.3)	589 (3.3)	42 (1.0)	588 (4.0)	12 (0.7)	573 (5.8)
Singapore	44 (0.7)	618 (3.2)	43 (0.6)	602 (4.0)	13 (0.5)	576 (5.7)
Australia	43 (1.2)	510 (4.7)	40 (1.0)	507 (5.3)	18 (0.9)	499 (5.0)
New Zealand	40 (1.5)	506 (5.7)	41 (1.3)	492 (5.4)	19 (1.2)	482 (7.6)
United States	– –	– –	– –	– –	– –	– –
¶ England	51 (1.4)	503 (5.9)	37 (1.0)	503 (5.4)	12 (1.0)	488 (7.0)
International Avg.	48 (0.2)	478 (0.7)	37 (0.1)	465 (0.6)	15 (0.1)	447 (0.9)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.

Exhibit 8.30 Trends in Index of Availability of School Resources for Mathematics Instruction (ASRMI)

Countries		Low ASRMI 2003 Percent of Students	Low ASRMI 1999 Percent of Students	Low ASRMI 1995 Percent of Students
Singapore		1 (0.0)	4 (1.4)	2 (1.2)
Hong Kong, SAR		2 (1.2)	10 (2.7) ▼	5 (2.6)
Belgium (Flemish)		2 (1.2)	0 (0.0)	0 (0.0)
Japan		0 (0.3)	3 (1.5)	4 (1.9) ▼
Australia	r	1 (0.7)	– –	6 (2.3) ▼
Netherlands	r	0 (0.0)	0 (0.0) ▼	1 (0.1) ▼
United States	r	2 (0.8)	4 (1.5)	6 (1.4) ▼
New Zealand		1 (0.9)	4 (1.7)	6 (2.1) ▼
Italy		2 (1.1)	6 (2.0)	– –
Scotland		1 (1.2)	' '	– –
Hungary		1 (0.8)	6 (2.2) ▼	2 (1.2)
¶ England	s	9 (4.0)	2 (1.5)	2 (1.5)
International Avg.		11 (0.4)	19 (0.6) ▼	10 (0.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by schools.

¶ Did not satisfy guidelines for sample participation rates.

Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and 1995 data are not shown for Italy.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A dash (–) indicates comparable data are not available.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

An inverted comma (') indicates the country did not participate in the assessment.

Trends in Index of Availability of School Resources for Mathematics Instruction (ASRMI)

Index of Availability of School Resources for Mathematics Instruction

Index based on principals' average response to five questions about shortages that affect general capacity to provide instruction: instructional materials (e.g., textbook); budget for supplies (e.g., paper, pencils); school buildings and grounds; heating/cooling and lighting systems; and instructional space (e.g., classrooms); and the average response to five questions about shortages that affect mathematics instruction: computers for mathematics instruction; computer software for mathematics instruction; calculators for mathematics instruction; library materials relevant to mathematics instruction; and audio-visual resources for mathematics instruction. Average is computed based on a 4-point scale: 1=none; 2=a little; 3=some; 4=a lot. High level indicates that both shortages are on average lower than 2. Low level indicates that both shortages are on average greater than or equal to 3.

Countries		High ASRMI			Medium ASRMI		
		2003 Percent of Students	1999 Percent of Students	1995 Percent of Students	2003 Percent of Students	1999 Percent of Students	1995 Percent of Students
Singapore		88 (0.0)	50 (4.0) ▲	55 (4.6) ▲	10 (0.0)	46 (4.1) ▼	43 (4.4) ▼
Hong Kong, SAR		63 (4.0)	22 (4.1) ▲	23 (5.4) ▲	35 (4.0)	67 (4.4) ▼	72 (5.6) ▼
Belgium (Flemish)		60 (4.9)	54 (4.6)	48 (5.3)	38 (4.7)	46 (4.6)	52 (5.3)
Japan		57 (3.8)	36 (4.3) ▲	28 (3.5) ▲	42 (3.8)	61 (4.2) ▼	68 (3.9) ▼
Australia	r	56 (3.8)	– –	42 (5.0) ▲	43 (3.9)	– –	52 (5.2)
Netherlands	r	56 (4.9)	40 (6.2) ▲	46 (7.1)	44 (4.9)	60 (6.2) ▼	53 (7.0)
United States	r	53 (3.8)	37 (3.8) ▲	18 (3.2) ▲	46 (3.8)	59 (3.6) ▼	75 (3.6) ▼
New Zealand		44 (4.8)	34 (4.3)	15 (2.9) ▲	55 (4.9)	62 (4.3)	79 (3.6) ▼
Italy		39 (3.7)	28 (3.4) ▲	– –	59 (3.8)	66 (4.0)	– –
Scotland		37 (5.6)	' '	– –	62 (5.7)	' '	– –
¶ England							
Hungary		32 (3.9)	35 (4.0)	19 (3.2) ▲	67 (3.8)	59 (4.1)	79 (3.3) ▼
¶ England	s	35 (6.6)	26 (4.2)	25 (4.7)	56 (6.2)	72 (4.4) ▼	73 (4.9) ▼
International Avg.		26 (0.5)	19 (0.6) ▲	23 (0.8) ▲	64 (0.6)	64 (0.8)	67 (1.0) ▼

▲ 2003 significantly higher

▼ 2003 significantly lower

Science Study (TIMSS) 2003

Background data provided by schools.
¶ Did not satisfy guidelines for sample participation rates.
Trend notes: Because of differences in population coverage, 1999 data are not shown for Australia and 1995 data are not shown for Italy.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A dash (–) indicates comparable data are not available.
An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.
An inverted comma (') indicates the country did not participate in the assessment.

Exhibit 8.31 Index of Teachers' Reports on Teaching Mathematics Classes With Few or No Limitations on Instruction Due to Student Factors (MCFL)

8th grade Mathematics TIMSS 2003

Index of Teachers' Reports on Teaching Mathematics Classes With Few or No Limitations on Instruction Due to Student

Index based on teachers' responses to six statements about student factors limiting mathematics instruction: 1) Students with different academic abilities; 2) Students who come from a wide range of backgrounds; 3) Students with special needs; 4) Uninterested students; 5) Low morale among students; 6) Disruptive students. Average is computed across the six statements based on a 4-point scale: 1. Not at all/Not applicable; 2. A little; 3. Some; 4. A lot. High level indicates average is less than or equal to 2. Medium level indicates average is greater than 2 and less than 3. Low level indicates average is greater than or equal to 3.

Countries	High MCFL		Medium MCFL		Low MCFL	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Netherlands	81 (3.7)	549 (4.6)	16 (3.3)	482 (11.2)	3 (1.9)	477 (18.4)
Belgium (Flemish)	73 (2.8)	556 (3.6)	20 (2.5)	506 (7.3)	7 (1.7)	454 (18.3)
Scotland	65 (4.3)	519 (5.2)	29 (3.8)	475 (6.5)	6 (2.0)	439 (10.9)
Japan	63 (4.1)	574 (3.1)	33 (3.7)	565 (3.0)	5 (1.7)	547 (12.4)
Hungary	54 (3.7)	544 (4.0)	43 (3.7)	513 (5.6)	2 (1.3)	~ ~
¶ England						
United States	51 (2.9)	530 (3.9)	30 (2.8)	492 (5.3)	19 (2.1)	474 (7.7)
Australia	42 (4.1)	538 (6.0)	42 (4.4)	497 (7.5)	16 (3.2)	448 (13.4)
New Zealand	40 (4.6)	510 (8.4)	39 (4.9)	491 (7.2)	21 (3.6)	482 (11.5)
Singapore	35 (2.5)	633 (5.4)	41 (2.9)	607 (6.0)	24 (2.8)	566 (6.8)
Hong Kong, SAR	32 (4.3)	612 (7.0)	35 (3.9)	577 (5.7)	33 (4.2)	569 (8.4)
Italy	24 (3.4)	500 (8.2)	52 (4.0)	481 (4.2)	24 (3.0)	472 (6.1)
¶ England r	52 (5.8)	540 (8.4)	42 (5.7)	479 (9.7)	6 (2.2)	417 (11.9)
International Avg.	40 (0.6)	480 (1.1)	41 (0.6)	460 (0.9)	20 (0.5)	449 (1.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An “r” indicates data are available for at least 70 but less than 85% of the students.

8.5 The teachers and schools: multilevel modelling outcomes

Multilevel modelling enables predictions to be made regarding the value of one variable given the value of another. In this case the main interest is in the relationships between background variables and performance. The factors discussed in sections 8.1 to 8.4 above, along with other relevant background information about the pupils, teachers and schools, were entered into the multilevel models. Section 10 gives further information about the modelling process and the factors used. The impact of attitude on performance has been summarised in Section 7. This section reports the main findings regarding the teachers and schools, as they impact on pupils' performance and in mathematics and science at grades 4 and 8.

It should be remembered that, as discussed in Section 7, the multilevel models cannot indicate the direction of causality of any effects identified as significant. They simply state that, from the numerical value of one factor, a prediction of the value of another factor can be estimated. They cannot account for whether the first factor causes the second, for whether the reverse is true, or whether a third factor causes the effect.

At each grade, several models were run, relating to pupils' performance in each of mathematics and science overall, and in the separate TIMSS components of each subject. In mathematics at both grades, this comprised five areas: fractions and numbers, algebra (patterns and relationships at grade 4), data analysis and probability, geometry and measurement. In science at grade 4, there were three areas (earth science, life science and physics), supplemented by two further areas at grade 8 (chemistry and environmental science).

The students in the class and their backgrounds

Student intake was a significant factor in predicting performance. At both grades in both subjects, the percentage of pupils eligible for free school meals was a strong negative predictor of attainment, both overall and in each subject area. For all but grade 4 science, this was a non-linear relationship: as the percentage eligible for free school meals rose so attainment fell, but the change in score became less pronounced with higher percentages. For grade 4 science, the relationship was linear: as the percentage eligible for free school meals increased, the scores fell consistently.

The range of students in a class was also a significant factor at grade 8 (equivalent data was not collected at grade 4). Mathematics teachers' views of the extent to which the abilities, needs and attitudes of the students was a limiting factor in how they taught, were a strong negative predictor of their pupils' attainment. In other words, as the perception of limitations related to the

Countries	Percentage of Students Whose Teachers Reported Students Doing the Activity About Half of the Lessons or More			
	Practice Adding, Subtracting, Multiplying, and Dividing Without Using Calculator	Work on Fractions and Decimals	Interepret Data in Tables, Charts, or Graphs	Write Equations and Functions to Represent Relationships
Australia	38 (4.3)	26 (3.9)	8 (2.2)	17 (3.5)
Belgium (Flemish)	67 (3.5)	45 (3.4)	1 (0.5)	3 (1.1)
Hong Kong, SAR	10 (2.8)	6 (2.2)	6 (2.2)	32 (4.2)
Hungary	75 (3.2)	80 (3.4)	5 (1.3)	50 (4.4)
Italy	53 (3.5)	62 (3.5)	20 (3.0)	22 (2.8)
Japan	53 (4.3)	11 (2.6)	36 (3.7)	62 (3.7)
Netherlands	15 (3.5)	8 (3.0)	34 (4.8)	28 (4.1)
New Zealand	40 (4.2)	24 (4.3)	12 (3.6)	15 (4.4)
Scotland	63 (4.5)	25 (4.0)	8 (2.7)	5 (2.4)
Singapore	38 (2.5)	26 (2.3)	10 (1.6)	37 (2.8)
United States	46 (2.6)	45 (3.1)	25 (2.5)	47 (2.9)
¶ England	s 50 (5.7)	s 19 (4.4)	s 9 (3.2)	s 14 (3.7)
International Avg.	62 (0.5)	43 (0.6)	17 (0.5)	30 (0.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.33 Students' Reports on Problem Solving Related Emphasis in Classroom Activities

Countries	Percentage of Students Who Reported Doing the Activity About Half of the Lessons or More		
	Relate What is Being Learned in Mathematics to Their Daily Lives	Explaining Answers	Deciding Procedures for Solving Complex Problems
Australia	37 (1.1)	69 (1.1)	45 (1.1)
Belgium (Flemish)	22 (1.0)	71 (1.1)	38 (1.0)
Hong Kong, SAR	41 (0.8)	57 (0.9)	52 (0.7)
Hungary	38 (1.4)	72 (1.1)	50 (1.1)
Italy	37 (1.1)	57 (1.3)	55 (1.1)
Japan	24 (0.8)	32 (1.5)	45 (0.9)
Netherlands	22 (1.2)	67 (1.8)	28 (1.2)
New Zealand	40 (1.2)	68 (1.7)	49 (1.3)
Scotland	36 (1.1)	75 (1.2)	45 (1.1)
Singapore	41 (0.9)	60 (0.7)	51 (0.8)
United States	45 (1.0)	79 (0.8)	53 (0.9)
¶ England	27 (1.2)	69 (1.6)	42 (1.1)
International Avg.	44 (0.2)	67 (0.2)	53 (0.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 8.34 Teachers' Reports on Problem Solving Related Emphasis in Classroom Activities

Countries	Percentage of Students Whose Teachers Reported Students Doing the Activity About Half of the Lessons or More		
	Relate What is Being Learned in Mathematics to Students' Daily Lives	Explaining Answers	Deciding Procedures for Solving Complex Problems
Australia	39 (4.3)	64 (4.2)	23 (3.7)
Belgium (Flemish)	32 (3.3)	78 (3.0)	22 (2.7)
Hong Kong, SAR	26 (4.0)	60 (4.7)	40 (4.6)
Hungary	63 (3.7)	98 (1.2)	68 (4.2)
Italy	31 (3.4)	89 (2.1)	57 (3.4)
Japan	14 (3.0)	44 (3.9)	21 (3.5)
Netherlands	26 (4.2)	62 (4.7)	19 (4.0)
New Zealand	57 (4.7)	75 (4.3)	35 (4.4)
Scotland	41 (4.2)	69 (4.5)	25 (4.5)
Singapore	32 (2.5)	48 (2.7)	27 (2.5)
United States	66 (2.8)	80 (2.4)	62 (2.9)
¶ England	s 46 (6.9)	s 75 (5.5)	s 45 (7.1)
International Avg.	50 (0.6)	78 (0.5)	45 (0.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “s” indicates data are available for at least 50 but less than 70% of the students.

Percentage of Time in Mathematics Lessons Students Spend on Various Activities in a Typical Week

Countries	Listening to Teachers Re-teach and Clarify Content / Procedures	Taking Tests and Quizzes	Participating in Classroom Management Tasks not Related to the Lesson's Content/Purpose	Other Student Activities
Australia	9 (0.4)	7 (0.4)	7 (0.6)	3 (0.4)
Belgium (Flemish)	16 (0.8)	11 (0.4)	4 (0.3)	2 (0.2)
Hong Kong, SAR	9 (0.7)	6 (0.3)	4 (0.5)	4 (0.4)
Hungary	10 (0.4)	10 (0.4)	3 (0.3)	3 (0.3)
Italy	13 (0.4)	11 (0.5)	4 (0.3)	2 (0.3)
Japan	15 (0.9)	6 (0.4)	2 (0.2)	2 (0.4)
Netherlands	7 (0.5)	8 (0.5)	5 (0.5)	4 (0.4)
New Zealand	9 (0.4)	8 (0.4)	7 (0.5)	4 (0.5)
Scotland	r 8 (0.5)	r 4 (0.3)	r 6 (0.5)	r 3 (0.5)
Singapore	9 (0.3)	8 (0.3)	6 (0.4)	4 (0.4)
United States	11 (0.3)	11 (0.4)	5 (0.3)	4 (0.4)
¶ England	s 11 (0.6)	s 4 (0.4)	s 7 (0.6)	s 4 (0.8)
International Avg.	11 (0.1)	10 (0.1)	5 (0.1)	4 (0.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Exhibit 8.35 Percentage of Time in Mathematics Lessons Students Spend on Various Activities in a Typical Week

Countries	Reviewing Homework	Listening to Lecture-Style Presentations	Working Problems with Teacher's Guidance	Working Problems on Their Own Without Teacher's Guidance
Australia	8 (0.5)	15 (0.8)	23 (1.2)	28 (1.2)
Belgium (Flemish)	7 (0.4)	14 (1.0)	26 (1.0)	20 (0.9)
Hong Kong, SAR	8 (0.4)	36 (1.5)	18 (0.7)	16 (0.8)
Hungary	12 (0.4)	13 (0.7)	25 (0.9)	25 (1.0)
Italy	15 (0.6)	22 (0.6)	19 (0.6)	13 (0.6)
Japan	7 (0.6)	29 (1.3)	28 (1.1)	11 (1.0)
Netherlands	15 (1.1)	13 (0.7)	21 (2.0)	28 (2.5)
New Zealand	7 (0.4)	17 (0.8)	24 (1.1)	23 (1.3)
Scotland	r 8 (0.3)	r 22 (0.7)	r 26 (1.3)	r 22 (1.5)
Singapore	11 (0.4)	27 (0.7)	19 (0.6)	15 (0.5)
United States	13 (0.5)	18 (0.7)	21 (0.6)	18 (0.6)
¶ England	s 8 (0.4)	s 15 (1.2)	s 32 (2.3)	s 20 (1.7)
International Avg.	11 (0.1)	19 (0.1)	22 (0.2)	18 (0.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries	Percentage of Students Whose Teachers Give a Mathematics Test or Examination		
	Every Two Weeks or More	About Once a Month	A Few Times a Year or Less
Australia	19 (3.6)	64 (4.6)	16 (3.4)
Belgium (Flemish)	94 (1.7)	4 (1.5)	2 (0.9)
Hong Kong, SAR	43 (4.8)	39 (4.8)	18 (3.6)
Hungary	68 (4.1)	30 (3.9)	2 (1.2)
Italy	31 (3.4)	67 (3.4)	2 (1.2)
Japan	17 (3.4)	38 (4.4)	45 (4.3)
Netherlands	43 (4.8)	57 (4.8)	0 (0.0)
New Zealand	25 (4.4)	59 (4.6)	16 (4.0)
Scotland	14 (3.2)	31 (4.5)	55 (4.6)
Singapore	31 (1.8)	57 (2.4)	12 (1.5)
United States	73 (2.6)	24 (2.7)	3 (1.1)
¶ England r	9 (2.6)	38 (6.2)	53 (6.5)
International Avg.	47 (0.5)	40 (0.6)	14 (0.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

Exhibit 8.37 Item Formats Used by Teachers in Mathematics Tests or Examinations

Countries		Only or Mostly Constructed-Response		About Half Constructed-Response and Half Multiple-Choice		Only or Mostly Multiple-Choice	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia		69 (3.8)	504 (6.3)	22 (2.8)	497 (8.9)	9 (3.0)	537 (31.2)
Belgium (Flemish)		62 (3.5)	542 (4.3)	12 (2.5)	532 (15.7)	26 (3.8)	534 (9.0)
Hong Kong, SAR		72 (3.4)	576 (5.1)	27 (3.5)	611 (6.1)	1 (0.8)	~ ~
Hungary		86 (2.5)	531 (3.8)	12 (2.6)	513 (6.5)	2 (1.0)	~ ~
Italy		48 (4.2)	492 (3.8)	43 (4.1)	475 (5.8)	9 (2.0)	475 (7.9)
Japan		89 (2.2)	571 (2.3)	10 (2.2)	561 (6.0)	1 (1.0)	~ ~
Netherlands		95 (1.8)	537 (4.3)	2 (1.1)	~ ~	3 (1.4)	536 (35.1)
New Zealand		72 (4.4)	495 (5.3)	17 (3.4)	487 (11.4)	10 (3.1)	530 (15.3)
Scotland		99 (1.1)	502 (4.2)	1 (1.1)	~ ~	0 (0.0)	~ ~
Singapore		85 (1.9)	607 (3.9)	4 (1.1)	577 (8.7)	11 (1.6)	603 (12.4)
United States		55 (3.3)	516 (4.2)	31 (3.1)	487 (5.7)	14 (2.0)	521 (11.0)
¶ England	s	97 (2.0)	509 (6.6)	3 (2.0)	392 (33.1)	0 (0.0)	~ ~
International Avg.		56 (0.5)	472 (0.9)	32 (0.5)	463 (1.4)	12 (0.4)	464 (2.8)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries	Percentage of Students Taught by Teachers Reporting Textbook Use		
	Do Not Use Textbook to Teach Mathematics	Use Textbook to Teach Mathematics	
		As Primary Basis for Lessons	As Supplementary Resource
Australia	5 (1.8)	52 (4.5)	43 (4.2)
Belgium (Flemish)	10 (2.3)	64 (3.5)	26 (2.8)
Hong Kong, SAR	0 (0.3)	83 (3.6)	17 (3.5)
Hungary	1 (0.4)	60 (3.6)	40 (3.6)
Italy	4 (1.2)	34 (3.8)	62 (3.9)
Japan	2 (1.2)	76 (3.7)	22 (3.8)
Netherlands	0 (0.0)	99 (1.2)	1 (1.2)
New Zealand	4 (2.4)	44 (5.6)	52 (5.5)
Scotland	4 (1.8)	80 (3.7)	16 (3.2)
Singapore	0 (0.0)	74 (2.3)	26 (2.3)
United States	3 (0.9)	64 (3.0)	33 (3.0)
¶ England r	14 (4.0)	46 (6.6)	40 (7.0)
International Avg.	3 (0.2)	65 (0.6)	32 (0.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

intake increased, so mathematics scores decreased. Interestingly, this factor was also a negative predictor of students' attainment in science even though, in most cases, the mathematics teachers would not have also taught the students for science, and students were likely to be placed in different sets for each subject. This suggests that attainment is not simply an outcome of the interaction between teacher and pupil, but that interactions in one area of school life can impact on others. This reinforces the importance of pupil attitude in learning, as highlighted in Section 7.

The extent to which grade 8 science teachers felt that their students' backgrounds, abilities, needs and attitudes were a limiting factor was also predictive of students' science scores, though the effect was weaker than that observed for mathematics.

A further relevant factor for grade 8 mathematics was that encompassing the range and number of students in a class and shortages of equipment. This factor was a positive predictor of mathematics achievement. In other words, as the extent to which mathematics teachers regarded these matters as limiting their teaching increased, pupils' attainment increased. It is difficult to explain this finding. It is possible that able students are taught in larger groups than less able pupils, which may impact on the finding, and perhaps that resources are targeted at the less able at the expense of the more able. As with many of the outcomes of this analysis, the absence of prior attainment data makes it difficult to interpret some of the findings.

Activities in the classroom

Classroom activities were also shown by the modelling process to be related to test performance. At grade 8, the factor labelled Relevance, presentation, homework and tests was a negative predictor of attainment in both mathematics and science. This factor was derived from students' responses to statements about the frequency with which their lessons made links between lesson content and daily life, and the frequency with which they worked with other pupils in mathematics, made presentations to the class, started their homework in class, checked their science homework, and had a test. It is difficult to interpret this finding, although it may relate to the findings reported in Section 7 about the difference between pupils' and teachers' perceptions of classroom activities and the relevance of science and mathematics to students' lives. It is also possible that students do not perceive some of the activities included in this factor as 'learning activities' and this may impact on what they gain from their lessons.

Interestingly, another factor, derived from the same set of questions about classroom activities, showed a positive relationship with performance in both subjects. This factor, Class and individual activities in mathematics and science, comprised responses to statements about listening while the teacher teaches the

Exhibit 8.39	Computer Use in Mathematics Class	8th grade Mathematics	TIMSS 2003

Countries	National Curriculum Contains Policies / Statements About the Use of Computers	Percentage of Students Whose Teachers Reported that Computers are Not Available	Percentage of Students Whose Teachers Reported on Computer Use About Half of the Lessons or More			
			Discovering Principles and Concepts	Practicing Skills and Procedures	Looking up Ideas and Information	Processing and Analyzing Data
Australia	●	46 (4.2)	0 (0.4)	1 (0.4)	1 (0.6)	0 (0.0)
Belgium (Flemish)	●	52 (3.8)	1 (1.0)	1 (0.9)	1 (0.9)	1 (0.8)
Hong Kong, SAR	o	61 (4.3)	0 (0.4)	0 (0.0)	1 (0.9)	3 (1.5)
Hungary	●	73 (3.5)	1 (0.7)	1 (1.0)	1 (0.7)	1 (0.7)
Italy	o	68 (3.6)	0 (0.3)	1 (0.6)	0 (0.0)	1 (0.8)
Japan	●	14 (3.2)	2 (1.2)	1 (0.9)	1 (1.0)	1 (0.7)
Netherlands	●	70 (4.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
New Zealand	●	29 (4.6)	1 (0.3)	0 (0.3)	1 (0.6)	1 (0.6)
Scotland	●	60 (4.8)	2 (1.0)	2 (1.0)	0 (0.0)	0 (0.0)
Singapore	●	33 (2.7)	3 (1.0)	4 (1.0)	3 (0.9)	3 (0.8)
United States	o	54 (3.0)	2 (0.7)	4 (1.0)	3 (1.0)	2 (0.7)
¶ England	●	r 34 (6.6)	r 1 (0.8)	r 5 (2.9)	r 2 (1.4)	r 1 (1.3)
International Avg.		68 (0.5)	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.2)

● Yes

o No

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by National Research Coordinators and by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

Exhibit 8.40

Emphasis on Calculators in Mathematics Class

8th grade Mathematics — TIMSS 2003

Countries	National Curriculum Contains Policies / Statements About the Use of Calculators	Percentage of Students Whose Teachers Reported that Calculators are Not Permitted	Percentage of Students Whose Teachers Reported on Calculator Use About Half of the Lessons or More			
			Checking Answers	Doing Routine Computations	Solving Complex Problems	Exploring Number Concepts
Australia	●	4 (2.2)	62 (4.5)	74 (4.1)	56 (4.7)	25 (3.6)
Belgium (Flemish)	●	3 (1.4)	32 (3.6)	27 (3.1)	61 (3.8)	18 (2.8)
Hong Kong, SAR	o	2 (1.1)	49 (4.4)	66 (4.4)	50 (4.6)	13 (3.1)
Hungary	●	19 (3.1)	29 (3.7)	23 (3.4)	33 (3.9)	9 (2.3)
Italy	●	16 (2.9)	40 (4.2)	45 (3.9)	55 (4.0)	11 (2.3)
Japan	●	37 (4.1)	0 (0.0)	2 (1.2)	1 (0.9)	3 (1.6)
Netherlands	●	0 (0.0)	72 (4.3)	94 (2.3)	75 (4.1)	42 (4.8)
New Zealand	●	4 (2.5)	60 (4.8)	77 (3.2)	64 (5.4)	42 (4.5)
Scotland	●	2 (1.4)	11 (2.3)	22 (3.8)	37 (5.2)	12 (3.2)
Singapore	●	0 (0.0)	63 (2.4)	63 (2.1)	65 (2.5)	32 (2.2)
United States	●	6 (1.4)	55 (3.1)	52 (2.6)	69 (2.7)	48 (3.0)
¶ England	●	r 0 (0.0)	r 42 (6.7)	r 35 (5.4)	r 51 (6.3)	r 16 (4.1)
International Avg.		23 (0.5)	27 (0.5)	29 (0.5)	31 (0.5)	14 (0.4)

● Yes

o No

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by National Research Coordinators and by teachers.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

An “r” indicates data are available for at least 70 but less than 85% of the students.

whole class, working individually in lessons, checking mathematics homework, explaining answers and deciding on procedures for complex problems. It was related positively to all areas of science attainment, and to all but two areas (fractions/numbers and geometry) of mathematics. Some of these activities may be perceived by students to be more engaging than some of those listed in the previous paragraph. Nevertheless, there is some overlap between the two factors, in that some of the mathematics statements are in one factor, while the equivalent statement for science is included with the other. This makes a clear interpretation difficult.

Classroom activities were also implicated at grade 4. The Lecture and exercise mode of working variable comprised pupils' responses to two statements for mathematics and the same two statements for science: I listen to the teacher talk, and I work by myself to answer questions. This factor was a positive predictor of attainment in both science and mathematics: when the frequency of this way of working in mathematics and science was higher, attainment was higher. As was noted earlier, however, it is not clear whether this way of working caused the higher attainment, whether previous higher attainment determined the method of teaching, or whether a third variable caused the effect. Access to previous attainment data would be needed in order to establish this.

Pupils' estimates of the time spent on different activities were also predictors of attainment. As the perceived frequency with which they engaged in mathematical activities other than practising computation increased, their mathematics scores in all areas decreased. The activities in question were: working on fractions and decimals; measuring things; and data-handling and shape activities. Conversely, as the frequency of time pupils reported spending on practising computation increased, so their mathematics scores in all areas but one (geometry) increased. These two factors had the same predictive effects on attainment in all areas of science.

As was discussed earlier in Section 8, pupils at grade 4 are likely to have a less well developed sense of time than do their teachers, and this may have distorted their answers to some extent. It may also be the case that the same event may simply be perceived differently by different participants. Even so, their perceptions of classroom activities are valid from their point of view and, therefore, deserve consideration. In Section 7, it was reported that the practice of computation was a positive predictor of confidence in and enjoyment of mathematics, and that time spent on activities other than computation was also a positive predictor of enjoyment of mathematics, though not of confidence in it. The importance of a balance in the breadth and depth of the curriculum was considered, and it may be that this balance is also relevant to the role of these two factors in predicting pupils' attainment in mathematics and science.

A similar cross-subject relationship was found in terms of investigation and explanation in science at grade 4. This factor was derived from pupils' reports of the frequency with which they made scientific observations, watched or carried out investigative activities, planned their own investigations, worked with other children on investigations, and gave explanations of scientific phenomena. As the reported time on such activities increased, so did achievement in all areas of science and achievement in mathematics, with the one exception of the area of algebra (patterns and relationships). As reported in Section 7, this factor was also a predictor of enjoyment and confidence in science at both grades. This suggests that it might be important to ensure that pupils not only have, but also perceive that they have, sufficient access to such activities to maximise any potential gains in terms of achievement. Such a conclusion assumes that the perception of time spent on practical science activities causes the higher attainment. As noted before, the causal relationship may be otherwise, and this should be borne in mind.

The school climate

Pupil perception was also key in terms of safety at school at grade 4. As pupils' reports of problems at school (such as being hit or hurt, being made to do things they did not want to do, or being made fun of) increased, their scores in both subjects decreased. As discussed in section 8.3, the fact that this finding occurred consistently at grade 4 but not at grade 8 probably reflects the greater social maturity of the older students. This may imply that further attention needs to be given to social and emotional development at the primary school level, as pupils' perceptions of their personal safety are clearly related to their attainment.

School climate also featured as a significant variable in the model. Pupils' perceptions of school climate (as measured by the extent to which they like being at school, and their perceptions of the attitudes of the teachers and other pupils) were a negative predictor of attainment in mathematics at grade 4. The more positive pupils were about school climate, the less well they performed in mathematics; the less positive they were, the better they performed. This was also true for one area of science (physics). These findings seem counter-intuitive. However, as stated before, the modelling analysis cannot assign causality to any given finding, and this may be an example of causality operating in the opposite direction from that expected. For example, it may be that the more able pupils are more perceptive about or more critical of their schools.

Factors relating to school climate at grade 4 were also derived from teachers' and headteachers' ratings of school climate. As reported earlier in Section 8, the perceptions of the two groups differed. Interestingly, the factors derived from the teachers' responses were not generally significant in the model, whereas some of those derived from the headteachers' responses were. The first of these was headteachers' ratings of teachers in relation to the school climate. The more positive the headteachers' views of the school's teachers (in terms of job satisfaction, understanding of the school's goals, success in implementing the curriculum, and expectations of pupils), the less well the pupils performed in all areas of mathematics and all but one area (life science) of science. Similarly, if headteachers' ratings of the infrastructure of the school (its buildings, heating/cooling and lighting systems and budget for supplies) were positive, attainment in science at grade 4 was lower. These, again, seem to be counter-intuitive findings and cannot easily be explained.

8.6 The curriculum in England

A feature of schools not so far considered is the curriculum. This is also examined at country level in TIMSS, and the international report contains a wealth of information on the curriculum in the participating countries (Section 4). There are two aspects examined, the intended curriculum and the implemented curriculum. The intended curriculum was established by questionnaires completed by the relevant authority in each country. In the case of England this was Qualifications and Curriculum Authority (QCA). Information on the implemented curriculum in each class tested was obtained via teacher questionnaires.

In England, the percentage of topics intended to be taught to all or almost all students was very high for both subjects at both grade levels. The same was true for the average percentages of students reported by teachers to have been taught the topics assessed in TIMSS. For virtually all the measures shown England exceeded both the international average and the average for the comparison group countries.

Since these values are so high for England, showing little in the way of interesting variation, only summary information is given here in exhibits 8.41 to 8.44. These also show the percentages for the comparison group countries. Ratings which suggest that large numbers of the TIMSS topics are not intended to be taught to grade 4, or have not been taught to grade 4, do not necessarily match performance levels in the country concerned. Japan, for example, has much lower ratings than England both for the intended and implemented curricula in science and mathematics for grade 4. Japan, however, performed at a similar level to England in science and outscored England in mathematics at this grade. The Netherlands has low ratings relative to its performance level in all four assessments, while in Italy the reverse is the case.

Exhibit 8.41 Curriculum coverage for grade 4 science

Grade 4 Science	Intended Curriculum Percentage of Topics Intended to be taught to:			Implemented Curriculum Average Percentage of Students Taught the Topics			
	All or Almost All Students	Only the Most Able Students	Not in the Curriculum	All Topics	Life Science Topics	Physical Science Topics	Earth Science Topics
Hungary	91	0	9	71	88	61	68
England	**84**	**0**	**16**	**69**	**71**	**74**	**62**
United States	95	2	2	69	74	60	75
Italy	98	0	2	65	72	55	72
Hong Kong	64	16	20	62	62	67	53
New Zealand	57	27	16	62	73	54	60
Australia	55	0	45	58	74	45	57
Singapore	77	0	23	58	65	68	37
Scotland	75	18	7	49	60	44	45
Netherlands	73	9	18	47	65	31	49
Belgium	23	7	70	43	59	30	44
Japan	73	0	27	37	35	46	24
CG Average	**72**	**7**	**21**	**58**	**67**	**53**	**54**
Int Average	**71**	**4**	**25**	**61**	**69**	**56**	**58**

Exhibit 8.42 Curriculum coverage for grade 4 mathematics

Grade 4 Mathematics	Intended Curriculum Percentage of Topics Intended to be taught to:			Implemented Curriculum Average Percentage of Students Taught the Topics					
	All or Almost All Students	Only the Most Able Students	Not in the Curriculum	All Topics	Number Topics	Patterns and Relation-ships	Measure-ment Topics	Geometry Topics	Data Topics
England	**81**	**12**	**7**	**88**	**87**	**80**	**95**	**87**	**89**
Singapore	71	0	29	82	97	87	95	51	90
United States	83	17	0	82	83	89	81	74	90
Belgium	38	31	31	81	93	83	93	62	79
Italy	86	0	14	78	88	73	71	72	83
Australia	74	0	26	77	74	79	89	69	81
New Zealand	69	24	7	77	76	84	85	65	87
Scotland	52	12	36	75	67	84	86	65	86
Hong Kong	52	0	48	73	90	55	84	53	83
Hungary	69	0	31	73	68	92	89	61	74
Japan	69	0	31	54	59	63	80	21	69
Netherlands	43	0	57	54	63	67	78	13	67
CG Average	**66**	**8**	**26**	**75**	**79**	**78**	**86**	**58**	**82**
Int Average	**59**	**9**	**32**	**73**	**77**	**79**	**86**	**55**	**80**

Exhibit 8.43 Curriculum coverage for grade 8 science

Grade 8 Science	Intended Curriculum Percentage of Topics Intended to be taught to: All or Almost All Students	Only the Most Able	Not in the Curriculum
Italy	98	0	2
United States	95	2	2
Hungary	91	0	9
England	**84**	**0**	**16**
Singapore	77	0	23
Scotland	75	18	7
Japan	73	0	27
Netherlands	73	9	18
Hong Kong	64	16	20
New Zealand	57	27	16
Australia	55	0	45
Belgium	23	7	70
CG Average	**72**	**7**	**21**
Int Average	**71**	**4**	**25**

Because the number of science teachers responding to these questions in England was low, the data for pupils being taught particular topics in England is not presented in the international report.

Exhibit 8.44 Curriculum coverage for grade 8 mathematics

Grade 8 Mathematics	Intended Curriculum Percentage of Topics Intended to be taught to:			Implemented Curriculum Average Percentage of Students Taught the Topics					
	All or Almost All Students	Only the Most Able Students	Not in the Curriculum	All Topics	Number Topics	Patterns and Relation-ships	Measure-ment Topics	Geometry Topics	Data Topics
Hungary	82	0	18	85	100	93	98	83	54
England	**89**	**11**	**0**	**83**	**99**	**73**	**84**	**77**	**79**
Singapore	80	9	11	83	100	89	86	82	54
United States	98	2	0	83	100	80	84	72	83
Italy	87	0	13	79	99	62	88	85	50
Hong Kong	82	0	18	77	98	66	86	81	45
New Zealand	76	22	2	75	94	67	80	62	69
Japan	80	0	20	74	98	92	79	75	21
Australia	69	29	2	71	95	61	79	61	57
Netherlands	53	22	24	71	93	71	81	64	43
Scotland	58	29	13	68	93	47	79	56	62
Belgium	80	13	7	62	93	42	69	61	35
CG Average	**78**	**11**	**11**	**76**	**97**	**70**	**83**	**72**	**54**
Int Average	**70**	**6**	**24**	**72**	**95**	**66**	**78**	**69**	**46**

9 The pupils and the home

The pupils are at the centre of the teaching and learning process and any consideration of factors affecting their achievement must include their perspective and information relevant to their progress. The sections above have discussed factors that impact on pupils' attitudes to their learning of mathematics and science, and factors relating to the schools they attend and the staff who teach them. This section explores factors relating to the pupils and their home life and explores the interaction of these with their achievement in TIMSS 2003.

Because the same pupils participated in both the mathematics and science surveys, this section follows a somewhat different pattern from that of previous sections, in that it does not separate mathematics and science. Section 9.1 describes pupil and home factors at grade 4, covering both mathematics and science, while section 9.2 describes relevant factors at grade 8. Section 9.3 summarises the main outcomes from the multilevel modelling analysis at both grades.

9.1 The pupils and the home: grade 4

Pupils taking these tests were drawn from year 5 (grade 4). Their average age was 10.3 years and the majority of them (94 per cent) reported speaking English at home always or almost always (Exhibit 9.1).

Thirty-nine per cent estimated that they have at least one hundred books at home (Exhibit 9.2), while a further third have between 26 and 100 books (other than schoolbooks). Eight per cent of pupils reported having 10 or fewer books at home. While this might seem a surprisingly large percentage, it is not the largest figure in this category among the comparison group countries.

Pupils were also asked about other items they might have at home. Most English pupils have a computer at home (Exhibit 9.3). Indeed, more reported having a computer (91 per cent) than having a study desk (80 per cent). It is not clear whether the percentage owning a computer is really this high, or whether pupils included computer games: the questions specified that they should not include game computers, but it is possible that some did so.

Other resources asked about were a calculator, dictionary, own bedroom, mobile phone and encyclopaedia. The number of books and other resources in the home may be seen as a measure of social status and, while it appears that many of the pupils in the TIMSS sample came from well-resourced homes, other indicators suggest that they are not atypical, when compared with pupils across the country.

Responses to all these questions about resources in the home were combined into a single factor on home resources, which was used in the multilevel modelling analysis (see section 9.3).

Pupils were asked further questions about computers: whether they use them, where and for what purposes. Most (79 per cent) reported using a computer both at school and at home, with a further 11 per cent using one at school but not at home (Exhibit 9.4). A surprising number (eight per cent) said that they used a computer at home but not at school. However, the figure was higher in some other comparison group countries.

Pupils were also asked whether they had received extra tutoring in mathematics or science in the current school year. This referred to extra lessons or tutoring that was not part of the normal school lessons for their class; in other words, extra tutoring whether at or beyond the school setting. Eighteen per cent had received extra tutoring in mathematics at least once or twice a week and a further 31 per cent 'sometimes', while 10 per cent and 28 per cent respectively had received tutoring in science at similar levels of frequency. The frequency of extra tutoring was entered into the multilevel model as a single factor for each subject.

Both pupils and teachers were asked about frequency of homework in mathematics and science. According to their own reports, England's pupils receive less homework than that given in most other comparison group countries and homework tends to be given more frequently in mathematics than in science (Exhibits 9.5 and 9.6). Teachers consider that they emphasise homework less than the pupils seem to believe (Exhibit 9.7 and 9.8). This is a trend repeated across the comparison group countries for science and, to a lesser extent, for mathematics. The differences may be accounted for by differences in estimates of the time the homework should take. As has already been noted, grade 4 pupils have a less well developed sense of time than do their teachers. This may have affected their estimates of how long they spend on homework. It is also possible that some pupils might take longer to complete their homework than their teachers anticipate. This would affect their respective estimates. The teachers' estimates of frequency and amount of homework were used in the multilevel modelling analysis.

9.2 The pupils and the home: grade 8

Pupils taking these tests were drawn from year 9 (grade 8). Their average age was 14.3 years and the majority of them (97 per cent) reported speaking English at home always or almost always (Exhibit 9.9).

Responses about the number of books in the home at grade 8 were similar to those seen at grade 4, with 42 per cent reporting at least 100 books, and 13 per cent of pupils reporting being in homes with 10 or fewer books. Again, the relatively high percentage owning few books is not unusual for comparison group countries (Exhibit 9.10).

Pupils were also asked about other items they might have at home. Most pupils in the sample had a computer at home (Exhibit 9.11). As was the case at grade 4, more reported having a computer (94 per cent) than having a study desk (87 per cent).

Other resources asked about were the same as those asked at grade 4, namely a calculator, dictionary, own bedroom, mobile phone and encyclopaedia. Responses related to these resources in the home were combined into a single resources factor, used in the multilevel modelling analysis (see section 9.3).

The number of books and other resources in the home may be seen as a measure of social status and, while it appears that many of the pupils in the TIMSS sample came from well-resourced homes, other indicators suggest that they are not atypical, when compared with pupils across the country.

Pupils were asked further questions about computers: whether they use them, where and for what purposes. Responses at grade 8 were remarkably similar to those obtained at grade 4. Most pupils (81 per cent) reported using a computer both at school and at home, with a further seven per cent using one at school but not at home (Exhibit 9.12). A surprising number (10 per cent) said that they used a computer at home but not at school. However, as was the case at grade 4, the figure was higher in some other comparison group countries.

Pupils were also asked whether they had received extra tutoring in mathematics or science in the current school year. As was the case at grade 4, this referred to extra lessons or tutoring beyond the normal school lessons for their class; in other words, extra tutoring whether in or out of school. Six per cent of grade 8 students had received extra tutoring in mathematics at least once or twice a week and 15 per cent 'sometimes', while four per cent and 13 per cent respectively had received tutoring in science at similar levels of frequency. These figures are lower than those found at grade 4. The frequency of extra tutoring was entered into the multilevel model as a single factor for each subject.

Exhibit 9.1 | Students Speak Language of the Test at Home

4th grade | TIMSS 2003 | Science

Countries	Always		Almost Always		Sometimes		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	80 (1.7)	525 (4.6)	11 (0.9)	525 (4.9)	8 (1.0)	493 (8.5)	1 (0.2)	~ ~
Belgium (Flemish)	68 (1.4)	525 (1.6)	16 (0.9)	520 (2.7)	12 (1.2)	487 (5.4)	4 (0.5)	500 (6.9)
England	82 (1.3)	544 (3.7)	12 (0.8)	549 (5.8)	5 (0.7)	484 (7.2)	1 (0.2)	~ ~
Hong Kong, SAR	51 (1.3)	558 (3.5)	24 (0.8)	535 (3.3)	21 (1.0)	523 (3.6)	4 (0.4)	495 (5.4)
Hungary	91 (0.6)	531 (2.9)	8 (0.6)	540 (5.7)	1 (0.2)	~ ~	0 (0.1)	~ ~
Italy	88 (0.7)	520 (3.8)	3 (0.3)	494 (10.3)	6 (0.5)	486 (6.7)	2 (0.3)	~ ~
Japan	91 (0.5)	547 (1.5)	8 (0.5)	526 (5.2)	1 (0.2)	~ ~	0 (0.1)	~ ~
Netherlands	75 (1.2)	531 (1.8)	17 (0.9)	518 (4.7)	7 (0.8)	485 (5.0)	1 (0.3)	~ ~
New Zealand	76 (1.0)	529 (2.3)	13 (0.6)	533 (5.6)	11 (0.8)	458 (7.8)	1 (0.2)	~ ~
Scotland	78 (1.3)	506 (3.2)	10 (0.6)	509 (5.3)	9 (0.8)	480 (5.9)	3 (0.4)	450 (10.9)
Singapore	24 (1.2)	592 (6.0)	22 (1.0)	598 (4.5)	47 (1.5)	545 (5.6)	7 (0.6)	512 (8.1)
United States	73 (1.1)	546 (2.4)	13 (0.5)	538 (3.8)	12 (0.8)	482 (4.4)	2 (0.1)	~ ~
International Avg.	67 (0.3)	494 (1.1)	14 (0.2)	493 (1.6)	15 (0.2)	462 (1.8)	5 (0.2)	411 (2.8)

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Exhibit 9.2 Books in the Home

4th grade TIMSS 2003 Science

Countries	More Than 200 Books		101-200 Books		26-100 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	23 (1.3)	542 (4.5)	23 (1.1)	543 (3.7)	34 (1.1)	519 (4.0)
Belgium (Flemish)	11 (0.7)	532 (4.3)	17 (0.7)	532 (2.8)	42 (1.0)	524 (1.8)
England	19 (1.2)	575 (5.8)	20 (1.0)	561 (4.6)	35 (1.2)	542 (3.3)
Hong Kong, SAR	7 (0.6)	557 (5.0)	10 (0.8)	555 (5.7)	28 (1.0)	548 (3.8)
Hungary	18 (1.1)	560 (4.9)	17 (0.8)	549 (4.3)	35 (1.0)	536 (2.8)
Italy	10 (0.8)	525 (4.6)	11 (0.6)	531 (5.2)	27 (0.8)	525 (4.8)
Japan	7 (0.4)	566 (5.6)	14 (0.6)	561 (3.2)	40 (0.9)	553 (2.1)
Netherlands	14 (1.1)	548 (3.9)	18 (1.0)	533 (3.6)	37 (1.2)	529 (2.5)
New Zealand	17 (0.7)	548 (3.8)	21 (0.8)	544 (4.2)	36 (1.0)	526 (3.1)
Scotland	21 (1.1)	523 (5.0)	18 (0.8)	520 (5.3)	31 (1.0)	508 (3.4)
Singapore	10 (0.6)	609 (6.3)	17 (0.9)	595 (5.8)	40 (0.9)	578 (4.7)
United States	15 (0.7)	563 (3.6)	17 (0.5)	568 (3.0)	34 (0.7)	545 (2.4)
International Avg.	12 (0.2)	518 (1.5)	14 (0.2)	507 (1.5)	31 (0.2)	502 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	11-25 Books		0-10 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	13 (0.9)	487 (6.8)	6 (0.8)	464 (10.2)
Belgium (Flemish)	23 (0.9)	506 (2.5)	8 (0.5)	484 (5.2)
England	17 (1.0)	511 (4.5)	8 (0.8)	475 (6.3)
Hong Kong, SAR	30 (0.8)	540 (3.2)	25 (1.4)	533 (4.0)
Hungary	22 (0.9)	506 (4.1)	8 (0.7)	479 (6.2)
Italy	33 (1.0)	511 (4.3)	18 (0.9)	498 (6.8)
Japan	28 (0.8)	529 (2.4)	12 (0.8)	514 (3.6)
Netherlands	21 (1.1)	515 (2.8)	9 (0.8)	486 (5.6)
New Zealand	17 (0.6)	491 (4.9)	9 (0.7)	463 (6.2)
Scotland	20 (1.1)	481 (3.6)	11 (0.7)	462 (6.3)
Singapore	22 (0.9)	538 (4.8)	11 (0.8)	497 (8.6)
United States	22 (0.6)	509 (2.5)	13 (0.6)	491 (3.5)
International Avg.	24 (0.2)	480 (1.1)	18 (0.2)	453 (1.4)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 9.3 Computer and Study Desk/Table in the Home

4th grade Science — TIMSS 2003

Countries	Have Computer		Do Not Have Computer		Have Study Desk/Table		Do Not Have Study Desk/Table	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	92 (0.9)	526 (3.9)	8 (0.9)	478 (8.3)	85 (1.1)	526 (3.5)	15 (1.1)	501 (8.3)
Belgium (Flemish)	90 (0.5)	520 (1.9)	10 (0.5)	505 (3.5)	91 (0.5)	519 (1.9)	9 (0.5)	517 (3.0)
England	91 (0.6)	545 (3.6)	9 (0.6)	508 (6.7)	80 (1.1)	544 (3.7)	20 (1.1)	529 (4.4)
Hong Kong, SAR	85 (1.0)	544 (3.0)	15 (1.0)	537 (4.2)	71 (1.1)	541 (3.2)	29 (1.1)	548 (3.4)
Hungary	71 (1.2)	543 (2.9)	29 (1.2)	510 (4.0)	96 (0.5)	533 (2.8)	4 (0.5)	482 (8.9)
Italy	79 (0.7)	519 (3.5)	21 (0.7)	507 (6.1)	72 (0.9)	523 (3.9)	28 (0.9)	501 (4.6)
Japan	77 (0.8)	548 (1.7)	23 (0.8)	532 (2.7)	94 (0.4)	545 (1.5)	6 (0.4)	530 (5.6)
Netherlands	93 (0.6)	527 (1.8)	7 (0.6)	500 (6.8)	94 (0.5)	526 (1.9)	6 (0.5)	516 (6.9)
New Zealand	87 (0.7)	530 (2.2)	13 (0.7)	483 (5.3)	80 (0.7)	529 (2.3)	20 (0.7)	498 (4.2)
Scotland	89 (0.8)	506 (2.9)	11 (0.8)	488 (5.9)	77 (1.1)	509 (2.9)	23 (1.1)	483 (4.8)
Singapore	89 (0.8)	573 (5.4)	11 (0.8)	511 (5.9)	90 (0.7)	572 (5.3)	10 (0.7)	511 (8.8)
United States	92 (0.4)	541 (2.4)	8 (0.4)	492 (3.9)	77 (0.8)	545 (2.3)	23 (0.8)	511 (4.0)
International Avg.	65 (0.2)	499 (1.2)	35 (0.2)	472 (1.1)	80 (0.2)	496 (1.0)	20 (0.2)	470 (1.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	Use Computer Only at Places Other than Home and School		Do Not Use Computers at All	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	1 (0.2)	~ ~	1 (0.1)	~ ~
England	1 (0.2)	~ ~	1 (0.2)	~ ~
Netherlands	1 (0.2)	~ ~	5 (0.5)	511 (6.3)
Scotland	1 (0.2)	~ ~	1 (0.2)	~ ~
Hong Kong, SAR	1 (0.2)	~ ~	2 (0.3)	~ ~
United States	2 (0.2)	~ ~	2 (0.1)	~ ~
Singapore	2 (0.2)	~ ~	2 (0.2)	~ ~
New Zealand	3 (0.3)	481 (8.7)	2 (0.3)	~ ~
Belgium (Flemish)	1 (0.2)	~ ~	5 (0.4)	504 (5.4)
Japan	2 (0.3)	~ ~	3 (0.4)	526 (6.2)
Italy	8 (0.6)	502 (9.0)	12 (0.7)	511 (7.2)
Hungary	12 (0.8)	504 (5.7)	12 (0.8)	528 (4.8)
International Avg.	9 (0.2)	455 (2.1)	18 (0.3)	458 (1.5)

SOURCE: IEA Trends in International Mathematics anc Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Exhibit 9.4 Use of Computer

4th grade TIMSS 2003 Science

Countries	Use Computer Both at Home and at School		Use Computer at Home but Not at School		Use Computer at School but Not at Home	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	80 (1.6)	531 (3.4)	7 (0.8)	503 (8.4)	11 (1.1)	475 (10.5)
England	79 (1.0)	547 (3.6)	8 (0.6)	533 (7.7)	11 (0.8)	505 (6.1)
Netherlands	79 (2.0)	528 (2.0)	12 (1.7)	524 (3.3)	4 (0.4)	496 (13.6)
Scotland	78 (1.0)	508 (2.8)	8 (0.7)	482 (6.3)	12 (0.7)	484 (5.2)
Hong Kong, SAR	76 (1.3)	547 (3.1)	9 (0.9)	519 (5.2)	11 (0.9)	541 (4.6)
United States	73 (1.2)	547 (2.3)	12 (0.9)	525 (6.5)	11 (0.6)	491 (4.0)
Singapore	71 (1.4)	578 (5.2)	17 (1.0)	551 (6.3)	8 (0.6)	509 (7.7)
New Zealand	71 (1.1)	533 (2.3)	12 (0.8)	511 (5.7)	13 (0.7)	479 (4.6)
Belgium (Flemish)	66 (1.4)	524 (1.9)	21 (1.5)	513 (2.9)	6 (0.6)	508 (4.9)
Japan	54 (1.1)	555 (1.9)	9 (0.7)	537 (4.6)	31 (1.0)	531 (2.5)
Italy	30 (1.8)	524 (4.7)	38 (1.9)	520 (4.8)	12 (1.0)	497 (6.3)
Hungary	24 (2.1)	548 (5.0)	43 (2.1)	536 (3.3)	9 (1.0)	503 (8.1)
International Avg.	43 (0.3)	496 (1.9)	20 (0.3)	492 (1.2)	11 (0.2)	474 (1.9)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Both pupils and teachers were asked about frequency of homework in mathematics and science. According to their own reports, England's pupils receive less homework than that given in many other comparison group countries (Exhibits 9.13 and 9.14).

Whereas, at grade 4, pupils rated their homework load higher than did their teachers, at grade 8, the differences were mainly in the 'high' and 'medium' homework categories. More teachers considered their emphasis on homework to be high than did their pupils. While this at first appears to be a surprising finding, it may be affected by differences in estimates of the time the homework should take. Both teachers and students were asked to say how frequently homework was given (teachers on a three-point scale labelled from 'some lessons' to 'every or almost every lesson' and pupils on a five-point scale labelled from 'every day' to 'never'). Both also reported how many minutes of homework were set, on a five-point scale from 'less than 15 minutes' to 'more than 90 minutes'. The different reported emphases may arise from differences in time taken against time expected to be taken. The teachers' estimates of frequency and amount of homework were used in the multilevel modelling analysis.

While mathematics homework seemed to have a greater emphasis than science homework at grade 4, there was no discernible difference at grade 8 (Exhibits 9.15 and 9.16).

9.3 The pupils and the home: multilevel modelling outcomes

In addition to the educational factors outlined above, personal information about the pupils drawn from their responses to the pupil questionnaires was available. Age was available through pupils' reports of the month and year in which they were born. Pupils' gender was self-reported, as was the frequency of speaking English at home. Pupils also disclosed how many people (including themselves) lived in their home, and whether their mother and father (or female/male guardians) were born in the United Kingdom (defined for pupils as including England, Wales, Scotland and Northern Ireland). Finally, they reported whether they had been born in the United Kingdom and, if not, how old they had been on arrival in the United Kingdom. These variables were entered into the multilevel model alongside the factors discussed earlier.

A final set of variables was derived from the NFER's Register of Schools, which showed the percentage of pupils eligible for free school meals in each of the schools represented in the TIMSS 2003 sample, and the schools' achievement band in terms of key stage 2 or 3 attainment (as appropriate). These variables were also used in the model.

Exhibit 9.5 Index of Time Students Spend Doing Science Homework (TSH) in a Normal School Week

4th grade — TIMSS 2003 Science

Countries	High TSH		Medium TSH		Low TSH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore	11 (0.8)	555 (6.9)	46 (0.9)	564 (6.0)	43 (1.3)	574 (5.2)
Italy	8 (0.5)	488 (7.5)	35 (1.1)	508 (5.1)	57 (1.2)	528 (3.5)
Hong Kong, SAR	7 (0.6)	520 (6.8)	52 (2.0)	547 (3.6)	41 (2.2)	545 (2.9)
United States	4 (0.3)	494 (7.4)	24 (0.9)	526 (4.1)	71 (1.1)	547 (2.4)
Hungary	4 (0.4)	487 (11.9)	30 (1.2)	518 (3.9)	66 (1.4)	544 (2.8)
New Zealand	3 (0.4)	478 (10.7)	31 (1.0)	519 (3.3)	66 (1.1)	531 (2.6)
Belgium (Flemish)	2 (0.3)	~ ~	23 (1.3)	507 (2.9)	75 (1.4)	525 (1.8)
Scotland	2 (0.2)	~ ~	16 (1.0)	494 (5.0)	82 (1.1)	508 (3.1)
Australia	2 (0.3)	~ ~	20 (1.2)	522 (7.7)	78 (1.3)	527 (3.9)
England	2 (0.2)	~ ~	26 (1.8)	551 (6.7)	73 (1.9)	544 (3.5)
Japan	1 (0.2)	~ ~	16 (1.1)	534 (3.3)	82 (1.1)	546 (1.7)
Netherlands	1 (0.2)	~ ~	8 (0.9)	506 (5.3)	92 (0.9)	528 (2.1)
International Avg.	6 (0.1)	458 (1.8)	33 (0.3)	485 (1.1)	61 (0.3)	500 (1.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in

A tilde (~) indicates insufficient data to report achievement.

Exhibit 9.6 Index of Time Students Spend Doing Mathematics Homework (TMH) in a Normal School Week

Countries	High TMH		Medium TMH		Low TMH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore	40 (1.5)	604 (6.0)	49 (1.3)	595 (5.8)	11 (0.6)	575 (7.2)
Hong Kong, SAR	24 (1.0)	575 (3.8)	71 (0.9)	580 (3.2)	5 (0.5)	530 (5.6)
Italy	24 (1.1)	496 (5.2)	52 (1.1)	504 (4.5)	24 (1.6)	512 (3.6)
Hungary	17 (0.9)	515 (4.9)	78 (1.1)	538 (3.1)	5 (0.9)	535 (10.6)
United States	12 (0.6)	504 (4.0)	63 (1.3)	524 (2.7)	25 (1.5)	520 (3.5)
Belgium (Flemish)	9 (0.7)	538 (3.9)	48 (1.7)	549 (2.7)	43 (2.0)	557 (2.0)
Japan	8 (0.6)	543 (4.6)	57 (1.8)	568 (2.3)	35 (2.1)	565 (2.7)
New Zealand	7 (0.4)	489 (6.7)	41 (1.1)	491 (3.3)	52 (1.3)	504 (3.1)
Australia	7 (0.8)	486 (13.0)	43 (2.1)	500 (4.6)	50 (2.1)	505 (4.4)
Scotland	6 (0.8)	477 (6.8)	40 (2.0)	488 (4.2)	54 (2.2)	498 (3.4)
England	4 (0.6)	489 (14.3)	37 (1.8)	531 (4.8)	59 (1.9)	540 (4.2)
Netherlands	1 (0.2)	~ ~	10 (0.8)	508 (6.6)	89 (0.9)	546 (1.8)
International Avg.	18 (0.2)	489 (1.4)	56 (0.3)	500 (0.9)	26 (0.3)	494 (1.6)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Index of Teachers' Emphasis on Science Homework (ESH)

Countries		High ESH		Medium ESH		Low ESH	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Italy		24 (3.1)	517 (7.8)	34 (2.9)	508 (6.7)	42 (3.7)	521 (5.1)
Singapore		13 (2.9)	564 (9.4)	25 (3.3)	566 (9.6)	62 (4.2)	565 (7.6)
England	r	2 (1.4)	~ ~	13 (3.8)	531 (13.9)	85 (4.0)	541 (4.4)
New Zealand	r	1 (0.6)	~ ~	3 (1.0)	535 (22.5)	95 (1.1)	522 (2.9)
Belgium (Flemish)		1 (0.9)	~ ~	4 (1.7)	523 (10.1)	95 (1.9)	518 (1.9)
United States	r	1 (0.7)	~ ~	12 (2.1)	542 (7.5)	86 (2.2)	536 (3.1)
Hong Kong, SAR	r	1 (0.9)	~ ~	35 (4.6)	538 (5.8)	64 (4.7)	544 (3.7)
Hungary		1 (0.7)	~ ~	63 (4.5)	530 (4.4)	36 (4.4)	523 (5.8)
Netherlands		0 (0.4)	~ ~	8 (2.9)	531 (10.8)	92 (2.9)	525 (2.1)
Australia	r	0 (0.4)	~ ~	5 (1.4)	525 (12.6)	95 (1.4)	524 (3.7)
Japan		0 (0.0)	~ ~	8 (2.4)	546 (6.3)	92 (2.4)	543 (1.5)
Scotland	s	0 (0.0)	~ ~	4 (1.8)	494 (16.9)	96 (1.8)	508 (3.5)
International Avg.		6 (0.4)	466 (4.0)	25 (0.7)	497 (2.4)	69 (0.7)	495 (1.5)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insuffcient data to report achievement.

An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Countries		High EMH		Medium EMH		Low EMH	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Singapore		35 (4.2)	593 (7.7)	49 (3.8)	596 (8.7)	16 (2.8)	598 (11.0)
Hong Kong, SAR		33 (4.7)	575 (5.3)	63 (4.7)	577 (4.1)	4 (1.7)	552 (8.9)
Italy		33 (3.4)	498 (7.0)	33 (3.7)	501 (7.1)	34 (3.5)	509 (4.6)
United States		8 (1.3)	503 (8.8)	68 (2.8)	521 (2.8)	25 (2.8)	518 (5.6)
Hungary		7 (2.3)	499 (15.2)	88 (2.8)	529 (3.7)	4 (1.7)	547 (11.7)
England	r	5 (2.5)	483 (25.2)	13 (3.2)	553 (10.7)	82 (4.0)	531 (4.4)
Australia		4 (1.3)	520 (12.7)	26 (4.0)	504 (9.4)	70 (4.1)	498 (4.6)
Japan		3 (1.5)	563 (7.9)	40 (4.3)	567 (2.4)	57 (4.4)	563 (2.5)
Belgium (Flemish)		2 (1.0)	~ ~	10 (2.4)	544 (4.4)	88 (2.6)	551 (2.0)
Scotland	s	1 (0.6)	~ ~	20 (4.3)	503 (6.1)	80 (4.4)	491 (4.3)
New Zealand		1 (0.4)	~ ~	11 (2.4)	500 (10.7)	88 (2.5)	494 (2.7)
Netherlands		0 (0.0)	~ ~	2 (1.4)	~ ~	98 (1.4)	542 (2.4)
International Avg.		14 (0.6)	491 (2.7)	49 (0.7)	503 (1.4)	37 (0.6)	498 (2.1)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates data are available for at least 70 but less than 85% of the students. An "s" indicates data are available for at least 50 but less than 70% of the students.

Three factors were significant across both grades and for both subjects: resources in the home, extra tutoring and country of birth. It should be remembered that, as discussed in previous sections, multilevel models cannot indicate the direction of causality of any effects identified as significant. They can only state that, from the numerical value of one factor, a prediction of the value of another factor can be estimated. They cannot account for whether the first factor causes the second, for whether the reverse is true, or whether a third factor causes the effect.

Pupils' reports of the resources available to them at home (including books, study facilities and personal items such as a mobile phone), were a positive indicator of achievement in all four areas. Where pupils had more resources, their scores were higher. As was noted in Section 7, resources at home were also related to levels of confidence and enjoyment in both subjects, particularly at grade 4.

Pupils who reported receiving extra lessons or tutoring that was not part of the normal school lessons for their class (that is, extra tutoring either in or out of school) performed less well. This finding held across both grades and both subjects. This may, at first, appear to be a surprising finding, since it might be expected that pupils who receive extra lessons would achieve more highly. However, extra lessons are most likely to be provided for pupils who experience difficulty with a subject, and this probably explains the lower achievement. It is possible that such tutoring does improve the scores of such pupils. However, without access to measures of prior attainment, it is not possible to say this with certainty, or to quantify any such gains.

Pupils born outside the UK tended to achieve a lower score than those born in the UK. This was true of mathematics and science scores overall, and also true of all separate areas measured, with the exception of chemistry at grade 8. Although some of these pupils may have come to the UK prior to reaching the age at which they would be expected to start school, some would have joined schools in England at a later date, and the resulting disruption to their education may be influencing performance.

Many of these pupils are likely to also speak a language other than English as their first language. However, since language was entered into the model as a separate variable, its effects can be regarded as not impacting on the 'country of birth' finding. In fact, language was a significant variable for science attainment at both grades, but had less impact on mathematics. Pupils who reported never or only sometimes speaking English at home performed less well on science overall at both grades. At grade 4, the effect was found for life science and physics, but not for earth science; at grade 8, for all areas apart from chemistry and environmental science. In mathematics, isolated negative effects were found for data-handling at both grades and measurement at grade 4. There were no effects on mathematics or science scores overall.

Exhibit 9.9	Students Speak Language of the Test at Home	8th grade	TIMSS 2003 Science

Countries	Always		Almost Always		Sometimes		Never	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	80 (2.3)	529 (3.5)	12 (1.1)	524 (8.8)	7 (1.3)	521 (13.2)	1 (0.4)	~ ~
Belgium (Flemish)	77 (1.3)	526 (2.2)	11 (0.6)	506 (6.1)	9 (0.8)	459 (9.2)	4 (0.6)	489 (8.7)
Hong Kong, SAR	77 (0.8)	565 (2.6)	15 (0.6)	535 (5.6)	7 (0.5)	520 (7.6)	1 (0.2)	~ ~
Hungary	95 (0.4)	543 (2.8)	4 (0.4)	548 (9.2)	0 (0.1)	~ ~	0 (0.1)	~ ~
Italy	94 (0.5)	493 (3.0)	3 (0.3)	475 (8.0)	3 (0.3)	428 (8.5)	1 (0.2)	~ ~
Japan	94 (0.4)	554 (1.7)	4 (0.3)	533 (5.8)	1 (0.2)	~ ~	0 (0.1)	~ ~
Netherlands	83 (1.3)	541 (3.1)	12 (1.0)	517 (6.7)	4 (0.5)	488 (11.8)	1 (0.2)	~ ~
New Zealand	80 (1.3)	525 (5.1)	12 (0.8)	508 (6.9)	6 (0.8)	495 (11.7)	1 (0.3)	~ ~
Scotland	92 (0.6)	513 (3.3)	5 (0.5)	532 (8.7)	3 (0.3)	464 (10.3)	1 (0.2)	~ ~
Singapore	23 (0.6)	613 (3.9)	19 (0.6)	602 (3.9)	49 (0.8)	557 (5.1)	8 (0.4)	545 (6.7)
United States	83 (0.9)	533 (2.9)	10 (0.5)	516 (5.5)	5 (0.4)	472 (7.0)	1 (0.2)	~ ~
¶ England	87 (1.6)	547 (4.5)	10 (1.3)	540 (7.2)	2 (0.6)	~ ~	1 (0.2)	~ ~
International Avg.	68 (0.2)	482 (0.8)	11 (0.1)	483 (1.0)	17 (0.1)	442 (1.5)	4 (0.1)	389 (2.4)

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Countries	More Than 200 Books		101-200 Books		26-100 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	31 (1.4)	553 (4.1)	23 (0.8)	540 (3.4)	30 (1.0)	517 (4.8)
Belgium (Flemish)	12 (0.6)	539 (4.0)	15 (0.6)	538 (2.6)	34 (0.9)	524 (2.7)
Hong Kong, SAR	9 (0.6)	576 (5.6)	8 (0.4)	574 (4.2)	27 (0.6)	565 (3.0)
Hungary	31 (1.2)	578 (3.2)	22 (0.7)	551 (3.5)	29 (1.0)	531 (3.1)
Italy	19 (0.9)	524 (4.2)	14 (0.6)	502 (4.7)	25 (0.7)	497 (3.8)
Japan	17 (0.7)	584 (3.2)	17 (0.5)	567 (2.9)	32 (0.8)	552 (2.3)
Netherlands	21 (1.4)	567 (4.4)	19 (0.9)	556 (3.8)	31 (1.3)	535 (3.2)
New Zealand	25 (1.5)	556 (7.4)	22 (1.1)	537 (4.4)	31 (1.0)	512 (4.5)
Scotland	17 (1.0)	564 (4.8)	16 (0.7)	541 (4.3)	29 (0.8)	516 (3.6)
Singapore	14 (0.5)	631 (4.1)	16 (0.5)	607 (4.2)	33 (0.7)	589 (3.7)
United States	24 (0.9)	569 (3.6)	18 (0.5)	552 (3.4)	28 (0.6)	527 (2.9)
¶ England	24 (1.1)	588 (5.7)	18 (1.0)	564 (6.5)	27 (1.0)	541 (4.4)
International Avg.	15 (0.1)	506 (1.0)	13 (0.1)	498 (1.0)	27 (0.1)	483 (0.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries	11-25 Books		0-10 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	11 (0.8)	493 (5.8)	5 (0.5)	464 (8.7)
Belgium (Flemish)	25 (0.8)	503 (4.0)	14 (0.7)	477 (5.7)
Hong Kong, SAR	28 (0.7)	555 (3.6)	28 (0.7)	538 (4.2)
Hungary	13 (0.6)	499 (4.5)	5 (0.7)	466 (7.7)
Italy	29 (0.7)	474 (4.0)	13 (0.7)	457 (5.5)
Japan	22 (0.6)	539 (2.4)	13 (0.7)	517 (3.3)
Netherlands	19 (1.2)	508 (5.3)	10 (0.8)	492 (5.7)
New Zealand	14 (0.8)	490 (4.4)	8 (0.7)	453 (7.8)
Scotland	21 (1.0)	480 (3.3)	16 (0.9)	460 (4.8)
Singapore	24 (0.7)	546 (6.1)	12 (0.7)	508 (6.9)
United States	18 (0.6)	493 (3.3)	13 (0.6)	469 (4.6)
¶ England	17 (0.9)	520 (4.8)	13 (1.1)	487 (5.0)
International Avg.	26 (0.1)	458 (0.7)	18 (0.1)	438 (1.0)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 9.11 Computer and Study Desk/Table in the Home

8th grade Science | TIMSS 2003

Countries	Have Computer		Do Not Have Computer		Have Study Desk/Table		Do Not Have Study Desk/Table	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Australia	96 (0.3)	530 (3.7)	4 (0.3)	480 (7.8)	92 (0.5)	529 (3.9)	8 (0.5)	511 (6.5)
Belgium (Flemish)	95 (0.5)	519 (2.4)	5 (0.5)	457 (10.0)	95 (0.4)	518 (2.4)	5 (0.4)	485 (6.5)
Hong Kong, SAR	97 (0.3)	557 (2.9)	3 (0.3)	535 (9.2)	75 (0.8)	558 (3.0)	25 (0.8)	553 (4.2)
Hungary	75 (1.0)	554 (2.7)	25 (1.0)	512 (4.4)	98 (0.3)	544 (2.8)	2 (0.3)	~ ~
Italy	84 (0.7)	497 (3.0)	16 (0.7)	463 (6.0)	88 (0.6)	493 (3.1)	12 (0.6)	477 (4.7)
Japan	82 (0.8)	558 (1.7)	18 (0.8)	529 (3.2)	96 (0.3)	554 (1.7)	4 (0.3)	526 (6.5)
Netherlands	98 (0.3)	537 (3.1)	2 (0.3)	~ ~	99 (0.2)	537 (3.2)	1 (0.2)	~ ~
New Zealand	91 (0.7)	524 (5.2)	9 (0.7)	489 (5.8)	87 (0.8)	525 (5.1)	13 (0.8)	489 (7.3)
Scotland	91 (0.7)	516 (3.4)	9 (0.7)	475 (5.6)	82 (0.8)	517 (3.4)	18 (0.8)	489 (5.0)
Singapore	94 (0.4)	583 (4.0)	6 (0.4)	498 (9.4)	91 (0.5)	582 (4.1)	9 (0.5)	536 (7.8)
United States	93 (0.4)	532 (3.1)	7 (0.4)	471 (5.6)	86 (0.5)	533 (3.1)	14 (0.5)	496 (4.2)
¶ England	94 (0.5)	548 (4.5)	6 (0.5)	509 (7.5)	87 (1.0)	550 (4.4)	13 (1.0)	517 (6.4)
International Avg.	60 (0.2)	484 (0.7)	40 (0.2)	449 (0.9)	83 (0.1)	480 (0.6)	17 (0.1)	446 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Exhibit 9.12 Use of Computer

Countries	Use Computer Only at Places Other than Home and School		Do Not Use Computers at All	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Hong Kong, SAR	0 (0.1)	~ ~	0 (0.1)	~ ~
Australia	1 (0.1)	~ ~	1 (0.2)	~ ~
Singapore	1 (0.1)	~ ~	1 (0.1)	~ ~
United States	1 (0.1)	~ ~	1 (0.1)	~ ~
Netherlands	0 (0.1)	~ ~	2 (0.3)	~ ~
Scotland	1 (0.2)	~ ~	1 (0.2)	~ ~
New Zealand	2 (0.3)	~ ~	2 (0.3)	~ ~
Belgium (Flemish)	5 (0.3)	501 (7.6)	1 (0.2)	~ ~
Hungary	2 (0.4)	~ ~	3 (0.4)	516 (8.1)
Japan	1 (0.2)	~ ~	2 (0.2)	~ ~
Italy	5 (0.4)	457 (8.7)	9 (0.5)	460 (6.2)
¶ England	1 (0.2)	~ ~	1 (0.2)	~ ~
International Avg.	10 (0.1)	434 (1.1)	14 (0.2)	432 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

Countries	Use Computer Only at Places Other than Home and School		Do Not Use Computers at All	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Hong Kong, SAR	0 (0.1)	~ ~	0 (0.1)	~ ~
Australia	1 (0.1)	~ ~	1 (0.2)	~ ~
Singapore	1 (0.1)	~ ~	1 (0.1)	~ ~
United States	1 (0.1)	~ ~	1 (0.1)	~ ~
Netherlands	0 (0.1)	~ ~	2 (0.3)	~ ~
Scotland	1 (0.2)	~ ~	1 (0.2)	~ ~
New Zealand	2 (0.3)	~ ~	2 (0.3)	~ ~
Belgium (Flemish)	5 (0.3)	501 (7.6)	1 (0.2)	~ ~
Hungary	2 (0.4)	~ ~	3 (0.4)	516 (8.1)
Japan	1 (0.2)	~ ~	2 (0.2)	~ ~
Italy	5 (0.4)	457 (8.7)	9 (0.5)	460 (6.2)
¶ England	1 (0.2)	~ ~	1 (0.2)	~ ~
International Avg.	10 (0.1)	434 (1.1)	14 (0.2)	432 (1.2)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

A tilde (~) indicates insufficient data to report achievement.

It is interesting to note, as reported in Section 7, that pupils at grade 4 who never or sometimes spoke English at home, said that they enjoyed mathematics more and showed more enjoyment and confidence in science than did their peers who spoke English more often. The same was true at grade 8 for enjoyment of mathematics. This enjoyment does not appear to translate into achievement for these pupils.

Also interesting is the fact that age was a positive predictor of attainment at grade 4 but not at grade 8. Thus, at grade 4, older pupils achieved a higher score than younger pupils in both subjects. Age was also a positive predictor of confidence in mathematics and science at grade 4. All these effects had disappeared four years further on in the school system.

Likewise, computer use was a significant predictor of achievement at grade 4 only; this variable, however, was a negative predictor. The more frequently pupils used a computer for looking up ideas and information for mathematics or science, or for working on a school project, the less well they performed. It is possible that computer use is having a detrimental effect. However, it is perhaps more likely that the weaker pupils are given more opportunities to use computers to practise basic skills or to aid motivation. As was reported in Section 7, computer use was positively associated with enjoyment and confidence in science, and enjoyment in mathematics. The link with achievement probably arises from teachers harnessing this enjoyment to keep less able pupils motivated.

Finally, homework was a significant positive predictor of attainment at grade 8. As the frequency of science homework (as reported by teachers) increased, so did students' attainment in science. The amount of homework was not a significant factor, however. The frequency of mathematics homework was also a positive predictor of attainment in all areas of science.

Homework was also a predictor for mathematics at grade 8. Frequency of homework in mathematics impacted positively on overall mathematics score, and on all areas apart from data analysis and probability. Once again, the amount of homework was not a significant factor.

Based on these findings, it would be easy to assume that higher scores follow from more frequent homework. However, an alternative interpretation is that more able pupils might be set homework more frequently. Care must be taken in interpreting this finding. It is worth noting also that frequency and amount of homework were not significantly related to enjoyment or confidence in either subject.

Exhibit 9.13	Index of Time Students Spend Doing Science Homework (TSH) in a Normal School Week	8th grade Science	TIMSS 2003

Index of Time Students Spend Doing Science Homework

Index based on students' reports on the frequency and amount of science homework they are given. High level indicates more than 30 minutes of science homework assigned 3-4 times a week. Low level indicates no more than 30 minutes of science homework no more than twice a week. Medium level includes all other possible combinations of responses.

Countries	High TSH		Medium TSH		Low TSH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
General/ Integrated Science						
Singapore	18 (0.7)	595 (4.1)	48 (0.7)	585 (4.4)	34 (0.9)	564 (5.5)
Italy	14 (1.0)	489 (5.9)	41 (1.1)	487 (3.7)	45 (1.4)	496 (3.7)
United States	13 (0.7)	519 (4.3)	43 (1.4)	530 (3.4)	45 (1.7)	531 (3.7)
New Zealand	10 (1.3)	519 (6.2)	41 (1.6)	531 (6.9)	48 (2.0)	518 (5.1)
¶ England						
Australia	9 (0.8)	520 (6.4)	35 (1.6)	530 (3.3)	56 (2.0)	530 (4.4)
Hong Kong, SAR	6 (0.5)	548 (4.6)	43 (1.4)	563 (2.9)	50 (1.4)	554 (3.9)
Scotland	3 (0.4)	487 (14.2)	27 (1.4)	508 (5.0)	71 (1.5)	517 (3.4)
Japan	2 (0.3)	~ ~	22 (1.4)	549 (3.5)	76 (1.6)	557 (2.0)
¶ England	9 (1.3)	576 (9.6)	38 (1.5)	556 (5.0)	53 (1.8)	537 (5.2)
International Avg.	13 (0.2)	458 (1.3)	44 (0.2)	466 (0.9)	43 (0.3)	467 (0.9)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in
A tilde (~) indicates insufficient data to report achievement.

Exhibit 9.14	Index of Time Students Spend Doing Mathematics Homework (TMH) in a Normal School Week	8th grade Mathematics	TIMSS 2003

Index of Time Students Spend Doing Mathematics Homework

Index based on students' reports on the frequency and amount of mathematics homework they are given. High level indicates more than 30 minutes of mathematics homework assigned 3-4 times a week. Low level indicates no more than 30 minutes of mathematics homework no more than twice a week. Medium level includes all other

Countries	High TMH		Medium TMH		Low TMH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Italy	54 (1.4)	484 (3.8)	40 (1.1)	487 (3.6)	7 (0.7)	471 (8.0)
Singapore	38 (1.1)	621 (3.1)	51 (0.9)	604 (3.8)	11 (0.8)	566 (7.8)
Hong Kong, SAR	32 (1.9)	600 (3.5)	49 (1.5)	587 (3.6)	19 (1.5)	566 (7.6)
United States	31 (1.0)	518 (4.1)	60 (0.9)	506 (3.2)	9 (0.9)	461 (6.3)
Hungary	20 (1.2)	516 (5.8)	77 (1.2)	537 (3.1)	3 (0.5)	501 (14.1)
Australia	19 (1.6)	520 (6.0)	50 (1.5)	509 (5.4)	31 (2.0)	497 (5.5)
Netherlands	19 (1.3)	540 (5.2)	62 (1.4)	542 (4.4)	19 (1.7)	518 (6.5)
New Zealand	14 (1.1)	488 (5.1)	49 (1.8)	505 (6.0)	37 (2.1)	492 (7.2)
Belgium (Flemish)	13 (1.1)	542 (4.5)	42 (1.4)	546 (3.2)	44 (2.0)	532 (3.7)
Scotland	8 (0.8)	493 (5.8)	46 (2.1)	507 (4.5)	46 (2.5)	496 (4.1)
¶ England						
Japan	6 (0.7)	565 (10.1)	36 (1.5)	566 (2.8)	58 (1.9)	576 (2.1)
¶ England	7 (1.2)	509 (7.0)	37 (1.5)	507 (5.3)	56 (1.9)	498 (5.8)
International Avg.	26 (0.2)	468 (0.8)	54 (0.2)	471 (0.6)	19 (0.2)	456 (1.0)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by students.

¶ Did not satisfy guidelines for sample participation rates.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Index of Teachers' Emphasis on Science Homework

Index based on teachers' responses to two questions about how often they usually assign science homework and how many minutes of science homework they usually assign. High level indicates the assignment of more than 30 minutes of homework about half of the lessons or more. Low level indicates no assignment or the assignment of less than 30 minutes of homework about half of the lessons or less. Medium level includes all other possible combinations of responses.

Countries		High ESH		Medium ESH		Low ESH	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Italy		44 (4.1)	483 (4.7)	35 (3.8)	500 (5.6)	21 (3.0)	494 (6.3)
Singapore		29 (2.6)	603 (6.5)	32 (2.5)	573 (8.4)	38 (2.2)	565 (7.6)
¶ England							
Hong Kong, SAR		12 (3.0)	560 (8.6)	40 (4.3)	565 (5.4)	48 (5.0)	548 (5.9)
United States	r	8 (1.4)	510 (8.9)	34 (2.8)	532 (4.9)	58 (3.0)	533 (4.5)
Netherlands	r	6 (1.7)	543 (10.2)	65 (2.9)	544 (3.5)	29 (3.0)	520 (5.4)
Hungary		3 (0.7)	530 (8.1)	45 (2.2)	546 (3.9)	52 (2.4)	538 (3.3)
Scotland	s	2 (1.2)	~ ~	14 (2.5)	507 (8.2)	84 (2.7)	517 (4.7)
Australia	r	2 (1.0)	~ ~	32 (3.6)	529 (6.8)	66 (3.5)	525 (5.2)
Japan		2 (1.2)	~ ~	18 (3.2)	554 (3.5)	80 (3.2)	552 (2.1)
Belgium (Flemish)		2 (0.9)	~ ~	15 (2.3)	524 (7.3)	83 (2.5)	516 (2.7)
New Zealand		1 (0.8)	~ ~	41 (4.9)	535 (6.9)	58 (4.9)	510 (5.4)
¶ England	s	28 (4.2)	562 (9.8)	20 (2.9)	581 (11.4)	52 (4.0)	534 (7.5)
International Avg.		15 (0.4)	466 (1.4)	41 (0.5)	476 (0.9)	44 (0.5)	472 (1.0)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insuffcient data to report achievement.
An “r” indicates data are available for at least 70 but less than 85% of the students. An “s” indicates data are available for at least 50 but less than 70% of the students.

Index of Teachers' Emphasis on Mathematics Homework

Index based on teachers' responses to two questions about how often they usually assign mathematics homework and how many minutes of mathematics homework they usually assign. High level indicates the assignment of more than 30 minutes of homework about half of the lessons or more. Low level indicates no assignment or the assignment of less than 30 minutes of homework about half of the lessons or less. Medium level includes all other possible combinations of responses.

Countries	High EMH		Medium EMH		Low EMH	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Italy	71 (3.5)	482 (3.2)	25 (3.2)	489 (8.4)	4 (1.5)	480 (11.2)
Singapore	59 (2.4)	620 (4.2)	33 (2.5)	592 (6.6)	8 (1.3)	563 (13.1)
United States	27 (2.5)	531 (8.0)	62 (2.9)	504 (3.8)	11 (2.2)	471 (9.5)
Hong Kong, SAR	26 (3.7)	598 (6.0)	50 (4.6)	593 (6.0)	24 (4.0)	566 (10.0)
¶ England						
Australia	10 (3.0)	544 (19.7)	56 (4.1)	518 (5.9)	34 (3.8)	475 (9.5)
Belgium (Flemish)	9 (2.5)	555 (6.5)	30 (3.8)	555 (5.8)	60 (3.9)	529 (5.6)
Hungary	8 (2.0)	532 (8.9)	90 (2.2)	530 (3.5)	2 (0.9)	~ ~
New Zealand	7 (2.1)	479 (15.6)	67 (4.1)	510 (6.6)	25 (4.2)	471 (5.3)
Netherlands	7 (2.4)	550 (15.3)	82 (3.7)	541 (4.9)	11 (3.1)	495 (14.1)
Japan	7 (2.2)	583 (23.4)	29 (3.8)	573 (6.9)	64 (3.9)	567 (2.5)
Scotland	3 (1.7)	549 (10.6)	45 (4.6)	527 (5.7)	51 (4.5)	477 (6.2)
¶ England r	24 (6.1)	528 (10.2)	21 (4.5)	519 (15.8)	56 (5.9)	493 (9.7)
International Avg.	30 (0.5)	473 (1.4)	51 (0.6)	469 (0.9)	19 (0.4)	453 (1.7)

SOURCE: IEA Trends in International Mathematics and Science Study (TIMSS) 2003

Background data provided by teachers.
¶ Did not satisfy guidelines for sample participation rates.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70 but less than 85% of the students.

10 Factors associated with mathematics and science achievement

Previous sections have made use of the results of multilevel modelling to establish the relationships between performance and background variables when these are considered as a package. The following types of data were available for the analysis of the international study outcomes in England:

- Internationally-derived scales for pupils' performance in mathematics and science (at grade 4 and grade 8)
- Nationally-derived factor scores for pupils, teachers and schools derived from questionnaire information
- Pupil background information
- Class and school information

For both grades the scores for mathematics and science were:

- Overall mathematics score
- Overall science score
- Algebra score (referred to as Patterns and Relationships at grade 4)
- Data Analysis & Probability score
- Fractions & Numbers score
- Geometry score
- Measurement score
- Earth science score
- Life science score
- Physics score

At grade 8 only, the cognitive outcomes included, in addition to the previous cognitive outcomes, Chemistry and Environmental Science Scores.

Preliminary analysis was undertaken to investigate which factors at the school, class and pupil levels might be associated with the various international scales, and to see which were statistically significant.

Setting up multilevel models

Multilevel modelling is a development of a common statistical technique known as 'regression analysis'. This is a technique for finding a straight-line relationship which allows us to predict the values of some measure of interest (these are sometimes called 'dependent variables') given the values of one or more related measures. For example, we may wish to predict schools' average test performance given some background factors, such as free school meals and school size (these are sometimes called 'independent variables').

Multilevel modelling takes account of data which are grouped into similar clusters at different levels. For example, individual pupils are grouped into classes, and those classes are grouped within schools. There may be more in common between pupils within the same class than with other classes, and there may be elements of similarity between different classes in the same school. Multilevel modelling allows us to take account of this hierarchical structure of the data and produce more accurate predictions, as well as estimates of the differences between pupils, between classes, and between schools.

Ideally, it would be advantageous to have an indicator of pupils' prior attainment, for example at the start of a key stage. It is hoped to have access to pupils' national curriculum results at the end of key stage 1 and 2 at a later stage. The analysis reported here is not, therefore, 'value-added' in any sense.

The models fitted to the data incorporated three levels already mentioned:

1. School
2. Class
3. Pupil

Thus, there are assumed to be variations between schools in their average scores, between classes in the same school, and within each class there are almost bound to be variations between pupils in their attitudes and cognitive scores. The sizes of these variations at each level of the model are measured in terms of 'random variances', and the relative sizes of these are of interest.

For each outcome measure the fitting process was carried out in two stages:

1. The 'base case', with no background variables
2. Including school-level, class-level and pupil-level variables in the final model, removing those which were clearly not significant

Pupil, class and school composite variables were derived following factor analysis of attitude questions on each instrument (see Sections 7–9).

Results of multilevel analysis – relationships with background variables

In technical language, the multilevel model results comprise the random variances at each level at each stage of model fitting, plus the coefficients of the background variables in the 'full model'. From estimated standard errors we may deduce whether or not variances or coefficients are statistically significant at the 5 per cent level, as well as 95 per cent confidence intervals for each parameter.

These results may not be easy to interpret for all readers. To aid in interpretation, therefore, the coefficients which express the estimated relationships between the scales and each of the background variables have been converted into 'Quasi Effect Size coefficients' (Schagen and Elliot, 2004) which represent the expected change (in percentage) in the outcome for an average switch between low and high values in the background variables.

Quasi Effect Size coefficients are plotted in the figures provided in the Appendix for each of the international scales. For each variable, the estimated Quasi Effect Size coefficient is plotted as a diamond, with a vertical line indicating the 95 per cent confidence interval for the estimate. Any variable whose line intersects the horizontal zero axis can be regarded as not statistically significant (at the 5 per cent level). Positive values imply a positive relationship with the international scale outcome; negative values imply that scale values tend to decrease with higher values of the given background variable.

To further aid interpretation, the main findings from each of the models have been summarised as a series of bullet points. These written results can be compared with the tables and figures in the Appendix. Care should be taken when interpreting the coefficients of some variables. Any variable whose influence might be explained by the effect of prior attainment on outcome may invite a false conclusion about its usefulness in improving achievement. This problem arises as a prior attainment measure was not present in the models. Secondly, a significant relationship between the outcome measure and the squared term (derived from percentage eligibility for free school meals) indicates a non-linear relationship between the outcome and free school meals eligibility. This has been explained in the text. Thirdly, attitude measures were included in the attainment models and, since particular attitudes (e.g. confidence in mathematics) are biased towards one gender, the coefficient for sex is often strongly influenced by attitude variables. The interpretations given take into account this confounding influence and summarise the difference in attainment between boys and girls without controlling for attitude.

10.1 Results of multilevel modelling

In all the models of achievement in mathematics and science, the lack of prior attainment measure makes interpretation of many of the coefficients problematic. Negative coefficients for tutoring are common to all the attainment models. These might be explained by the possibility that less able students are receiving tutoring rather than tutoring being detrimental to achievement. Similarly, at grade 4 computer use always comes out with a negative coefficient: less able students may be using computers to aid their learning. At grade 8, students' report on the frequency of relevance, presentation, homework and tests in both mathematics and science was a significant negative predictor in all areas of mathematics and science. This is also a result that may have been different if prior attainment had been taken into account. At grade 4 the lecture/exercise mode of working in mathematics comes out as having a potentially positive influence on both mathematics and science achievement. This could be explained simply because more able students are taught in this traditional way.

These examples highlight the fact that care should be taken in interpreting outcomes from this analysis. What may seem, on the face of it, to be a fairly straightforward finding may, in fact, have multiple and complex causes which are not immediately clear. The context in which a finding occurs is crucial. The findings summarised below and reported in greater detail in earlier sections relate to TIMSS 2003 performance in England only and trends observed here may not apply in other countries. Similarly, findings regarding performance in other countries, outlined earlier in this report, may not be easily applicable to England because of the different cultural and educational contexts. This should be borne in mind throughout.

10.2 Grade 4 science

Models were run for the following scores: overall science score and scores for earth science, life science and physics. The important relationships found can be summarised as:

- Taking other background variables into account, a strong negative predictor of attainment in science was percentage eligibility for free school meals.
- Enjoyment and confidence in science was a strong positive predictor of science score in all areas that were assessed. Boys did not differ significantly from girls on the enjoyment and confidence in science factor or on science achievement overall.
- If pupils were born outside the UK, they were likely to achieve a lower score for science in all the measured aspects. If they scored highly on the resources at home factor they were more likely to do well.

- The use of investigation and explanation in science was a significant positive predictor of achievement in all areas.
- If pupils' own perceptions of safety were generally negative, they were less likely to do well. As teacher ratings of school climate varied, science achievement stayed roughly constant but if school ratings of its climate for teachers were more positive, students did slightly less well in science overall. Similarly, a negative opinion of school infrastructure in the school questionnaire meant pupils were more likely to do well.
- Never or only sometimes speaking English at home was a significant negative predictor in both life science and physics. It was not significant in the model for earth science.
- Age of student was an important background variable in all the models as it was always a significant positive predictor of science achievement.

10.3 Grade 4 mathematics

Models were run for the following scores: overall mathematics, algebra (patterns and relationships), data analysis and probability, fractions and numbers, geometry and measurement.

- Taking other background variables into account, a strong negative predictor of attainment in mathematics was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as the percentage eligible for free school meals rose so attainment fell, but the change in score became less pronounced with higher percentages.
- Self-confidence in mathematics was a strong positive predictor of mathematics score in all areas measured. However, boys were significantly more confident in mathematics than girls, but did not do any better overall.
- If pupils were born outside the UK, they were likely to achieve a lower score for mathematics in all the measured aspects. If they scored highly on the resources at home factor they were more likely to do well.
- If pupils' own perceptions of safety were generally negative, they were less likely to do well. As teacher ratings of school climate varied, mathematics achievement stayed roughly constant but if school ratings of its climate for teachers were more positive, students did slightly less well in mathematics.
- If pupils' own perceptions of school climate were generally positive, they were less likely to do well.
- If the majority of mathematics lessons were deemed by pupils to involve practising methods other than computation, students were liable to do less well in all aspects of mathematics. Conversely, if pupils perceived

computation to be used in the majority of lessons, they were likely to do better in all areas apart from geometry.

- Age of student was an important background variable in all the models as it was always a significant positive predictor of mathematics achievement.

10.4 Grade 8 science

Models were run for the following scores: overall, earth science, life science, physics, chemistry and environmental science.

- For all the models apart from environmental science, class-level variance was greater than both school- and pupil-level variance. This may reflect the policy of many schools of placing pupils in sets according to ability for science.
- Taking other background variables into account, the strongest negative predictor of attainment in science was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as percentage eligibility for free school meals gets higher, the change in science score becomes less pronounced.
- Enjoyment and confidence in science was a strong positive predictor of science score in all areas that were assessed. Boys scored significantly higher for the enjoyment and confidence in science factor than girls and also performed significantly better in all areas apart from life science. In this latter case, boys' confidence did not translate into achieving better than the girls (there was no significant difference in life science score across gender).
- Frequency of homework in science was a significant positive predictor of score in all areas. The frequency of homework in mathematics was also a significant positive predictor of score in all areas of science.
- Students' report on class/individual activities in both mathematics and science was a significant positive predictor in all areas assessed.
- Resources at home was a consistent positive predictor of all aspects of science score, whereas being born outside the UK was negative apart from in the case of chemistry, where it was not a significant variable.
- Perhaps surprisingly, never or only sometimes speaking English at home was a significant negative predictor in only four of the six models. It was not significant in the model for chemistry or the model for environment/resources.

10.5 Grade 8 mathematics

Models were run for the following scores: overall mathematics, algebra, data analysis and probability, fractions and numbers, geometry and measurement.

- For all the models, class-level variance was greater than both school- and pupil-level variance. This reflects the policy of many schools of placing pupils in sets according to ability for mathematics.
- Taking other background variables into account, the strongest negative predictor of attainment in mathematics was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as percentage eligibility for free school meals gets higher, the change in mathematics score becomes less pronounced.
- Mathematics teachers' perception of student ability, needs and attitude as a limiting factor to how they teach was a strong negative predictor of attainment in all aspects of mathematics. Interestingly, if the range of student background, number of students and resources were seen to be limiting, then students were likely to do better. This may be due to the targeting of resources and the possibility that more able students are grouped into larger sets.
- Confidence in mathematics was a strong positive predictor of mathematics score. However, boys were significantly more confident in mathematics than girls, but did not do any better overall.
- Frequency of homework in mathematics was a significant positive predictor of score in all areas aside from data analysis and probability.
- Resources at home was a consistent positive predictor of all aspects of mathematics score, whereas being born outside the UK was consistently negative.

10.6 Grade 4 attitudes

Three models of student attitude were run: enjoyment and confidence in science, enjoyment of mathematics and confidence in mathematics.

Other measures of attitude were left in the models to explore the relationship between them and the outcome attitude variable.

- The use of investigation and explanation in science was a significant positive predictor of enjoyment and confidence in science and the lecture/exercise mode of working in mathematics meant pupils were more likely to be confident in mathematics. Since prior attainment may have an influence on confidence and this was absent from the model, this could explain the latter point if more able students are taught using a traditional method.
- Good resources at home was a positive predictor of both enjoyment and confidence in science as well as confidence in mathematics.
- The use of a computer had a potentially positive influence on both enjoyment and confidence in science and enjoyment of mathematics: those that used computers more had improved attitudes. However, computer use meant

students were less likely to be confident in mathematics. This may also be an anomaly caused by lack of prior attainment data.

- If pupils' perception of school climate was generally more positive, their enjoyment and confidence in science and particularly their enjoyment of mathematics was higher.
- The use of computation in mathematics teaching meant pupils were more likely to be confident in and enjoy mathematics.
- The strongest positive predictor of confidence in mathematics was enjoyment of mathematics and the strongest positive predictor of enjoyment in mathematics was confidence in mathematics.
- Boys had significantly higher enjoyment/confidence levels in mathematics than girls, but were not significantly different in science for the same measure.
- If English was used never or only sometimes in the home, pupils were likely to enjoy mathematics more and were likely to score higher on the enjoyment and confidence in science factor.

10.7 Grade 8 attitudes

Three models of student attitude were run: enjoyment and confidence in science, enjoyment of mathematics and confidence in mathematics.

Other measures of attitude were left in the models to explore the relationship between them and the outcome attitude variable.

- The use of investigation and explanation in science was a significant positive predictor of enjoyment and confidence in science, as was the use of class/individual activities in mathematics and science.
- Scoring highly on the relevance/presentation/homework/tests factor was likely to mean less enjoyment and confidence in science and less confidence in mathematics.
- If student ability, needs and attitude were seen as a limiting factor for mathematics teaching, low confidence in mathematics was more likely to be a problem.
- Good resources at home was a positive predictor of both enjoyment and confidence in science as well as confidence in mathematics.
- The use of a computer for schoolwork had a potentially positive influence on both enjoyment and confidence in science and enjoyment of mathematics: those that used computers more had improved attitudes.

- If pupils' perception of school climate was generally more positive, their enjoyment and confidence in science and particularly their enjoyment of mathematics was higher.
- The strongest positive predictor of enjoyment in science was motivation in science, with confidence in mathematics also coming out of the model with a positive coefficient. Confidence in mathematics was also a strong positive predictor of enjoyment of mathematics: the reverse was also true.
- If students were more motivated in mathematics, they were more likely to be confident and more likely to enjoy mathematics.
- Boys had a significantly higher enjoyment/confidence level in both science and mathematics than girls.

Appendix 1 Sampling

The samples for England are outlined below.

Exhibit A1: The Samples of Schools

Schools	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
Grade 4	150	150	79	44	123
Grade 8	160	160	62	25	87

Exhibit A2: The Samples of Pupils

Pupils	Within School Participation Rate (Weighted Percentage)	Number of Sampled Pupils	Number of Eligible Pupils	Number of Pupils Absent	Number of Pupils Assessed
Grade 4	93%	3917	3872	287	3585
Grade 8	86%	3360	3326	496	2830

Technical appendix

Details of multilevel analysis carried out

The following types of data were available for the analysis of the international study outcomes in England:

- internationally-derived scales for pupils' performance in mathematics and science (at grade 4 and grade 8)
- nationally-derived factor scores for pupils', teachers' and schools derived from questionnaire information
- pupil background information
- class and school information.

For both grades the scores for mathematics and science were:

- overall mathematics score
- overall science score
- algebra score
- data analysis and probability score
- fractions and numbers score
- geometry score
- measurement score
- earth science score
- life science score
- physics score.

At grade 8 only, the cognitive outcomes included, in addition to the previous cognitive outcomes, Chemistry and Environment Science Scores.

Preliminary analysis was undertaken to investigate which factors at the school, class and pupil levels which might be associated with the various international scales, and to see which were apparently statistically significant.

Setting up multilevel models

Multilevel modelling is a development of a common statistical technique known as 'regression analysis'. This is a technique for finding a straight-line relationship which allows us to predict the values of some measure of interest ('dependent variable') given the values of one or more related measures. For example, we may wish to predict schools' average test performance given some background factors, such as free school meals and school size (these are sometimes called 'independent variables').

Multilevel modelling takes account of data which areis grouped into similar clusters at different levels. For example, individual pupils are grouped into classes, and those classes are grouped within schools. There may be more in common between pupils within the same class than with other classes, and there may be elements of similarity between different classes in the same school. Multilevel modelling allows us to take account of this hierarchical structure of the data and produce more accurate predictions, as well as estimates of the differences between pupils, between classes, and between schools.

Ideally, it would be advantageous to have an indicator of pupils' prior attainment, for example at the start of a key stage. It is hoped at a later stage to have access to pupils' national curriculum results at the end of key stage 1 and 2. at a later stage. The analysis reported here is not, therefore, 'value-added' in any sense.

The models fitted to the data incorporated three levels already mentioned:

1. school
2. class
3. pupil.

Thus, there are assumed to be variations between schools in their average scores, between classes in the same school, and within each class there are almost bound to be variations between pupils in their attitudes and cognitive scores. The sizes of these variations at each level of the model are measured in terms of 'random variances', and the relative sizes of these are of interest.

For each outcome measure the fitting process was carried out in two stages:

1. The 'base case', with no background variables
2. Including school-level, class-level and pupil-level variables in the final model, removing those which were clearly not significant

Pupil, class and school composite variables were derived following factor analysis of attitude questions on each instrument.

Results of multilevel analysis – relationships with background variables

In technical language, the multilevel model results comprise the random variances at each level at each stage of model fitting, plus the coefficients of the background variables in the 'full model'. From estimated standard errors we may deduce whether or not variances or coefficients are statistically significant at the 5% level, as well as 95% confidence intervals for each parameter.

These results may not be easy to interpret for all readers. To aid in interpretation, therefore, the coefficients which express the estimated relationships between the scales and each of the background variables have been converted into 'Quasi Effect Size coefficients' (Schagen and Elliot, 2004) which represent the expected change (in percentage) in the outcome for an average switch between low and high values in the background variables.

Quasi Effect Size coefficients are plotted in Figures A1 to A for each of the international scales at grade 4 and grade 8 in science and mathematics, as well as for each of the attitude scales analysed. For each variable, the estimated Quasi Effect Size coefficient is plotted as a diamond, with a vertical line indicating the 95% confidence interval for the estimate. Any variable whose line intersects the horizontal zero axis can be regarded as not statistically significant (at the 5% level). Positive values imply a positive relationship with the international scale outcome; negative values imply that scale values tend to decrease with higher values of the given background variable.

In Tables A1 to A6, we present the outcomes of the modelling in terms of 'adjusted coefficients'. These are presented in terms of the expected change in international scale score points associated with an 'average change' in one of the background factors. For binary variables (e.g. born outside the UK) this 'average change' is just going from the low value (0) to the high value (1). For other variables, it is computed taking account of the underlying standard deviation of the variable. See Schagen (2004) for more details. Only coefficients which are significant at the 5% level are shown.

To further aid interpretation, the main findings from each of the models have been summarised as a series of bullet points. These written results can be compared with the tables and figures in the Appendix. Care should be taken when interpreting the coefficients of some variables. Any variable whose influence might be explained by the effect of prior attainment on outcome may invite a false conclusion about its usefulness in improving achievement. This problem arises as a prior attainment measure was not present in the models. Secondly, a significant relationship between the outcome measure and the squared term (derived from percentage eligibility for free school meals) indicates a non-linear relationship between the outcome and free school meals eligibility. This has been explained in the text. Thirdly, attitude measures were included in the attainment models and, since particular attitudes (e.g. confidence in maths) are biased towards one gender, the coefficient for sex is often strongly influenced by attitude variables. The interpretations given take into account this confounding influence and summarise the difference in attainment between boys and girls without controlling for attitude.

Results of multilevel modelling

In all the models of achievement in maths and science, the lack of prior attainment measure makes interpretation of many of the coefficients problematic. Negative coefficients for tutoring are common to all the attainment models. These might be explained by the possibility that less able students are receiving tutoring rather than tutoring being detrimental to achievement. Similarly, at grade 4 computer use always comes out with a negative coefficient: less able students may be using computers to aid their learning. At grade 8, students' report on the frequency of relevance, presentation, homework and tests in both maths and science was a significant negative predictor in all areas of maths and science. This is also a result that may have been different if prior attainment had been taken into account. At grade 4 the lecture/exercise mode of working in maths comes out as having a potentially positive influence on both maths and science achievement. This could be explained simply because more able students are taught in this traditional way.

Results of Multilevel Modelling for grade 4 science

Models were run for the following scores: overall science score and scores for earth science, life science and physics. The important relationships found can be summarised as:

- Taking other background variables into account, a strong negative predictor of attainment in science was percentage eligibility for free school meals.
- Enjoyment and confidence in science was a strong positive predictor of science score in all areas that were assessed. Boys did not differ significantly from girls on the enjoyment and confidence in science factor or on science achievement overall.
- Self-confidence in mathematics appeared as a significant positive predictor of science score in all areas, whereas enjoyment of mathematics worked in the opposite direction: the more you enjoyed mathematics, the less likely you were to do well in science.
- If a pupil was born outside the UK, they were likely to achieve a lower score for science in all the measured aspects. If they scored highly on the resources at home factor they were more likely to do well.

The use of investigation and explanation in science was a significant positive predictor of achievement in all areas.

- If pupils' own perceptions of safety were generally negative, they were less likely to do well. Curiously, as teacher ratings of school climate varied, science achievement stayed roughly constant but if school ratings of its climate for teachers were more positive, students did slightly less well in science overall. Similarly, a negative opinion of school infrastructure in the school questionnaire meant pupils were more likely to do well.
- Never or only sometimes speaking English at home was a significant negative predictor in both life science and physics. It was not significant in the model for earth science.
- Age of student was an important background variable in all the models as it was always a significant positive predictor of science achievement.

The lack of prior attainment measure in the models makes interpretation of many of the coefficients more difficult. The potentially positive influence of the lecture/exercise mode of working in mathematics on scores in all assessed areas of science may be explained because more able students are taught in this traditional way. The negative coefficients for tutoring and computer use might be explained by the possibility that less able students are using these aids rather then them being detrimental to achievement.

Results of Multilevel Modelling for grade 4 mathematics

Models were run for the following scores: overall mathematics, algebra, data analysis and probability, fractions and numbers, geometry and measurement.

- Taking other background variables into account, a strong negative predictor of attainment in mathematics was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as percentage eligibility for free school meals gets higher, the change in mathematics score becomes less pronounced.
- Self-confidence in mathematics was a strong positive predictor of mathematics score in all areas measured. However, boys were significantly more confident in mathematics than girls, but did not do any better overall.
- If a pupil was born outside the UK, they were likely to achieve a lower score for mathematics in all the measured aspects. If they scored highly on the resources at home factor they were more likely to do well.
- If pupils' own perceptions of school climate or safety were generally negative, they were less likely to do well. Curiously, as teacher ratings of school climate varied, mathematics achievement stayed roughly constant but if school ratings of its climate for teachers were more positive, students did slightly less well in mathematics.
- If the content of mathematics lessons was deemed by teachers to mainly contain methods other than computation, students were liable to do less well

in all aspects of mathematics. Conversely, if computation was used more extensively, students were likely to do better in all areas apart from geometry.

- Age of student was an important background variable in all the models as it was always a significant positive predictor of mathematics achievement.

The lack of prior attainment measure in the models makes interpretation of many of the coefficients problematic. The potentially positive influence of the lecture/exercise mode of working in mathematics could be explained because more able students are taught in this traditional way. The negative coefficients for tutoring and computer use might be explained by the possibility that less able students are using these aids rather then them being detrimental to achievement.

Results of Multilevel Modelling for grade 8 science

Models were run for the following scores: overall, earth science, life science, physics, chemistry and environment/resources.

- For all the models apart from environment/resources, class-level variance was greater than both school- and pupil-level variance. This reflects the policy of many schools of placing pupils in sets according to ability for science.

- Taking other background variables into account, the strongest negative predictor of attainment in science was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as percentage eligibility for free school meals gets higher, the change in science score becomes less pronounced.

- Mathematics teachers' perception of student ability, needs and attitude as a limiting factor to how they teach was a strong negative predictor of attainment in all aspects of science. This corresponded to a similar limiting factor highlighted by science teachers, which was a weaker negative predictor in the model. Interestingly, if the range of student background, number of students and resources were seen to be limiting to the mathematics teachers, then students were likely to do better in science. This is probably due to more able students being grouped into larger sets.

- Enjoyment and confidence in science was a strong positive predictor of science score in all areas that were assessed. Boys scored significantly higher for the enjoyment and confidence in science factor than girls and also performed significantly better in all areas apart from life science. In this latter case, boys' confidence did not translate into achieving better than the girls (there was no significant difference in life science score across gender).

- Confidence in mathematics appeared as a significant positive predictor of science score in all areas, whereas enjoyment of mathematics worked in the opposite direction: the more you enjoy mathematics, the less likely you were to do well in science.

- Frequency of homework in science was a significant positive predictor of score in all areas. The frequency of homework in mathematics was also a significant positive predictor of score in all areas aside from environment/resources.
- Students' report on relevance, presentation, homework and tests in both mathematics and science was a significant negative predictor in all areas of science as was tutoring. These results may have been different if prior attainment had been taken into account. For example, lower achieving pupils may be receiving tutoring, which would explain the negative coefficient for this predictor.
- Students' report on class/individual activities in both mathematics and science was a significant positive predictor in all areas assessed.
- Resources at home was a consistent positive predictor of all aspects of science score, whereas being born outside the UK was negative apart from in the case of chemistry, where it was not a significant variable.
- Perhaps surprisingly, never or only sometimes speaking English at home was a significant negative predictor in only four of the six models. It was not significant in the model for chemistry or the model for environment/resources.

The lack of prior attainment measure in the models makes interpretation of some of the coefficients more difficult..

Results of Multilevel Modelling for grade 8 mathematics

Models were run for the following scores: overall mathematics, algebra, data analysis and probability, fractions and numbers, geometry and measurement.

- For all the models, class-level variance was greater than both school- and pupil-level variance. This reflects the policy of many schools of placing pupils in sets according to ability for mathematics.
- Taking other background variables into account, the strongest negative predictor of attainment in mathematics was percentage eligibility for free school meals. The relationship between attainment and percentage eligibility for free school meals is non-linear: as percentage eligibility for free school meals gets higher, the change in mathematics score becomes less pronounced.
- Mathematics teachers' perception of student ability, needs and attitude as a limiting factor to how they teach was a strong negative predictor of attainment in all aspects of mathematics. Interestingly, if the range of student background, number of students and resources were seen to be limiting, then students were likely to do better. This is probably due to more able students being grouped into larger sets.

- Confidence in mathematics was a strong positive predictor of mathematics score. However, boys were significantly more confident in mathematics than girls, but did not do any better overall.
- Frequency of homework in mathematics was a significant positive predictor of score in all areas aside from data analysis and probability.

Students' report on relevance, presentation, homework and tests in both mathematics and science was a significant negative predictor in all areas of mathematics as was tutoring. These results may have been different if prior attainment had been taken into account. For example, lower achieving pupils may be receiving tutoring, which would explain the negative coefficient for this predictor.

- Resources at home was a consistent positive predictor of all aspects of maths score, whereas being born outside the UK was consistently negative.

The lack of prior attainment measure in the models makes interpretation of some of the coefficients more difficult..

Reference

SCHAGEN, I. and ELLIOT, K. (2004) *But what does it mean? The use of effect sizes in educational research*. Slough: NFER.

Figure A1 Quasi effect sizes for grade 4 science overall

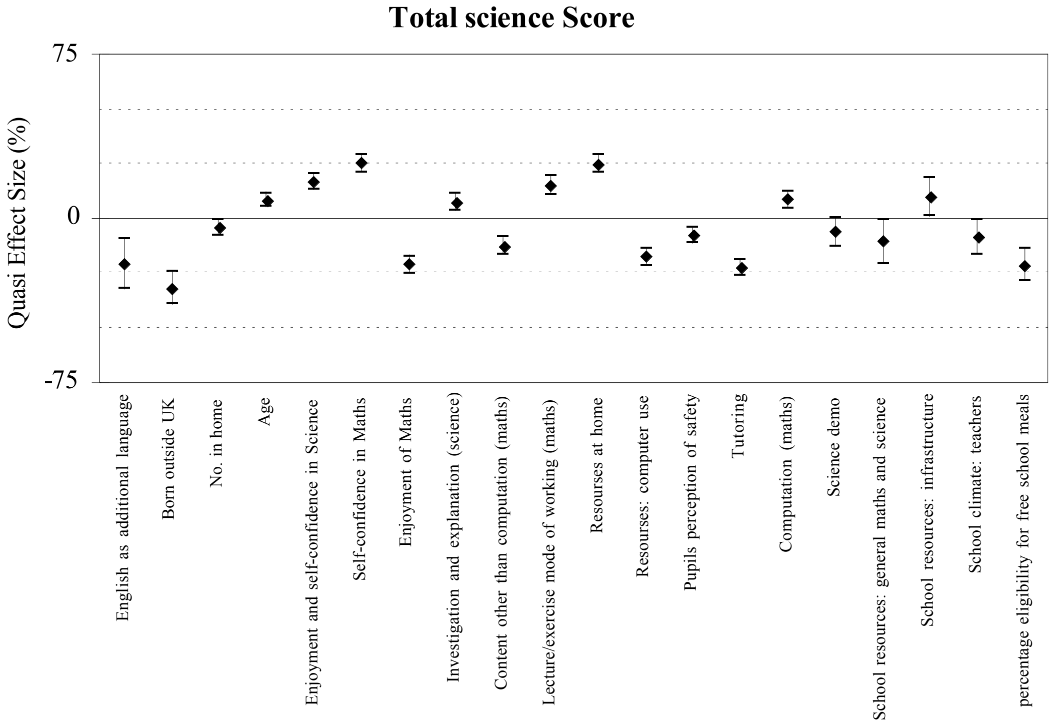


Figure A2 Quasi effect sizes for grade 4 earth science

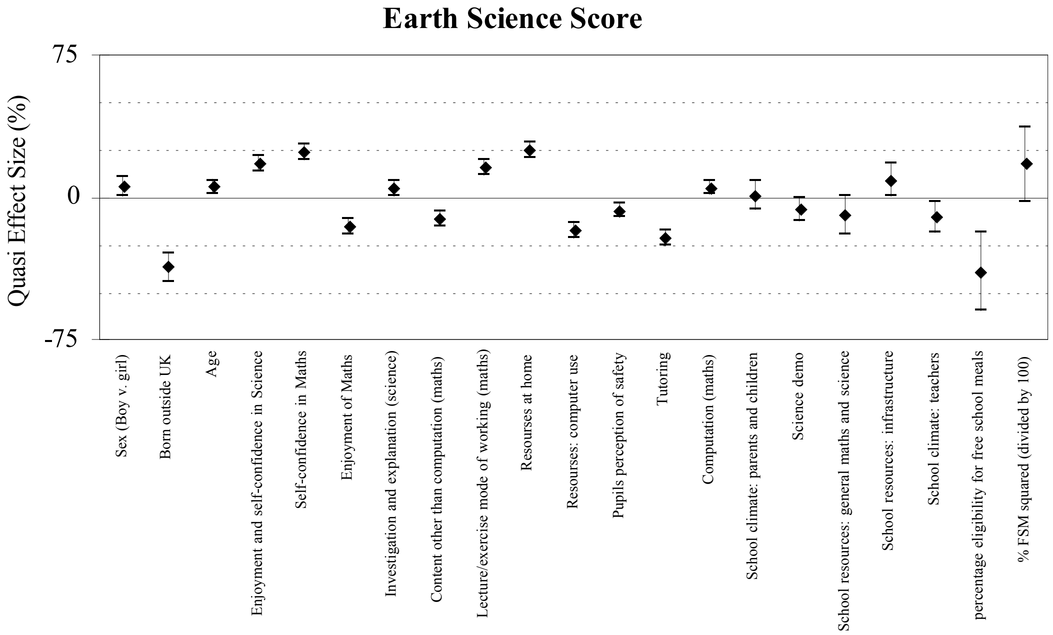


Figure A3 Quasi effect sizes for grade 4 life science

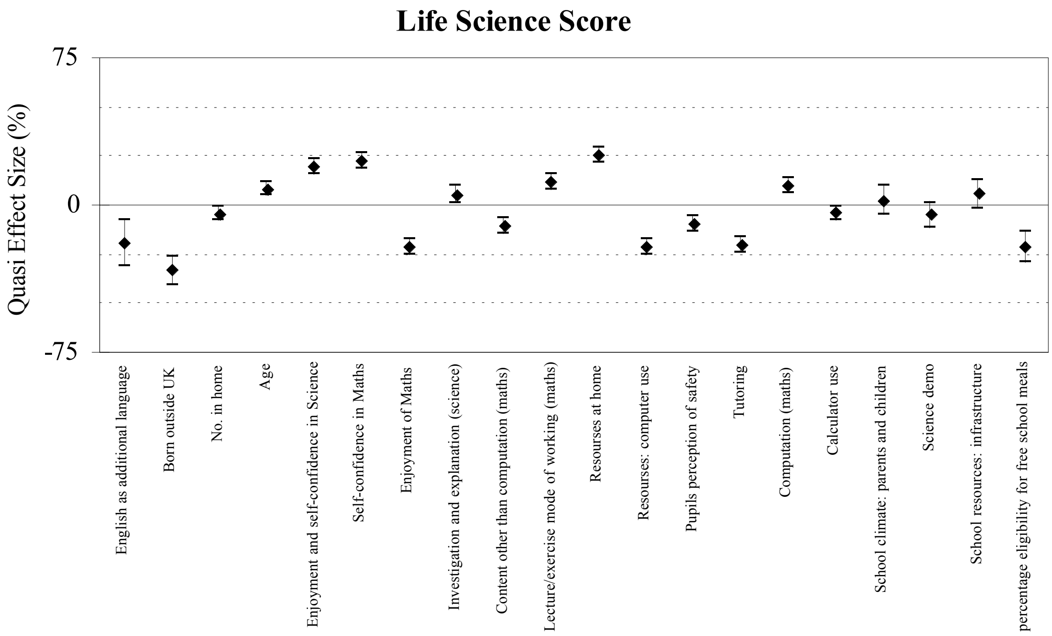


Figure A4 Quasi effect sizes for grade 4 physics

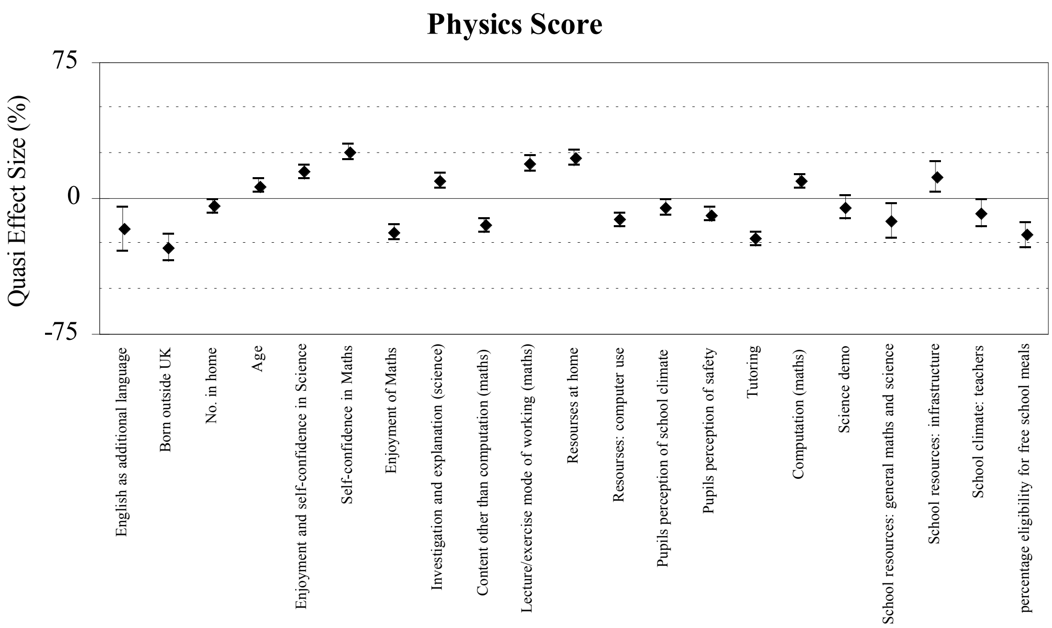


Figure A5 Quasi effect sizes for grade 4 mathematics overall

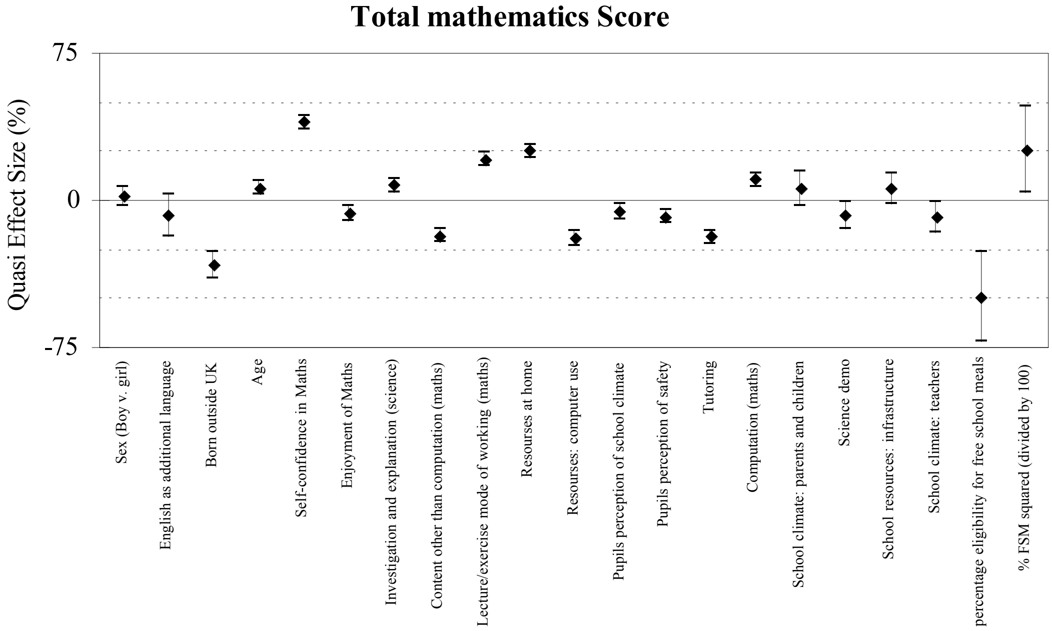


Figure A6 Quasi effect sizes for grade 4 algebra

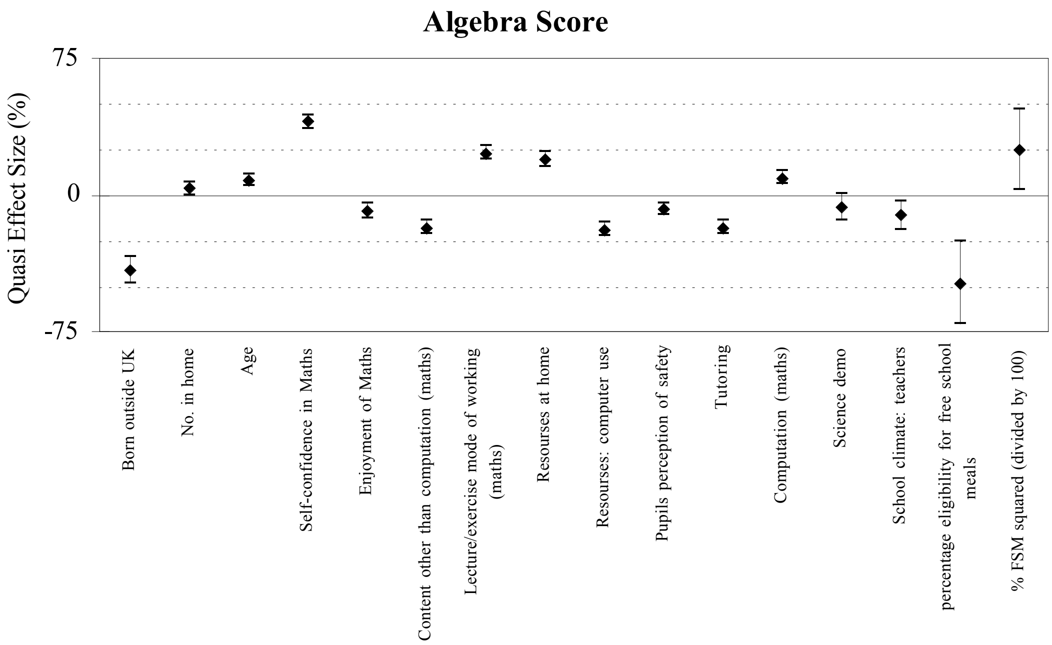


Figure A7 Quasi effect sizes for grade 4 data analysis and probability

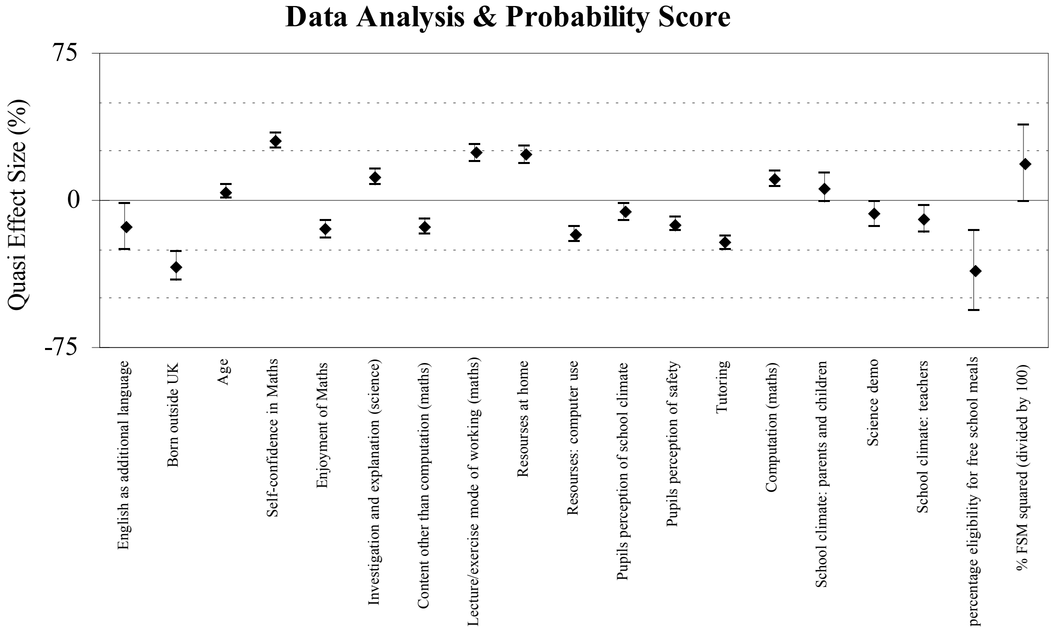


Figure A8 Quasi effect sizes for grade 4 fractions and numbers

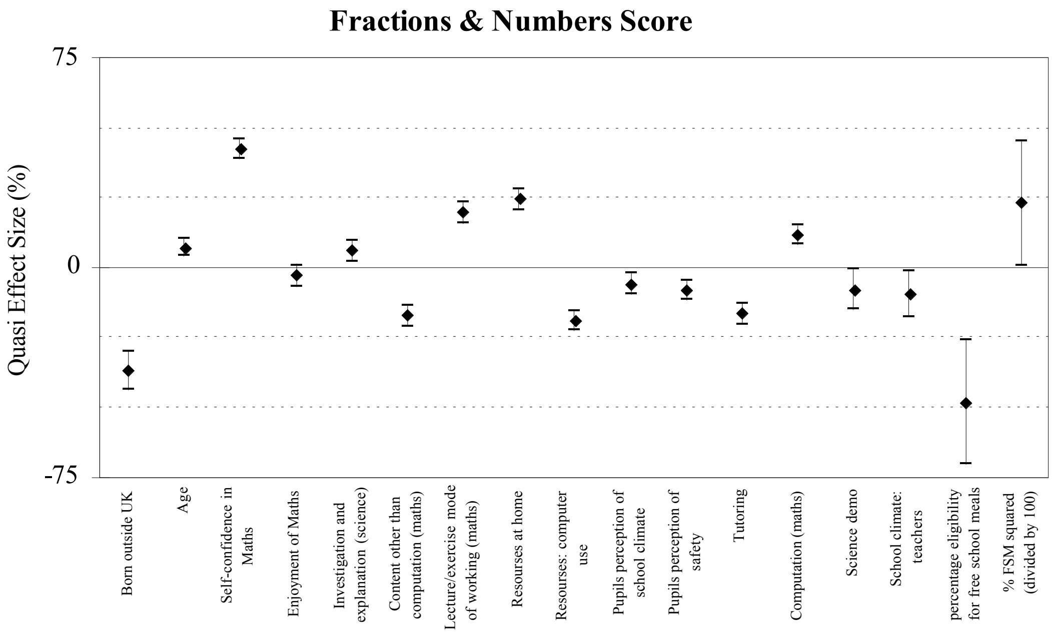


Figure A9 Quasi effect sizes for grade 4 geometry

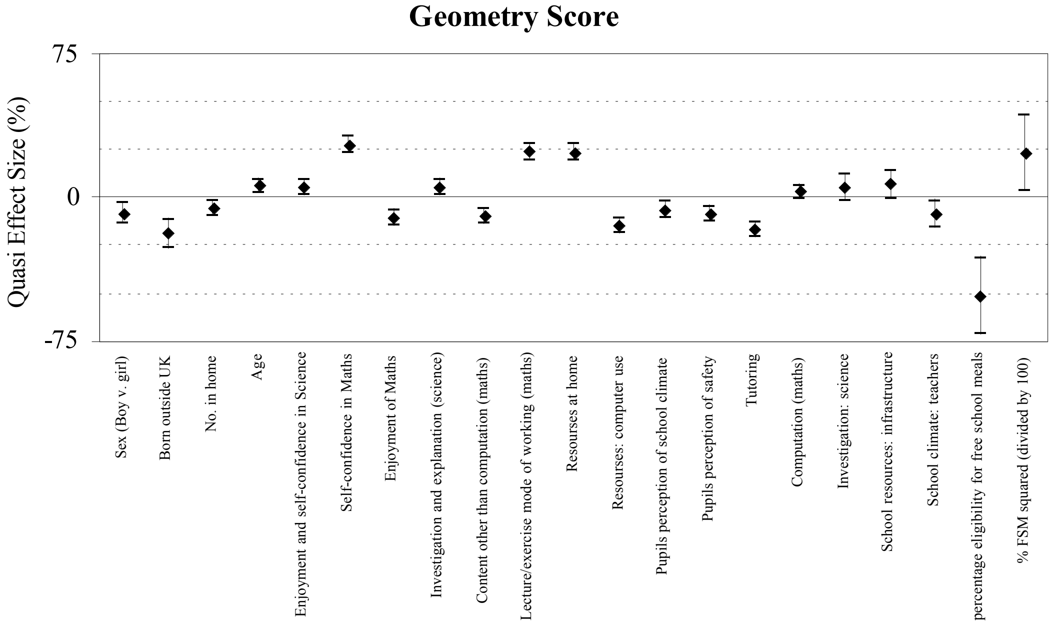


Figure A10 Quasi effect sizes for grade 4 measurement

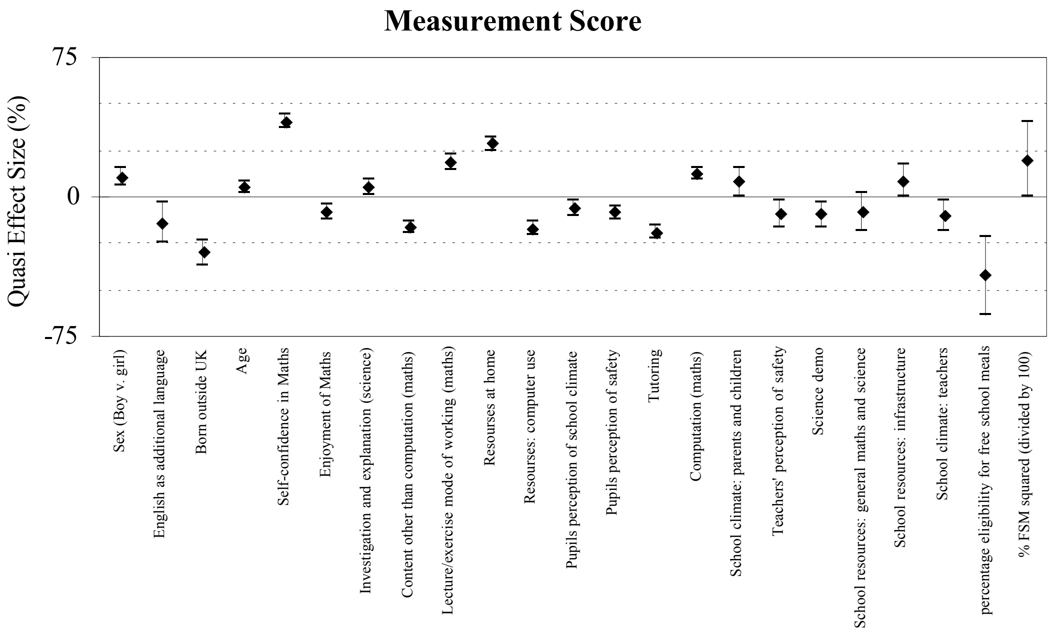


Figure A11 Quasi effect sizes for grade 4 enjoyment and confidence in science

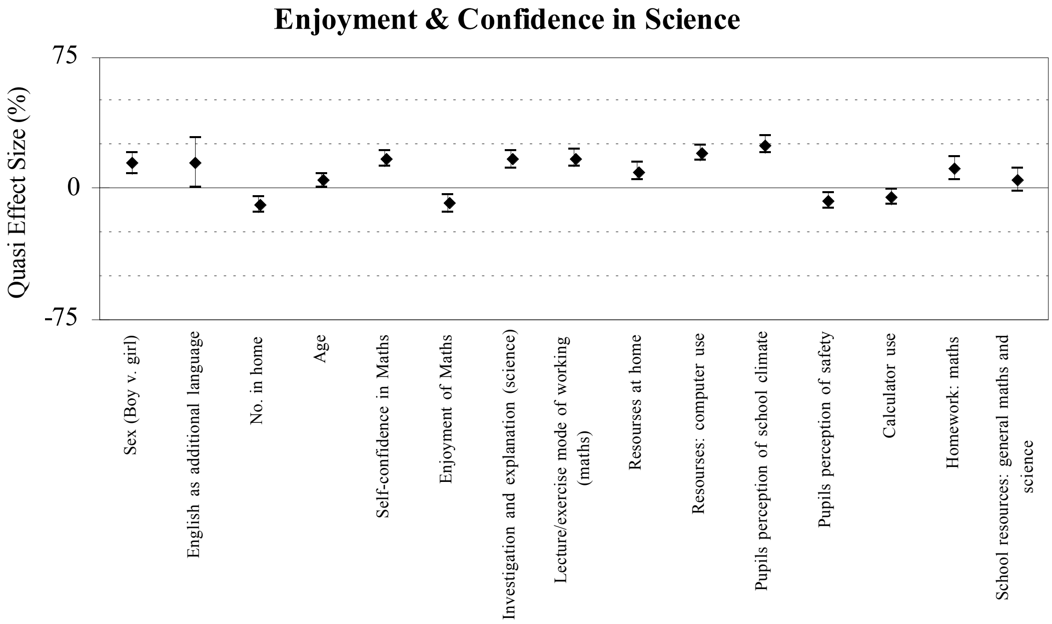


Figure A12 Quasi effect sizes for grade 4 confidence in mathematics

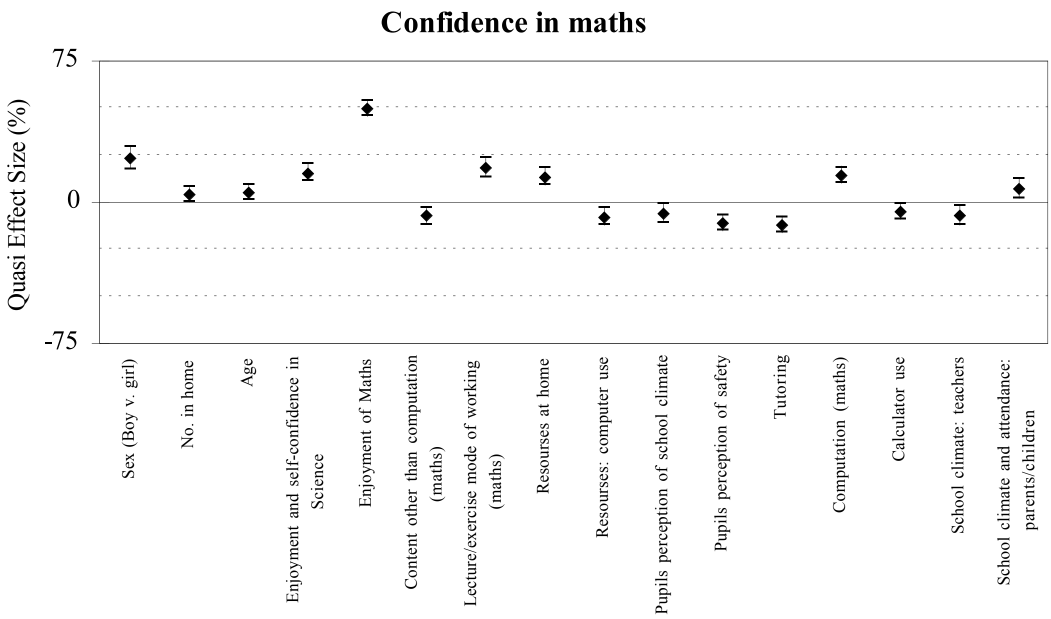


Figure A13 Quasi effect sizes for grade 4 enjoyment of mathematics

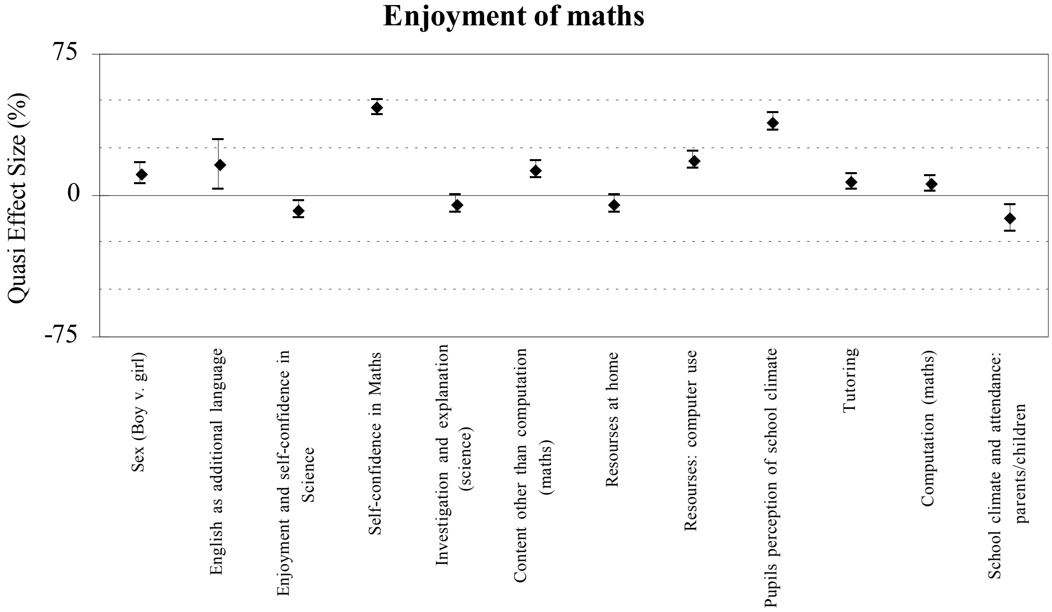


Figure A14 Quasi effect sizes for grade 8 science overall

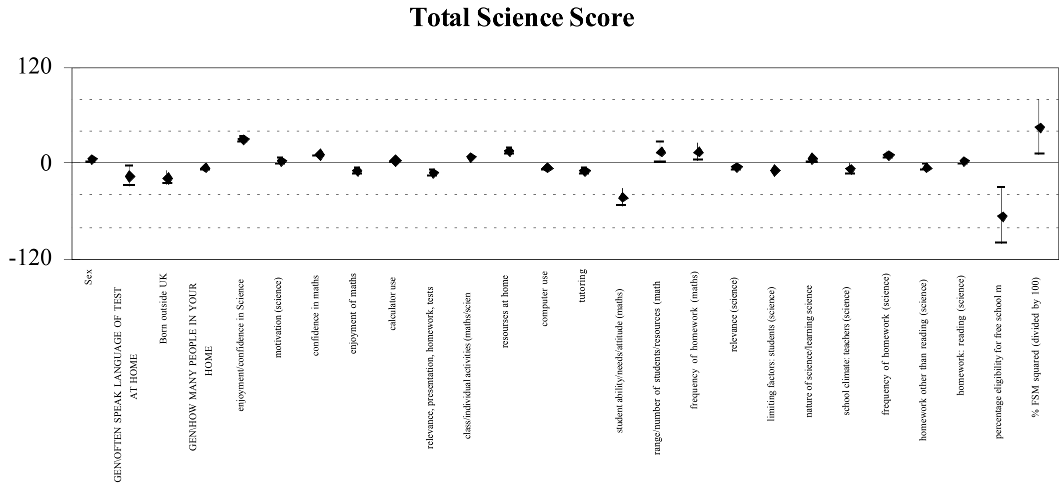


Figure A15 Quasi effect sizes for grade 8 earth science

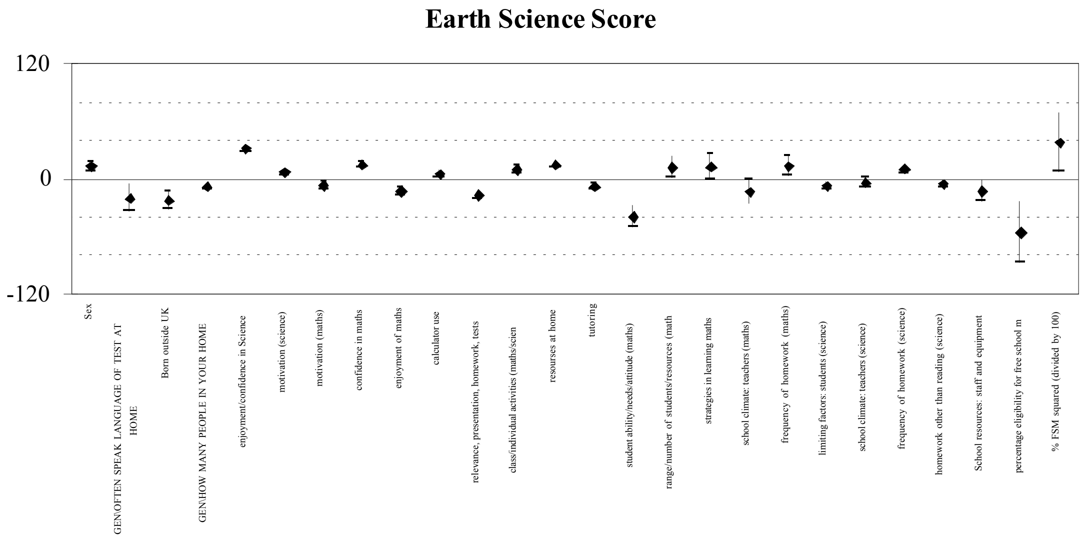


Figure A16 Quasi effect sizes for grade 8 life science

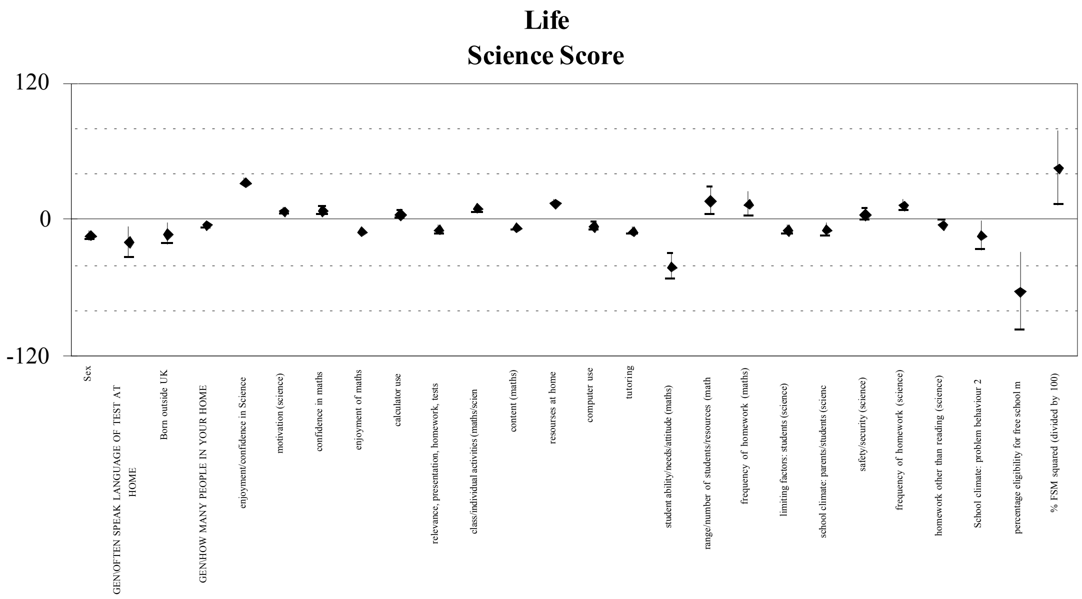


Figure A17 Quasi effect sizes for grade 8 physics

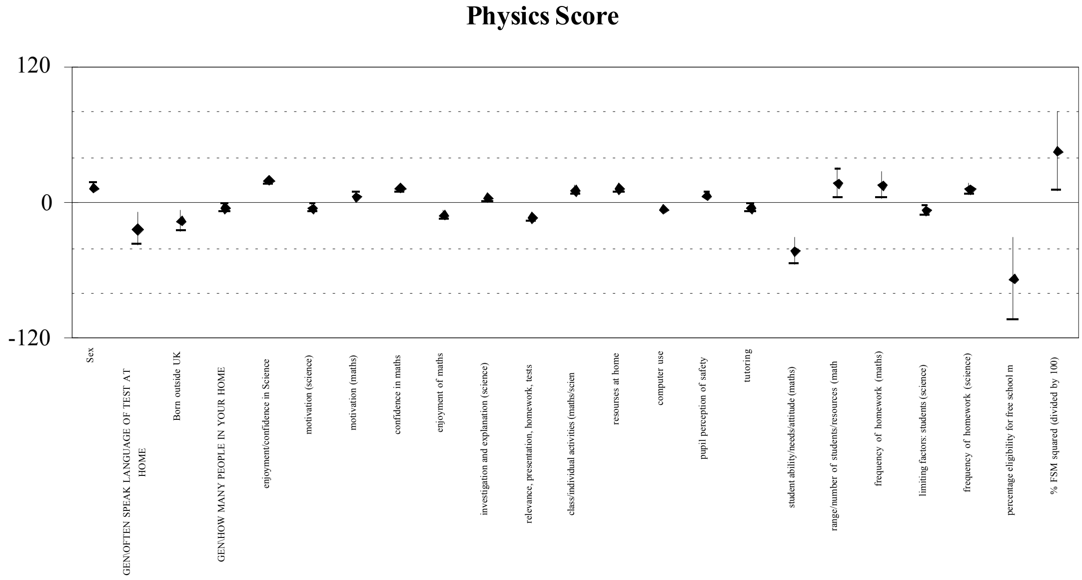


Figure A18 Quasi effect sizes for grade 8 chemistry

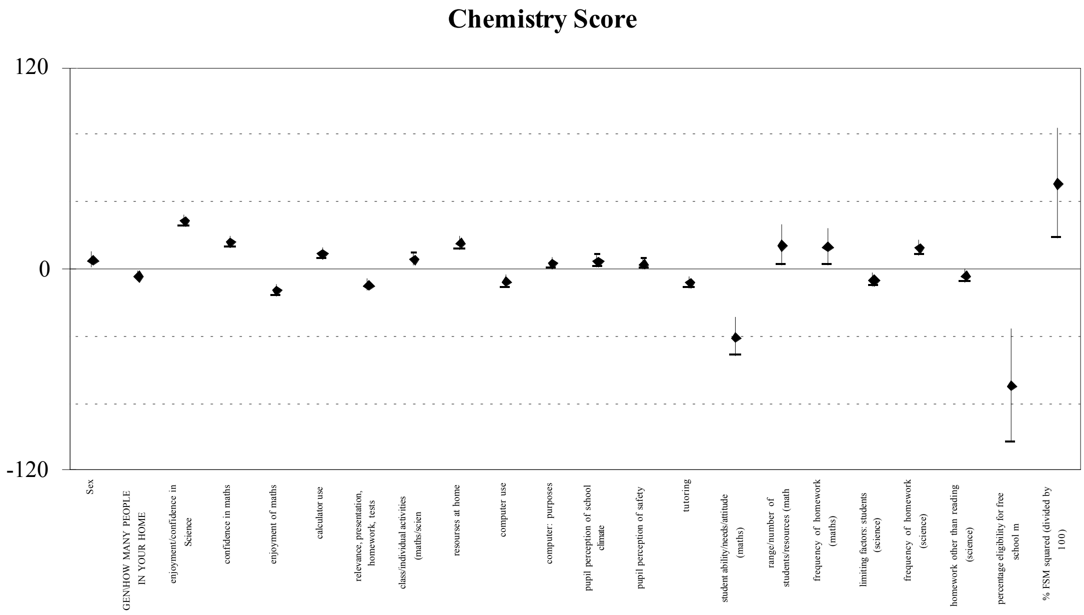


Figure A19 Quasi effect sizes for grade 8 environmental resources

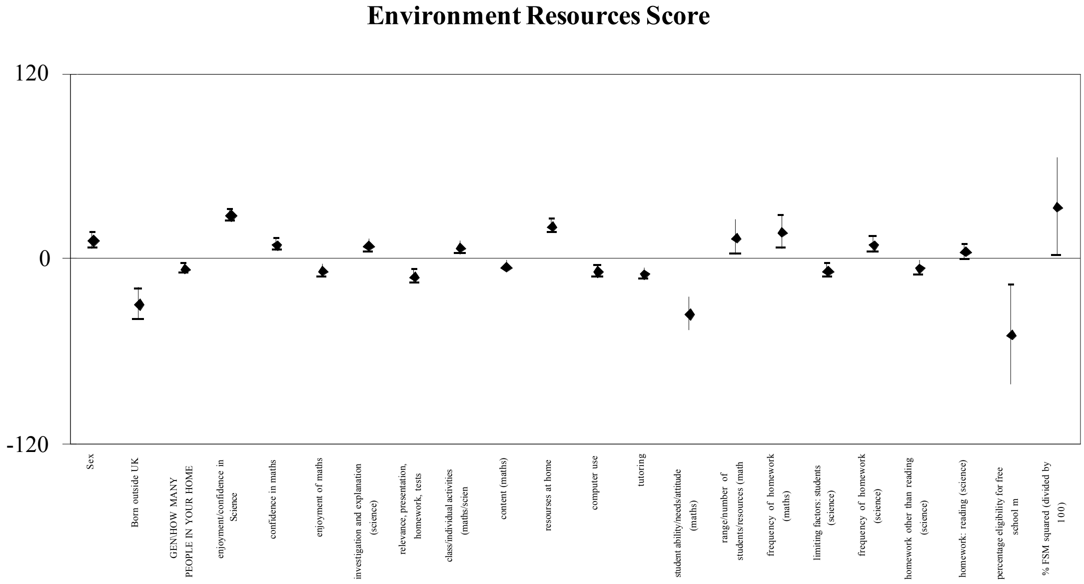


Figure A20 Quasi effect sizes for grade 8 mathematics overall

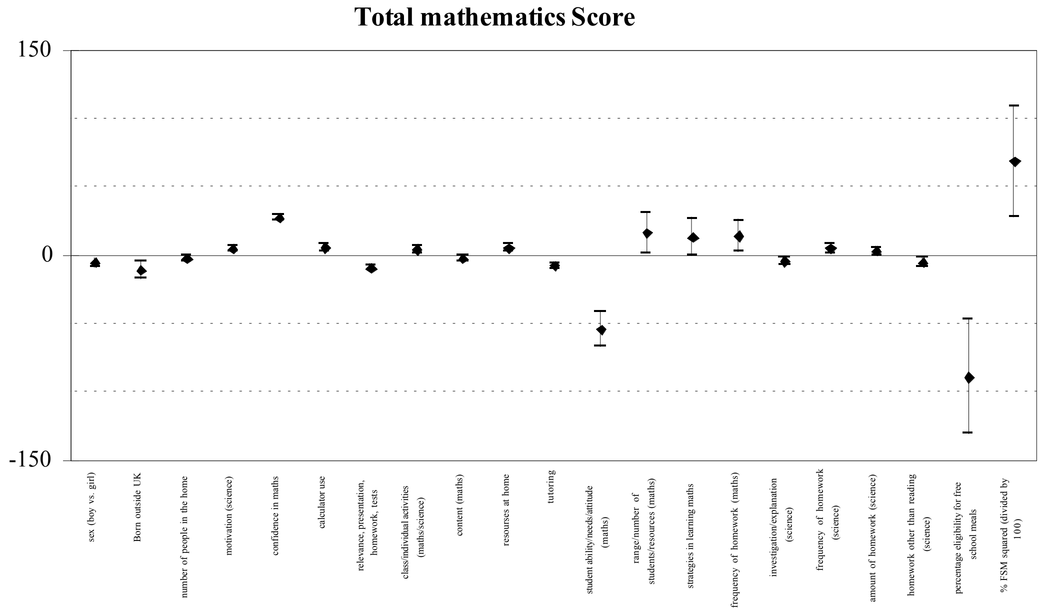


Figure A21 Quasi effect sizes for grade 8 algebra

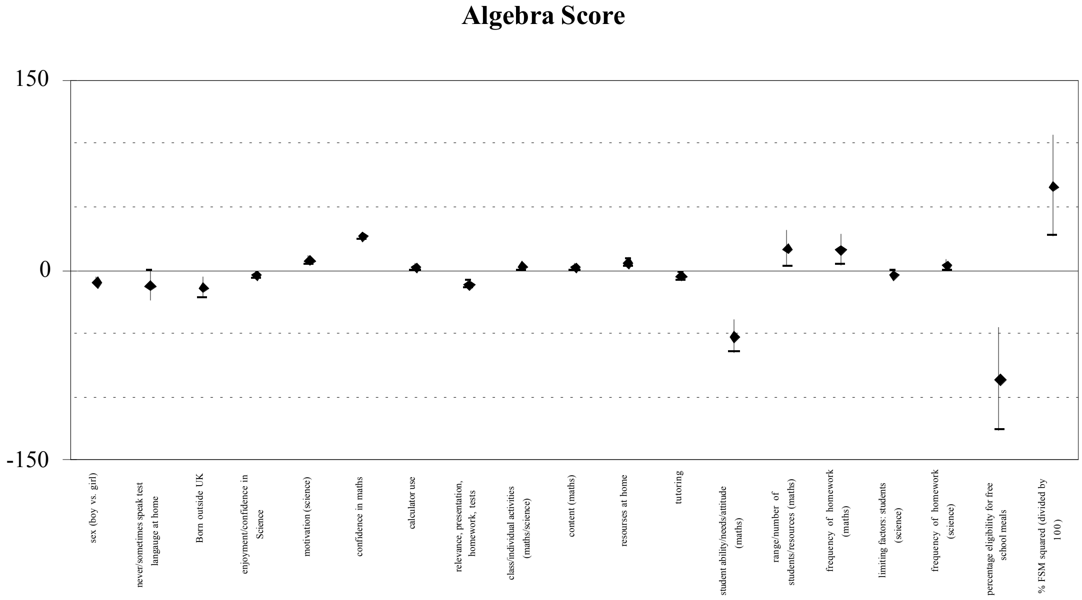


Figure A22 Quasi effect sizes for grade 8 data analysis & probability

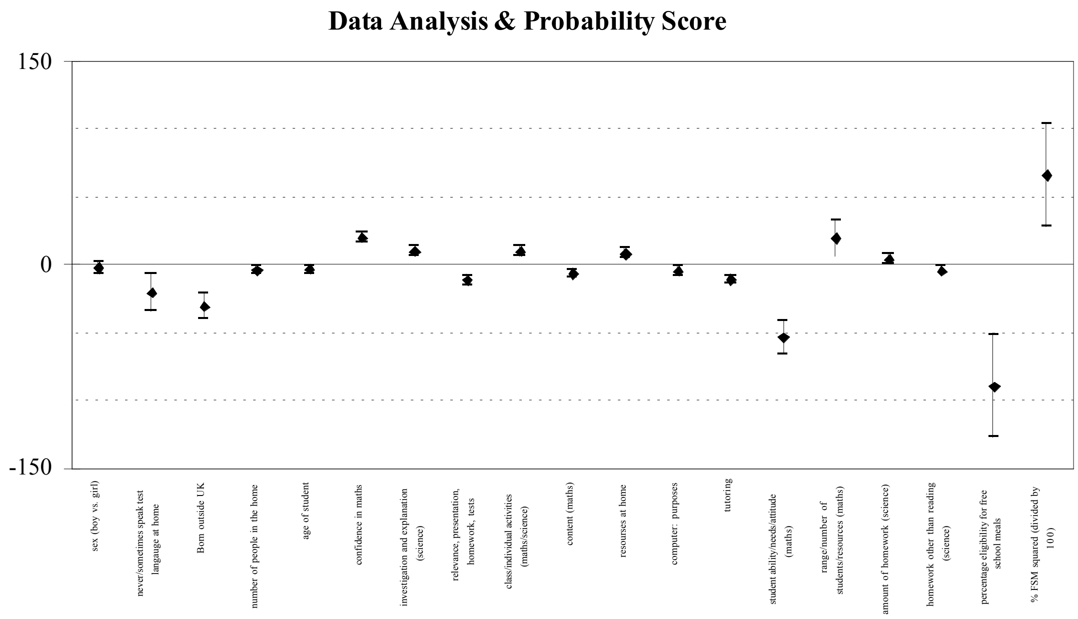


Figure A23 Quasi effect sizes for grade 8 fractions & numbers

Fractions & Numbers Score

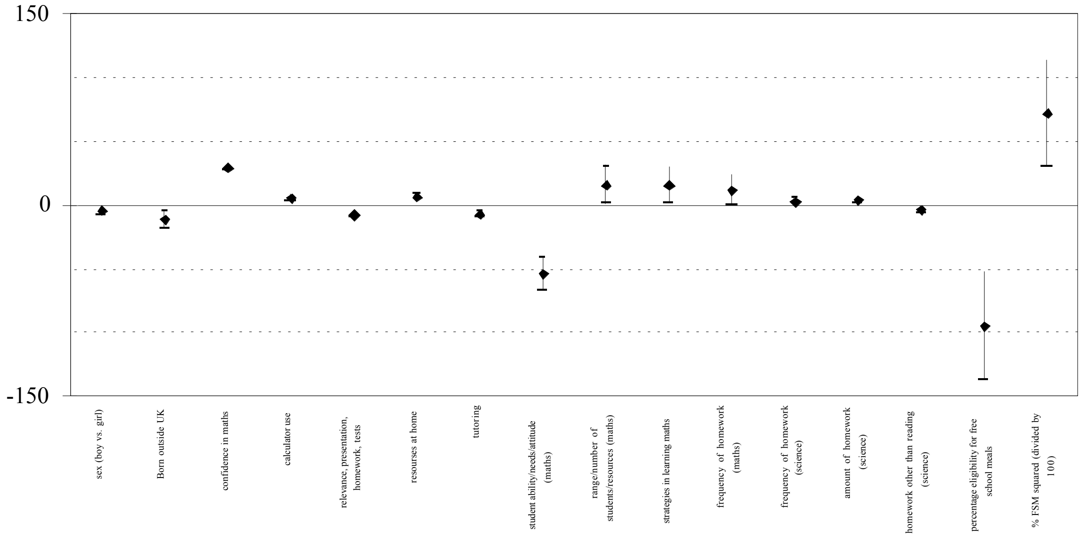


Figure A24 Quasi effect sizes for grade 8 geometry

Geometry Score

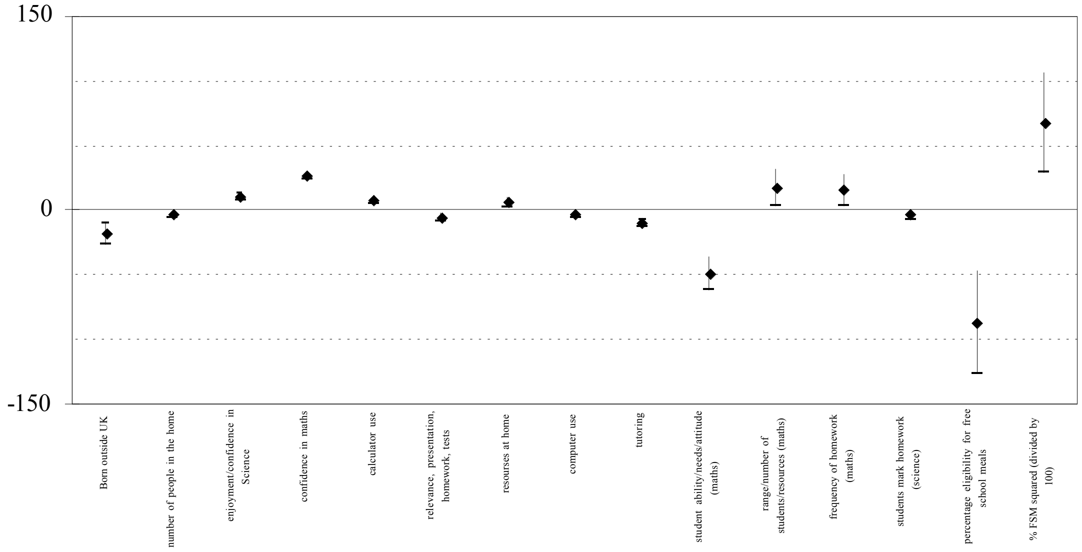


Figure A25 Quasi effect sizes for grade 8 measurement

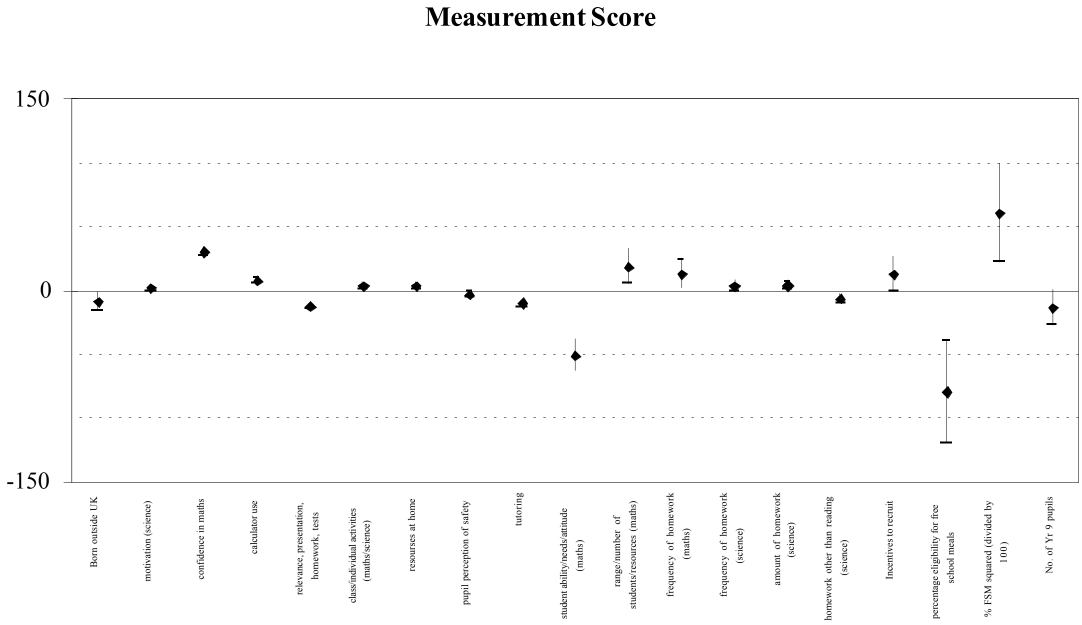


Figure A26 Quasi effect sizes for grade 8 enjoyment and confidence in science

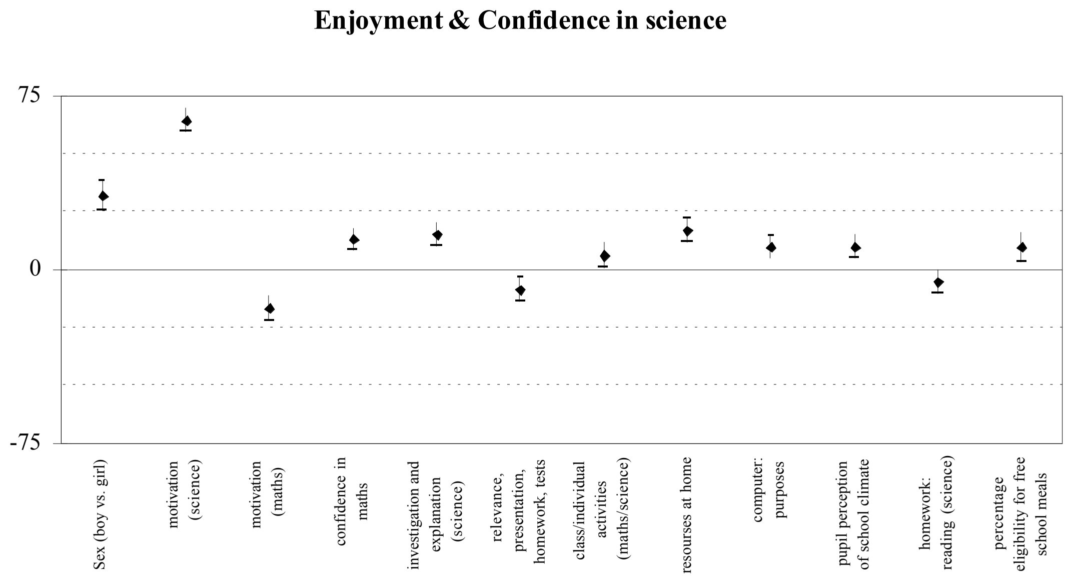


Figure A27 Quasi effect sizes for grade 8 confidence in mathematics

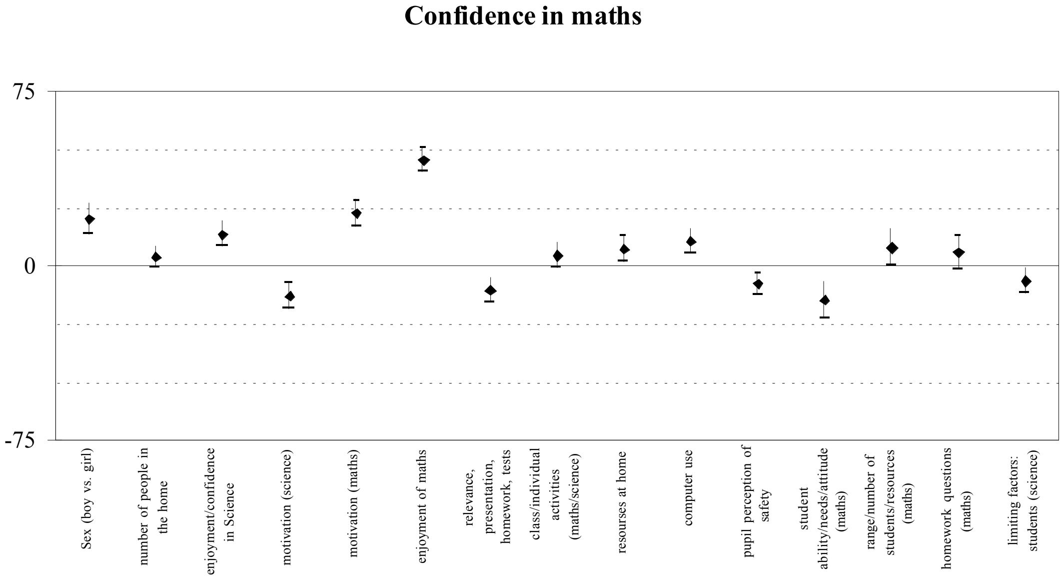


Figure A28 Quasi effect sizes for grade 8 enjoyment of mathematics

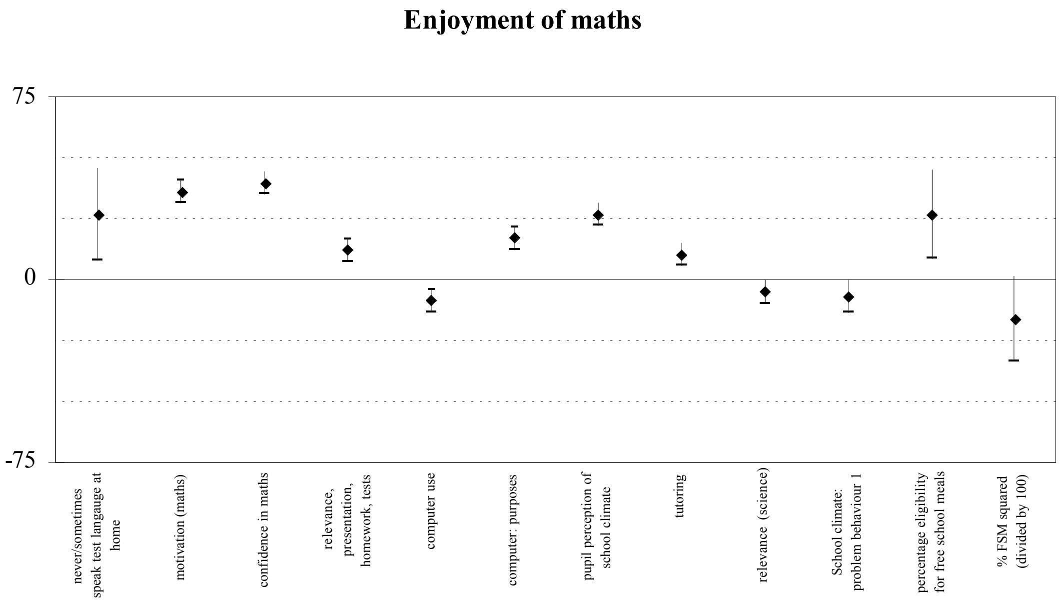


Table A1 Significant adjusted coefficients for grade 4 science

Variable	Overall Science Score	Earth Science Score	Life Science Score	Physics Science Score
Sex (Boy v. girl)		4.7		
English as additional language	-16.3		-13.5	-12.9
Born outside UK	-25.1	-28.6	-23.6	-20.5
No. in home	-3.1		-2.9	-3.4
Age	6.6	4.7	6.2	5.1
Enjoyment and self-confidence in Science	13.2	14.4	14.1	10.9
Self-confidence in Maths	19.9	18.9	16.2	18.8
Enjoyment of Maths	-16.4	-11.5	-14.9	-13.8
Investigation and explanation (science)	5.8	4.0	4.2	7.1
Content other than computation (maths)	-9.8	-8.4	-7.4	-11.2
Lecture/exercise mode of working (maths)	11.9	12.6	8.7	14.1
Resources at home	19.7	20.2	18.7	16.3
Resources: computer use	-13.7	-13.3	-15.0	-8.9
Pupils perception of school climate				-3.6
Pupils perception of safety	-6.2	-5.1	-6.	-6.8
Tutoring	-17.6	-16.7	-14.1	-16.6
Computation (maths)	6.8	4.2	7.3	6.9
Group work (maths)				
Calculator use			-2.8	
Explanation: maths and science				
Presentation and content not computation				
Investigation: science				
School climate: parents and children				
School climate: teachers				
Teachers' perception of safety				
Homework: science				
Homework: maths				
Maths homework amount				
Science demo				
Science observation				
School resources: general maths and science	-8.2			-9.6
School resources: IT support maths and science				
School resources: infrastructure	7.6	7.4		8.8
School climate: problem behaviours				
School climate: teachers	-6.4	-7.8		-6.2
School climate and attendance: parents/children				
Teacher shortage				
Vacancies				
Vacancy incentives				
IT support staff				
Achievement Band (KS2 Overall performance)				
percentage eligibility for free school meals	-16.7	-30.6	-14.9	-15.2
% FSM squared (divided by 100)				
No. of Yr 5 pupils				

Table A2 Significant adjusted coefficients for grade 4 mathematics

Variable	Overall Maths Score	Algebra Score	Data Analysis & Probability Score	Fractions Numbers Score	Geometry Score	Measure-ment Score
Sex (Boy v. girl)					-6.1	8.1
English as additional language			-9.5			-9.8
Born outside UK	-27.2	-34.0	-23.5	-33.6	-14.7	-21.5
No. in home		3.2			-4.0	
Age	5.6	7.0	3.1	6.5	5.1	4.1
Enjoyment and self-confidence in Science				4.5		
Self-confidence in Maths	33.7	34.0	21.7	38.8	22.3	29.7
Enjoyment of Maths	-5.4	-6.8	-10.1		-8.0	-5.5
Investigation and explanation (science)	6.6	8.6	5.7	4.5	4.0	
Content other than computation (maths)	-14.9	-14.6	-9.0	-15.6	-7.6	-11.6
Lecture/exercise mode of working (maths)	17.9	19.7	17.1	18.0	19.2	13.7
Resourses at home	21.2	16.7	16.4	22.2	19.0	20.9
Resourses: computer use	-15.8	-15.4	-11.7	-17.2	-11.3	-12.3
Pupils perception of school climate	-4.4	-4.0	-5.2	-4.7	-4.2	
Pupils perception of safety	-6.6	-5.9	-8.3	-7.3	-6.3	-6.0
Tutoring	-15.4	-14.5	-15.0	-15.0	-13.1	-13.7
Computation (maths)	9.3	8.2	7.9	10.6		9.2
Group work (maths)						
Calculator use						
Explanation: maths and science						
Presentation and content not computation						
Investigation: science						
School climate: parents and children					5.9	
School climate: teachers						
Teachers' perception of safety						-6.1
Homework: science						
Homework: maths						
Maths homework amount						
Science demo	-6.1		-4.7	-7.1		-6.4
Science observation						
School resources: general maths and science						
School resources: IT support maths and science						
School resources: infrastructure					5.8	

Table A2 contd

Variable	Overall Maths Score	Algebra Score	Data Analysis & Probability Score	Fractions Numbers Score	Geometry Score	Measure-ment Score
School climate: problem behaviours						
School climate: teachers	-6.9	-8.7	-6.5	-8.6	-6.5	-7.0
School climate and attendance: parents/children						
Teacher shortage						
Vacancies						
Vacancy incentives						
IT support staff						
Achievement Band (KS2 Overall performance)						
percentage eligibility for free school meals	-41.1	-39.9	-24.8	-43.8	-40.4	-30.4
% FSM squared (divided by 100)	21.7	21.3		21.0	18.9	14.7
No. of Yr 5 pupils						

Table A3 Significant adjusted coefficients for grade 4 attitudes

Variable	Enjoyment & Confidence in Science	Confidence in maths	Enjoyment of maths
Sex (Boy v. girl)	0.4	0.6	0.4
English as additional language	0.4		0.6
Born outside UK			
No. in home	-0.2		
Age	0.1	0.1	
Enjoyment and self-confidence in Science		0.4	-0.3
Self-confidence in Maths	0.4		1.6
Enjoyment of Maths	-0.2	1.2	
Investigation and explanation (science)	0.4		-0.2
Content other than computation (maths)		-0.2	0.5
Lecture/exercise mode of working (maths)	0.4	0.4	
Resourses at home	0.2	0.3	-0.2
Resourses: computer use	0.5	-0.2	0.7
Pupils perception of school climate	0.6	-0.1	1.4
Pupils perception of safety	-0.2	-0.3	
Tutoring		-0.3	0.3
Computation (maths)		0.3	0.2
Group work (maths)			
Calculator use	-0.1	-0.1	
Explanation: maths and science			
Presentation and content not computation			
Investigation: science			
School climate: parents and children			
School climate: teachers			
Teachers' perception of safety			
Homework: science			
Homework: maths	0.3		
Maths homework amount			
Science demo			
Science observation			
School resources: general maths and science			
School resources: IT support maths and science			
School resources: infrastructure			
School climate: problem behaviours			
School climate: teachers		-0.2	
School climate and attendance: parents/children	0.2	-0.4	
Enjoyment of maths			
Vacancies			
Vacancy incentives			
IT support staff			
Achievement Band (KS2 Overall performance)			
percentage eligibility for free school meals			
% FSM squared (divided by 100)			
No. of Yr 5 pupils			

Table A4 Significant adjusted coefficients for grade 8 science

Variable	Overall Science Score	Earth Science Score	Life Science Score	Physics Score	Chemistry Score	Envir. Resources Score
Sex	4.7	10.5	-10.1	8.8	4.3	8.9
GEN\OFTEN SPEAK LANGUAGE OF TEST AT HOME	-12.0	-14.9	-14.2	-15.1		
Born outside UK	-13.7	-16.4	-8.9	-10.4		-21.2
GEN\HOW MANY PEOPLE IN YOUR HOME	-3.6	-5.8	-3.0	-2.6	-3.2	-4.5
D:STUDENTS AGE						
enjoyment/confidence in Science	23.8	24.9	24.0	13.5	22.5	20.8
motivation (science)	2.7	6.1	5.6	-3.0		
motivation (maths)		-4.7		3.6		
confidence in maths	9.0	11.6	6.0	8.9	12.8	6.9
enjoyment of maths	-6.9	-9.3	-7.2	-7.1	-9.7	-5.6
investigation and explanation (science)			3.2		6.4	
calculator use	3.5	4.2	3.5		7.2	
relevance, presentation, homework, tests	-8.8	-12.6	-6.1	-8.5	-7.2	-8.0
class/individual activities (maths/scien	6.9	7.9	7.6	7.5	4.6	5.5
content (maths)			-4.7			-3.5
resourses at home	12.3	11.6	10.6	8.7	12.3	15.6
computer use	-3.6		-4.0	-3.4	-5.6	-5.8
computer: purposes					2.7	
pupil perception of school climate				3.9		
pupil perception of safety				4.3	2.6	
tutoring	-6.9	-5.8	-7.1	-2.8	-6.0	-6.9
computation/fractions (maths)						
problem-solving/interpretation (maths)						
relevance/individual and group work (mat						
student ability/needs/attitude (maths)	-32.6	-29.6	-29.7	-27.9	-31.4	-25.8
range/number of students/ resources (math	11.4	9.4	12.3	11.5	11.2	10.3
shortage of computer resources (maths)						
strategies in learning maths		10.1				
nature of maths						
school climate: teachers (maths)		-9.9				

Table A4 contd

Variable	Overall Science Score	Earth Science Score	Life Science Score	Physics Score	Chemistry Score	Envir. Resources Score
school climate: parents/ students (maths)						
perception of safety (maths)						
frequency of homework (maths)	11.6	10.7	10.3	10.4	10.5	12.7
amount of homework (maths)						
homework questions (maths)						
homework application and follow-up (math						
investgations: demo/planning (science)						
investigation/explanation (science)						
nature, impact, presentation (science)						
relevance (science)						
limiting factors: students (science)	-6.2	-5.0	-6.4	-4.4	-4.8	-5.3
limiting factors: computer resources (sc						
limiting factors: resources (science)						
limiting factors: student numbers (scien						
nature of science/learning science	5.3					
natural phenomena (science)						
school climate: teachers (science)						
school climate: parents/ students (scienc		-6.0				
school buildings (science)						
safety/security (science)						
frequency of homework (science)	8.5	8.5	9.6	8.2	10.0	6.8
amount of homework (science)						
homework other than reading (science)	-3.4	-3.5	-3.2		-4.1	
homework: reading (science)						3.6
homework: monitoring/ follow-up (science)						
students mark homework (science)						

Table A4 contd

Variable	Overall Science Score	Earth Science Score	Life Science Score	Physics Score	Chemistry Score	Envir. Resources Score
discuss homwork (science)						
School resources: infrastructure						
School resources: IT support for maths a						
School resources: staff and equipment	-9.4					
School climate: teachers/ parents/student						
School climate: problem behaviour 1						
School climate: problem behaviour 2		-10.1				
Difficulty filling vacancies						
Incentives to recruit						
Achievement Band (KS3 Overall performanc						
percentage eligibility for free school m -35.7	-50.5	-42.1	-45.8		-44.2	-53.8
% FSM squared (divided by 100)	35.3	29.4	33.3	30.2	39.8	24.6
No. of Yr 9 pupils						

Table A5 Significant adjusted coefficients for grade 8 mathematics

Variable	Overall Maths Score	Algebra Score	Data Analysis & Probability Score	Fractions & Numbers Score	Geometry Score	Measure-ment Score
sex (boy vs. girl)	-4.2	-7.1		-2.8		
never/sometimes speak test langauge at home	-14.9					
Born outside UK	-8.6	-10.2	-22.2	-8.9	-14.1	-5.8
number of people in the home		-2.7		-2.7		
age of student						
enjoyment/confidence in Science		-2.7			8.5	
motivation (science)	3.8	6.4				1.8
motivation (maths)						
confidence in maths	22.0	21.5	15.3	23.9	21.8	22.0
enjoyment of maths						
investigation and explanation (science)		7.8				
calculator use	4.6			5.1	6.7	5.9
relevance, presentation, homework, tests	-7.3	-8.7	-8.0	-5.8	-4.4	-8.3
class/individual activities (maths/science)	3.5	2.7	7.6			3.1
content (maths)		2.3	-4.4			
resourses at home	4.6	4.8	6.4	5.5	5.2	3.0
computer use						
computer: purposes		-3.0				
pupil perception of school climate						
pupil perception of safety						-1.8
tutoring	-6.0	-3.4	-7.7	-5.4	-7.8	-6.7
computation/fractions (maths)						
problem-solving/interpretation (maths)						
relevance/individual and group work (maths)						
student ability/needs/attitude (maths)	-43.3	-40.8	-39.2	-43.5	-38.7	-35.9
range/number of students/ resources (maths)	13.3	13.8	14.8	13.2	14.1	13.7
shortage of computer resources (maths)						
strategies in learning maths				12.9		
nature of maths						

Table A5 contd

Variable	Overall Maths Score	Algebra Score	Data Analysis & Probability Score	Fractions & Numbers Score	Geometry Score	Measurement Score
school climate: teachers (maths)						
school climate: parents/ students (maths)						
perception of safety (maths)						
frequency of homework (maths)	11.4	13.0		10.0	12.5	9.7
amount of homework (maths)						
homework questions (maths)						
homework application and follow-up (maths)						
investgations: demo/planning (science)						
investigation/explanation (science)	-3.3					
nature, impact, presentation (science)						
relevance (science)						
limiting factors: students (science)		-2.7				
limiting factors: computer resources (science)						
limiting factors: resources (science)						
limiting factors: student numbers (science)						
nature of science/learning science						
natural phenomena (science)						
school climate: teachers (science)						
school climate: parents/students (science)						
school buildings (science)						
safety/security (science)						
frequency of homework (science)	4.3	3.4			3.2	
amount of homework (science)	2.7		3.6	3.6		3.3
homework other than reading (science)	-3.8		-3.1	-2.7		-4.1
homework: reading (science)						
homework: monitoring/ follow-up (science)						

Table A5 contd

Variable	Overall Maths Score	Algebra Score	Data Analysis & Probability Score	Fractions & Numbers Score	Geometry Score	Measure-ment Score
students mark homework (science)						
discuss homwork (science)						
School resources: infrastructure						
School resources: IT support for maths and science						
School resources: staff and equipment						
School climate: teachers/ parents/student						
School climate: problem behaviour 1						
School climate: problem behaviour 2						
Difficulty filling vacancies						
Incentives to recruit						9.5
Achievement Band (KS3 Overall performance)						
percentage eligibility for free school meals	-71.1	-67.4	-65.9	-76.5	-68.8	-56.0
% FSM squared (divided by 100)	55.2	52.5	49.4	58.6	53.8	43.9
No. of Yr 9 pupils						

Table A6 Significant adjusted coefficients for grade 8 attitudes

Variable	Enjoyment & Confidence in Science	Confidence in maths	Enjoyment of maths
Sex (boy vs. girl)	0.8	0.5	
never/sometimes speak test langauge at home			0.8
Born outside UK			
number of people in the home			
age of student			
enjoyment/confidence in Science		0.3	
motivation (science)	1.5	-0.3	
motivation (maths)	-0.4	0.5	1.0
confidence in maths	0.3		1.1
enjoyment of maths		1.1	
investigation and explanation (science)	0.4		
calculator use			
relevance, presentation, homework, tests	-0.2	-0.2	0.3
class/individual activities (maths/science)	0.1		
content (maths)			
resourses at home	0.4	0.2	
computer use		0.3	-0.2
computer: purposes	0.2		0.5
pupil perception of school climate	0.2		0.8
pupil perception of safety		-0.2	
tutoring			0.3
computation/fractions (maths)			
problem-solving/interpretation (maths)			
relevance/individual and group work (maths)			
student ability/needs/attitude (maths)		-0.3	
range/number of students/resources (maths)	0.2		
shortage of computer resources (maths)			
strategies in learning maths			
nature of maths			
school climate: teachers (maths)			
school climate: parents/students (maths)			
perception of safety (maths)			
frequency of homework (maths)			
amount of homework (maths)			
homework questions (maths)			
homework application and follow-up (maths)			
homework marking (maths)			
investgations: demo/planning (science)			
nature, impact, presentation (science)			
relevance (science)			-0.1
limiting factors: students (science)		-0.1	

Table A6 contd

Variable	Enjoyment & Confidence in Science	Confidence in maths	Enjoyment of maths
limiting factors: computer resources (science)			
limiting factors: resources (science)			
limiting factors: student numbers (science)			
nature of science/learning science			
natural phenomena (science)			
school climate: teachers (science)			
school climate: parents/students (science)			
school buildings (science)			
safety/security (science)			
frequency of homework (science)			
amount of homework (science)			
homework other than reading (science)			
homework: reading (science)	-0.1		
homework: monitoring/follow-up (science)			
students mark homework (science)			
discuss homwork (science)			
School resources: infrastructure			
School resources: IT support for maths and science			
School resources: staff and equipment			
School climate: teachers/parents/student			
School climate: problem behaviour 1			
School climate: problem behaviour 2			
Difficulty filling vacancies			
Incentives to recruit			
Achievement Band (KS3 Overall performance)			
percentage eligibility for free school meals	0.2		0.8
% FSM squared (divided by 100)			
No. of Yr 9 pupils			

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Summary of Previous International Mathematics and Science Studies

The 2003 TIMSS study is the latest in a series of international studies of mathematics and science performance which began in 1964. The previous studies are listed below, first for mathematics and then for science.

Studies involving mathematics

Date of Testing	Study	References
1964	First International Mathematics Study (FIMS)	Husen (1967) Pidgeon (1967)
1980–82	Second International Mathematics Study (SIMS)	Robitaille and Garden (1989) Cresswell and Gubb (1987)
1988	The first study carried out by the International Association for the Evaluation of Educational Progress (IAEP1)	Travers and Westbury (1989) Lapointe *et al*. (1989) Keys and Foxman (1989)
1991	The second study carried out by the International Association for the Evaluation of Educational Progress (IAEP2)	Lapointe *et al*. (1992a) Foxman (1992)
1994–5	The Third International Mathematics and Science Study (TIMSS)	Beaton *et al*. (1996a) Mullis *et al*. (1997) Keys, Harris and Fernandes (1996) (1997a) Harris, Keys and Fernandes (1997) Keys, Harris and Fernandes (1997b)
1998–9	The Third International Mathematics and Science Study Repeat(TIMSS-R)	Mullis *et al*. (2000) Ruddock (2000)

Full references for the above can be found below.

Studies involving science

Date of Testing	Study	References
1970–71	First International Science Study (FISS)	Comber and Keeves (1973)
1984	Second International Science Study (SISS)	Postlethwaite and Wiley (1992) IEA (1988) Keys (1987)
1988	The first study carried out by the International Association for the Evaluation of Educational Progress (IAEP1)	Lapointe *et al*. (1989) Keys and Foxman (1989)
1991	The second study carried out by the International Association for the Evaluation of Educational Progress (IAEP2)	Lapointe *et al*. (1992b) Foxman (1992)
1994–5	The Third International Mathematics and Science Study (TIMSS)	Beaton *et al*. (1996b) Martin *et al*. (1997) Keys, Harris and Fernandes (1996) (1997a) Harris, Keys and Fernandes (1997) Keys, Harris and Fernandes (1997b)
1998–9	The Third International Mathematics and Science Study Repeat(TIMSS-R)	Martin *et al*. (2000) Ruddock (2000)

Full references for the above can be found below.

The international reports for TIMSS 2003

There are two main international reports for TIMSS 2003, one covering mathematics and one covering science. A further volume, a technical report, is also available. References for the international reports on mathematics and science studies, and for previous national reports on England are given below:

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