Department for Education

# Trends in International Mathematics and Science Study (TIMSS) 2023: National report for England Volume 1

## Research report

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Government Social Research

# Contents

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## About the research team

The Principal Investigators are based at UCL Institute of Education in the Department of Curriculum Pedagogy and Assessment. Dr Jennie Golding, Associate Professor of Mathematics Education and Dr Mary Richardson, Professor of Educational Assessment, oversaw all aspects of the research analysis, reporting and dissemination.

David Wilkinson led the statistical analysis for the report, with support from PhD student Robbie Maris. David is a Principal Research Fellow in the Social Research Institute at UCL. Dr Tina Isaacs, Honorary Associate Professor of Educational Assessment, led the drafting of the report with support from Dr Iain Barnes. Christina Swensson provided project management throughout. Iain and Christina are both associates of the UCL Centre for Educational Leadership.

# Executive summary

## What is TIMSS?

The Trends in International Mathematics and Science Study (TIMSS) is an international comparison study of mathematics and science performance, organised by the International Association for the Evaluation of Educational Achievement (IEA). The study's main purpose is to provide participating countries with internationally comparable data on the performance and attitudes of 9 to 10 year olds (year 5 in England) and 13 to 14 year olds (year 9 in England) in mathematics and science, together with comparisons of the curriculum and the teaching of these subjects in primary and secondary schools. Sixty-six countries and 6 benchmarking systems participated in TIMSS 2023. England has participated in every TIMSS since the study was first carried out in 1995, and the results provide valuable information on trends in England's absolute and relative performance. This report focuses on changes over the last 20 years (2003 to 2023) since in 1995 the TIMSS sample comprised both year 4 and 5 pupils and in 1999 no year 5 pupils participated. In addition, the timing of the assessments were later from 2003, giving pupils more learning time prior to taking the tests.

In England, testing was conducted with pupils in years 5 and 9 between March and June 2023, with a sample of 8330 pupils across 267 schools. All pupils took the tests online. England's year 5 cohort started school in 2017. These pupils were at the end of Key Stage 1 in Summer 2020, but did not take part in statutory assessments at that point because of the COVID-19 pandemic. The year 9 cohort started primary school in 2013 and secondary school in 2020, and will take their GCSEs in summer 2025. They did not take statutory external assessments at the end of their year 6 because of the pandemic.

This *Trends in International Mathematics and Science Study (TIMSS) 2023: National Report for England Volume 1* focuses on comparisons of England's pupils' performance in mathematics and science with the performance of pupils in the highest-performing countries, other English-speaking countries and a selection of other European countries. *Trends in International Mathematics and Science Study (TIMSS) 2023: National Report for England Volume 2*, published in March 2025, focuses on performance in England analysed by pupil characteristics[1] and participating pupils' reported experiences of mathematics and science teaching and learning, including some international comparisons. The *TIMSS International Report 2023* offers comparisons across all participating countries[2].

[1] Characteristics include gender, language spoken at home and socio-economic status.
[2] See: International Association for the Evaluation of Educational Achievement (2024) *TIMSS 2023.* Available at https://timssandpirls.bc.edu/timss2023/

## How does the mathematics and science performance of pupils in England compare internationally?

In 2023, pupils in England performed, on average, significantly[3] above the TIMSS centrepoint (500) in mathematics and science in both years 5 and 9. They also performed significantly above the 2023 international mean in both subjects and both year groups. Comparing England's pupils' overall performance in 2023 with 2019, year 5 pupils' performance remained stable in mathematics and improved significantly in science. Year 9 pupils' performance in mathematics improved but not significantly; in science it improved significantly, following a significant decrease in performance in 2019.

Between 2003 and 2023, the mathematics performance of year 5 and year 9 pupils in England improved significantly. The performance of year 5 pupils in science has been more varied but has still seen significant improvement over the 20-year period, while in year 9 science performance has remained broadly stable except in 2019 when it decreased significantly.

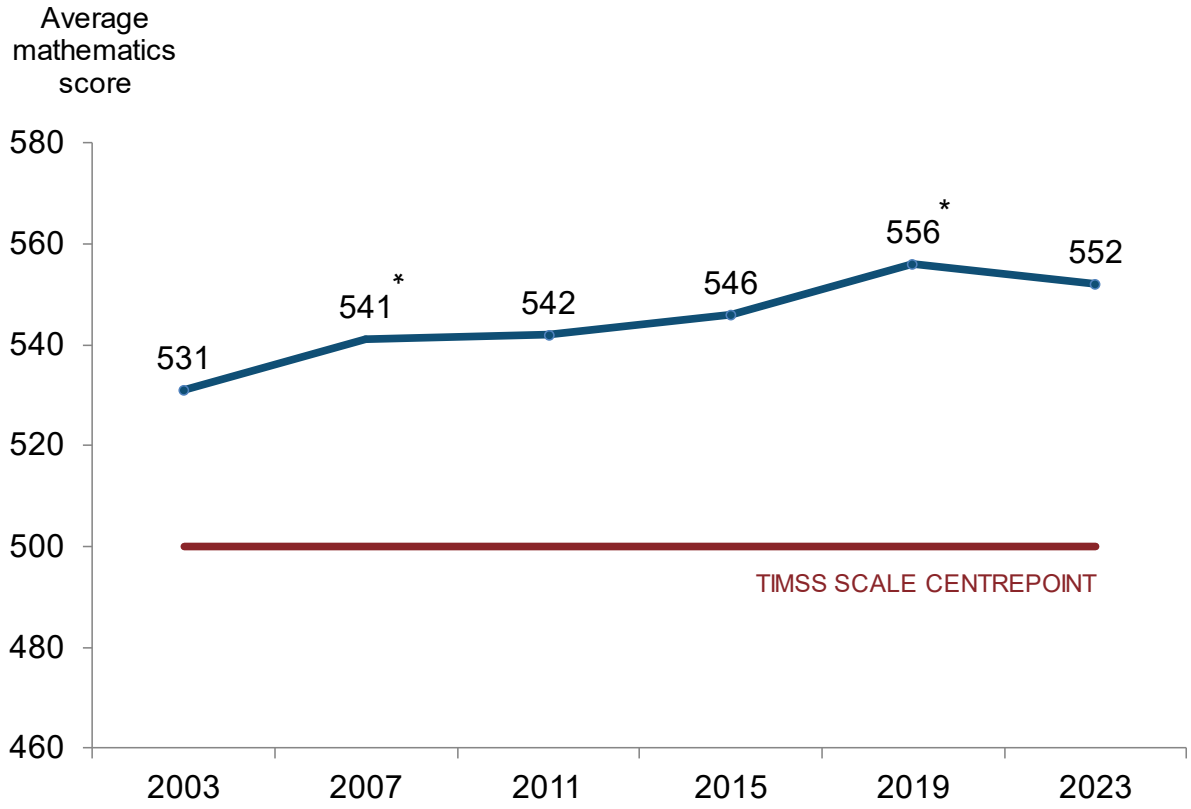
England's pupils' performance in 2023 placed them in a group of countries whose pupils performed below the highest-performers but significantly above the TIMSS centrepoint in mathematics and science in both years 5 and 9. In most of the 5 East Asian comparator countries pupils performed significantly above their peers in England across both subjects and year groups (Chinese Taipei, Japan, the Republic of Korea and Singapore), except for year 5 peers in Japan who performed similarly. In comparison with Hong Kong's pupils, pupils in England performed significantly below them in mathematics in both years 5 and 9, while in year 5 science they performed significantly above them and in year 9 similarly to them.

## Mathematics – year 5

The trend in England's year 5 mathematics score is one of significant improvement between 2003 and 2023. Figure 1 and Table 1 show that the performance of pupils in England increased in each consecutive TIMSS cycle until 2023, when there was a small but not significant decrease.

[3] Throughout the report, explanations are presented about data collection, methodology used and how to interpret data. Where the terms 'significant' or 'not significant' are given, these mean that the finding referred to is either statistically significant or not statistically significant at the 5% level. Significance levels will depend on the averages but also on the standard deviations. Both averages and standard deviations are used to calculate a T-statistic, which is then compared to the critical values in t-tables.

**Figure 1: Trend in average year 5 mathematics score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Note 2: Mathematics scores that represent a significant increase on the previous TIMSS cycle are marked with an asterisk (*).

**Table 1: Year 5 average mathematics scores between 2003 and 2023 (England)**

| Year | Average mathematics score |
|---|---|
| 2003 | 531 |
| 2007 | 541 (significant increase) |
| 2011 | 542 |
| 2015 | 546 |
| 2019 | 556 (significant increase) |
| 2023 | 552 |

Source: IEA TIMSS International Report 2023

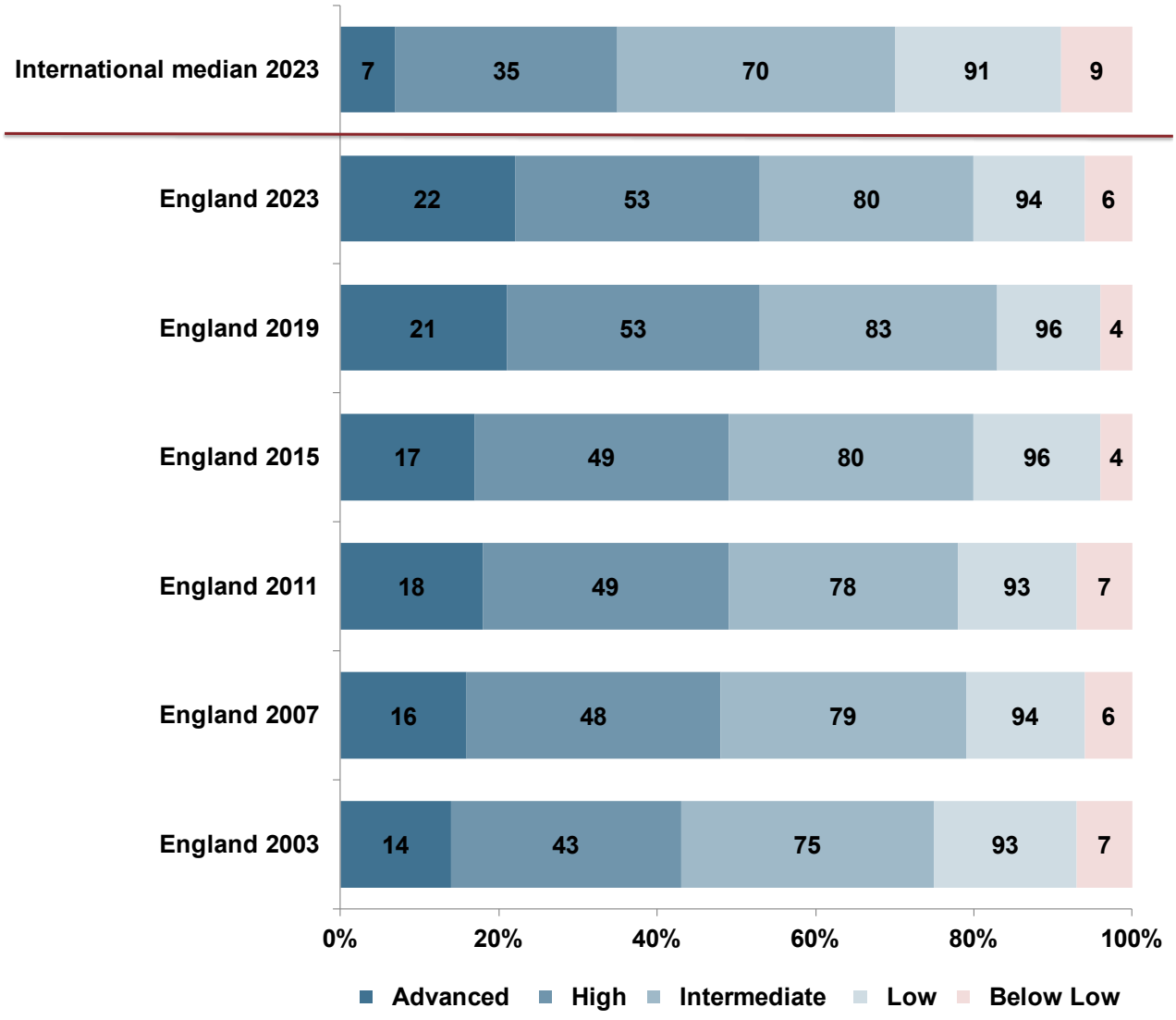
Note 1: Response rates for TIMSS in England were relatively low in 2003.

Year 5 pupils in 7 countries performed significantly above pupils in England, 4 at a similar level, and 46 significantly below. Five of the countries in which pupils performed

significantly above pupils in England in 2023 also did so in 2019: the East Asian comparator countries (Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore); the other 2 were Macao and Lithuania.

Between 2003 and 2023 there has been a significant improvement in the proportion of year 5 pupils in England reaching each of the international benchmarks except the low benchmark or above. The proportion of year 5 pupils reaching the low international benchmark or above significantly decreased in 2023 from 2019, from 96% to 94% (see Figure 2 and Table 2 below).

**Figure 2: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 2: Percentage of year 5 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 35 | 70 | 91 | 9 |
| England 2023 | 22 | 53 | 80 | 94 | 6 |
| England 2019 | 21 | 53 | 83 | 96 | 4 |
| England 2015 | 17 | 49 | 80 | 96 | 4 |
| England 2011 | 18 | 49 | 78 | 93 | 7 |
| England 2007 | 16 | 48 | 79 | 94 | 6 |
| England 2003 | 14 | 43 | 75 | 93 | 7 |

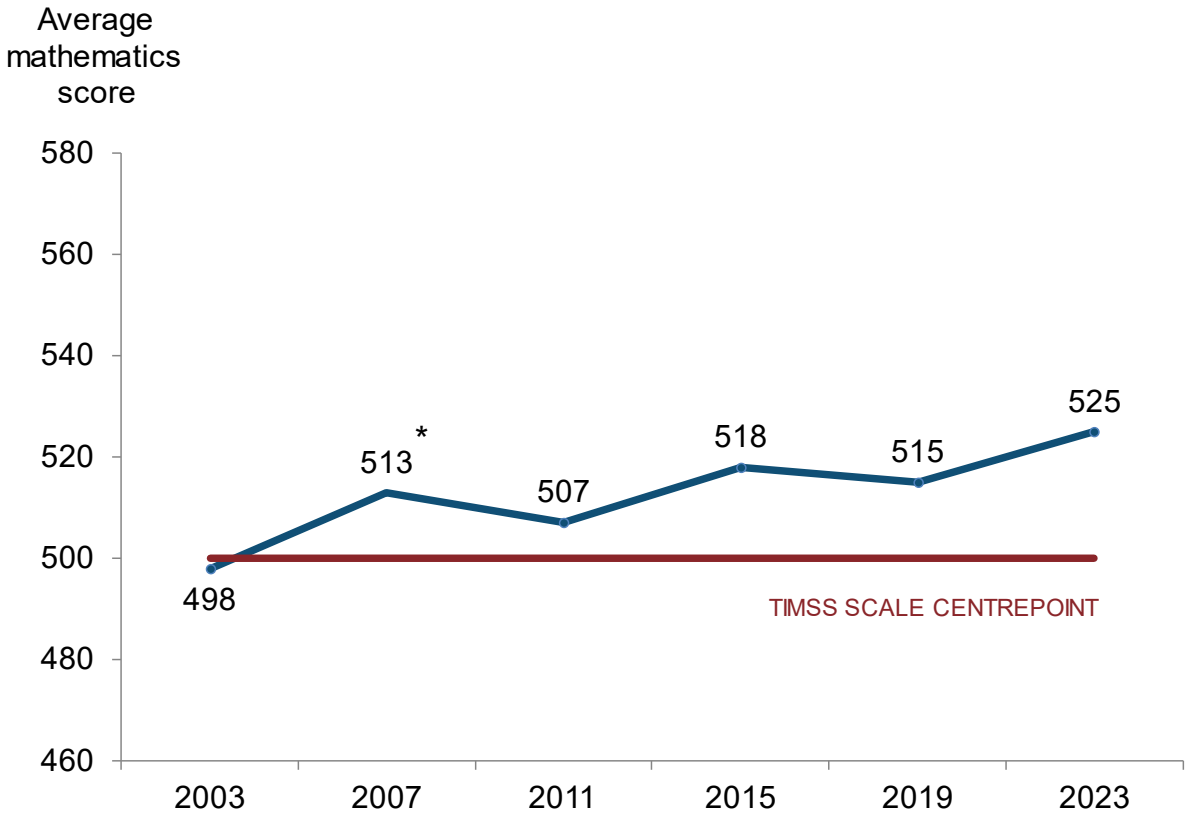
Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

## Mathematics – year 9

The performance in year 9 pupils in mathematics saw significant improvement between 2003 and 2007, and has been broadly stable since 2007 (see Figure 3 and Table 3). The 2023 TIMSS average score for pupils in England was 525, 10 scale points higher than in 2019 but this was not a significant improvement.

**Figure 3: Trend in average year 9 mathematics score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Note 2: Scores that represent a significant increase on the previous TIMSS cycle are marked with an asterisk (*).

**Table 3: Year 9 average mathematics scores between 2003 and 2023 (England)**

| Year | Average mathematics score |
|---|---|
| 2003 | 498 |
| 2007 | 513 (significant increase) |
| 2011 | 507 |
| 2015 | 518 |
| 2019 | 515 |
| 2023 | 525 |

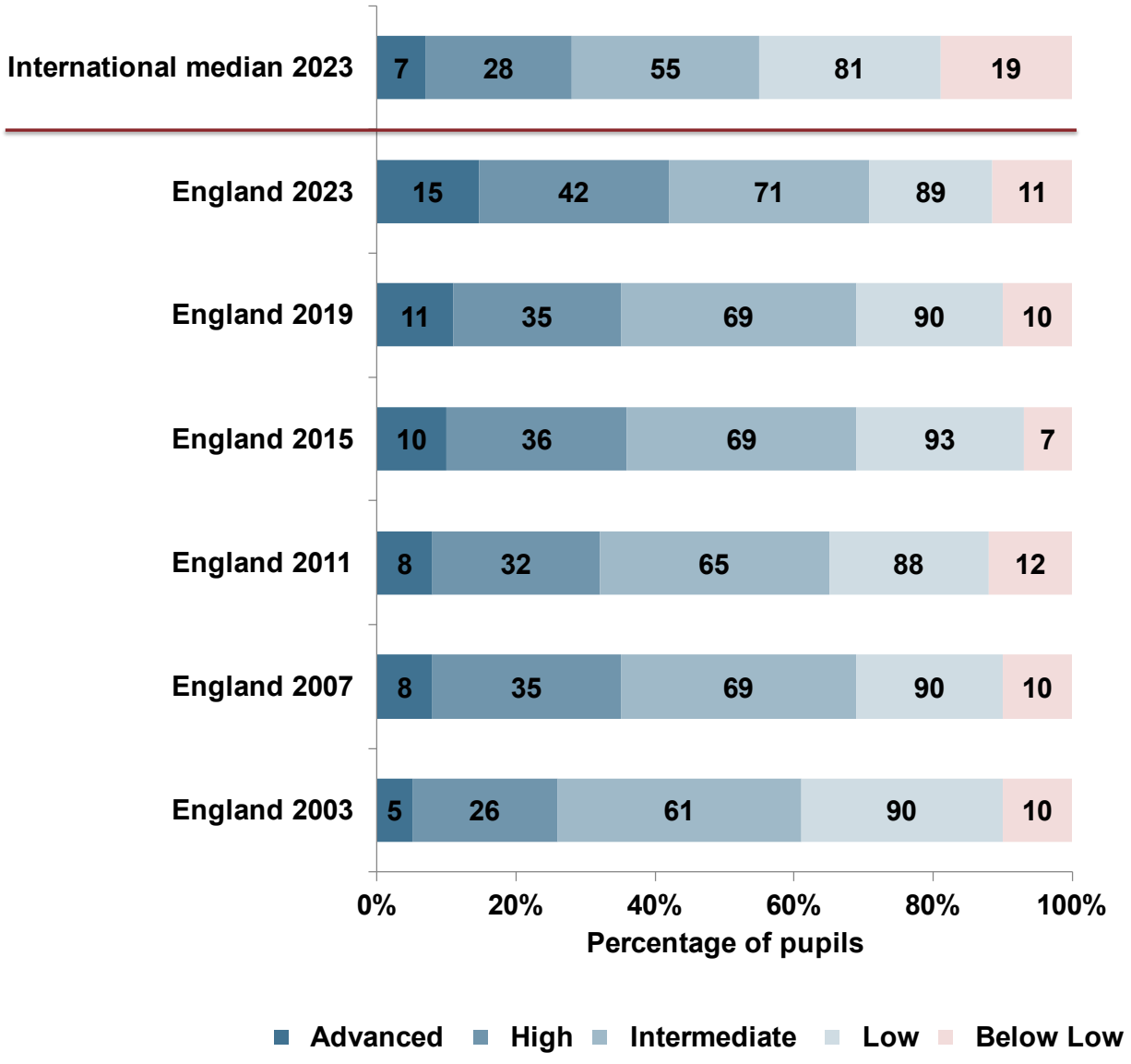
Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

England's year 9 pupils continued to perform significantly above the international average in 2023. Pupils in 5 countries performed significantly above England's pupils, in 3 countries they performed at a similar level, and in 35 countries they performed significantly below them. Pupils from the same 5 East Asian countries that performed significantly above England's pupils in 2019 (Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore) also did so in 2023.

In 2023, the 7 percentage point increase in pupils reaching the high or above benchmark was significant. The 4 percentage point increase for pupils reaching the advanced benchmark was not significantly different from 2019. The percentages of year 9 pupils reaching the low or above and intermediate or above benchmarks have remained similar to 2019 (see Figure 4 and Table 4).

**Figure 4: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**



Source: IEA TIMSS International Report 2023

**Table 4: Percentage of year 9 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 28 | 55 | 81 | 19 |
| England 2023 | 15 | 42 | 71 | 89 | 11 |
| England 2019 | 11 | 35 | 69 | 90 | 10 |
| England 2015 | 10 | 36 | 69 | 93 | 7 |
| England 2011 | 8 | 32 | 65 | 88 | 12 |
| England 2007 | 8 | 35 | 69 | 90 | 10 |
| England 2003 | 5 | 26 | 61 | 90 | 10 |

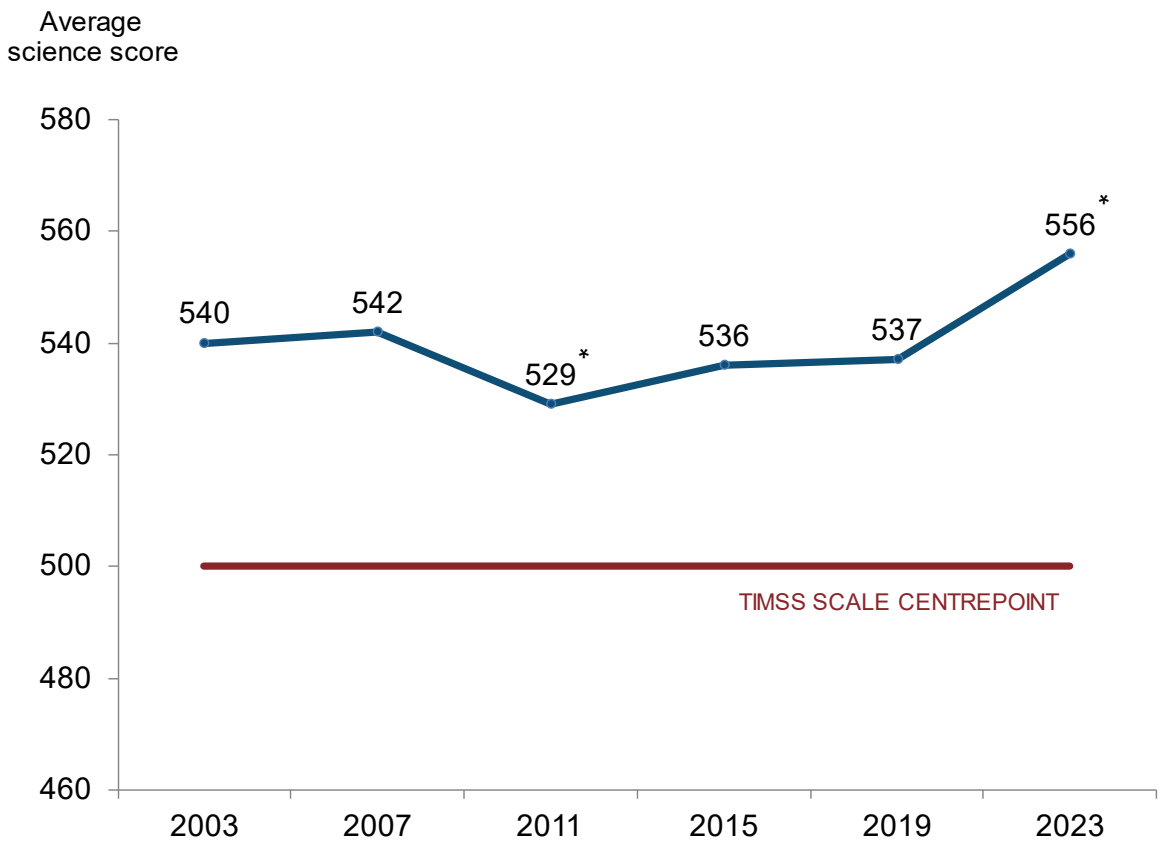
Source: IEA TIMSS International Report 2023

The difference between the highest- and lowest-performing year 9 pupils' scores increased in 2023 by 25 scale points (from 297 in 2019 to 322 in 2023), driven largely by improvements in the highest performance. The difference in the range of pupils' scale scores in the highest-performing countries compared with that in England was mixed, while the range for England's pupils was larger than in each of the English-speaking and European comparator countries.

## Science – year 5

Year 5 pupils' performance in science has been consistently and significantly above the international centrepoint in all TIMSS cycles (see Figure 5 and Table 5). The performance of year 5 pupils in England in 2023 was significantly above average scale scores in each previous TIMSS cycle.

## Figure 5: Trend in average year 5 science score (England)




Source: IEA TIMSS International Report 2023

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Note 1: Response rates for TIMSS in England were relatively low in 2003.

Note 2: Scores that represent a significant increase or decrease from the previous TIMSS cycle are marked with an asterisk (*).

## Table 5: Year 5 average science scores between 2003 and 2023 (England)

| Year | Average score |
|---|---|
| 2003 | 540 |
| 2007 | 542 |
| 2011 | 529 (significant decrease) |
| 2015 | 536 |
| 2019 | 537 |
| 2023 | 556 (significant increase) |

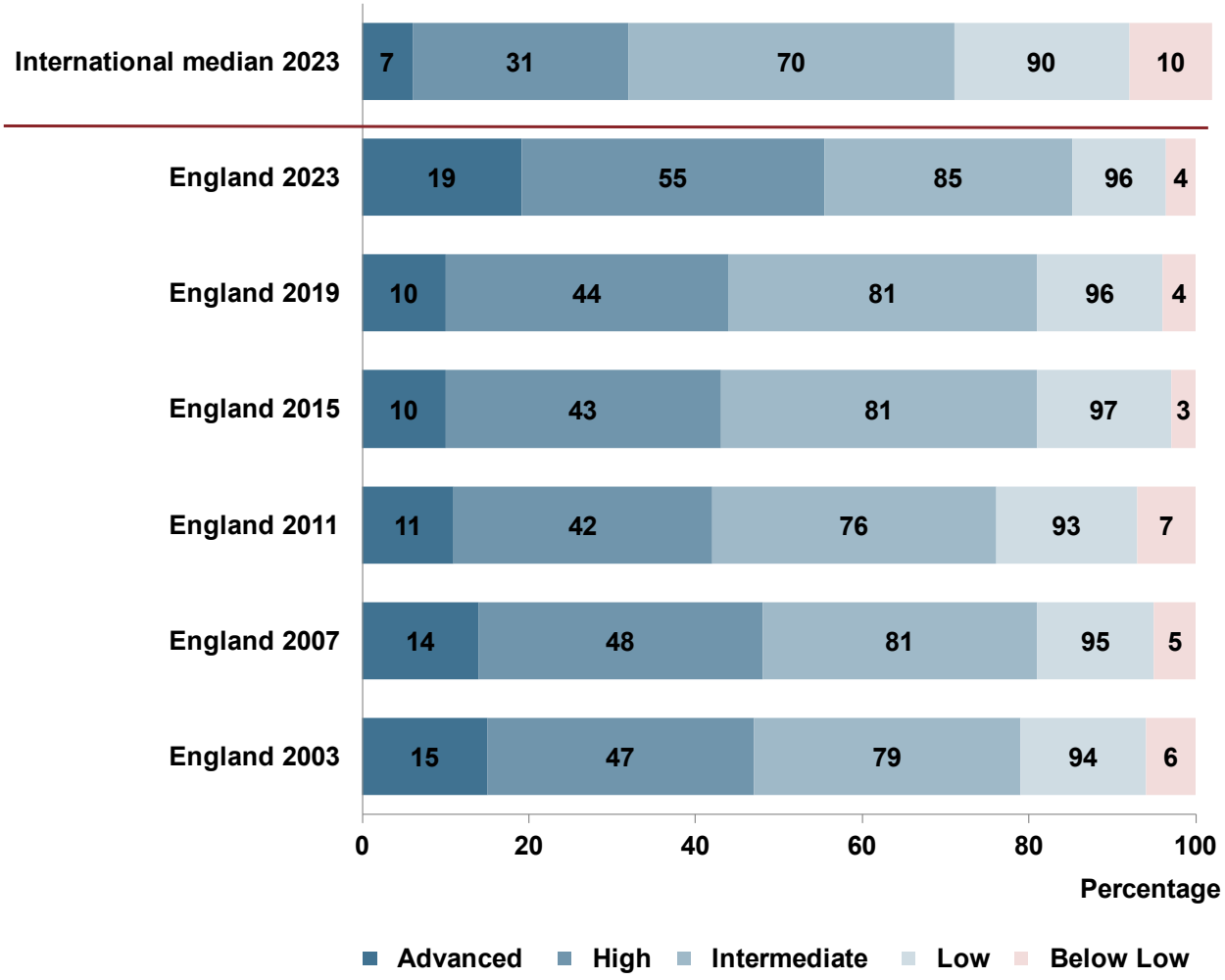
Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

For year 5, pupils in 4 countries (Chinese Taipei, the Republic of Korea, Singapore and Turkey) performed significantly above their peers in England; this was 2 fewer than in 2019. Only pupils in Japan performed at a similar level to pupils in England. Pupils in England performed significantly above their peers in the remaining 52 countries.

Figure 6 and Table 6 below show that, in 2023, the percentages of year 5 pupils reaching each of the international TIMSS benchmarks, except the low or above benchmark, were larger than those in 2019 and in any TIMSS cycle. The percentage of pupils reaching the advanced benchmark nearly doubled.

**Figure 6: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in science (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 6: Percentage of year 5 pupils reaching each of the TIMSS international benchmarks in science (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 31 | 70 | 90 | 10 |
| England 2023 | 19 | 55 | 85 | 96 | 4 |
| England 2019 | 10 | 44 | 81 | 96 | 4 |
| England 2015 | 10 | 43 | 81 | 97 | 3 |
| England 2011 | 11 | 42 | 76 | 93 | 7 |
| England 2007 | 14 | 48 | 81 | 95 | 5 |
| England 2003 | 15 | 47 | 79 | 94 | 6 |

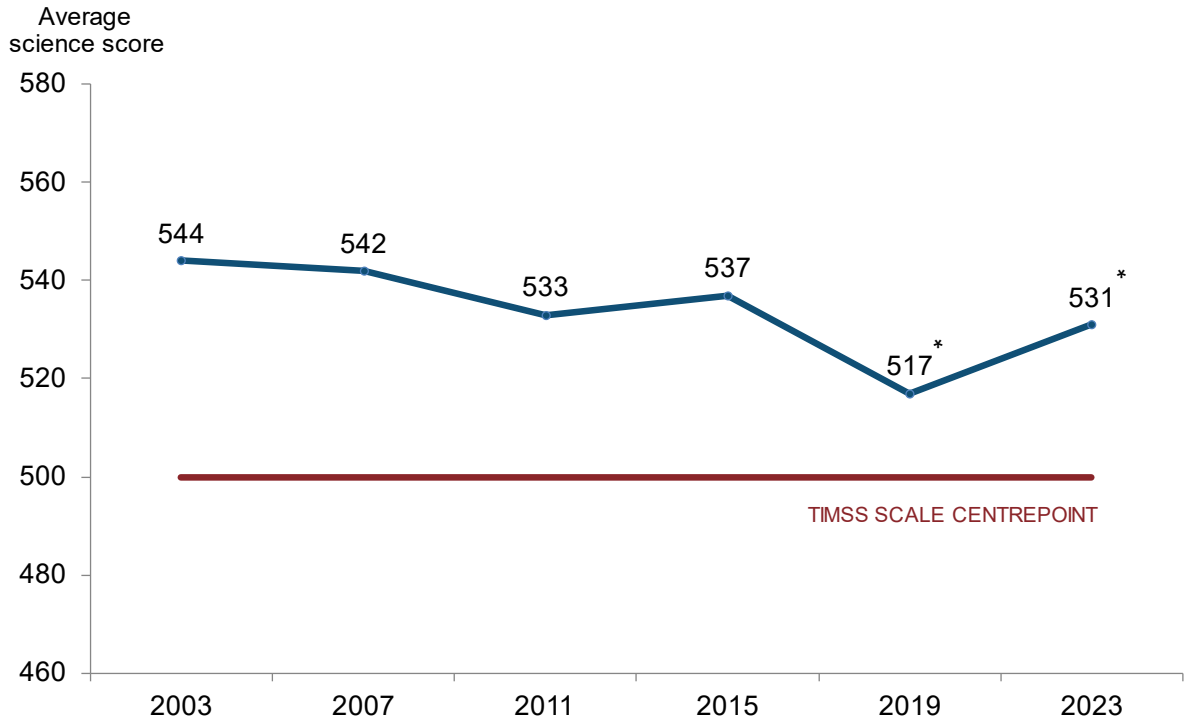
Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

## Science – year 9

The performance of year 9 pupils in England in science was a significant improvement on 2019. Performance over time between 2003 and 2023 has remained broadly stable, although there was a significant decrease in 2019 (see Figure 7 and Table 7 below).

**Figure 7: Trend in average year 9 science score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.
Note 2: Scores that represent a significant increase or decrease from the previous TIMSS cycle are marked with an asterisk (*).

**Table 7: Year 9 average science scores between 2003 and 2023 (England)**

| Year | Average science score |
|---|---|
| 2003 | 544 |
| 2007 | 542 |
| 2011 | 533 |
| 2015 | 537 |
| 2019 | 517 (significant decrease) |
| 2023 | 531 (significant increase) |

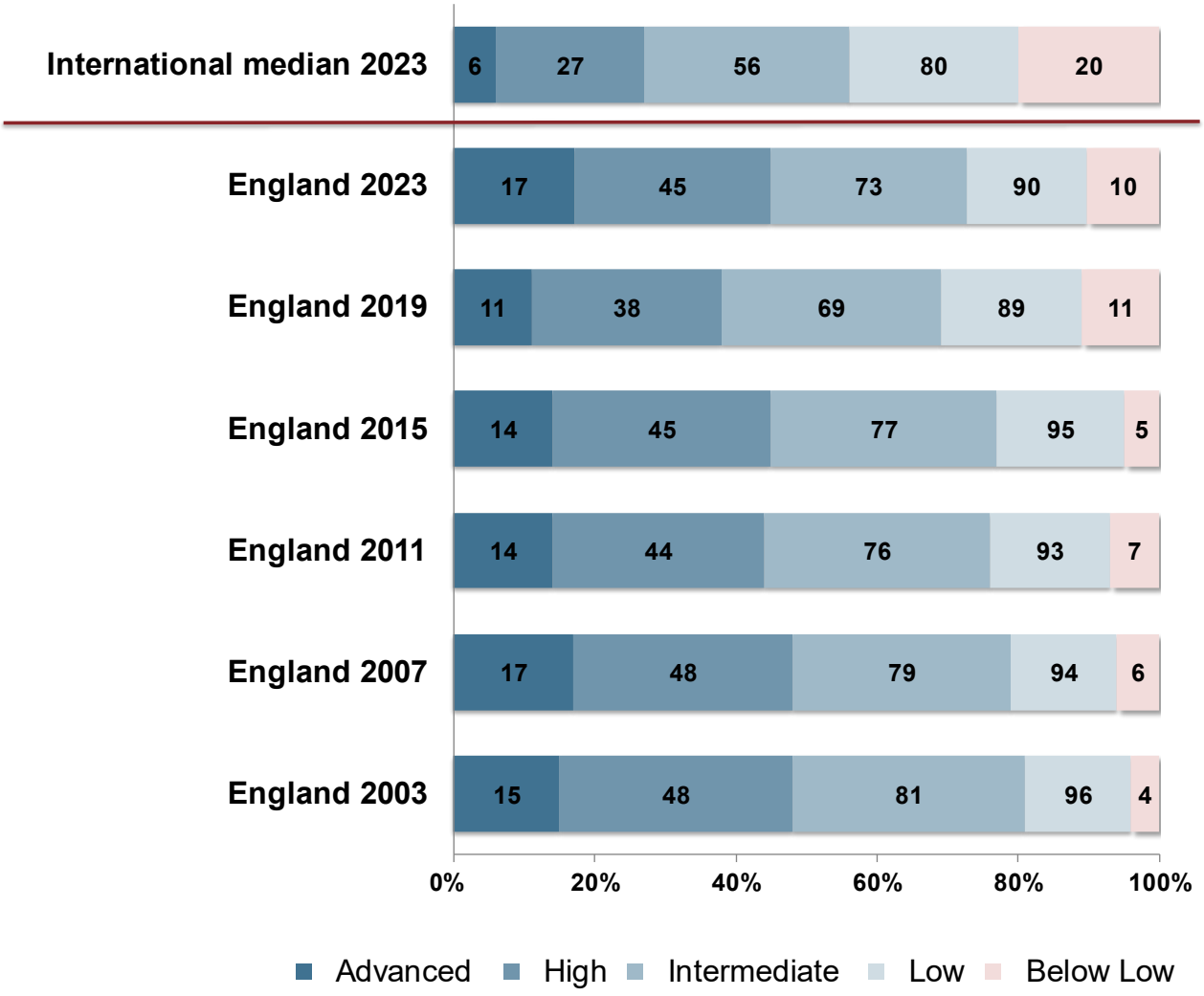
Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Pupils in 4 countries performed significantly above England's pupils in 2023 (5 fewer than in 2019): the same 4 East Asian countries as in 2019 (Chinese Taipei, Japan, the Republic of Korea and Singapore). Pupils in 6 countries performed at a similar level to England's pupils and in 33 countries significantly below them.

A larger percentage of year 9 pupils achieved each of the international benchmarks in England compared with the international median across all participating countries (see Figure 8 and Table 8). There was a significant increase in the percentage of pupils reaching each of the benchmarks in 2023, except the low benchmark or above, compared with 2019.

**Figure 8: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in science (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 8: Percentage of year 9 pupils reaching each of the TIMSS international benchmarks in science (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 6 | 27 | 56 | 80 | 20 |
| England 2023 | 17 | 45 | 73 | 90 | 10 |
| England 2019 | 11 | 38 | 69 | 89 | 11 |
| England 2015 | 14 | 45 | 77 | 95 | 5 |
| England 2011 | 14 | 44 | 76 | 93 | 7 |
| England 2007 | 17 | 48 | 79 | 94 | 6 |
| England 2003 | 15 | 48 | 81 | 96 | 4 |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

In 2023, the difference between England's highest- and lowest-performing year 9 pupils' scores in science was 326 scale points compared with 302 in 2019. The increase was driven by an improvement in the scores of the strongest performing pupils. The range for England's pupils was larger than that found for pupils in any of the comparator countries with the exception of Singapore where it was the same (326).

## Pupils' performance in the content and cognitive domains

TIMSS enables a detailed comparison of pupils' mathematics and science performance in specific subject and cognitive domains. Each of the assessment questions is categorised according to the area of the curriculum it covers (referred to in TIMSS as content domains) and the different cognitive skills it requires (referred to in TIMSS as cognitive domains)[4].

In both mathematics and science, pupils in England in 2023 performed above the international averages in all content and cognitive domains for both year 5 and year 9.

[4] See Mullis, I. V. S., Martin, M. O. & von Davier, M. (Eds.) (2021) *TIMSS 2023 Assessment Frameworks*. Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2023/frameworks/index.html

In mathematics in 2023, as in 2015 and 2019, year 5 pupils in England were strongest in the data domain and weakest in the measurement and geometry domain. Their performance in number in 2023 was not significantly different from their overall mathematics average score. In 2023, year 5 pupils' strength in data was in contrast to the majority of the highest-performing countries, which performed strongly in measurement and geometry.

Year 9 pupils in England were stronger in data and probability and in number, and weaker in algebra and geometry. These relative strengths and weaknesses in 2023 mirrored the 2019 and 2015 outcomes. In year 9 the strengths of pupils in the highest-performing countries were mixed, lying across the data and probability, geometry and measurement and number domains.

In the cognitive domains in 2023, year 5 pupils in England performed significantly higher in the knowing domain than their overall average mathematics score. Year 9 pupils performed significantly higher in the knowing and applying domains and significantly lower in the reasoning domain than their overall average mathematics performance.

Year 5 pupils' performance in each of the science content domains in 2023 was not significantly different from their overall average science score, in contrast to 2015 and 2019 when pupils were weakest in the Earth science domain. In 2023, year 5 pupils in England did not perform significantly differently from the overall science average score in any cognitive domain.

In 2023, year 9 pupils in England achieved average scores in each content domain (biology, chemistry, physics and Earth science) that were not significantly different from the overall average science score. In 2023, as in 2019, year 9 pupils' average scores in all content domains were significantly higher in 2023 than in 2019, in line with England's higher overall science average score. In 2023, year 9 pupils' average score for the knowing domain was not significantly different from the overall science average score, as in 2019. However, in contrast to both 2015 and 2019 pupils were relatively weaker in applying in 2023. Pupils' performance in the reasoning domain has fluctuated over the most recent 3 TIMSS cycles between this being the strongest domain in 2015 and 2023 and weakest in 2019.

The 2023 TIMSS results saw stability in year 5 pupils' performance in mathematics, an increase, though not significant, in year 9 mathematics and significant increases in both year 5 and year 9 science. Such outcomes in the wake of considerable disruption to education over the extended pandemic period reflect schools' strong commitment to recovery. However, within these generally encouraging outcomes, continued attention should be given to both content and cognitive domains, noting the relatively weak performance in geometry and measurement in both year groups, as well as in algebra in year 9. Additionally, development of a consistently balanced and strong range of

cognitive skills would support effective mathematical and scientific development. Increased ranges of performance in both subjects and levels were driven by enhanced scores of high-performing pupils; more work is needed to establish exactly which groups of pupils are not currently benefiting from these pleasing average performances.

# Chapter 1. Introduction

## 1.1 What is the Trends in International Mathematics and Science Study (TIMSS)?

Designed by the International Association for the Evaluation of Educational Achievement (IEA), TIMSS is a worldwide research project that takes place every 4 years[5]. The TIMSS & PIRLS International Study Center, located at Boston College's Lynch School of Education and Human Development in the United States, directs TIMSS with support from the IEA and the national centres of participating countries. Research Triangle Institute (RTI) International organised and led the sampling, data collection, date file preparation and reporting activities. TIMSS is 1 of 3 international large-scale assessments (ILSAs) described in section 1.2.3 below.

The study's main purpose is to provide internationally comparable data about trends in pupils' mathematics and science achievement[6] at primary and secondary school levels over time. Teachers and headteachers in participating schools complete questionnaires on factors that potentially have an impact on academic attainment. TIMSS findings can therefore have policy and practice implications for readers. Pupil data is collected through academic assessments and attitudinal surveys. Contextual data from the pupils' headteachers and teachers is also collected through attitudinal surveys.

TIMSS was first carried out in 1995 and data has been collected every 4 years since, so that 2023 represents the study's 8th cycle over a 28-year period[7], which is the longest of any international educational assessment. To enable robust international comparisons, the study uses data collected from samples of pupils in the same academic year groups: pupils aged 9 to 10 and 13 to 14. In England, these pupils are in years 5 and 9[8].

TIMSS 2023 has transitioned to digital assessment, which began with TIMSS 2019 and reflects the increasing use of technology in schools. It used assessments in new item formats and interactive features as well as scenario-based Problem Solving and Inquiry tasks (PSIs), created to motivate pupils and take advantage of the digital environment. The IEA has also produced new digital teacher-directed publications − IEA Teacher

[5] The IEA (International Association for the Evaluation of Educational Achievement) 'is an international cooperative of national research institutions, governmental research agencies, scholars, and analysts working to research, understand, and improve education worldwide.' It conducts 'high-quality, large-scale comparative studies of education across the globe in order to provide educators, policymakers, and parents with insights into how students perform' (source: https://www.iea.nl/).
[6] In general, in England, education professionals use 'attainment' for absolute performance, and 'achievement' for performance relative to initial capacity. However, IEA use 'achievement' through most of their TIMSS documentation, so this report follows that usage.
[7] The 1999 study in England included year 9 pupils only.
[8] In the IEA's methodology and TIMSS International Reports, these year groups are referred to as 4th and 8th grade, reflecting terminology used across the range of participating countries.

Snippets and Research for Educators − that provide tools, information, and ideas to implement in the classroom as education systems and curricula develop.

In 2023, a total of 66 jurisdictions/countries[9] and 6 benchmarking systems[10] participated in TIMSS (see Table 9 below). Across these countries and systems, more than 659,000 pupils participated in 2023. Information about the study design and conduct in each country can be found in the TIMSS International Report 2023[11]. In 2023, 59 countries and 6 benchmarking systems participated in the 4th grade (year 5 in England) TIMSS, and 44 countries and 3 benchmarking systems participated in the 8th grade (year 9 in England) TIMSS[12]. England participated in both the year 5 and 9 mathematics and science assessments in 2023 and has participated in these since 1995. This report focuses on changes over the last 20 years (2003 to 2023) since in 1995 the TIMSS sample comprised both year 4 and 5 pupils and in 1999 no year 5 pupils participated. In addition, the timing of the assessments were later from 2003, giving pupils more learning time prior to taking the tests.

**Table 9: TIMSS 2023: participating countries and benchmarking systems**

| **Continents, regions and systems** | **Participating countries and benchmarking systems** |
|---|---|
| Africa (3) | Côte d'Ivoire, Morocco, South Africa |
| Asia (10) | Chinese Taipei, Hong Kong SAR[13], Japan, Kazakhstan, Macau SAR[14], Malaysia, Republic of Korea, Singapore, Turkey |
| Australasia (2) | Australia, New Zealand |
| Europe (39) | Albania, Armenia, Austria, Azerbaijan, Belgium (Flemish), Belgium (French), Bosnia and<br>Herzegovina, Bulgaria, Cyprus, Czech Republic, Denmark, England, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Kosovo, Kurdistan, Latvia, Lithuania, Malta, Montenegro, Netherlands, Norway, North Macedonia, |

[9] For ease of reading, the term 'country' will be used in the report.
[10] States and provinces within countries that collect representative samples in TIMSS and so can provide comparative findings.
[11] Available at https://timssandpirls.bc.edu/timss2023/
[12] See https://nces.ed.gov/timss/participation.asp
[13] Hong Kong Special Administrative Region (SAR) is referred to as Hong Kong in the report.
[14] Macau Special Administrative Region (SAR) is referred to as Macau in the report.

| Continents, regions and systems | Participating countries and benchmarking systems |
|---|---|
| | Poland, Portugal, Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Uzbekistan |
| The Middle East (13) | Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, United Arab Emirates (UAE) |
| The Americas (4) | Brazil, Canada, Chile, United States |
| Benchmarking systems (6) | Abu Dhabi (UAE), Dubai (UAE), Kurdistan Region of Iraq, Ontario (Canada), Quebec (Canada), Sharjah (UAE) |

A consortium comprising Pearson and the UCL Institute of Education (UCL IOE) managed test administration, national data analysis and reporting in England. Pearson recruited schools for the field trial and main study assessments, adapted the test items for use in England and supported participating schools in the administration of the tests during the main study period from 6 March to 30 June 2023. Pearson also marked all assessment and questionnaire responses. UCL IOE undertook a curriculum matching exercise to identify which of the TIMSS test items pupils in schools in England would have been expected to have studied by the time they took the TIMSS assessments. They were also responsible for national data analysis and the writing of this national report.

The IEA analysed the international database of country results and the evidence from pupil, headteacher and teacher questionnaires. This analysis is available in the IEA's TIMSS International Report 2023. The IEA also commissioned a TIMSS Encyclopedia[15] chapter from each participating country to provide an overview of the structure of each participating education system; England's chapter was written by the UCL IOE team.

Appendix A provides more detailed information about the TIMSS survey methodology and the processes that underpinned the creation of the IEA's TIMSS International Report 2023.

[15] T Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). *TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882

## 1.2 What TIMSS tells us

### 1.2.1 Why England participates in TIMSS

TIMSS enables governments to benchmark education policy and performance, to make evidence-based decisions and to learn from one another. Participation is also of great value to academic and research communities and to participating schools.

In England, TIMSS gives interested individuals and organisations important insights into how well pupils are performing in mathematics and science in years 5 and 9 at the content and cognitive levels, in relation both to England's previous achievements – trends over time – and to the achievements of pupils in other participating countries. This Volume 1 of the report for England analyses pupil performance across both subjects and year groups, comparing these with selected other countries. TIMSS also provides a valuable opportunity for achievement to be considered in the context of school and background factors that potentially influence it. The factors reported in Volume 2 of the report for England, published in spring 2025, include:

- pupils' attitudes towards mathematics and science
- pupils' perceptions of teaching in these subjects
- teachers' education, experience and job satisfaction
- headteachers' and teachers' views on school discipline
- pupils' reports on their home environment and resources at home

### 1.2.2 What is the impact of TIMSS?

England has taken part in all TIMSS cycles since 1995. Policymakers, educators, academics and research organisations in England study the results to explore the potential for improvements in teaching, learning and assessment of mathematics and science, and to conduct further research relating to significant changes in results. Factors of interest include the proportion of pupils reaching each international benchmark and the range of scores – with particular interest in narrowing attainment gaps between advantaged and disadvantaged pupils. Using matched data from England's National Pupil Database (NPD) provides insights into potential relationships between pupils' achievement and characteristics such as gender, socio-economic status and first language. Comparisons can also be made between how much pupils value learning mathematics and science and their TIMSS performance.

Awareness of teachers' and headteachers' perceptions of discipline and safety, and professional development opportunities can provide evidence to guide suggested areas for future planning. And while it is impossible to single out the effect of the COVID-19

pandemic on pupil performance, the longitudinal analysis of trends over time in England provides some insight into impacts since March 2020.

Since 1995, TIMSS findings (together with those from other international benchmark studies) have been used to identify priorities for improving mathematics and science policy and practice – for example, informing the activities of the National Centre for Excellence in the Teaching of Mathematics (NCETM)[16] and the National Science, Technology, Engineering and Mathematics (STEM) Learning Centre [17].

### 1.2.3 How does TIMSS compare to other international surveys?

England takes part in 2 other international large-scale assessments looking at the performance of school-age pupils in schools: the Progress in International Reading Literacy Study (PIRLS) and the Programme for International Student Assessment (PISA).

The PIRLS programme is organised in a similar manner to TIMSS. PIRLS is also coordinated by the IEA and is an international test for pupils in the 4th grade (year 5 in England) that measures pupils' reading literacy. It is administered every 5 years. The first iteration took place in 2001 and England has participated in every cycle. Like TIMSS, the PIRLS assessments survey teachers and headteachers to document school and teacher instructional practices and other school experiences related to developing reading literacy. Pupils also complete questionnaires about their attitudes toward reading and their reading habits. The most recent cycle, in 2021, included 57 countries and benchmarking systems.

Pupils in England scored significantly[18] above the international median of 520 with a score of 558. This score was not significantly different from England's scores in previous cycles. In PIRLS 2021 most education systems experienced significant performance drops since 2016, but that may be because many systems collected data during the COVID-19 pandemic, while England collected its data one year later[19].

The curriculum model in TIMSS differs from that used in the PISA study from the Organisation for Economic Co-operation and Development (OECD), which was last administered in 2022, a delay of one year due to the COVID-19 pandemic. The 3-yearly PISA international study assesses pupils aged 15 (primarily in year 11 in England) in

[16] See https://www.ncetm.org.uk/
[17] See https://www.stem.org.uk/
[18] Throughout the report, explanations are presented about data collection, methodology used and how to interpret data. Where the terms 'significant' or 'not significant' are given, these mean that the finding referred to is either statistically significant or not statistically significant at the 5% level. Significance levels will depend on the averages but also on the standard deviations. Both averages and standard deviations are used to calculate a T-statistic, which is then compared to the critical values in t-tables.
[19] Progress in International Reading Literacy Study (PIRLS): National Report for England (2024). Available at: https://www.gov.uk/government/publications/pirls-2021-reading-literacy-performance-in-england

reading, mathematics and science literacies. TIMSS and PISA are complementary but differ in particular ways: TIMSS assesses pupils across 2 separate year groups and its assessments are focused on pupils' knowledge and understanding of curriculum content, whereas PISA assesses the application of education to real-life problems in reading, mathematics and science. In 2022, 81 education systems participated in PISA.

In PISA 2022, mean scores in England were significantly above the OECD average in all 3 subjects (mathematics 492, OECD average 472; reading 496, OECD average 476; science 503, OECD average 485). England's score of 492 in mathematics was significantly lower than the 504 achieved in 2018, although it was not significantly different from average scores in PISA cycles prior to 2018. England's score in reading for PISA 2022 (505) was significantly below the average score in 2018, although not significantly different from scores achieved between 2006 and 2015. England's overall average science score for 2022 (503) was not significantly different from the score of 507 that was achieved in PISA 2018, though the decrease might suggest a slight, if any, COVID-19 pandemic impact. However, between 2015 and 2022 the performance of pupils in science declined significantly. These patterns were observed in many education systems[20].

Please see this report's conclusion for further discussion on TIMSS and PISA performance in England.

## 1.3 About the TIMSS sample

All countries and benchmarking systems participating in TIMSS followed strict guidelines and sampling targets to ensure that the group of pupils that eventually participated in the study was nationally representative.

In England, 152 primary and 154 secondary schools were invited to participate in the main TIMSS study of which 131 and 136 respectively participated. Schools were selected according to a sampling framework representative of all schools in England. Depending on class size, 1 or 2 randomly selected year 5 or year 9 classes were chosen from each participating school and all the pupils from the selected classes were asked to participate in the study.

The IEA's sampling referee inspected the school and pupil samples, and they were accepted for TIMSS 2023 if they met one or both of the following criteria:

- a minimum school participation rate of 85%

[20] PISA 2022: National Report for England (2023). Available at: https://www.gov.uk/government/publications/pisa-2022-national-report-for-england

- a minimum combined school, classroom and student participation rate of 75%, based on main sample schools (classroom and student participation rates include replacement schools)

In England, a total of 4,091 year 5 pupils from 131 primary schools participated in TIMSS 2023, 79% of main sample schools, missing the first participation criterion. It met the second criterion of 75% school, class and pupil participation. A total of 4,239 year 9 pupils from 136 secondary schools participated in TIMSS 2023, 76% of main sample schools recruited, missing the first participation criterion but meeting the second criterion of 75% school, class and pupil participation.

Tables 10, 11 and 12 below summarise the characteristics of the TIMSS school and pupil samples for England in 2023. Tables 10 and 11 demonstrate that England's year 5 and year 9 samples were broadly representative of primary and secondary schools nationally, although there is an under-representation of independent schools in the year 9 sample. Table 12 shows that the sample also broadly reflected national composition of pupil-level characteristics, although data is only available for pupils in state-funded schools.

**Table 10: All schools participating in TIMSS (England, 2023)[21,22]**

| Schools | Year 5 TIMSS sample | Mainstream primary schools (England) | Year 9 TIMSS sample | Mainstream secondary schools (England) |
|---|---|---|---|---|
| TIMSS sample schools | 131 | 15817 | 136 | 3674 |
| Independent schools | 3.8% | 6.6% | 4.4% | 14.3% |
| State-funded schools | 96.1% | 93.4% | 95.6% | 85.7% |

Data from TIMSS 2023 results and 2024 school characteristics statistics

Note: Percentages may not sum to 100% due to rounding.

[21] https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2024.
[22] The sample was inspected by IEA statisticians and deemed to be representative of schools, taking into account all sample stratification variables.

**Table 11: State-funded schools (only) participating in TIMSS (England, 2023) by school type[23,24]**

| Schools | Year 5 TIMSS sample | Mainstream primary schools (England) | Year 9 TIMSS sample | Mainstream secondary schools (England) |
|---|---|---|---|---|
| Academy schools | 37.4% | 36.1% | 71.3% | 62.4% |
| Community schools | 35.1% | 30.6% | 11.8% | 7.7% |
| Foundation schools | 4.6% | 3.0% | 5.2% | 4.1% |
| Voluntary aided schools | 12.2% | 14.1% | 2.2% | 5.3% |
| Voluntary controlled schools | 5.3% | 8.4% | 0% | 0.6% |
| Free schools, UTCs and Studio schools | 1.5% | 1.2% | 5.2% | 5.5% |

Data from TIMSS 2023 results and 2024 school characteristics statistics

Note: Percentages may not sum to 100% due to rounding.

**Table 12: Pupils participating in TIMSS (England, 2023)[25,26]**

| Pupils | Year 5 TIMSS sample | Pupils in mainstream, state-funded primary schools (England) Year 5 unless stated otherwise | Year 9 TIMSS sample | Pupils in mainstream, state-funded secondary schools (England) Year 9 unless stated otherwise |
|---|---|---|---|---|
| Total number of pupils in TIMSS | 4,091 | 633,243 age 10 | 4,239 | 635,545 age 14 |

[23] https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2024

[24] The sample was inspected by IEA statisticians and deemed to be representative of schools, taking into account all sample stratification variables.

[25] https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2024; https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2022

[26] The sample was inspected by IEA statisticians and deemed to be representative of pupils, taking into account all sample stratification variables.

| Pupils | Year 5 TIMSS sample | Pupils in mainstream, state-funded primary schools (England) Year 5 unless stated otherwise | Year 9 TIMSS sample | Pupils in mainstream, state-funded secondary schools (England) Year 9 unless stated otherwise |
|---|---|---|---|---|
| Number of pupils with an NPD record | 3,831 | - | 3,893 | - |
| Percentage of male pupils in 2023-2024 | 49.6% | 51.2% | 48.3% | 51.4% |
| Percentage of female pupils in 2023-2024 | 50.4% | 48.8% | 51.7% | 48.6% |
| Percentage of pupils eligible for free school meals (FSM) in 2022-2023 | 27.4% | 28.3% | 21.8% | 25.0% |
| Percentage of pupils for whom English is not their first language in 2023-2024 | 24.4% | 22.8% (primary) | 19.0% | 18.6% (secondary) |

Pupil profile data is presented for TIMSS pupils with an NPD record.

Note: Percentages may not sum to 100% due to rounding.

Samples cannot fully reflect entire populations, therefore the sample achieved may not exactly mirror the sample aspired to. The non-response bias analysis in Appendix E analyses the implications of such sampling.

## 1.4 Report structure

This National Report is in 2 volumes, this one published on the same day as the international report, 4 December 2024, the second in March 2025. They are structured using a series of questions that were asked of the TIMSS 2023 data. These enable users to identify the questions most relevant to them. Data for England in 2023 is presented for each question and comparisons made, as appropriate, with previous TIMSS studies

and/or other countries' data. England's TIMSS data has also been matched to data from the NPD, allowing additional analysis of factors such as free school meals (FSM) and English as an additional language (EAL) that would not have been possible using TIMSS data alone.

The reports comprise 6 main foci:

1. The Volume 1 report explores pupils' overall performance in mathematics and science. This section (chapters 3 to 6) focuses on how England's year 5 and 9 pupils have performed over time, and in comparison with other countries, both in terms of average achievement and achievement against international benchmarks. It includes analyses of how pupils have performed in different aspects of the curriculum (content domains), as well as in different cognitive domains. Its concluding chapter offers a summary of findings and inferences that might be drawn from them as well as introducing the Phase 2 report.

2. The Volume 2 report (chapters 7 to 12) explores different aspects of pupil, teacher and headteacher experience. The first section (chapter 7) analyses the differences in mathematics and science performance by pupil characteristics. It focuses on how well different groups of England's year 5 and 9 pupils have performed in comparison with each other and, where appropriate, with other countries.

3. Pupil engagement and confidence in mathematics and science. This section (chapter 8) focuses on pupils' attitudes towards their teaching, their subject confidence and whether they like and value mathematics and science. Where appropriate, the chapter makes comparisons with other countries.

4. School environment and resources. This section (chapter 9) considers whole-school issues, such as the extent to which schools focus on academic success, to provide a broader context to the schooling that England's year 5 and 9 pupils receive, and to consider how this compares to their peers in other countries.

5. Teachers and teaching. This section (chapter 10) focuses on matters such as teachers' professional development, years of teaching experience and the use of computers in the classroom. Where appropriate, the chapter makes comparisons with other countries.

6. Home environment. This section (chapter 11) focuses on the extent to which England's year 5 and 9 pupils are supported in their mathematics and science learning through resources at home and how they use these. Comparisons are provided with the experiences of pupils in other countries where appropriate.

The conclusion draws together the main findings and provides some reflections upon their implications for policy and practice in England. Each report will reflect on the COVID-19 pandemic's possible effects on results where relevant.

## 1.5 Comparator countries

Throughout the report, comparisons are made with other countries that took part in the study. The report analyses England's performance in relation to all participating countries in some places, but readers are generally referred to the IEA's *TIMSS International Report 2023* for such comparisons.

Analysis in this report focuses on England's performance compared with a sub-set of participating countries; these were selected to provide relevant and interesting comparisons.

The comparator countries referenced in this report fit into one of the following categories:

- highest-performing countries that over time have consistently performed significantly better than England in TIMSS (5 countries: Chinese Taipei, Hong Kong, Japan, Republic of Korea, Singapore)
- other English-speaking countries, since these can be seen as having similar contexts to England and provide helpful benchmarks for TIMSS (5 countries: Australia, Canada, Ireland, New Zealand, United States)
- a selection of European countries, chosen to provide a balanced view of performance across Europe in relation to TIMSS (4 countries: Finland, France, Italy, Lithuania)

We note that interpretation of headline performance data is rarely straightforward. For example, in 2023 Turkey's grade 4 pupils performed particularly well in both mathematics and science. In Appendix B we explain why we have not in fact included Turkey as a key comparator, and we draw attention there also to some characteristics of comparator data we have used, that mean comparisons need to be particularly careful. Whenever comparisons are made with other countries it is important to consider the potential effect of cultural differences. This is particularly important in chapters 7 to 11, which draw on responses from the attitudinal questionnaires that accompanied the main TIMSS assessments.

Although the benchmarking systems follow the same guidelines that apply to countries participating in TIMSS, in this report international comparisons are made between England and other participating countries, rather than with these systems.

## 1.6 Interpreting differences over time and between countries

Throughout the report, explanations of how the data was collected are given so that users can understand the methodology used and how to interpret data presented. Where

the terms ‘significant’ or ‘not significant’ are given, these mean that the finding referred to is either statistically significant or not statistically significant at the 5% level[27].

In order to understand which interpretations and conclusions can reasonably be drawn from the TIMSS data, it is important to keep factors such as sampling error and measurement error in mind. No test results can be entirely free from error, and error needs to be understood in its technical sense in the context of this report.

Sampling error arises because the statistical characteristics of a population as a whole must be estimated using a subset, or sample, of that population. A different sample for England’s population might produce slightly different results. Only if every year 5 and year 9 pupil in England (the entire population) had taken part in TIMSS assessments could the outcomes be interpreted as totally representative. TIMSS sampling methodology[28] – which makes use of the jackknife repeated replication (JRR) – is derived to minimise sampling error, but it cannot entirely eliminate it, which is why confidence intervals and standard error measurements are included in TIMSS reports[29].

The same holds true for measurement error, which can occur when test instruments do not accurately measure the knowledge or aptitude they are intended to measure. In TIMSS assessments, a potential source of this error comes from the different curricula in participating countries. As with sampling error, the TIMSS methodology attempts to offset measurement error by using the Test-Curriculum Matching Analysis, in which each participating country identifies, for each item, whether or not the topic is found in the curriculum for the majority of its pupils[25].

These 2 factors offer useful background to understanding TIMSS rank ordering and differences in scores over time. This is the reason this study concentrates on statistically significant differences rather than reporting on simple rank orders or score changes. Significant differences are less likely to have been entirely caused by sampling or measurement errors. It is also important to remember that changes in ranking over time may result from changes to the cohort of countries participating in each cycle.

[27] Significance levels will depend on the averages but also on the standard errors. Both averages and standard errors are used to calculate a T-statistic which is then compared to the critical values in t-tables.
[28] See https://timssandpirls.bc.edu/timss2023/methods/index.html
[29] See https://nces.ed.gov/statprog/handbook/timss_dataquality.asp

# Chapter 2. TIMSS assessment approach and curriculum match

The TIMSS assessment is based on the TIMSS curriculum model, which considers how educational opportunities are provided to pupils and the factors that influence how pupils use these opportunities. The model captures the mathematics and science that most students are expected to learn and how an educational system might be organised to facilitate this learning. It has 3 domains:

1. The national, social and educational context, which informs the creation of the intended curriculum;
2. The school, teacher and classroom context, which affects the implemented curriculum;
3. Student learning outcomes and characteristics, which reflect the attained curriculum.

Underpinning the first domain is an encyclopedia documenting education policies and curricula in all countries participating in TIMSS[30]. The second and third domains form the basis of the TIMSS contextual (pupil and teacher) questionnaires and pupil assessments.

## 2.1 How was TIMSS administered?

TIMSS 2019 included a bridging study, using both paper and on-screen delivery modes for the first time in England. TIMSS 2023 pupil assessments and questionnaires were solely delivered on computers using the Assessment Master platform developed by RM. Schools typically used their own computers (either PCs or laptops, not tablets) and Wi-Fi to deliver the online assessments, but in some cases, laptops were provided for schools to complete an offline version, with data uploaded afterwards. Both online and offline versions provided an identical user experience.

In addition to being easier to administer (item development, printing, shipping, data entry and scoring were all more efficient), the digital TIMSS tests facilitated assessment of complex areas of the curriculum model that are difficult to measure with paper and pencil.

[30] Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). *TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882

## 2.2 How were the TIMSS scores calculated?

The main measures of mathematics and science performance in TIMSS are the average (mean) scores, which are calculated for each participating country based on the scores achieved by pupils who took the TIMSS assessments. The full distribution of TIMSS average scores was 'centred' at 500, corresponding to the TIMSS 1995 average of the overall attainment distribution, with 100 points on the scale originally corresponding to one standard deviation. The scale is linked into subsequent TIMSS assessment cycles via the use of 'trend' items, to allow the attainment scores in a given subject and year group to be compared over time and across countries. Because country participation in TIMSS varies by cycle, that does mean that the 'centrepoint' of 500 no longer represents the average attainment, but it does act as an ongoing baseline. Reference will be made throughout the report to the TIMSS centrepoint of 500 and average (mean) scores, except with respect to the international benchmarks, which use international medians as the average measure. We also reference performance of a subset of participating countries using a variety of measures, for particular purposes as analysed in chapter 1.

Every average score calculated using the TIMSS data is accompanied by a standard error (SE) indicating how precisely the sample average can be generalised for the population. Standard errors are used to calculate confidence intervals (at the 95% level) for all the TIMSS average scores. The lower the standard error, the less uncertainty there is due to sampling variations and, therefore, the better the TIMSS sample is as an estimate of the whole population's performance. In Appendix E, we analyse the uncertainty introduced through necessary changes to the originally planned sample; it will be seen that this is well within usual tolerances.

In addition to providing overall scores in mathematics and science, TIMSS enables a detailed comparison of pupils' mathematics and science performance in specific subject and cognitive domains (see Table 13 below, with target % composition). Each of the assessment questions is categorised according to the area of the curriculum it covers (referred to in TIMSS as *content* domains) and the different cognitive skills it draws on (referred to in TIMSS as *cognitive* domains)[31].

**Table 13: Content and cognitive domains in TIMSS**

| Domain | Year 5 | Year 9 |
|---|---|---|
| Mathematics content domains | Number 50%; measurement and geometry 30%; data 20% | Number 30%; algebra 30%; geometry 20%; data and probability 20% |

[31] See Mullis, I. V. S., Martin, M. O. and von Davier, M. (eds.). (2021). TIMSS 2023 Assessment Frameworks. Available at: https://timssandpirls.bc.edu/timss2023/frameworks/index.html

| Domain | Year 5 | Year 9 |
|---|---|---|
| Science content domains | Life science 45%; physical science 35%; Earth science 20% | Biology 35%; chemistry 20%; physics 25%; Earth science 20% |
| Cognitive domains in mathematics and science | Knowing 40%; reasoning 40%; applying 20% | *Mathematics:* Knowing 35%; reasoning 40%; applying 25%<br>*Science:* Knowing 35%; reasoning 35%; applying 30% |

Source: IEA TIMSS International Report 2023

Additionally, TIMSS 2023 assesses Science Practices within the given content and cognitive domains: asking questions based on observations and theories, designing investigations and generating evidence, working with data, answering research questions, and making arguments from evidence.

The TIMSS performance scales are not constructed to be comparable across subjects and year groups as they measure different competences. However, because the scores in each subject and each year group are based on parallel scales and are nationally representative, it is possible to compare the relative performance of pupils in different countries at any point in time. If the same cohort of pupils is studied in a subsequent cycle of TIMSS, it is possible to gain insights how well that same cohort of pupils has performed over time, relative to the TIMSS international centrepoint in each study[32].

## 2.3 The TIMSS international benchmarks

In each TIMSS cycle the distribution of pupil scores is described using a set of international benchmarks that reflect different levels of pupil attainment. There are 4 benchmarks each in mathematics and science, and these are designed to be comparable over time. A score of 625 indicates that a pupil has reached an ‘advanced’ level, a score of 550 indicates a ‘high’ level, a score of 475 indicates an ‘intermediate’ level and a score of 400 indicates a ‘low’ level of attainment. Tables 14 and 15 below present the main statements describing the application of knowledge and understanding required for pupils to achieve these benchmarks: full descriptions are given in Appendix C.

[32] Pupils in the sample assessed in 2019, when they were in year 5, will not necessarily be the same as pupils in the sample of year 9 pupils assessed in 2023, so care should be taken in attributing statistical confidence to the outcomes.

**Table 14: International benchmarks for TIMSS mathematics achievement at years 5 and 9 (scores required to reach each benchmark)**

| Year 5 international benchmarks | Year 9 international benchmarks |
|---|---|
| Advanced (625): Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. | Advanced (625): Students can apply and reason in a variety of problem situations, solve linear equations and make generalisations. |
| High (550): Students apply conceptual understanding to solve problems. | High (550): Students can apply their understanding and knowledge in a variety of relatively complex situations. |
| Intermediate (475): Students can apply basic mathematical knowledge in simple situations. | Intermediate (475): Students can apply basic mathematical knowledge in a variety of situations. |
| Low (400): Students have some basic mathematical knowledge. | Low (400): Students have some knowledge of whole numbers and basic graphs. |

Source: IEA TIMSS International Report 2023

**Table 15: International benchmarks for TIMSS science achievement at years 5 and 9 (scores required to reach each benchmark)**

| Year 5 international benchmarks | Year 9 international benchmarks |
|---|---|
| Advanced (625): Students communicate their understanding of life, physical and Earth sciences and demonstrate some knowledge of the process of scientific enquiry. | Advanced (625): Students communicate understanding of concepts related to biology, chemistry, physics and Earth science in a variety of contexts. |
| High (550): Students communicate and apply knowledge of the life, physical and Earth sciences. | High (550): Students apply understanding of concepts from biology, chemistry, physics and Earth science. |
| Intermediate (475): Students show knowledge and understanding of some aspects of life, physical and Earth sciences. | Intermediate (475): Students show and apply some knowledge of biology, chemistry and the physical sciences. |
| Low (400): Students show limited understanding of scientific concepts and | Low (400): Students show limited understanding of scientific principles and |

| Year 5 international benchmarks | Year 9 international benchmarks |
|---|---|
| limited knowledge of foundational science facts. | concepts and limited knowledge of scientific facts. |

Source: IEA TIMSS International Report 2023

## 2.4 Educational experience of the TIMSS cohorts

The year 5 and 9 pupils who participated in the study have experienced different curriculum and assessment arrangements during their schooling and this may have influenced their achievement and attitudes to learning. Of particular note is that both year groups have been severely disrupted by the COVID-19 pandemic, which in England resulted in schools closing to most pupils for March to June 2020 and again for January to March 2021; individual schools often experienced further pandemic-related closures. Pupil COVID-related absences remained common through to April 2022.

### The year 5 pupil cohort for TIMSS 2023

The year 5 pupils who completed TIMSS 2023 were typically born in 2012 or 2013, and entered full-time education from September 2017. Where applicable, they were taught entirely according to the then-established *National Curriculum in England: framework for key stages 1 to 4* (DfE, 2013).

These pupils were at the end of Key Stage 1 (year 2) in Summer 2020, and did not take part in the usual statutory assessments at that point, because of the pandemic. Most pupils were educated at home through the summer of their year 2 and also in the winter of their year 3.

### The year 9 pupil cohort for TIMSS 2023

The year 9 pupils who completed TIMSS 2023 were typically born in 2008 or 2009, entering full-time education from September 2013. Where applicable, they were taught the *National Curriculum in England: framework for key stages 1 to 4* (DfE, 2013) from September 2014.

At the time of school pandemic-related closures from March 2020 this cohort was in year 5, and was in year 6 for school closures in early 2021. The standard end of Key Stage 2 assessments in Summer 2021 could be delivered with some flexibility, and no teacher assessment of science performance was required. These pupils may also have experienced disrupted transfer into year 7, usually the first year of secondary school.

This pupil cohort was in year 5 at the time of the previous TIMSS 2019 assessment, which enables some comparison of the cohort's progress over time using representative samples from each cycle of TIMSS assessments.

The *TIMSS Encyclopedia*[33] chapter for England provides more detail about the wider education context in England at the time of the TIMSS assessments and questionnaires.

## 2.5 To what extent were the TIMSS topics taught in England prior to the 2023 assessments?

TIMSS assesses year 5 and 9 pupils in a number of mathematics and science topics. The IEA reports the extent to which of these topics are intended to be taught to pupils in these year groups so that the level of curriculum match can be established. Full information on the curriculum match for other countries can be found in the *TIMSS International Report 2023* and the TIMSS encyclopedia.

Overall, in England, the TIMSS 2023 assessments are well matched to the content of the national curriculum[34], both in mathematics and science, although with some exceptions as analysed below. This revised national curriculum was made statutory for local authority maintained schools in England in September 2014. Pupils in non-local authority schools such as academies during this period are required to be taught a broad and balanced curriculum that includes English, mathematics and science.

A high level of curriculum match is not necessarily associated with high levels of performance. For example, Singapore was the highest-achieving country for science in year 9, but it had taught only 14 of the 26 TIMSS topics by the time its pupils took their TIMSS assessments.

### Year 5

The national curriculum in England is arranged into 4 Key Stage sections. For schools following the national curriculum, there is a higher level of confidence in the topics covered by the end of each Key Stage period. The year 5 TIMSS pupils in England were only part way through the relevant Key Stage at the time of assessment, so it is not known with confidence which TIMSS topics they had covered by that time. The national curriculum provides guidance on splitting work up over the Key Stage period and this was used to assess which topics were *likely* to have been covered by the year 5 pupils participating in TIMSS part-way through their year 5.

[33] Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). *TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882
[34] *National Curriculum in England: framework for key stages 1 to 4* (DfE, 2013)

In mathematics, almost all topics included in the TIMSS assessments were intended to be taught by the *end* of year 5, with only some early algebra, work with pie charts, and combination/comparison of 2 sets of data not expected to be covered.

In science, again most of the TIMSS Framework topics were intended to be taught to year 5 pupils. In life sciences, inheritance, ecosystems, human health and transmission of communicable diseases may well not have been encountered. Four Earth science topics (Earth's resources used in everyday life; changes in Earth's surface over time; weather and climate) and one physical science topic (energy transfer) were not part of the national curriculum for pupils up to this age.

## Year 9

The national curriculum provides guidance on work to be covered by the end of year 9 in English schools but, as the pupils were only part way through the academic year by the time they took the assessments, it is not known which TIMSS topics they had by then covered.

In mathematics, representations of non-linear functions might not have been familiar, but all other TIMSS topics were intended to be taught at least by the *end* of year 9. On-screen calculators are available for use in year 9 TIMSS mathematics assessments.

In science, at least part of most TIMSS topic areas was intended to be taught, at least by the end of year 9. Some aspects of life sciences (elements of taxonomy, changes to ensure stable body conditions, fossils, energy flow ecosystems, human environmental impact, interactions with diseases) might well have been unfamiliar; in physics, machines might not have been addressed, and some aspects of TIMSS Earth sciences topics do not form part of the science national curriculum for pupils up to this age; they might, though, have addressed some aspects in other parts of the curriculum, such as geography.

## Sample TIMSS items

The sample test items cover a range of questions used to test pupils at the high and low international benchmarks for mathematics and science in both years 5 and 9. The format of the items is similar to national assessment items. A selection of the questions used in TIMSS 2023 is included in Appendix D and published in the IEA's *TIMSS International Report 2023*[35].

[35] International Association for the Evaluation of Educational Achievement (2024). TIMSS 2023 International Results in Mathematics and Science. Available at: https://timssandpirls.bc.edu/timss2023/

# Chapter 3. Overall performance in mathematics

## 3.1 Main findings

This chapter summarises the TIMSS 2023 year 5 and year 9 mathematics performance in England. It covers the changes in average performance[36] over time and changes in the percentage of pupils reaching each of the international benchmarks for achievement in mathematics[37]. The comparator countries referred to in this chapter are listed in Section 1.5.

- In 2023, the performance of pupils in both year 5 and year 9 in mathematics in England was significantly above the TIMSS centrepoint[38]. Both were also significantly above the relevant international average for 2023.
- The trend in England's year 5 pupils' average mathematics score is one of significant improvement between 2003 and 2023. The decrease in England's pupils' average score (4 scale points) between 2019 and 2023 was not significant.
- England's pupils' performance in year 9 mathematics has seen significant improvement between 2003 and 2023, most notably between 2003 and 2007. Performance has been broadly stable since 2007. The 2023 average mathematics score for pupils in England (525) was 10 scale points higher than for 2019, but this increase was not significant.
- For year 5, pupils in 7 countries performed significantly above pupils in England, 4 at a similar level, and 46 significantly below. Five of the countries in which pupils performed significantly above pupils in England in 2023 did so in 2019: the East Asian countries (Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore); the other 2 were Macao and Lithuania.
- For year 9, pupils in 5 countries performed significantly above pupils in England (Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore). Pupils in 3 countries performed at a similar level, and 35 significantly below. The same 5 countries also performed significantly above England in 2019.

[36] Performance is measured using pupils' average scale score. This is shortened to 'average score' in the main text for readability purposes.
[37] See Section 2.3 and Appendix C for descriptions of the international benchmarks.
[38] The TIMSS centrepoint is explained in Chapter 2, Section 2.2.

- A larger percentage of year 5 and 9 pupils reached each of the international benchmarks in England compared with the international median across all participating countries[39].

- Between 2003 and 2023 there was significant improvement in the percentage of year 5 and 9 pupils in England reaching each of the international benchmarks (except for the low benchmark or above for year 5 and year 9 pupils).

- The percentage of year 5 pupils reaching the advanced benchmark, the high benchmark or above and the intermediate benchmark or above in 2023 were not significantly different from 2019. However, the percentage of pupils not reaching the low benchmark or above in 2023 (6%) was significantly above the percentage reaching this benchmark in 2019 (4%).

- The percentages of year 9 pupils reaching the low or above and intermediate or above benchmarks have remained similar to 2019. The 7 percentage point increase in pupils reaching the high or above benchmark was significant while the 4 percentage point increase for pupils reaching the advanced benchmark in 2023 was not significantly different from 2019.

- The difference between the highest- and lowest-performing year 5 pupils' scores increased by 20 scale points from 2019 (from 282 in 2019 to 302 in 2023). The only countries for which the range of pupils' scores was larger than for England's pupils were Australia and the United States.

- The difference between the highest- and lowest-performing year 9 pupils' scores increased by 25 scale points from 2019 (from 297 in 2019 to 322 in 2023). The only comparator countries for which the range of pupils' scores was larger than for England's pupils were Chinese Taipei, the Republic of Korea and Singapore.

- The TIMSS 4-year cycle allows for a comparison of a cohort's performance for one cycle compared with the previous cycle since, for example, year 9 pupils in 2023 were in year 5 in 2019[40]. Relative to the TIMSS centrepoint, this cohort of pupils performed better in year 5 (average scale score 556) than in year 9 (average scale score 525). A similar decrease in performance was also reported in most comparator countries, with pupils only in Chinese Taipei and Japan seeing average scale scores increase.

[39] For each of the benchmarks, the international median is calculated by sorting all participating countries' percentage scores from smallest to largest and then finding the midpoint of this data. If the number of countries is odd, the middle country's percentage score is the median. If the number of countries is even, the median is the mean of the 2 middle percentage scores.
[40] Although the year 5 pupils who took the assessments in 2019 were from the same cohort, this does not mean they were the same pupils, because of the sampling approach (Section 1.3).

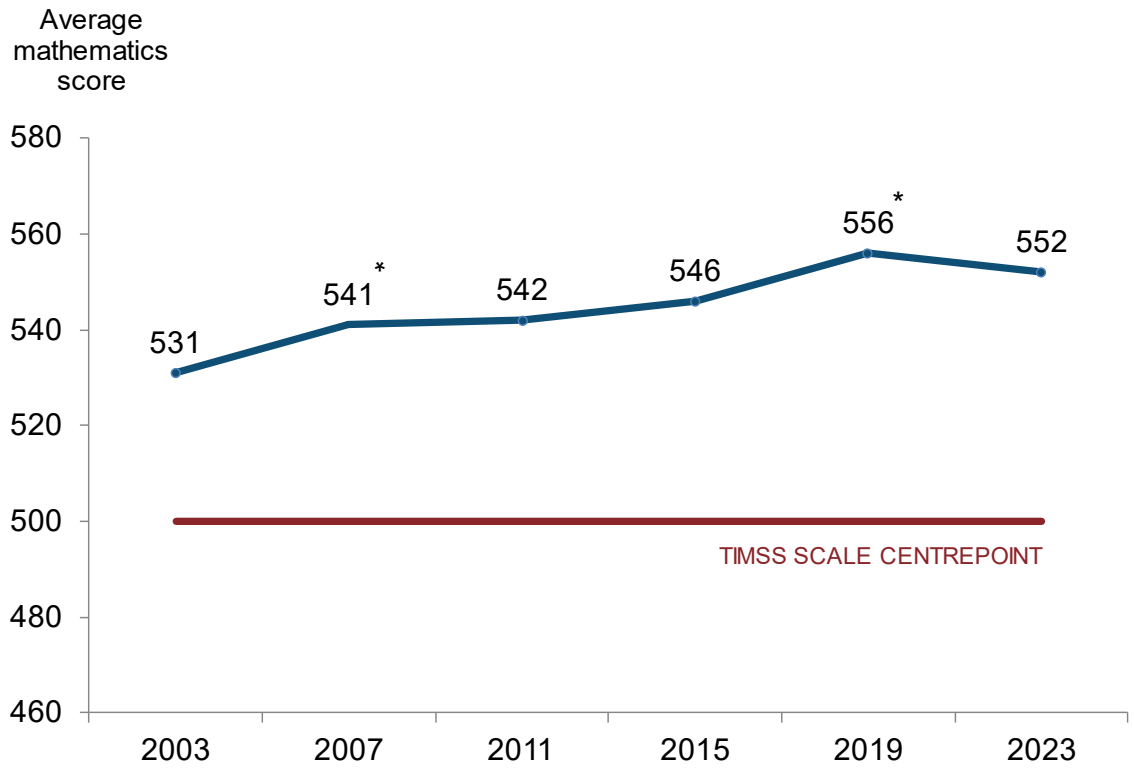
## 3.2 What does TIMSS tell us about England's performance in year 5 mathematics?

### 3.2.1 How has the mathematics performance of year 5 pupils in England changed over time?

The 2023 average mathematics score for England (552) was significantly above the TIMSS centrepoint (500).

The trend in mathematics performance for year 5 pupils in England is one of significant improvement between 2003 and 2023.The 4 scale-point score decrease in average score between 2019 (556) and 2023 (552) was not significant. Pupils' performance in 2023 was significantly above the performance in each cycle except 2015 and 2019. Figure 9 and Table 16 below show these changes over time and how this relates to the TIMSS centrepoint (500); scores marked with an asterisk were significantly different from the previous score.

**Figure 9: Trend in average year 5 mathematics score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.
Note 2: Mathematics scores that represent a significant increase or decrease compare with the previous TIMSS cycle are marked with an asterisk (*).

**Table 16: Trend in average year 5 mathematics score (England)**

| Year | Average mathematics score |
|---|---|
| 2003 | 531 |
| 2007 | 541 (significant increase) |
| 2011 | 542 |
| 2015 | 546 |
| 2019 | 556 (significant increase) |
| 2023 | 552 |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Figure 10 and Table 17 below show the percentage of year 5 pupils in England meeting each of the international TIMSS benchmarks[41] in mathematics since 2003. Figure 10 is cumulative so that, reading left to right, it presents the percentage of pupils who reached all of the benchmarks from advanced to low or above. For example, in 2023 in England 22% of pupils reached the advanced benchmark, 53% the high benchmark or above, 80% the intermediate benchmark or above and 94% the low benchmark or above. The remaining 6% did not reach the low benchmark.

Between 2003 and 2023 there was significant improvement in the percentage of year 5 pupils in England reaching each of the international benchmarks, except the low benchmark or above.

A similar percentage of year 5 pupils reached the advanced benchmark and high benchmark or above in 2023 (22% and 53% respectively) as in 2019 (21% and 53% respectively). The percentage of pupils reaching the intermediate benchmark or above in 2023 was not significantly different from the percentage reaching this benchmark between 2007 and 2019. However, the 2023 percentage was significantly above the percentage reaching the intermediate benchmark before 2007.

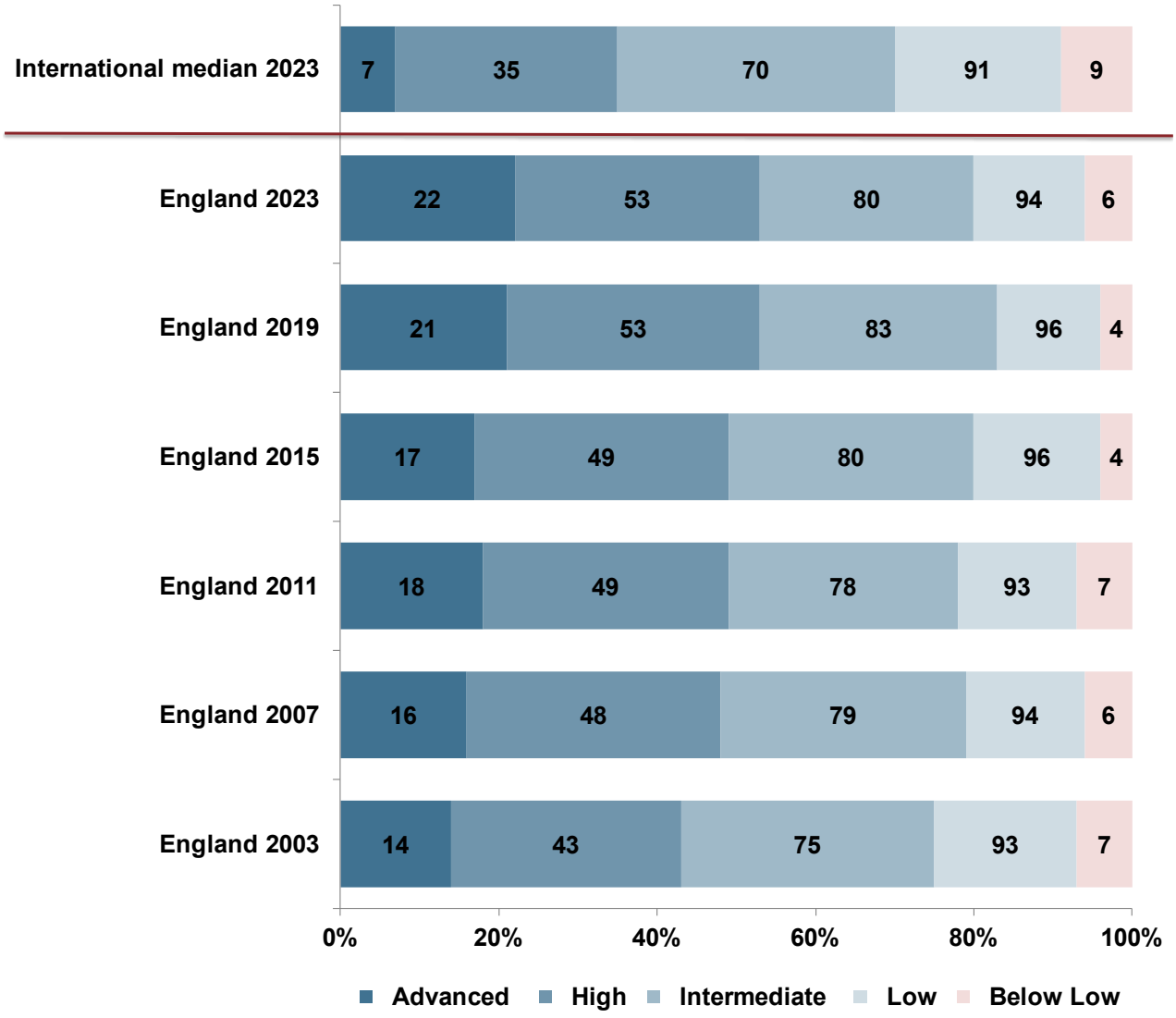
The percentage of pupils reaching the low benchmark or above in 2023 was significantly below the percentage reaching this benchmark in 2019. However, the 2023 percentage was not significantly different from the percentage reaching the low benchmark or above between 2003 and 2015.

[41] See Section 2.3 and Appendix C for descriptions of the international benchmarks.

Since 2003, the percentage of pupils in England reaching the high benchmark or above has increased from 43% to 53%, while the percentage reaching the advanced benchmark has increased from 14% to 22%.

A larger percentage of pupils in England reached each of the benchmarks compared with the international median.

**Figure 10: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 17: Percentage of year 5 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 35 | 70 | 91 | 9 |
| England 2023 | 22 | 53 | 80 | 94 | 6 |
| England 2019 | 21 | 53 | 83 | 96 | 4 |
| England 2015 | 17 | 49 | 80 | 96 | 4 |
| England 2011 | 18 | 49 | 78 | 93 | 7 |
| England 2007 | 16 | 48 | 79 | 94 | 6 |
| England 2003 | 14 | 43 | 75 | 93 | 7 |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

### 3.2.2 How did year 5 pupils in England perform in mathematics relative to their peers in all other TIMSS countries?

Pupils in 58 countries participated in the TIMSS 2023 year 5 mathematics assessments. Full international analyses of their performance can be found in the *TIMSS International Report 2023*.

Pupils in England performed significantly above the TIMSS 2023 international average score (552 compared with 503).

In 2023, pupils in 7 countries performed significantly above England's pupils. These included the same 5 East Asian countries as in 2019 (Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore), alongside Macao and Lithuania. Lithuania's pupils had performed significantly below England's in 2019, while Macao had not previously participated in any TIMSS cycle. Appendix B highlights some of the challenges in making easy comparisons of performance across countries, or even across time in the same country.

Pupils in Ireland, Poland, Romania and Turkey performed similarly to their peers in England in 2023. Ireland's pupils had also performed similarly to England's pupils in 2019 while Poland's pupils had performed significantly below England's in 2019. Pupils in Romania had not participated since 2011. Pupils in the remaining 46 countries performed significantly below pupils in England.

Tables 18, 19 and 20 below show how England's year 5 pupils performed in 2019 and 2023 relative to those in a selection of other countries by average score. England's average score was 556 in 2019 and 552 in 2023.

**Table 18: Year 5 mathematics: all countries in which pupils performed significantly above pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Singapore | 625 | 615 |
| Hong Kong | 602 | 594 |
| Republic of Korea | 600 | 594 |
| Chinese Taipei | 599 | 607 |
| Japan | 593 | 591 |
| Russia | 567 | Did not participate |
| Macao | Did not participate | 582 |
| Northern Ireland | 566 | Did not participate |
| Lithuania | Performed significantly below | 561 |
| England | 556 | 552 |

Sources: IEA TIMSS International Reports 2019 and 2023

**Table 19: Year 5 mathematics: all countries in which pupils performed at a similar level to pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| England | 556 | 552 |
| Ireland | 548 | 546 |
| Turkey | Performed significantly below | 553 |
| Poland | Performed significantly below | 546 |
| Romania | Did not participate | 542 |

Sources: IEA TIMSS International Reports 2019 and 2023

**Table 20: Year 5 mathematics: comparator group countries in which pupils performed significantly below pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| England | 556 | 552 |
| Lithuania | 542 | Performed significantly above |
| United States | 535 | 517 |
| Finland | 532 | 529 |
| Australia | 516 | 525 |
| Italy | 515 | 513 |
| Canada | 512 | 504 |
| New Zealand | 487 | 490 |
| France | 485 | 484 |

Sources: IEA TIMSS International Reports 2019 and 2023

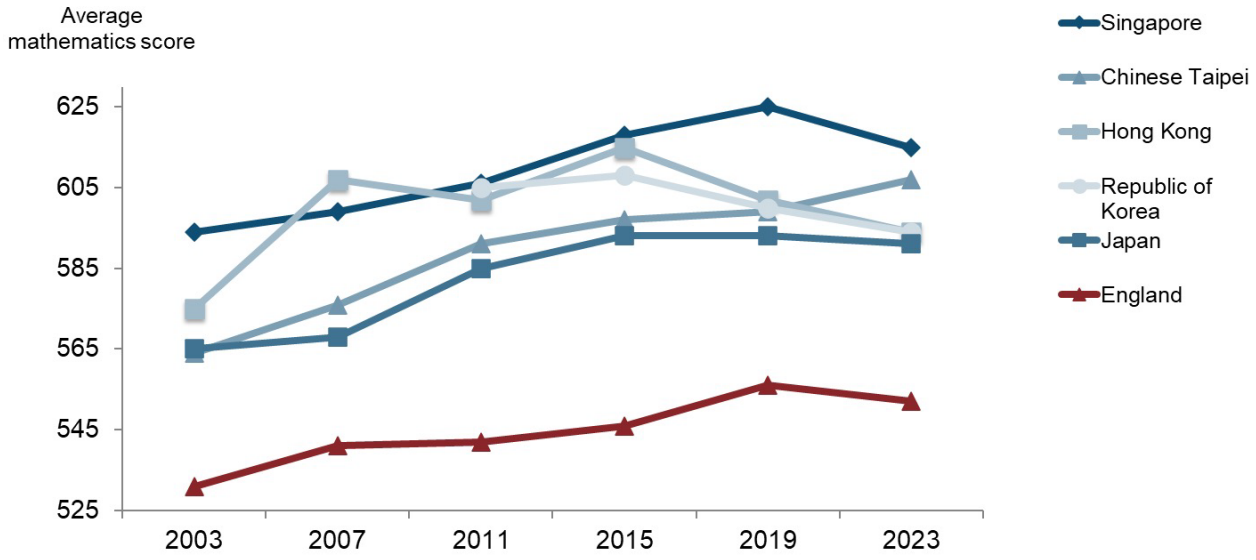
Note: 38 other countries not included as comparators

### 3.2.3 How did year 5 pupils in England perform in mathematics relative to their peers in the comparator countries?

In this section, comparisons are drawn between the performance of England's year 5 pupils and pupils from the 3 comparator groups: highest-performing, English-speaking and European (see Section 1.5). Trends are shown for countries with at least 2 cycles of assessment data since 2003.

The term 'highest-performing' is used to describe the group that comprises the 5 East Asian countries in 3.2.2. As shown in Figure 11 and Table 21 below, all of the countries from this group, alongside England, have seen significant improvement in year 5 pupils' mathematics performance between 2003 and 2023 (apart from the Republic of Korea which did not participate in 2003). Like England, each of these countries, except Chinese Taipei, saw decreases in their pupils' performance in 2023 compared with 2019, although only the decrease in Singapore was significant. These decreases might reflect the impact of COVID-19.

## Figure 11: Trends in year 5 mathematics performance between 2003 and 2023 for England and highest-performing comparator countries (average scores)




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.

Note 2. Pupils from the Republic of Korea did not participate in TIMSS 2003 and 2007.

## Table 21: Year 5 average mathematics scores between 2003 and 2023 for England and highest-performing comparator countries (average scores)

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 531 | 541 | 542 | 546 | 556 | 552 |
| Chinese Taipei | 564 | 576 | 591 | 597 | 599 | 607 |
| Hong Kong | 575 | 607 | 602 | 615 | 602 | 594 |
| Japan | 565 | 568 | 585 | 593 | 593 | 591 |
| Republic of Korea | No data | No data | 605 | 608 | 600 | 594 |
| Singapore | 594 | 599 | 606 | 618 | 625 | 615 |

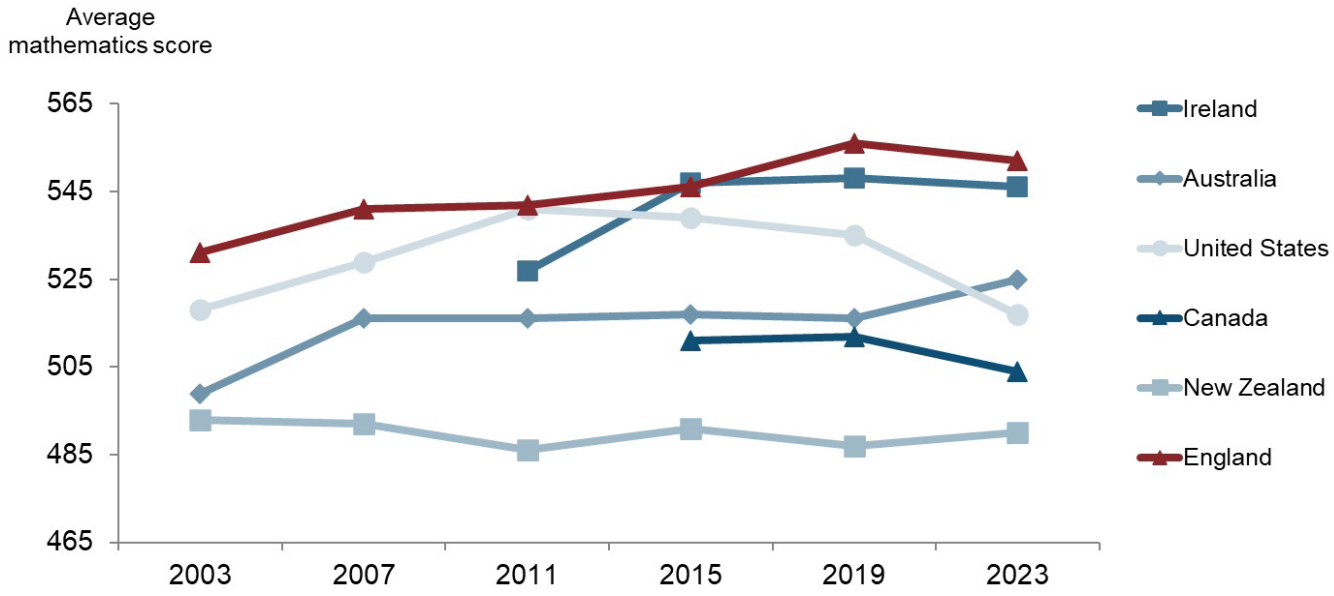
Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.

Note 2. Pupils from the Republic of Korea did not participate in TIMSS 2003 and 2007.

Three of the English-speaking comparator countries have time series data from 2003: Australia, New Zealand and the United States. Like England, Australia has seen significant improvements in its pupils' performance between 2003 and 2023, while the trend in performance for New Zealand is one of stability over time (see Figure 12 and Table 22 below). Pupils' performance in the USA in 2023 was similar to that of 2003 after a series of significantly higher average scores between 2011 and 2019. Ireland has a shorter time series of data, showing significant improvement in its pupils' performance between 2011 and 2023 and stability between 2015 and 2023. Pupils' performance in Canada was similar in 2015 and 2019, but their 2023 average score was significantly below that achieved in both these cycles. Australia was the only country from this group where pupils' performance in 2023 was significantly above that achieved in 2019. However, pupils in England performed significantly above their peers in each of the countries in this group in 2023, except pupils in Ireland.

**Figure 12: Trends in year 5 mathematics performance between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Canada did not participate in TIMSS 2003, 2007 and 2011.
Note 3: Year 5 pupils in Ireland did not participate in TIMSS 2003 and 2007.

**Table 22: Year 5 average mathematics scores between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 531 | 541 | 542 | 546 | 556 | 552 |

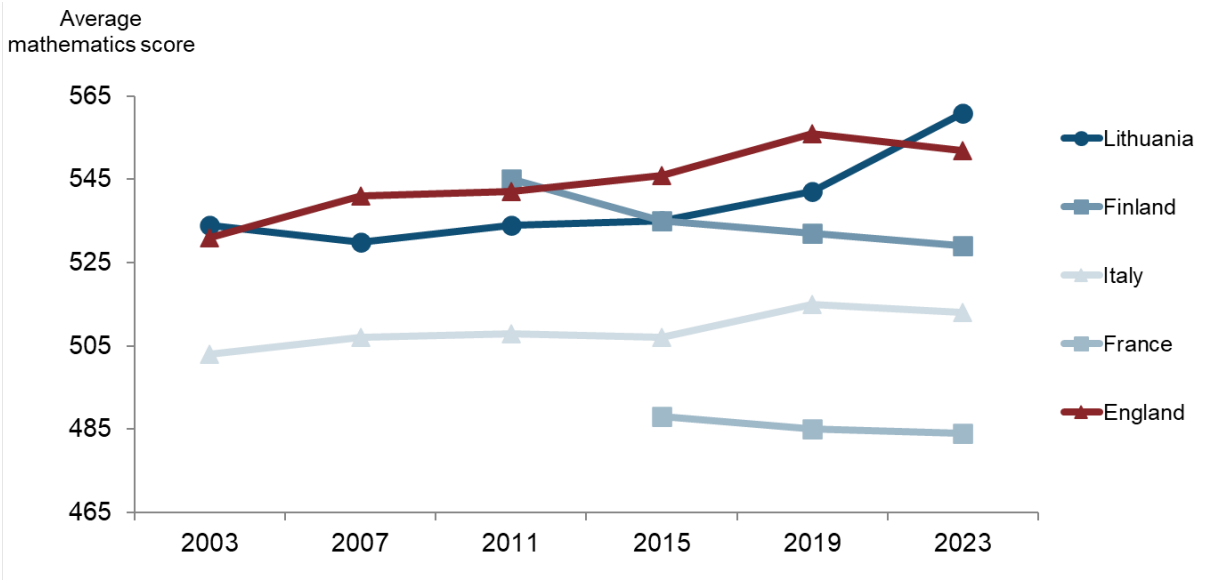
| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| Australia | 499 | 516 | 516 | 517 | 516 | 525 |
| Canada | No data | No data | No data | 511 | 512 | 504 |
| Ireland | No data | No data | 527 | 547 | 548 | 546 |
| New Zealand | 493 | 492 | 486 | 491 | 487 | 490 |
| United States | 518 | 529 | 541 | 539 | 535 | 517 |

Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Canada did not participate in TIMSS 2003, 2007 and 2011.
Note 3: Year 5 pupils in Ireland did not participate in TIMSS 2003 and 2007.

As shown in Figure 13 and Table 23 below, only 2 of the 5 European comparator countries have time series data from 2003: Italy and Lithuania. The performance of pupils in both countries has improved significantly over this period. Pupils' performance in Finland significantly decreased between 2011 and 2023. The trend for France's pupils' performance is one of stability between 2015 and 2023.

**Figure 13: Trends in year 5 mathematics performance between 2003 and 2023 for England and all European comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Finland did not participate in TIMSS 2003 and 2007.
Note 3. Year 5 pupils in France did not participate in TIMSS 2003, 2007 and 2011.

**Table 23: Year 5 average mathematics scores between 2003 and 2023 for England and all European comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 531 | 541 | 542 | 546 | 556 | 552 |
| Finland | No data | No data | 545 | 535 | 532 | 529 |
| France | No data | No data | No data | 488 | 485 | 484 |
| Italy | 503 | 507 | 508 | 507 | 515 | 513 |
| Lithuania | 534 | 530 | 534 | 535 | 542 | 561 |

Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Finland did not participate in TIMSS 2003 and 2007.
Note 3. Year 5 pupils in France did not participate in TIMSS 2003, 2007 and 2011.

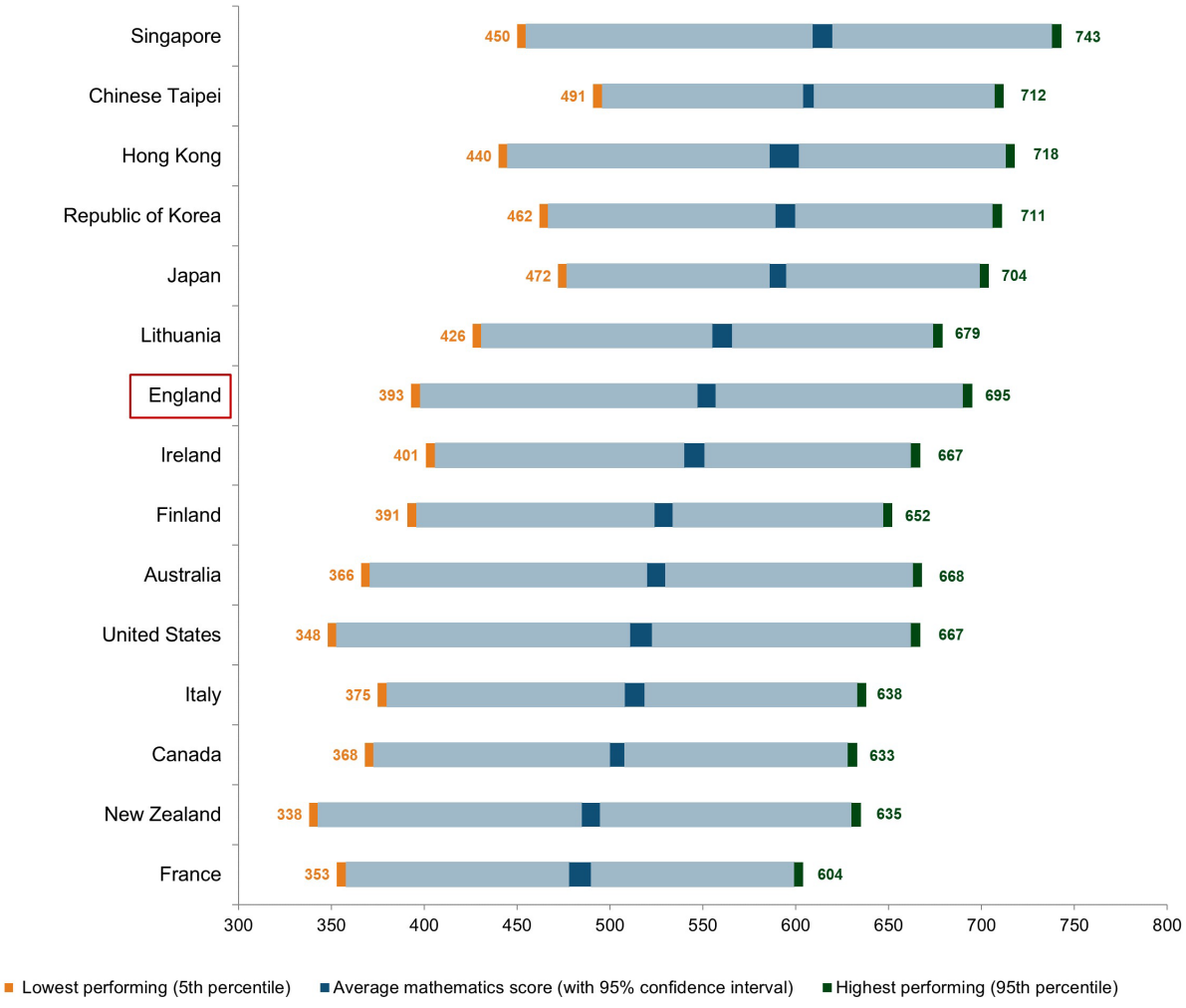
Figure 14 and Table 24 below show the range of year 5 mathematics scores in England from the 5th percentile (low-performing pupils) to the 95th percentile (high-performing pupils) against the range for countries from the 3 comparator groups. The range is not calculated using the difference between the maximum and minimum scores because of the potential distortion due to outliers. The dark section in the centre of each bar represents the average score for year 5 mathematics and the 95% confidence interval around it.

Year 5 pupils in England at the lower end of the distributions (the 5th percentile) achieved an average score of 411 in 2019 and 393 in 2023, a significant decrease of 18 scale points. At the top end of the distribution (the 95th percentile), pupils achieved an average score of 693 in 2019 and 695 in 2023, a small increase of 2 scale points. In combination, these average score changes have increased the achievement gap by 20 scale points from 282 in 2019 to 302 in 2023. This represents a further widening of the gap from TIMSS 2015 when it was 275 scale points.

Most of the highest-performing countries as well as those from other comparator groups had a smaller range than England's range of 302. In only 2 of the other comparator countries were the ranges in pupils' average scores as large or larger: Australia (302) and the United States (319).

Data on all other participating countries is available in the *TIMSS International Report 2023*.

**Figure 14: Range of year 5 mathematics achievement between the lowest and highest-performing pupils across comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

**Table 24: Range of year 5 mathematics achievement between the lowest and highest-performing pupils across comparator countries (average scores)**

| | Average mathematics score | Lowest performing (5th percentile) | Highest performing (95th percentile) | Range between lowest and highest performing |
|---|---|---|---|---|
| Singapore | 615 | 450 | 743 | 293 |

| | Average mathematics score | Lowest performing (5th percentile) | Highest performing (95th percentile) | Range between lowest and highest performing |
|---|---|---|---|---|
| Chinese Taipei | 607 | 491 | 712 | 221 |
| Hong Kong | 594 | 440 | 718 | 278 |
| Republic of Korea | 594 | 462 | 711 | 249 |
| Japan | 591 | 472 | 704 | 232 |
| Lithuania | 561 | 426 | 679 | 253 |
| England | 552 | 393 | 695 | 302 |
| Ireland | 546 | 401 | 667 | 266 |
| Finland | 529 | 391 | 652 | 261 |
| Australia | 525 | 366 | 668 | 302 |
| United States | 517 | 348 | 667 | 319 |
| Italy | 513 | 375 | 638 | 263 |
| Canada | 504 | 368 | 633 | 265 |
| New Zealand | 490 | 338 | 635 | 297 |
| France | 484 | 353 | 604 | 251 |

Source: IEA TIMSS International Report 2023

## TIMSS international benchmarks

As shown in Figure 15 and Table 25 below, fewer pupils in England reached the advanced benchmark and high benchmark or above compared with their peers in each of the highest-performing countries. For example, more than double the proportion of year 5 pupils in the highest-performing country, Singapore, reached the advanced benchmark as those in England (49% compared with 22%). Furthermore, 79% of pupils in Singapore reached the high benchmark or above compared with 53% in England (although the gap closed by 5 percentage points compared with 2019). In addition, 93% of pupils in Singapore reached the intermediate benchmark or above, compared with 80% of pupils in England.

Nevertheless, compared with the international median across all participating countries, a larger share of pupils in England reached each benchmark[42], with just over 3 times the percentage in England (22% compared with 7%) reaching the advanced benchmark.

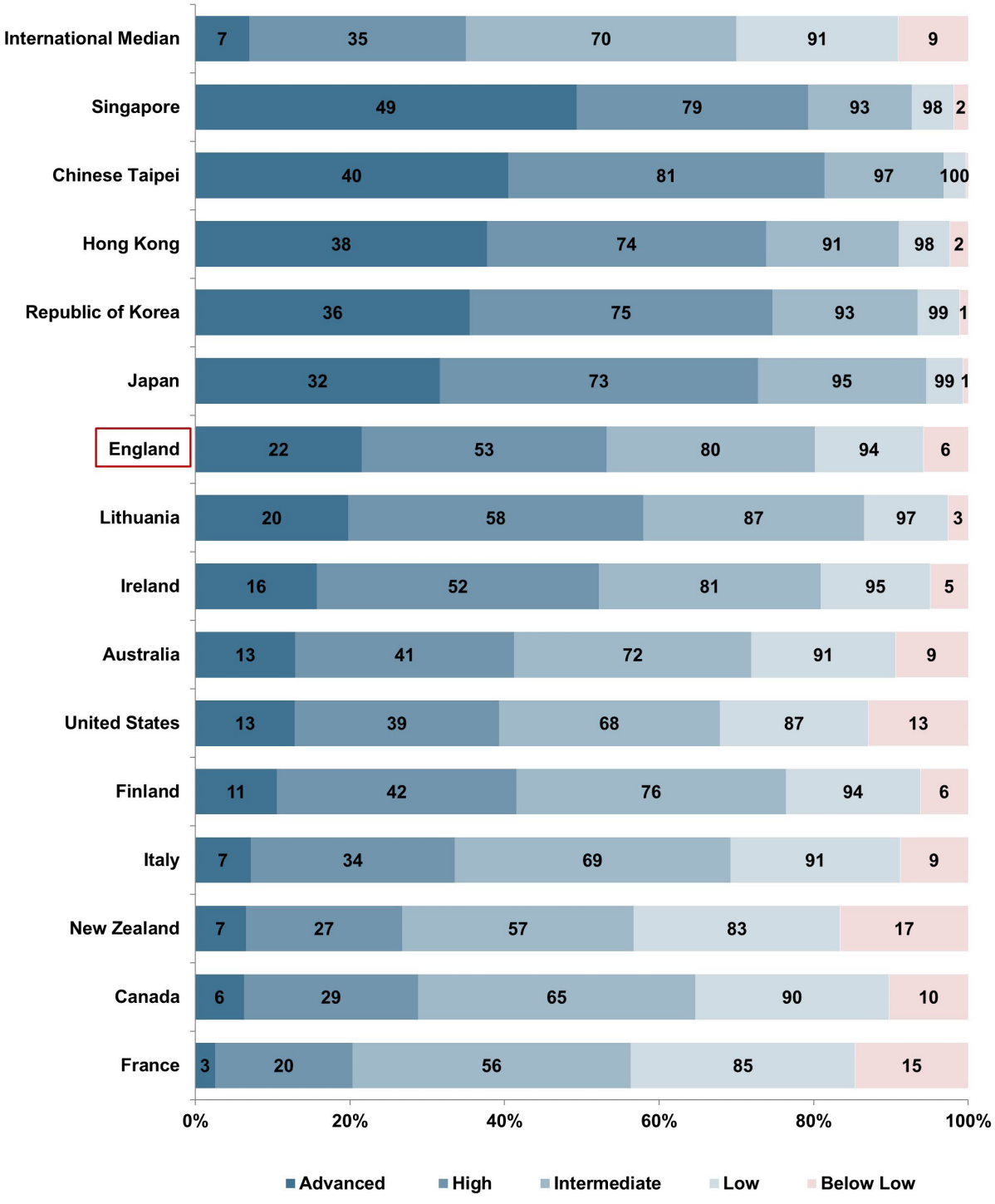
A larger percentage of England's pupils also reached each benchmark compared with their peers in most other English-speaking countries. The exception was in comparison with Ireland, where a lower, but not significant, percentage of pupils in England reached the intermediate and low benchmarks (by 1% in each case).

A larger percentage of England's pupils reached the advanced benchmark compared with their peers in the European comparator countries. However, a larger percentage of Lithuania's pupils reached the other 3 benchmarks or above than England's. A larger percentage of England's pupils reached each benchmark compared with the remaining 3 European countries (Finland, France and Italy) except in one instance – in both England and Finland, the same percentage of pupils reached the low benchmark or above (94%).

Data on all other participating countries is available in the *TIMSS International Report 2023*.

[42] The IEA calculates international medians rather than international averages for this data set.

**Figure 15: Percentage of year 5 pupils reaching the international benchmarks in year 5 mathematics (England and comparator countries)**




Source: IEA TIMSS International Report 2023

**Table 25: Percentage of year 5 pupils reaching the international benchmarks in mathematics in 2023 (England and comparator countries)**

| | Advanced benchmark | High benchmark and above | Intermediate benchmark and above | Low benchmark and above | Did not reach the low benchmark |
|---|---|---|---|---|---|
| International median | 7 | 35 | 70 | 91 | 9 |
| Singapore | 49 | 79 | 93 | 98 | 2 |
| Chinese Taipei | 40 | 81 | 97 | 100 | 0 |
| Hong Kong | 38 | 74 | 91 | 98 | 2 |
| Republic of Korea | 36 | 75 | 93 | 99 | 1 |
| Japan | 32 | 73 | 95 | 99 | 1 |
| England | 22 | 53 | 80 | 94 | 6 |
| Lithuania | 20 | 58 | 87 | 97 | 3 |
| Ireland | 16 | 52 | 81 | 95 | 5 |
| Australia | 13 | 41 | 72 | 91 | 9 |
| United States | 13 | 39 | 68 | 87 | 13 |
| Finland | 11 | 42 | 76 | 94 | 6 |
| Italy | 7 | 34 | 69 | 91 | 9 |
| New Zealand | 7 | 27 | 57 | 83 | 17 |
| Canada | 6 | 29 | 65 | 90 | 10 |
| France | 3 | 20 | 56 | 85 | 15 |

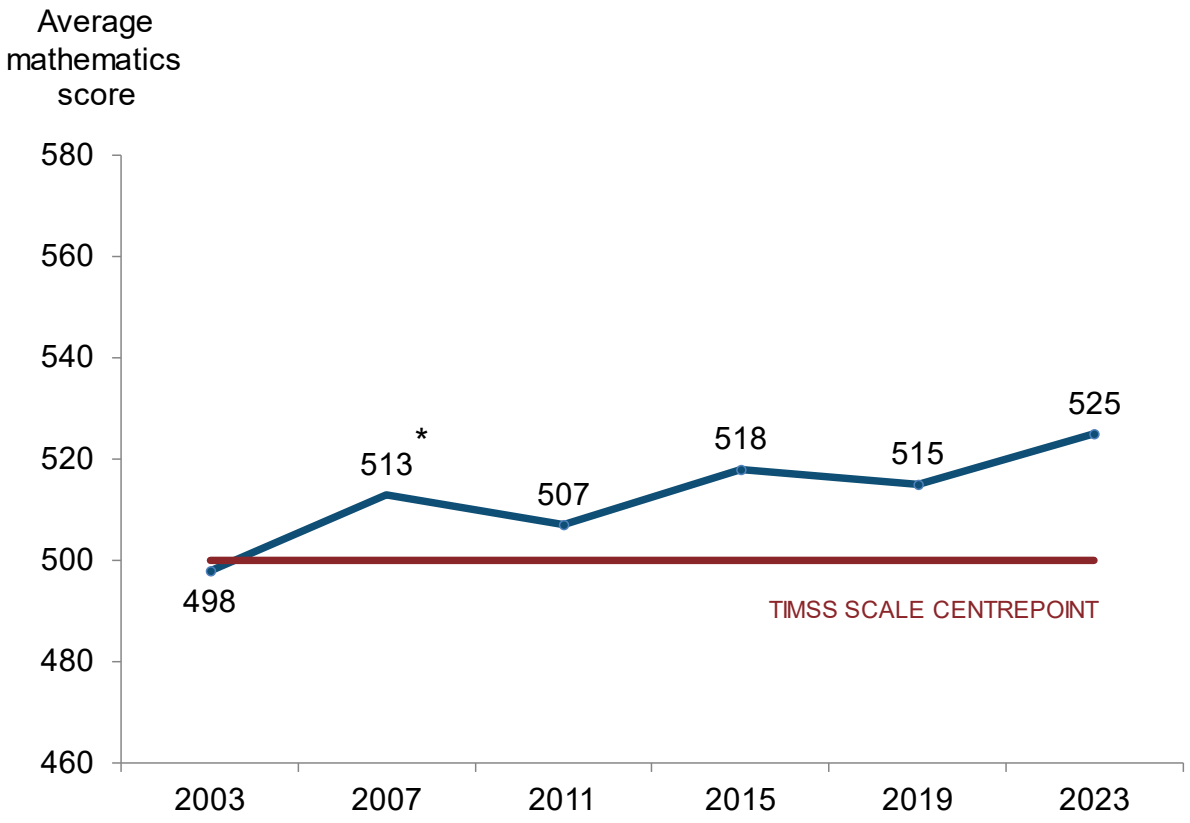
Source: IEA TIMSS International Report 2023

## 3.3 What does TIMSS tell us about England's performance in year 9 mathematics?

### 3.3.1 How has England's performance in mathematics changed over time for year 9 pupils?

England's performance in year 9 mathematics has seen significant improvement over the last 20 years, most notably between 2003 and 2007, with performance remaining broadly stable since 2007 (see Figure 16 and Table 26 below). In 2023, year 9 pupils in England performed above the TIMSS centrepoint, as they have since 2007. The 2023 average mathematics score for England (525) was 10 scale points higher than for 2019, but this increase was not significant.

**Figure 16: Trend in average year 9 mathematics score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Note 2: Scores that represent a significant increase or decrease compared with the previous TIMSS cycle are marked with an asterisk (*).

**Table 26: Year 9 average mathematics scores between 2003 and 2023 (England)**

| Year | Average mathematics score |
|---|---|
| 2003 | 498 |
| 2007 | 513 (significant increase) |
| 2011 | 507 |
| 2015 | 518 |
| 2019 | 515 |
| 2023 | 525 |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

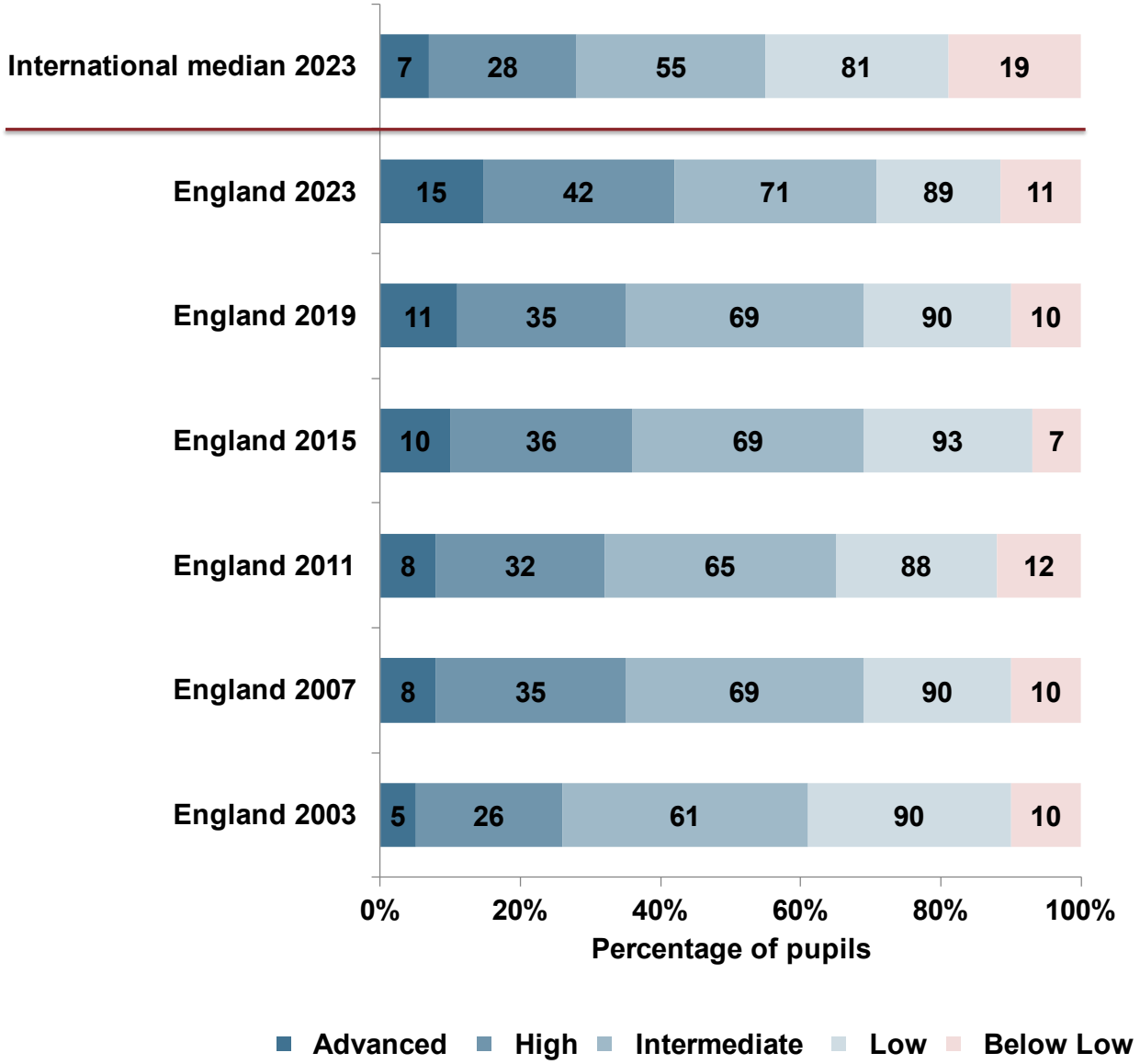
Figure 17 and Table 27 below show the percentage of year 9 pupils in England meeting each of the international TIMSS benchmarks[43] in mathematics since 2003. Figure 17 is cumulative so that, reading left to right, it presents the percentage of pupils who reached all of the benchmarks from the advanced benchmark to the low benchmark or above. For example, in 2023 in England 15% of pupils reached the advanced benchmark, 42% the high benchmark or above, 71% the intermediate benchmark or above and 89% the low benchmark or above. The remaining 11% did not reach the low benchmark.

Between 2003 and 2023, there has been a significant improvement in the percentage of year 9 pupils in England reaching each of the international benchmarks, except for the low benchmark. The percentage of pupils reaching the advanced benchmark between 2003 and 2023 has trebled (from 5% to 15%). In 2023, the percentages of pupils reaching the low or above and intermediate or above have remained similar to 2019. The percentage of pupils reaching the high or above benchmark in 2023 was significantly above the percentage reaching this in 2019 (a 7 percentage point increase). The 4 percentage point increase in pupils reaching the advanced benchmark between 2019 and 2023 was not significant.

A larger percentage of pupils in England reached each of the benchmarks compared with the international median.

[43] See Section 2.3 and Appendix C for descriptions of the international benchmarks and for a guide to interpreting the benchmark charts.

**Figure 17: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**




Source: IEA TIMSS International Report 2023

**Table 27: Percentage of year 9 pupils reaching each of the TIMSS international benchmarks in mathematics (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 28 | 55 | 81 | 19 |
| England 2023 | 15 | 42 | 71 | 89 | 11 |

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| England 2019 | 11 | 35 | 69 | 90 | 10 |
| England 2015 | 10 | 36 | 69 | 93 | 7 |
| England 2011 | 8 | 32 | 65 | 88 | 12 |
| England 2007 | 8 | 35 | 69 | 90 | 10 |
| England 2003 | 5 | 26 | 61 | 90 | 10 |

Source: IEA TIMSS International Report 2023

### 3.3.2 How did year 9 pupils in England perform in mathematics relative to their peers in all other TIMSS countries?

Forty-four countries participated in the TIMSS 2023 year 9 mathematics assessments. Full international analyses of their performance can be found in the *TIMSS International Report 2023*.

Pupils in England performed significantly above the TIMSS 2023 international average (525 compared with 478).

Year 9 pupils in 5 countries performed significantly above England's pupils in 2023 as in 2019: Chinese Taipei, Hong Kong, Japan, the Republic of Korea and Singapore. In 3 countries, they performed at a similar level to pupils in England and in 35 countries they performed significantly below.

The countries with similar average achievement to England in 2023 were the Czech Republic, Ireland and Sweden.

Tables 28, 29 and 30 below show how England's year 9 pupils performed, in 2019 and 2023, relative to those in a selection of other countries by average score. England's average score in 2019 was 515 and in 2023 was 525.

**Table 28: Year 9 mathematics: all countries in which pupils performed significantly above pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Singapore | 616 | 605 |
| Chinese Taipei | 612 | 602 |
| Republic of Korea | 607 | 596 |
| Japan | 594 | 595 |
| Hong Kong | 578 | 575 |
| Russia | 538 | Did not participate |
| **England** | **515** | **525** |

**Table 29: Year 9 mathematics: all countries in which pupils performed at a similar level to pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Ireland | 524 | 522 |
| Lithuania | 520 | Performed significantly below |
| Israel | 519 | Performed significantly below |
| Australia | 517 | Performed significantly below |
| Hungary | 517 | Performed significantly below |
| **England** | **515** | **525** |
| United States | 515 | Performed significantly below |
| Finland | 509 | Performed significantly below |
| Sweden | Performed significantly below | 517 |
| Czech Republic | Did not participate | 518 |

**Table 30: Year 9 mathematics: comparator countries in which pupils performed significantly below pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| England | 515 | 525 |
| Lithuania | Performed similarly | 514 |

| Country | 2019 | 2023 |
|---|---|---|
| Australia | Performed similarly | 509 |
| Finland | Performed similarly | 504 |
| United States | Performed similarly | 488 |
| Italy | 497 | 501 |
| New Zealand | 493 | 485 |
| France | 483 | 479 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Guidelines for minimum school participation rates in both New Zealand and the United States were not satisfied in 2023.[44]

Note 2: 28 other countries not included as comparators

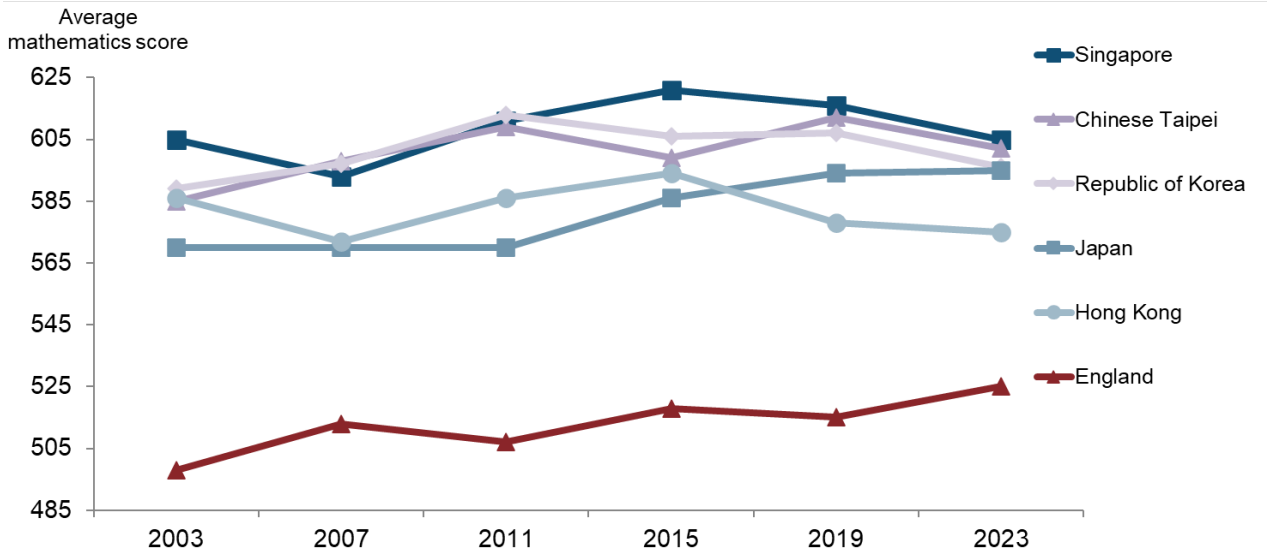
### 3.3.3 How did year 9 pupils in England perform in mathematics relative to their peers in the comparator countries?

In this section, comparisons are drawn between the performance of England's year 9 pupils and pupils from the 3 comparator groups: highest-performing, English-speaking and European (see Section 1.5). Trends are shown for countries with at least 2 cycles of assessment data since 2003.

The performance of pupils in each of the highest-performing countries (the 5 East Asian countries) was significantly above that of England's pupils in 2023. The increase in England's pupils' average score in 2023, while not significant, was in contrast to pupils' performance in each of these countries with the exception of Japan (a one scale-point increase). Like England, Chinese Taipei and Japan have seen a significant improvement in year 9 pupils' mathematics performance between 2003 and 2023 (see Figure 18 and Table 31 below). For Hong Kong, the Republic of Korea and Singapore, the trend in their pupils' performance has been one of stability over the same period.

[44] See Appendix B for discussion of the difficulty of making easy comparisons across countries, or even within country and across years.

**Figure 18: Trends in year 9 mathematics performance between 2003 and 2023 for England and highest-performing countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.

**Table 31: Year 9 average mathematics scores between 2003 and 2023 for England and highest-performing comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 498 | 513 | 507 | 518 | 515 | 525 |
| Chinese Taipei | 585 | 598 | 609 | 599 | 612 | 602 |
| Hong Kong | 586 | 572 | 586 | 594 | 578 | 575 |
| Japan | 570 | 570 | 570 | 586 | 594 | 595 |
| Republic of Korea | 589 | 597 | 613 | 606 | 607 | 596 |
| Singapore | 605 | 593 | 611 | 621 | 616 | 605 |

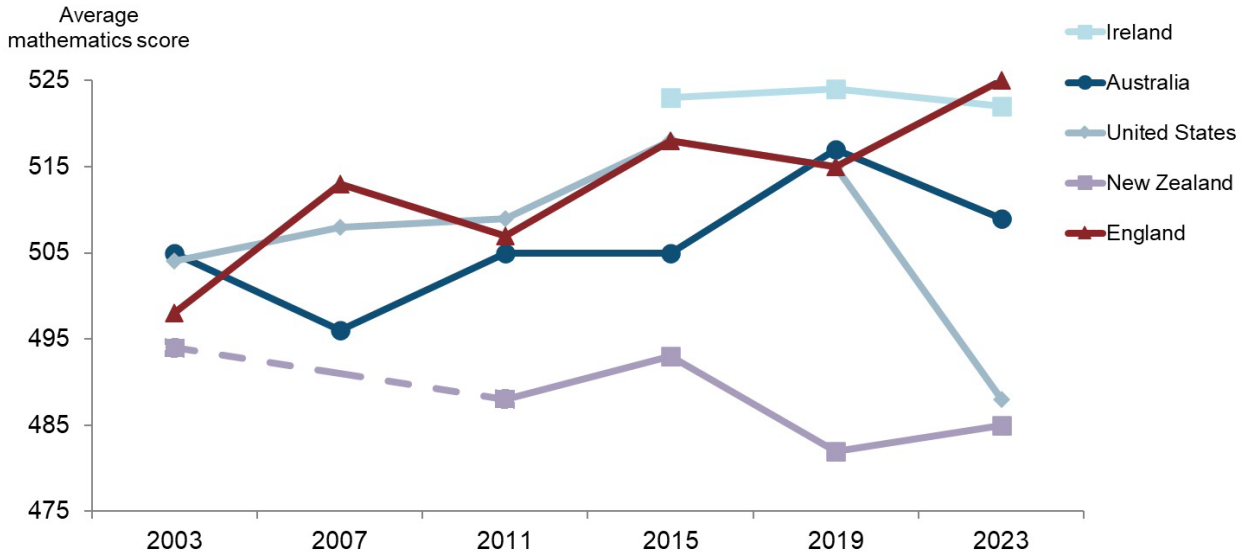
Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.

Within English-speaking countries, only the performance of England's year 9 pupils shows significant improvement between 2003 and 2023 compared with their peers (see Figure 19 and Table 32 below). The trends for Australia's and New Zealand's pupils have been stable overall across the same period while the United States' 27-point score decrease in 2023 means its pupils performed significantly below their average score compared with every cycle since 2003. Ireland's pupils' trend has been one of stability

across its 3 cycles from 2015 to 2023 (it did not participate in any previous cycles apart from 1995). Canada did not participate in year 9 TIMSS 2023.

**Figure 19: Trends in year 9 mathematics performance between 2003 and 2023 for England and English-speaking comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 9 pupils in Ireland did not participate in TIMSS 2003, 2007 and 2011.
Note 3: Year 9 pupils in New Zealand did not participate in TIMSS 2007.

**Table 32: Year 9 average mathematics scores between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 498 | 513 | 507 | 518 | 515 | 525 |
| Australia | 505 | 496 | 505 | 505 | 517 | 509 |
| Ireland | No data | No data | No data | 523 | 524 | 522 |
| New Zealand | 494 | No data | 488 | 493 | 482 | 485 |
| United States | 504 | 508 | 509 | 518 | 515 | 488 |

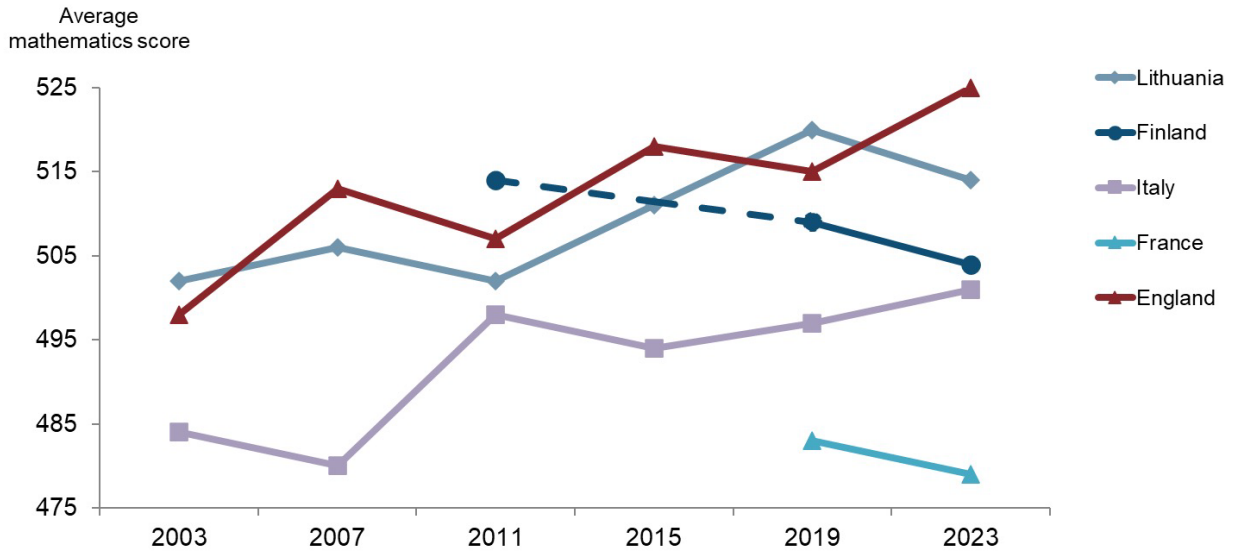
Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 9 pupils in Ireland did not participate in TIMSS 2003, 2007 and 2011.
Note 3: Year 9 pupils in New Zealand did not participate in TIMSS 2007.

Only 2 of the 4 European comparator countries have time series data from 2003: Italy and Lithuania. The performance of pupils in both countries has improved significantly

over this period. In 2023, pupils in Finland performed significantly below their 2011 average score. France has only participated in the 2 most recent cycles (2019 and 2023) since it participated in 1995; across these 2 cycles, its pupils' performance has been stable. Figure 20 and Table 33 below show these trends.

**Figure 20: Trends in year 9 mathematics performance between 2003 and 2023 for England and European comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003: pupils in France only participated in TIMSS 2019 and 2023.

Note 2: Year 9 pupils in Finland did not participate in TIMSS 2003, 2007 and 2015.

**Table 33: Year 9 average mathematics scores between 2003 and 2023 for England and European comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 498 | 513 | 507 | 518 | 515 | 525 |
| Finland | No data | No data | 514 | No data | 509 | 504 |
| France | No data | No data | No data | No data | 483 | 479 |
| Italy | 484 | 480 | 498 | 494 | 497 | 501 |
| Lithuania | 502 | 506 | 502 | 511 | 520 | 514 |

Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003: pupils in France only participated in TIMSS 2019 and 2023.

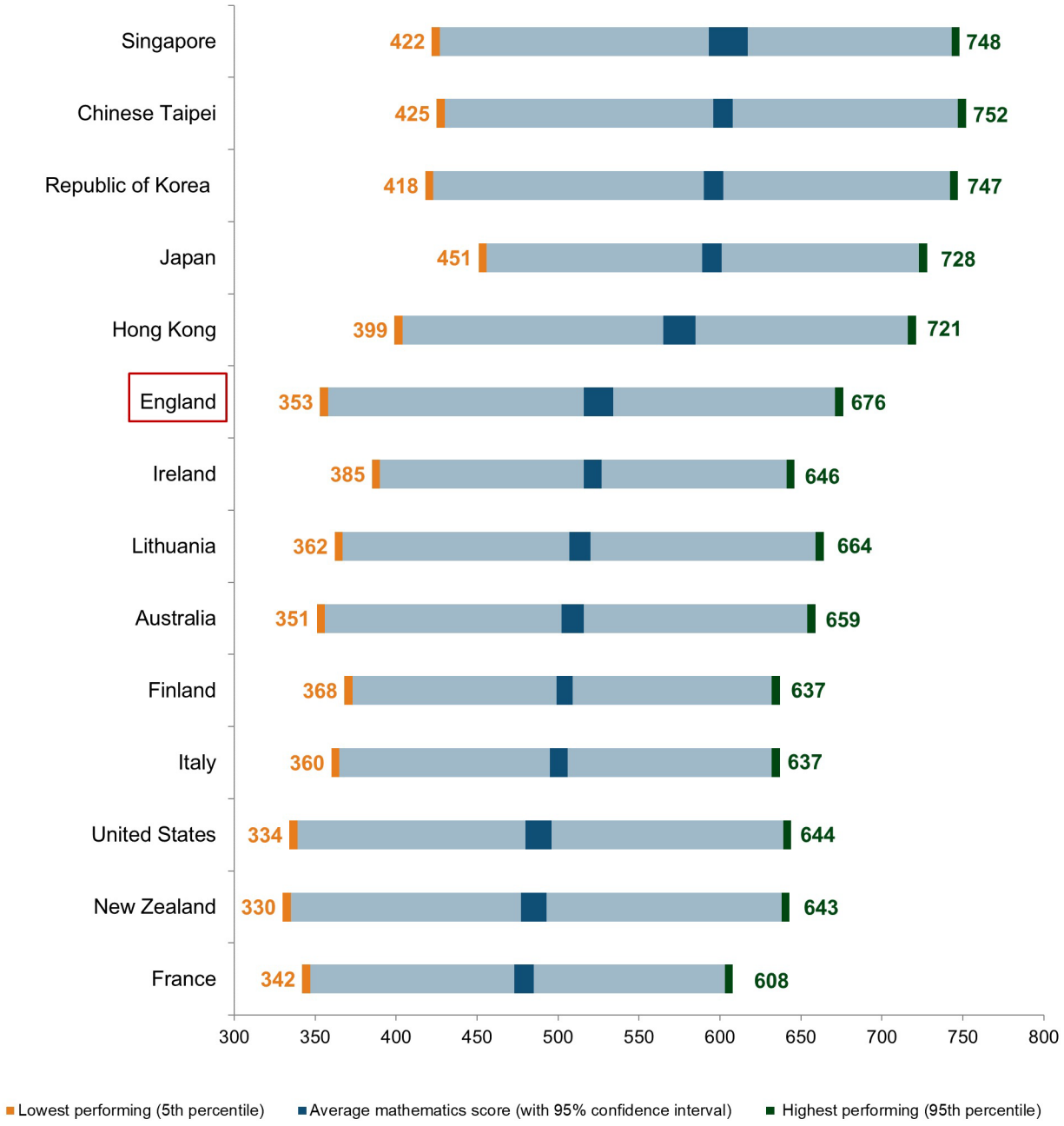
Note 2: Year 9 pupils in Finland did not participate in TIMSS 2003, 2007 and 2015.

Figure 21 and Table 34 below show the range of year 9 mathematics scores in England against the countries from the 3 comparator groups from the 5th percentile (low-performing pupils) to the 95th percentile (high-performing pupils) on the distribution of scores in each country.

Year 9 pupils in England at the lower end of the distribution (the 5th percentile) achieved an average score of 363 in 2019 and 353 in 2023, a decrease of 10 scale points. By contrast, at the top end of the distribution (the 95th percentile), pupils achieved an average score of 660 in 2019 and 676 in 2023, an increase of 16 scale points. This decrease in performance for lower-achieving pupils, combined with an increase for the higher-achieving pupils, meant the achievement gap between the higher- and lower-achieving pupils was greater in 2023 (322) than 2019 (297) by 25 scale points, largely driven by a change at the higher end of the distribution. This represents a further widening of the gap from TIMSS 2015 when it was 260 scale points.

This difference between the performance of the highest- and lowest-scoring year 9 pupils in England was smaller compared with their peers in Chinese Taipei, the Republic of Korea, and Singapore from the highest-performing countries. It was similar to that for pupils in Hong Kong and larger than the range for pupils in Japan. The range for England's pupils was larger than for pupils in each of the English-speaking countries and European comparator countries. Data on all other participating countries is available in the *TIMSS International Report 2023*.

**Figure 21: Range of year 9 mathematics achievement between the lowest and highest-performing pupils across comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

**Table 34: Range of year 9 mathematics achievement between the lowest and highest-performing pupils across comparator countries (average scores)**

| | Average mathematics score | Lowest performing (5th percentile) | Highest performing (95th percentile) | Range between lowest and highest performing |
|---|---|---|---|---|
| Singapore | 605 | 422 | 748 | 326 |
| Chinese Taipei | 602 | 425 | 752 | 327 |
| Republic of Korea | 596 | 418 | 747 | 329 |
| Japan | 595 | 451 | 728 | 277 |
| Hong Kong | 575 | 399 | 721 | 322 |
| England | 525 | 353 | 676 | 322 |
| Ireland | 522 | 385 | 646 | 260 |
| Lithuania | 514 | 362 | 664 | 302 |
| Australia | 509 | 351 | 659 | 308 |
| Finland | 504 | 368 | 637 | 269 |
| Italy | 501 | 360 | 637 | 277 |
| United States | 488 | 334 | 644 | 310 |
| New Zealand | 485 | 330 | 643 | 313 |
| France | 479 | 342 | 608 | 267 |

Source: IEA TIMSS International Report 2023

## TIMSS international benchmarks

As shown in Figure 22 and Table 35 below, a smaller percentage of year 9 pupils in England reached each of the 4 benchmarks compared with their peers in the highest-performing countries. In Singapore, around 3 times the percentage of pupils reached the advanced benchmark as pupils in England (46% compared with 15%). However, this gap has narrowed since 2019 when it was 51% compared with 11%. Similarly, the percentage gap between pupils reaching the high benchmark or above in England and Singapore has narrowed from 79% compared with 35% in 2019 (a gap of 44 percentage

points) to 74% compared with 42% in 2023 (a gap of 32 percentage points). Eighty-nine per cent of pupils in Singapore reached the intermediate benchmark or above compared with 71% in England. However, compared with the international median across all participating countries, a larger share of pupils in England reached each benchmark. Just over double the percentage reached the advanced benchmark (15% compared with 7%), while the percentage that reached the low benchmark or above was greater than the international median (89% in England compared with 81%)[45].

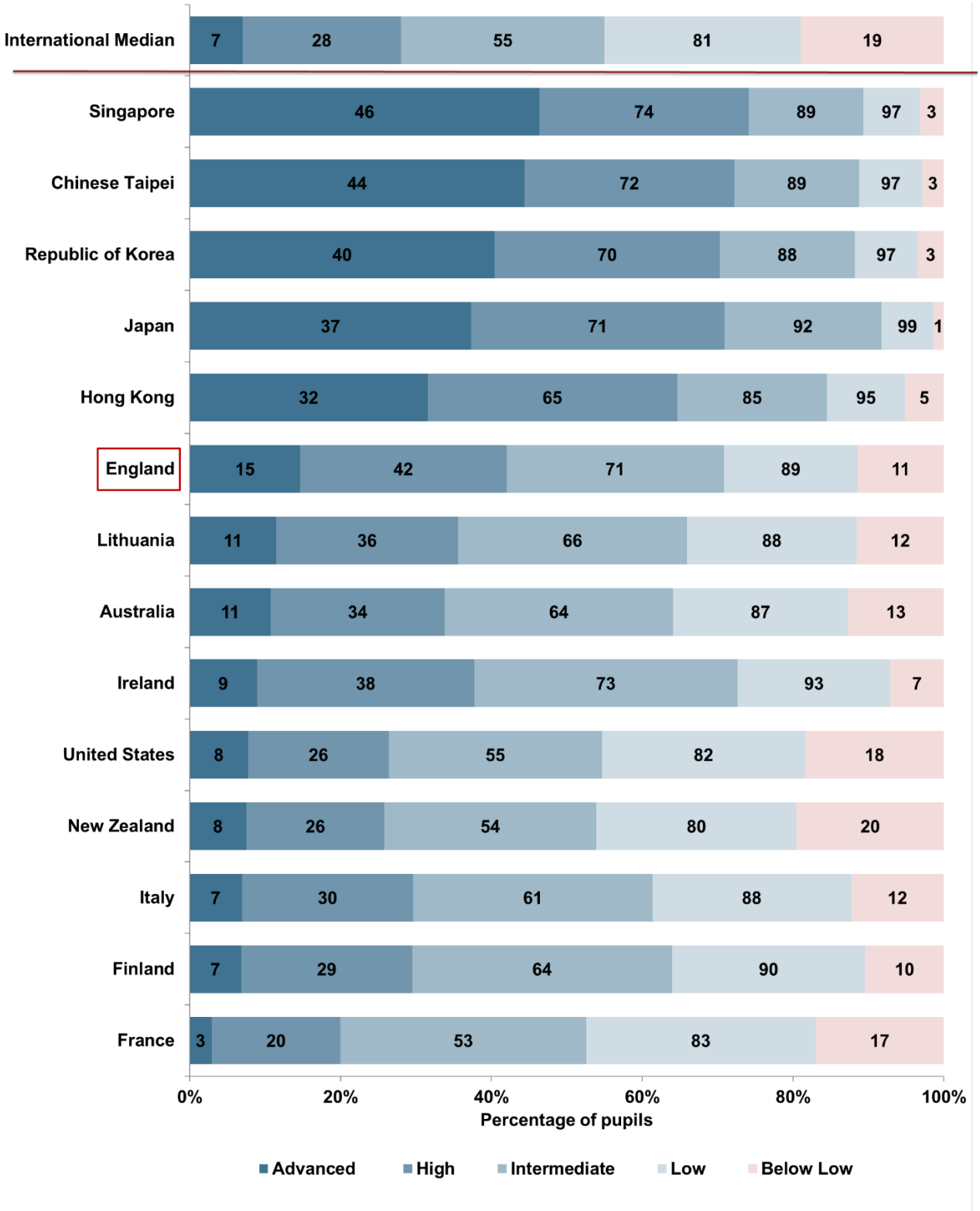
England's pupils' performance against the benchmarks relative to their peers in the other English-speaking countries was stronger overall. The percentage of year 9 pupils in England reaching the advanced benchmark and the high benchmark or above was larger than Ireland (15% compared with 9% and 42% compared with 38% respectively), but the percentages of pupils in England reaching the remaining benchmarks were smaller than the percentages for pupils in Ireland. The performance of England's pupils at each benchmark was above their peers in the remaining countries: Australia, New Zealand and the United States.

A larger percentage of pupils in England reached the advanced benchmark and high benchmark or above compared with their peers in all the European comparator group countries. A larger percentage of pupils in England also reached both the intermediate benchmark or above and low benchmark and above compared with their peers in all these countries, except in one instance: 1 percentage point fewer pupils in England reached the low benchmark and above compared with Finland. By contrast, a larger percentage of pupils in England achieved this benchmark compared with pupils in the remaining 3 countries (although differences were again only one percentage point compared with pupils in Italy and Lithuania).

Data on all other participating countries is available in the *TIMSS International Report 2023*.

[45] The IEA calculates international medians rather than international averages for this data set.

**Figure 22: Percentage of year 9 pupils reaching the international benchmarks in mathematics in 2023 (England and comparator countries)**




Source: TIMSS 2023

**Table 35: Percentage of year 9 pupils reaching the international benchmarks in mathematics in 2023 (England and comparator countries)**

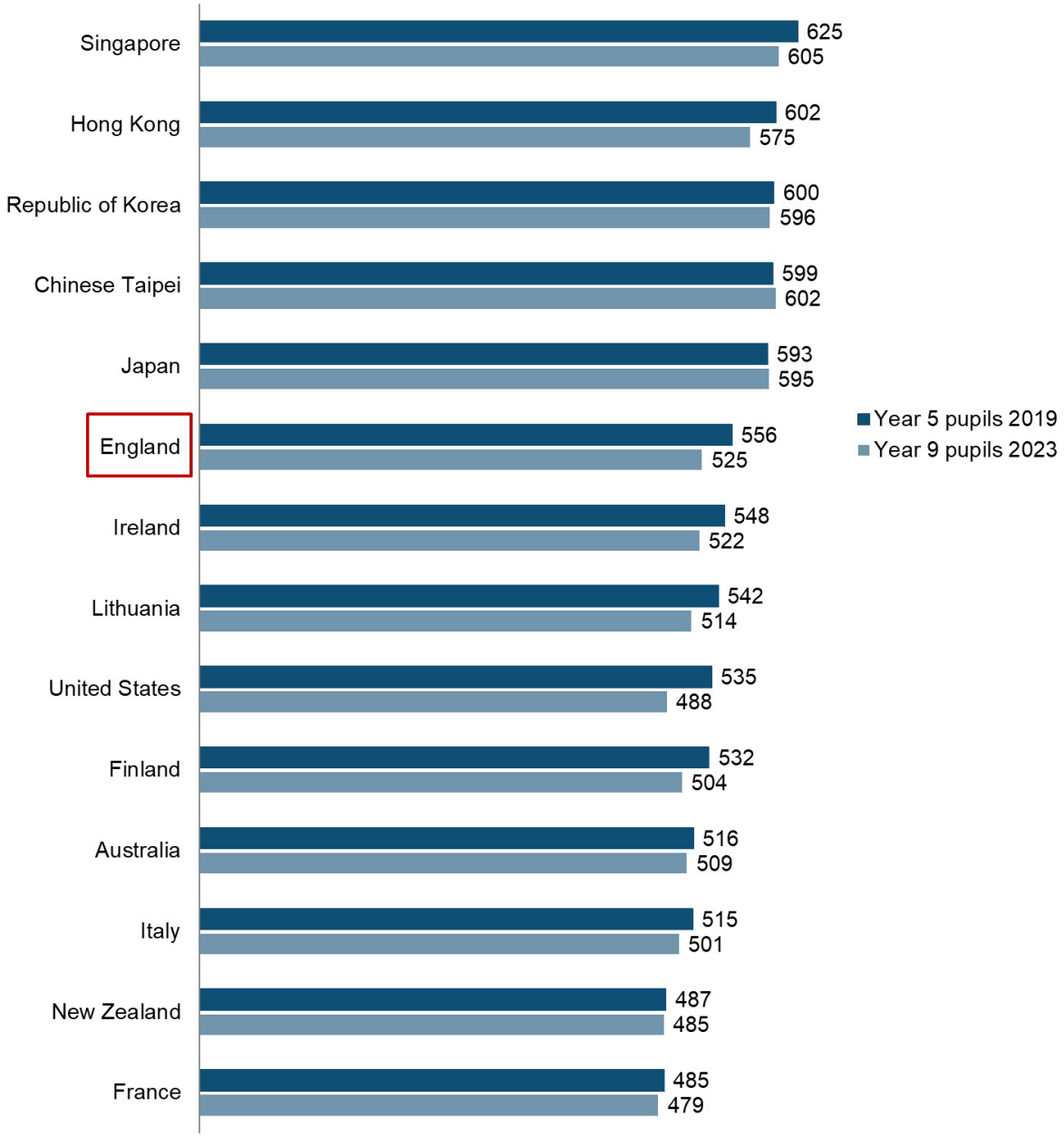
| | Advanced benchmark | High benchmark and above | Intermediate benchmark and above | Low benchmark and above | Did not reach the low benchmark |
|---|---|---|---|---|---|
| International median | 7 | 28 | 55 | 81 | 19 |
| Singapore | 46 | 74 | 89 | 97 | 3 |
| Chinese Taipei | 44 | 72 | 89 | 97 | 3 |
| Republic of Korea | 40 | 70 | 88 | 97 | 3 |
| Japan | 37 | 71 | 92 | 99 | 1 |
| Hong Kong | 32 | 65 | 85 | 95 | 5 |
| England | 15 | 42 | 71 | 89 | 11 |
| Lithuania | 11 | 36 | 66 | 88 | 12 |
| Australia | 11 | 34 | 64 | 87 | 13 |
| Ireland | 9 | 38 | 73 | 93 | 7 |
| United States | 8 | 26 | 55 | 82 | 18 |
| New Zealand | 8 | 26 | 54 | 80 | 20 |
| Italy | 7 | 30 | 61 | 88 | 12 |
| Finland | 7 | 29 | 64 | 90 | 10 |
| France | 3 | 20 | 53 | 83 | 17 |

Source: IEA TIMSS International Report 2023

## 3.4 What does TIMSS tell us about pupil progress in mathematics between years 5 and 9?

The TIMSS 4-year cycle allows for a comparison of a cohort's performance for one cycle compared with the previous cycle since, for example, year 9 pupils in 2023 were in year 5 in 2019. However, due to the sampling approach (see Section 1.3), the year 5 pupils who took the assessments in 2019 were from the same cohort, but were not necessarily the same pupils as those sampled in year 9 in 2023. The assessments taken by year 5 and year 9 pupils, and the frameworks from which these were taken, were also different, and have resulted in different mean scores and standard deviations, internationally. Taken together, these considerations mean it is not possible to directly compare year 5 scores in one TIMMS cycle with those achieved by year 9 in the next cycle. We do note, though, as in Figure 23 and Table 36 below, that the international comparator rankings across each year group are fairly similar, so that the relatively high mathematics performance achieved by year 5 pupils in Singapore, Hong Kong, Republic of Korea, Chinese Taipei and Japan was also a feature of year 9 mathematics performance, with England featuring in the next highest performing group of countries in both year groups.

**Figure 23: A comparison of the mathematics performance of year 5 pupils in 2019 and year 9 pupils in 2023 (England and other countries from the comparator groups)**




Source: TIMSS 2023

**Table 36: A comparison of the mathematics performance of year 5 pupils in 2019 and year 9 pupils in 2023 (England and other countries from the comparator groups)**

| | 2019 year 5 average score | 2023 year 9 average score |
|---|---|---|
| Singapore | 625 | 605 |
| Hong Kong | 602 | 575 |
| Republic of Korea | 600 | 596 |
| Chinese Taipei | 599 | 602 |
| Japan | 593 | 595 |
| England | 556 | 525 |
| Ireland | 548 | 522 |
| Lithuania | 542 | 514 |
| United States | 535 | 488 |
| Finland | 532 | 504 |
| Australia | 516 | 509 |
| Italy | 515 | 501 |
| New Zealand | 487 | 485 |
| France | 485 | 479 |

Source: IEA TIMSS International Report 2023

# Chapter 4. Overall performance in science

## 4.1 Main findings

This chapter summarises the TIMSS 2023 year 5 and year 9 science performance in England. It covers the changes in average performance over time and changes in the percentage of pupils reaching each of the international benchmarks in science[46]. The comparator countries referred to in this chapter are listed in Section 1.5.

- The 2023 average science scores for year 5 and 9 pupils in England remained significantly above the TIMSS centrepoint. Both were also significantly above the relevant international average for 2023.

- Performance in science of year 5 pupils in England has improved significantly since 2011 following a significant decline between 2003 and 2011. The performance in science of year 5 pupils in England in 2023 was significantly above average scale scores in each previous TIMSS cycle.

- The performance in science of year 9 pupils in England in 2023 was a significant improvement on 2019. Performance over the 20 year period from 2003 to 2023 has significantly decreased. However, compared with each cycle from 2007 to 2015, performance in 2023 was broadly stable.

- For year 5, pupils in 4 countries performed significantly above their peers in England (Chinese Taipei, the Republic of Korea, Singapore and Turkey); this was 2 fewer than in 2019. Only pupils in Japan performed at a similar level to pupils in England in 2023 and pupils in each of the remaining 52 countries performed significantly below them.

- For year 9, pupils in 4 countries performed significantly above their peers in England: the same 4 East Asian countries as in 2019 (Chinese Taipei, Japan, the Republic of Korea and Singapore). This was 5 fewer than in 2019. Pupils in 6 countries performed at a similar level to England's pupils and in each of the remaining 33 countries significantly below them.

- A larger percentage of year 5 and 9 pupils reached each of the international benchmarks in England compared with the international median across all participating countries.

- The percentage of year 5 pupils reaching each of the international benchmarks, except the low benchmark or above, in 2023 was larger than those from 2019 and

[46] See Section 2.3 and Appendix C for descriptions of the international benchmarks.

the largest in any TIMSS cycle. The percentage of pupils reaching the advanced benchmark nearly doubled.

- For year 9, there was a significant increase in the percentage of pupils reaching each of the benchmarks, except the low benchmark or above, compared with 2019.

- In 2023, the difference between England's highest- and lowest-performing year 5 pupils' scores in science was 265 scale points compared with 236 in 2019, an increase of 29 scale points. This increase was driven by a significantly larger percentage of pupils reaching the advanced benchmark at the top end of the distribution.

- At year 9, this range was 326 scale points, 24 points larger than in 2019 (302 scale points), again driven by the change at the top end of the distribution. This range was the joint largest (with Singapore's) compared with each of the other comparator countries.

- The TIMSS 4-year cycle allows for a comparison of a cohort's performance for one cycle compared with the previous cycle as, for example, year 9 pupils in 2023 were in year 5 in 2019[47]. Relative to the TIMSS centrepoint, this cohort of pupils performed better in year 5 science than in year 9 science. A similar decrease in relative performance was reported in all of the comparator countries except in Chinese Taipei and Singapore.

[47]Although the year 5 pupils who took the assessments in 2019 were from the same cohort, this does not mean they were the same pupils, because of the sampling approach (Section 1.3).

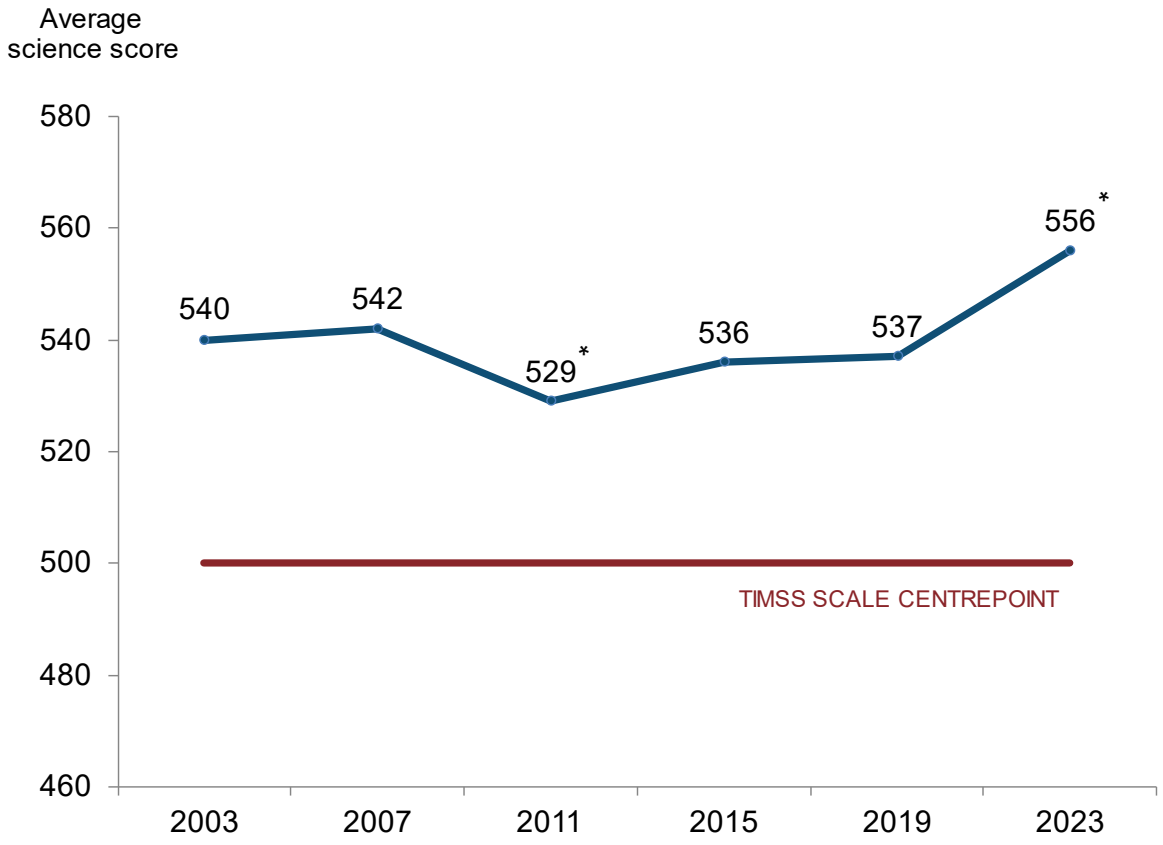
## 4.2 What does TIMSS tell us about England's performance in year 5 science?

### 4.2.1 How has England's performance in science changed over time for year 5 pupils?

Year 5 pupils' overall performance in science has been consistently and significantly above the TIMSS centrepoint (500) for all TIMSS cycles.

Pupils' performance has improved significantly since 2011, following a significant decline between 2003 and 2011. The average score for pupils in 2023 (556) was 19 scale points higher than in 2019 (537) and was significantly above the average score in each previous TIMSS cycle from 2003 (see Figure 24 and Table 37).

**Figure 24: Trend in average year 5 science score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.
Note 2: Scores that represent a significant increase or decrease from the previous TIMSS cycle are marked with an asterisk (*).

**Table 37: Year 5 average science scores between 2003 and 2023 (England)**

| Year | Average score |
|---|---|
| 2003 | 540 |
| 2007 | 542 |
| 2011 | 529 (significant decrease) |
| 2015 | 536 |
| 2019 | 537 |
| 2023 | 556 (significant increase) |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

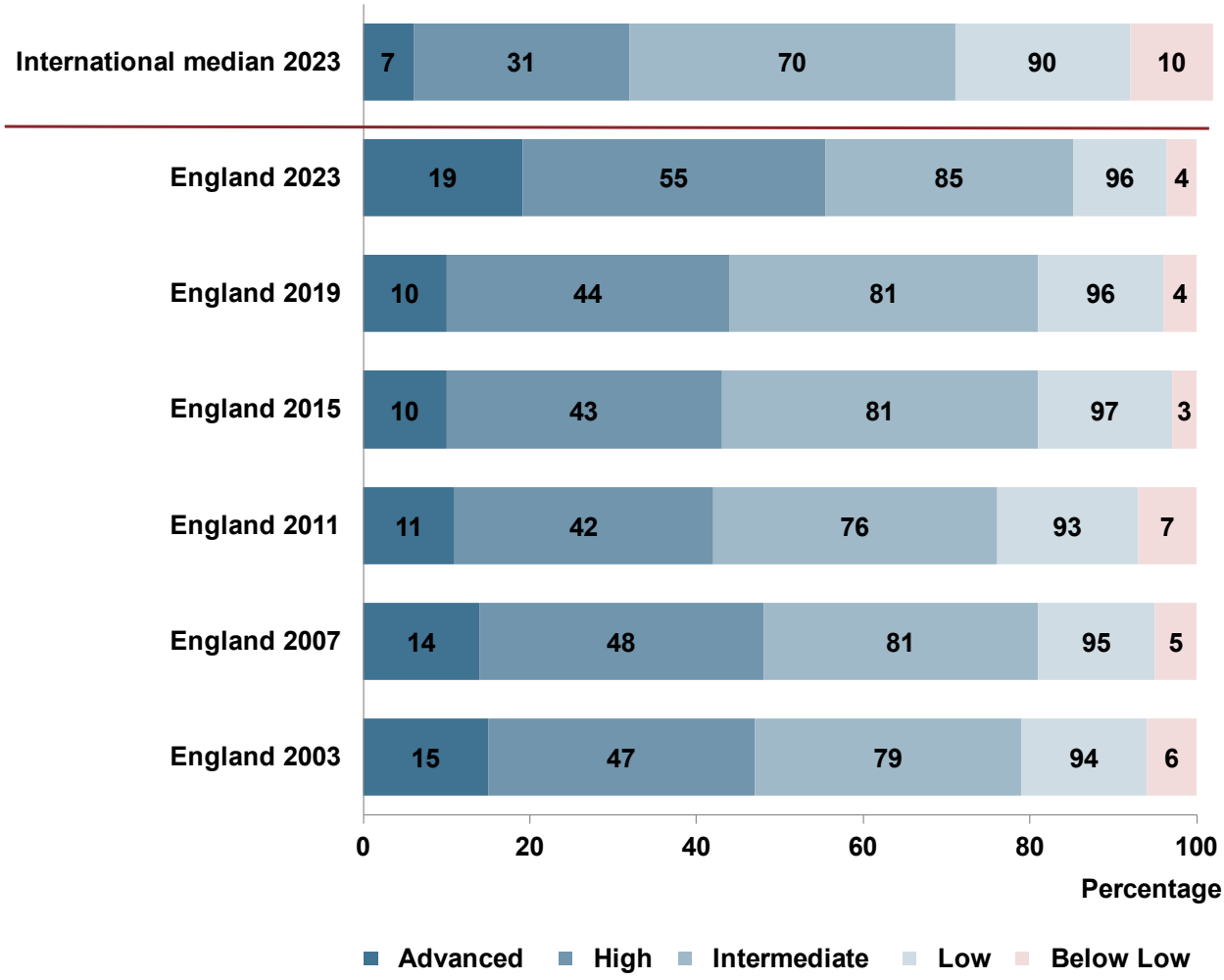
Figure 25 and Table 38 below show the percentage of year 5 pupils in England reaching each of the international TIMSS benchmarks[48] in science since 2003. Figure 25 is cumulative so that, reading left to right, it presents the percentage of pupils who reached each of the benchmarks from advanced to low. For example, in 2023 in England 19% of pupils reached the advanced benchmark, 55% the high benchmark or above, 85% the intermediate benchmark or above, and 96% the low benchmark or above. The remaining 4% did not reach the low benchmark.

The percentages of England's year 5 pupils reaching each of the benchmarks in 2023, except the low benchmark or above, were larger than those from 2019 and the largest achieved in any TIMSS cycle. There were 2 instances of significant improvement: the percentage of pupils reaching the advanced benchmark nearly doubled (19% compared with 10%), while the percentage reaching the high benchmark or above was also larger (55% compared with 44%). The percentage of pupils reaching the intermediate benchmark or above was also larger (85% compared with 81%) but this increase was not significant.

The percentage of pupils reaching the advanced benchmark had shown a significant decline between 2003 and 2019 but this has been overturned by the significant increase in 2023. The percentages of pupils reaching each of the benchmarks show significant improvement since 2003[49].

[48] See Section 2.3 and Appendix C for descriptions of the international benchmarks.

**Figure 25: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in science (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 38: Trend in the percentage of year 5 pupils reaching each of the TIMSS international benchmarks in science (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 7 | 31 | 70 | 90 | 10 |

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| England 2023 | 19 | 55 | 85 | 96 | 4 |
| England 2019 | 10 | 44 | 81 | 96 | 4 |
| England 2015 | 10 | 43 | 81 | 97 | 3 |
| England 2011 | 11 | 42 | 76 | 93 | 7 |
| England 2007 | 14 | 48 | 81 | 95 | 5 |
| England 2003 | 15 | 47 | 79 | 94 | 6 |

Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

### 4.2.2 How did year 5 pupils in England perform in science relative to their peers in all other TIMSS countries?

Fifty-eight countries participated in TIMSS 2023 year 5 science assessments. Full international analyses of their performance can be found in the *TIMSS International Report 2023*.

In 2023, pupils in England performed significantly above the TIMSS international average (556 compared with 495).

In 2023, pupils in 4 countries performed significantly above England's pupils; one performed at a similar level and 52 significantly below.

In 2023, pupils from fewer countries performed significantly above England's pupils compared with 2019. Those that did were from 3 of the 5 East Asian countries: Chinese Taipei, the Republic of Korea and Singapore, alongside Turkey. Appendix B highlights some of the challenges in making easy comparisons of performance across countries, or even across time in the same country.

Only pupils from Japan performed similarly to their peers in England in 2023. Pupils from each of the other countries who had performed similarly to England's pupils in 2019 performed significantly below them in 2023.

Tables 39, 40 and 41 below show how England's year 5 pupils performed in 2019 and 2023 relative to those in a selection of other countries by average score. England's average score was 537 in 2019 and 556 in 2023.

**Table 39: Year 5 science: all countries in which pupils performed significantly above pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Singapore | 595 | 607 |
| Republic of Korea | 589 | 583 |
| Russia | 567 | Did not participate |
| Japan | 562 | Performed similarly |
| Chinese Taipei | 558 | 573 |
| Finland | 555 | Performed significantly below |
| Turkey | Performed significantly below | 570 |
| England | 537 | 556 |

**Table 40: Year 5 science: all countries in which pupils performed at a similar level to pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Japan | Performed significantly above | 555 |
| Finland | Performed significantly above | Performed significantly below |
| Latvia | 542 | Performed significantly below |
| Norway | 539 | Performed significantly below |
| United States | 539 | Performed significantly below |
| Lithuania | 538 | Performed significantly below |
| Sweden | 537 | Performed significantly below |
| **England** | **537** | **556** |
| Czech Republic | 534 | Performed significantly below |
| Australia | 533 | Performed significantly below |
| Hong Kong | 531 | Performed significantly below |
| Poland | 531 | Performed significantly below |

**Table 41: Year 5 science: comparator countries in which pupils performed significantly below pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| Finland | Performed significantly above | 542 |
| United States | Performed similarly | 532 |
| Lithuania | Performed similarly | 537 |
| **England** | **537** | **556** |
| Australia | Performed similarly | 550 |
| Hong Kong | Performed similarly | 545 |
| Ireland | 528 | 532 |
| Canada | 523 | 521 |
| New Zealand | 503 | 517 |
| Italy | 510 | 511 |
| France | 488 | 488 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note: 42 other countries not included as comparators

### 4.2.3 How did year 5 pupils in England perform in science relative to their peers in the comparator countries?

In this section, comparisons are drawn between the performance of England's year 5 pupils and pupils from the 3 comparator groups: highest-performing, English-speaking and European (see Section 1.5). Trends are shown for countries with at least 2 cycles of assessment data since 2003.

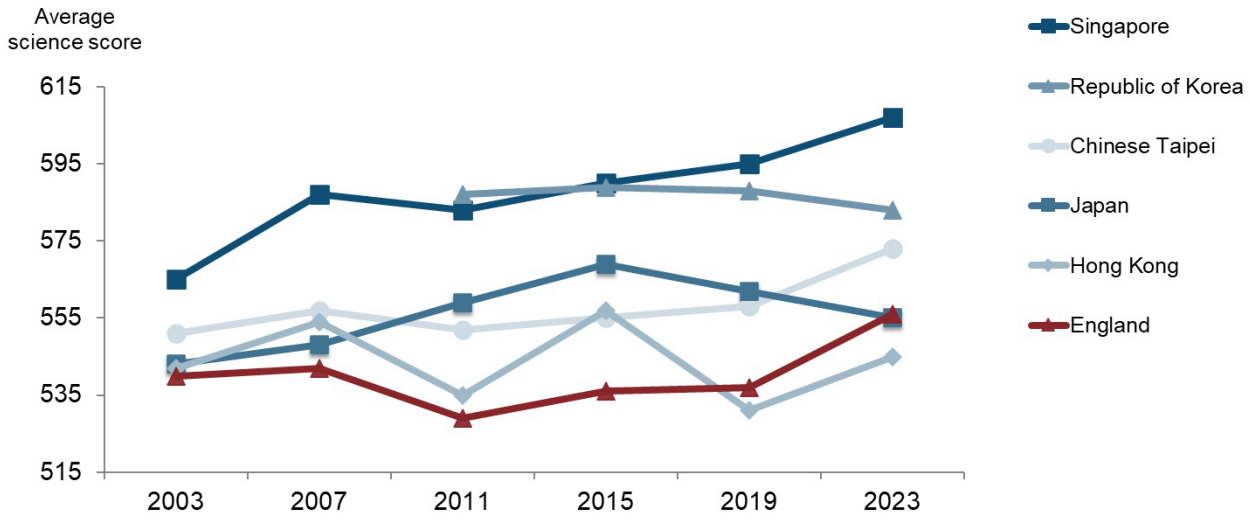
In 2023, pupils in England performed significantly above the TIMSS international average (556 compared with 495).

In 2019, Hong Kong saw a significant decrease in its pupils' average scale score in science. However, it saw a significant increase in its pupils' performance in 2023 and has been retained as a highest-performing country due to this and prior performance.

As in England, 3 of the highest-performing countries (Chinese Taipei, Japan and Singapore) have seen significant improvement in year 5 pupils' science performance between 2003 and 2023 (see Figure 26 and Table 42 below). The Republic of Korea did not participate in 2003 and Hong Kong's pupils' performance, while stable over this

period, has fluctuated with 3 cycles showing significant improvement (2007, 2015 and 2023) and 2 showing significant decreases in average scale score (2011 and 2019). The performance of pupils in Japan has similarly fluctuated with 2 cycles showing significant improvement (2011 and 2015) and significant decreases in average scale score in both 2019 and 2023. Pupils in each of these countries, except Hong Kong and Japan, performed significantly above their peers in England in 2023.

**Figure 26: Trends in year 5 science performance between 2003 and 2023 for England and highest-performing comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1. The Republic of Korea did not participate in 2003 and 2007.
Note 2. Comparator countries are only included if they have at least 2 cycles of data since 2003.

**Table 42: Year 5 average science scores between 2003 and 2023 for England and highest-performing comparator countries (average scores)**

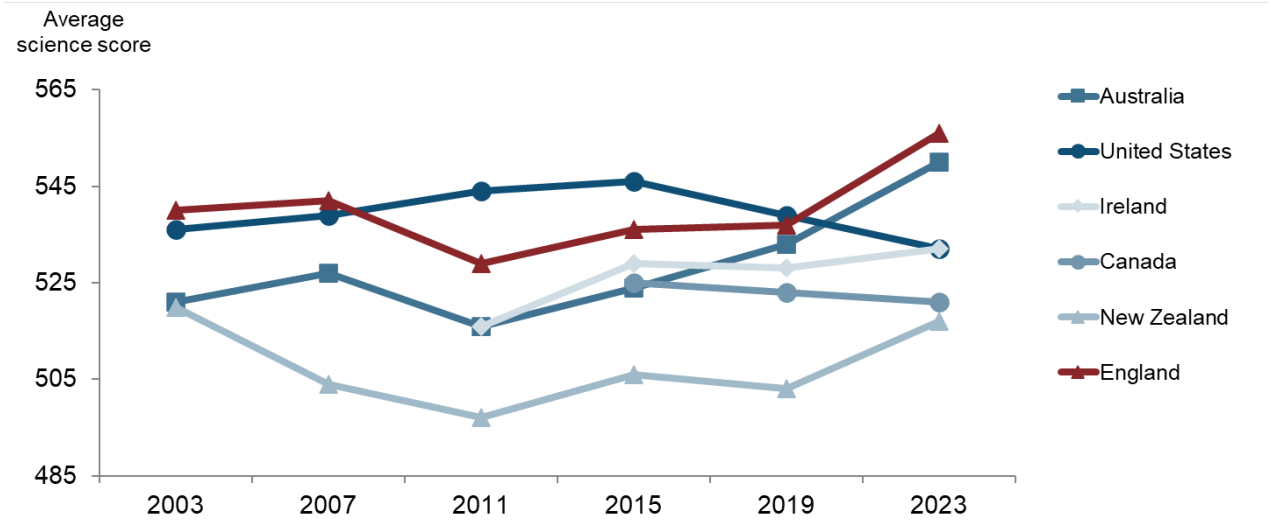
| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 540 | 542 | 529 | 536 | 537 | 556 |
| Chinese Taipei | 551 | 557 | 552 | 555 | 558 | 573 |
| Hong Kong | 542 | 554 | 535 | 557 | 531 | 545 |
| Japan | 543 | 548 | 559 | 569 | 562 | 555 |
| Republic of Korea | No data | No data | 587 | 589 | 588 | 583 |
| Singapore | 565 | 587 | 583 | 590 | 595 | 607 |

Source: IEA TIMSS International Report 2023

Note 1. The Republic of Korea did not participate in 2003 and 2007.
Note 2. Comparator countries are only included if they have at least 2 cycles of data since 2003.

Three of the English-speaking comparator countries have time series data from 2003, while Ireland has this from 2011 and Canada from 2015 (see Figure 27 and Table 43 below). Only the performance of year 5 pupils in England and Australia has significantly improved between 2003 and 2023. The performance of pupils in New Zealand and the United States has been stable over this period. However, the significant improvement in New Zealand's pupils' performance in 2023 means that their performance in this year compared with previous cycles from 2007 onwards has also significantly improved. The performance of pupils in Ireland has improved significantly between 2011 and 2023 while for pupils in Canada their performance across the 3 cycles in which they have participated has been stable. Pupils in England performed significantly above their peers in each of the English-speaking countries.

**Figure 27: Trends in year 5 science performance between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Canada did not participate in TIMSS 2003, 2007 and 2011
Note 3: Year 5 pupils in Ireland did not participate in TIMSS 20023 and 2007

**Table 43: Year 5 average science scores between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 540 | 542 | 529 | 536 | 537 | 556 |

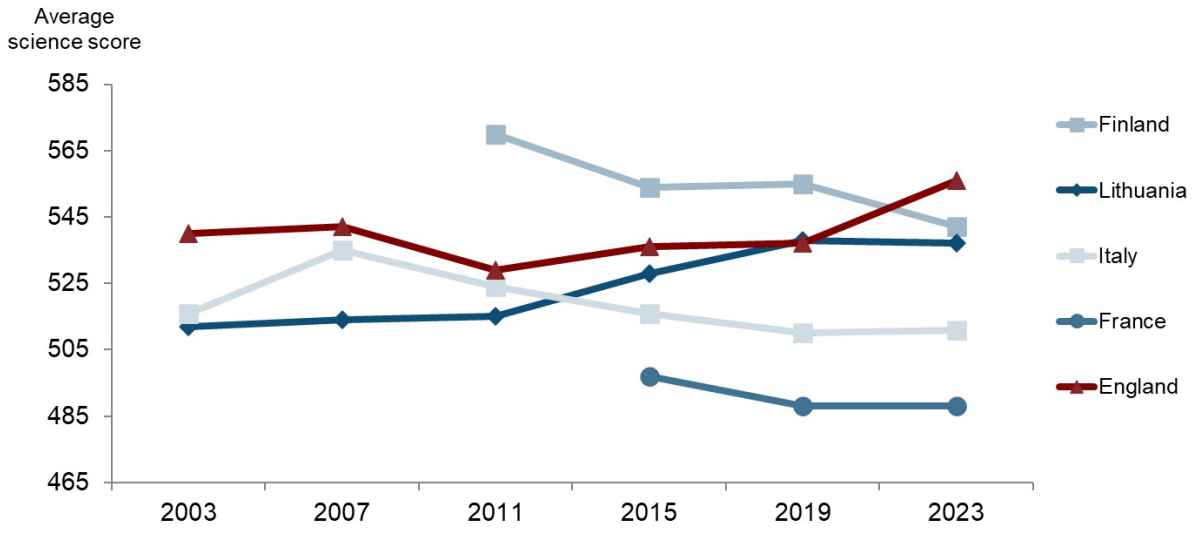
| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| Australia | 521 | 527 | 516 | 524 | 533 | 550 |
| Canada | No data | No data | No data | 525 | 523 | 521 |
| Ireland | No data | No data | 516 | 529 | 528 | 532 |
| New Zealand | 520 | 504 | 497 | 506 | 503 | 517 |
| United States | 536 | 539 | 544 | 546 | 539 | 532 |

Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Canada did not participate in TIMSS 2003, 2007 and 2011
Note 3: Year 5 pupils in Ireland did not participate in TIMSS 20023 and 2007

Only 2 of the 4 European comparator countries have time series data from 2003: Italy and Lithuania. The performance of pupils in Lithuania has significantly improved across this period while Italy's pupils' performance has been stable, although significantly below their performance in 2007 and 2011 (see Figure 28 and Table 44 below). The performance of Finland's pupils in 2023 was significantly below their performance in 2011. The performance of pupils in France has remained stable across the 3 TIMSS cycles in which they participated (2015, 2019 and 2023).

**Figure 28: Trends in year 5 science performance between 2003 and 2023 for England and European comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Finland did not participate in TIMSS 2003 and 2007.
Note 3: Year 5 pupils in France did not participate in TIMSS 2003, 2007 and 2011.

**Table 44: Year 5 average science scores between 2003 and 2023 for England and European comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 540 | 542 | 529 | 536 | 537 | 556 |
| Finland | No data | No data | 570 | 554 | 555 | 542 |
| France | No data | No data | No data | 487 | 488 | 488 |
| Italy | 516 | 535 | 524 | 516 | 510 | 511 |
| Lithuania | 512 | 514 | 515 | 528 | 538 | 537 |

Source: IEA TIMSS International Report 2023

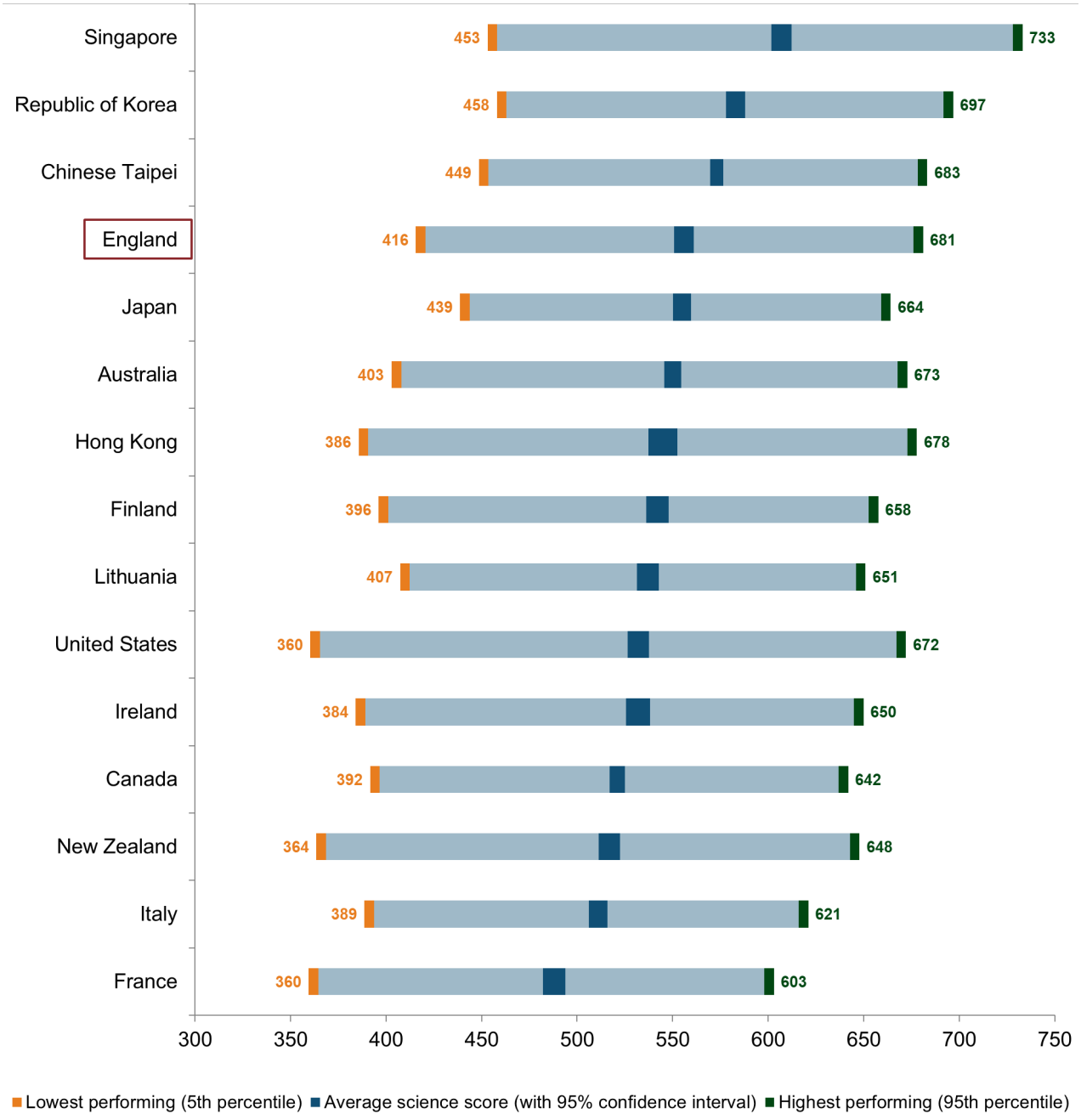
Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Year 5 pupils in Finland did not participate in TIMSS 2003 and 2007.
Note 3: Year 5 pupils in France did not participate in TIMSS 2003, 2007 and 2011.

Figure 29 and Table 45 below show the range of year 5 science scores from the 5th percentile (lowest- performing pupils) to the 95th percentile (highest-performing pupils) on the distribution of scores in England and countries from the 3 comparator groups. The range is not calculated using the difference between the maximum and minimum scores because of the potential distortion due to outliers. The dark section in the centre of each bar represents the average score for year 5 science and the 5% confidence interval around it.

Year 5 pupils in England at the lower end of the distribution (the 5th percentile) achieved an average score of and 413 in 2019 and 416 in 2023, a small increase of 3 scale points. However, at the top end of the distribution (the 95th percentile), there was a larger increase of 32 scale points from 649 in 2019 to 681 in 2023. In combination, these average score changes have increased the achievement gap by 29 scale points from 236 in 2019 to 265 in 2023. This represents a further widening of the gap from TIMSS 2015 when it was 231 scale points. The increase in the range of scores in England between 2019 and 2023 was driven by the change at the top end of the distribution

In 2023, this difference (265 scale points) between England's highest- and lowest-performing year 5 pupils in science was larger than for 3 of the highest-performing countries: Chinese Taipei, Japan and the Republic of Korea. However, it was smaller than for pupils in Hong Kong and Singapore. Compared with the English-speaking countries, the range for pupils in England was smaller than for their peers in Australia, New Zealand and the United States, the same as for peers in Ireland and larger than for pupils in Canada. Pupils in England had a larger range than their peers from each of the European comparator countries.
Data on all other participating countries is available in the *TIMSS International Report 2023*.

**Figure 29: Range of year 5 science achievement between the lowest and highest-achieving pupils across comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

**Table 45: Range of year 5 science achievement between the lowest and highest-performing pupils across comparator countries (average scores)**

| | Average mathematics score | Lowest performing (5th percentile) | Highest performing (95th percentile) | Range between lowest and highest performing |
|---|---|---|---|---|
| Singapore | 607 | 453 | 733 | 280 |
| Republic of Korea | 583 | 458 | 697 | 239 |
| Chinese Taipei | 573 | 449 | 683 | 235 |
| England | 556 | 416 | 681 | 265 |
| Hong Kong | 545 | 386 | 678 | 292 |
| Australia | 550 | 403 | 673 | 270 |
| United States | 532 | 360 | 672 | 312 |
| Japan | 555 | 439 | 664 | 225 |
| Finland | 542 | 396 | 658 | 262 |
| Lithuania | 537 | 407 | 651 | 244 |
| Ireland | 532 | 384 | 650 | 266 |
| New Zealand | 517 | 364 | 648 | 284 |
| Canada | 521 | 392 | 642 | 250 |
| Italy | 511 | 389 | 621 | 232 |
| France | 488 | 360 | 603 | 244 |

Source: IEA TIMSS International Report 2023

## TIMSS international benchmarks

A smaller percentage of pupils in England reached each benchmark compared with their peers in the highest-performing countries, except those in Hong Kong and Japan (see Figure 30 and Table 46 below). For example, more than double the percentage of year 5 pupils in the highest-performing country in this group, Singapore, reached the advanced benchmark compared with those in England (44% compared with 19%) although this performance gap has narrowed from 2019 by 3 percentage points (38% compared with 10%). However, the difference between the percentage of pupils in England reaching the advanced benchmark (19%) and that of pupils in both the Republic of Korea (29%) and Chinese Taipei (23%) was smaller (10 percentage points and 4 percentage points of pupils respectively).

In Singapore, 78% of pupils reached the high benchmark or above compared with 55% in England (a difference of 23 percentage points). This again showed a narrowing of the performance gap from 2019 when 74% of pupils in Singapore reached the high benchmark or above compared with 44% in England (a difference of 30 percentage points, 7 points more than in 2023). In addition, 93% of pupils in Singapore reached the intermediate benchmark or above, compared with 85% of pupils in England. A larger percentage of pupils in England reached each benchmark compared with their peers in Hong Kong and in the advanced and high benchmark or above compared with their peers in Japan.

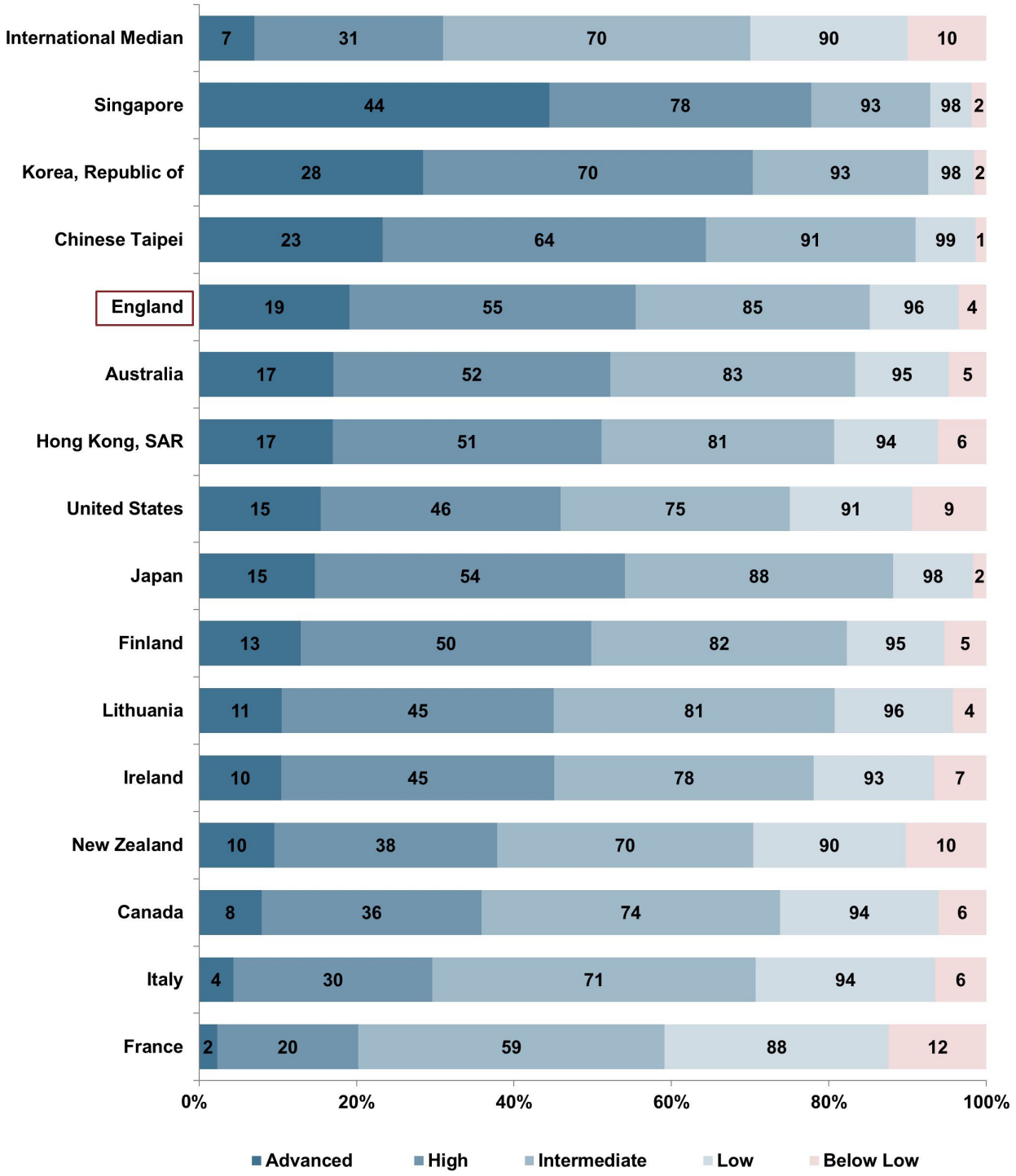
A larger percentage of pupils in England reached each benchmark compared with the international median across all participating countries[50], with nearly 3 times the percentage of pupils in England reaching the advanced benchmark (19% compared with 7%).

A larger percentage of pupils in England also reached each benchmark than their peers in each of the other English-speaking countries, although Australia's pupils performed similarly to their peers in England against each of the benchmarks.

A larger percentage of pupils in England reached each benchmark compared with their peers in the 4 European comparator countries with one exception. The same proportion of pupils in England reached the low benchmark as their peers in Lithuania (96%).

[50] International medians rather than international averages are calculated for this data set.

**Figure 30: Percentage of year 5 pupils reaching the international benchmarks in science (England and comparator countries)**




Source: IEA TIMSS International Report 2023

**Table 46: Percentage of year 5 pupils reaching the international benchmarks in science in 2023 (England and comparator countries)**

| | Advanced benchmark | High benchmark and above | Intermediate benchmark and above | Low benchmark and above | Did not reach the low benchmark |
|---|---|---|---|---|---|
| International median | 7 | 31 | 70 | 90 | 10 |
| Singapore | 44 | 78 | 93 | 98 | 2 |
| Korea, Republic of | 28 | 70 | 93 | 98 | 2 |
| Chinese Taipei | 23 | 64 | 91 | 99 | 1 |
| England | 19 | 55 | 85 | 96 | 4 |
| Australia | 17 | 52 | 83 | 95 | 5 |
| Hong Kong, SAR | 17 | 51 | 81 | 94 | 6 |
| United States | 15 | 46 | 75 | 91 | 9 |
| Japan | 15 | 54 | 88 | 98 | 2 |
| Finland | 13 | 50 | 82 | 95 | 5 |
| Lithuania | 11 | 45 | 81 | 96 | 4 |
| Ireland | 10 | 45 | 78 | 93 | 7 |
| New Zealand | 10 | 38 | 70 | 90 | 10 |
| Canada | 8 | 36 | 74 | 94 | 6 |
| Italy | 4 | 30 | 71 | 94 | 6 |
| France | 2 | 20 | 59 | 88 | 12 |

Source: IEA TIMSS International Report 2023

Data on all other participating countries is available in the *TIMSS International Report 2023*.

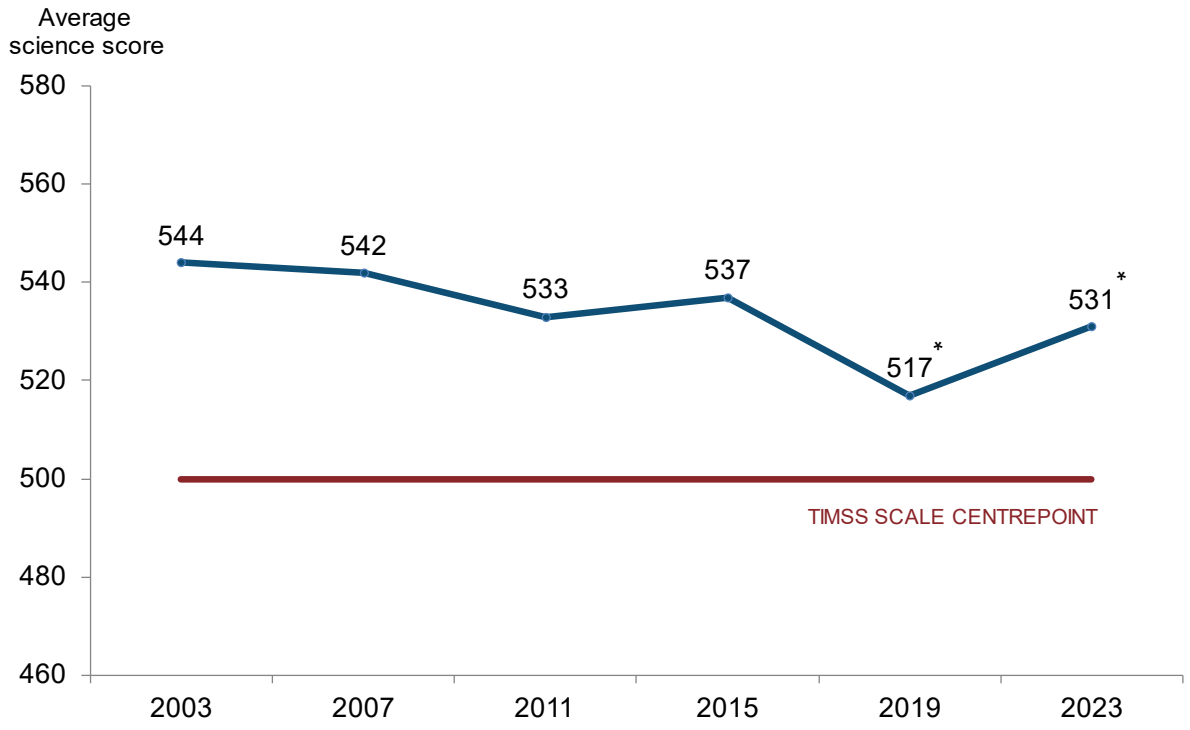
## 4.3 What does TIMSS tell us about England's performance in year 9 science?

### 4.3.1 How has England's performance in science changed over time for year 9 pupils?

In 2023, England's year 9 pupils' overall performance in science remained significantly above the TIMSS centrepoint (500), as it has for all previous TIMSS cycles.

The performance of year 9 pupils in 2023 was a significant improvement on that achieved in 2019 (531 compared with 517). Performance over the 20-year period from 2003 to 2023 has significantly decreased. However, compared with each cycle from 2007 to 2015 except for 2019, performance in 2023 was broadly stable. The only cycle in which pupils' average score was significantly above that achieved in 2023 was 2003 (544 compared with 531). Figure 31 and Table 47 below show this trend over time.

**Figure 31: Trend in average year 9 science score (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

Note 2: Scores that represent a significant increase or decrease from the previous TIMSS cycle are marked with an asterisk (*).

**Table 47: Year 9 average science scores between 2003 and 2023 (England)**

| Year | Average science score |
|---|---|
| 2003 | 544 |
| 2007 | 542 |
| 2011 | 533 |
| 2015 | 537 |
| 2019 | 517 (significant decrease) |
| 2023 | 531 (significant increase) |

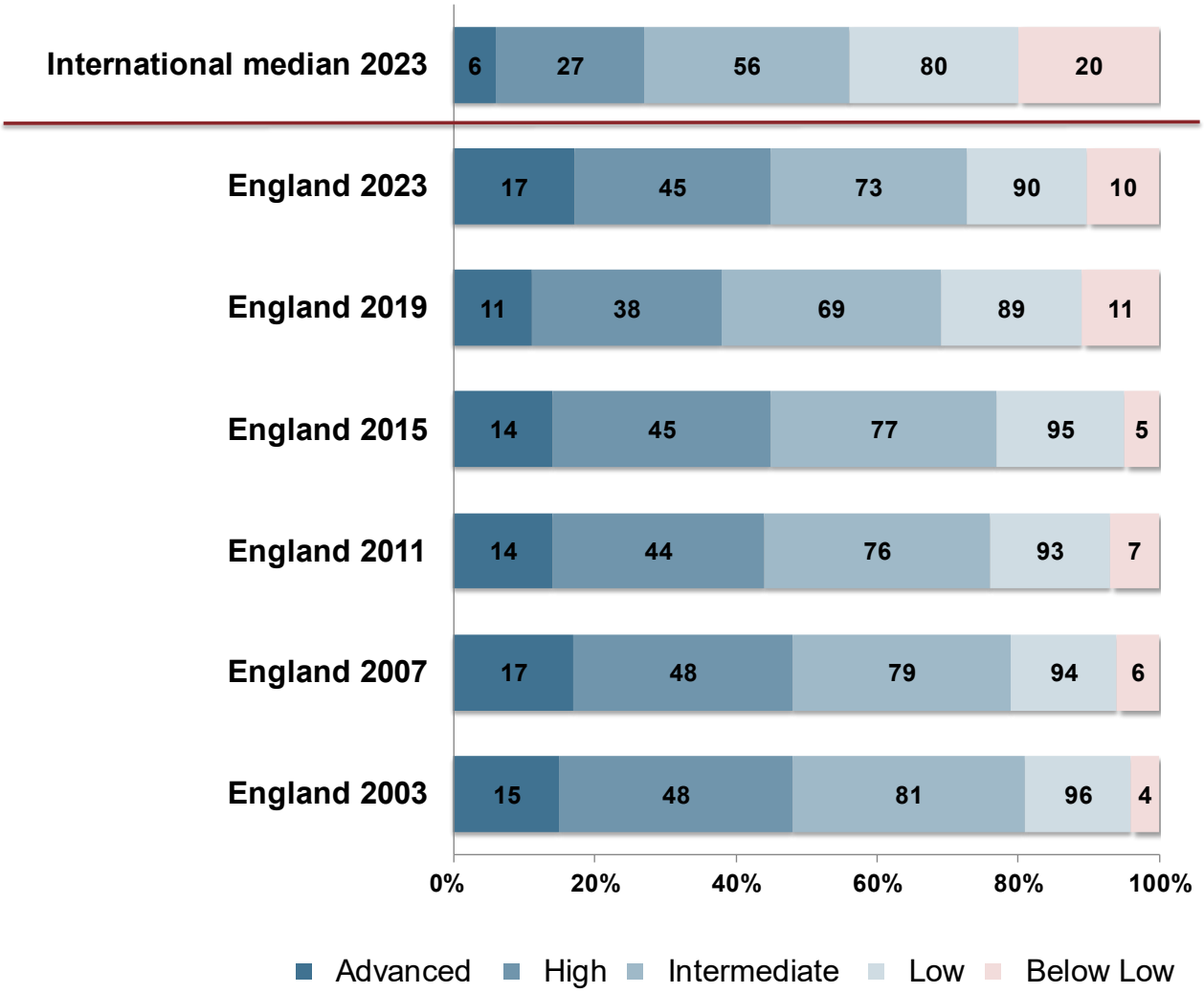
Source: IEA TIMSS International Report 2023

Figure 32 and Table 48 below show the percentage of year 9 pupils in England meeting each of the international TIMSS benchmarks[51] in science since 2003. Figure 32 is cumulative so that, read left to right, it presents the percentage of pupils who reached each of the benchmarks from advanced to low. For example, in 2023 17% of pupils in England reached the advanced benchmark, 45% the high benchmark or above, 73% the intermediate benchmark or above, and 90% the low benchmark or above. The remaining 10% did not reach the low benchmark.

In 2023, there was a significant increase in the percentage of year 9 pupils in England reaching each of the benchmarks, except the low benchmark or above, compared with 2019. The percentage of pupils not reaching the low benchmark or above in 2023 was similar to 2019 (10% compared with 11%), double, and significantly above, the 2015 percentage (5%).

[51] See Section 2.3 and Appendix C for descriptions of the international benchmarks.

**Figure 32: Trend in the percentage of year 9 pupils reaching each of the TIMSS international benchmarks in science (England)**




Source: IEA TIMSS International Report 2023

Note 1: Response rates for TIMSS in England were relatively low in 2003.

**Table 48: Percentage of year 9 pupils reaching each of the TIMSS international benchmarks in science (England)**

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| International Median | 6 | 27 | 56 | 80 | 20 |
| England 2023 | 17 | 45 | 73 | 90 | 10 |

| | Advanced benchmark | High benchmark | Intermediate benchmark | Low benchmark | Below the low benchmark |
|---|---|---|---|---|---|
| England 2019 | 11 | 38 | 69 | 89 | 11 |
| England 2015 | 14 | 45 | 77 | 95 | 5 |
| England 2011 | 14 | 44 | 76 | 93 | 7 |
| England 2007 | 17 | 48 | 79 | 94 | 6 |
| England 2003 | 15 | 48 | 81 | 96 | 4 |

Source: IEA TIMSS International Report 2023

### 4.3.2 How did year 9 pupils in England perform in science relative to their peers in all other TIMSS countries?

Forty-four countries participated in TIMSS 2023 year 9 science assessments. Full international analyses of their performance can be found in the *TIMSS International Report 2023*.

In 2023, pupils in England performed significantly above the TIMSS international average (531 compared with 478).

In 2023, pupils in 4 countries performed significantly above their peers in England, 5 fewer than in 2019. Pupils in 6 countries performed at a similar level and in 33 countries significantly below. Pupils in each of the East Asian countries, except Hong Kong, continued to perform significantly above England in 2023, as in 2019.

There was some consistency in the countries whose pupils performed similarly to their peers in England across the 2 cycles with Hong Kong, Ireland and Turkey still represented in this group. They were joined by pupils from Finland (who had performed above England in 2019) and the Czech Republic (which did not participate in TIMSS 2019 for year 9 science).

Tables 49, 50 and 51 below show how England's year 9 pupils performed in 2019 and 2023 relative to those in a selection of other countries by average score. England's average score was 517 in 2019 and 531 in 2023.

**Table 49: Year 9 science: all countries in which pupils performed significantly above pupils in England in 2019 and/or 2023 (average scores)**

| **Country** | **2019** | **2023** |
|---|---|---|
| Singapore | 608 | 606 |
| Chinese Taipei | 574 | 572 |
| Japan | 570 | 557 |
| Republic of Korea | 561 | 545 |
| Russia | 543 | Did not participate |
| Finland | 543 | Performed similarly |
| Lithuania | 534 | Performed significantly below |
| Hungary | 530 | Performed similarly |
| Australia | 528 | Performed significantly below |
| **England** | **517** | **531** |

**Table 50: Year 9 science: all countries in which pupils performed at a similar level to pupils in England in 2019 and/or 2023 (average scores)**

| **Country** | **2019** | **2023** |
|---|---|---|
| Finland | Performed significantly above | 531 |
| Hungary | 530 | 522 |
| Ireland | 523 | 525 |
| United States | 522 | Performed significantly below |
| Portugal | 519 | Performed significantly below |
| **England** | **517** | **531** |
| Turkey | 515 | 530 |
| Israel | 513 | Performed significantly below |
| Hong Kong | 504 | 528 |
| Czech Republic | Did not participate | 527 |

**Table 51: Year 9 science: all comparator countries in which pupils performed significantly below pupils in England in 2019 and/or 2023 (average scores)**

| Country | 2019 | 2023 |
|---|---|---|
| England | 517 | 531 |
| Lithuania | Performed significantly above | 519 |
| Australia | Performed significantly above | 520 |
| United States | Performed similarly | 513 |
| Italy | 500 | 501 |
| New Zealand | 499 | 502 |
| France | 489 | 486 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Guidelines for minimum school participation rates in both New Zealand and the United States were not satisfied in 2023[52].

Note 2: 27 other countries not included as comparators

### 4.3.3 How did year 9 pupils in England perform in science relative to their peers in the comparator countries?

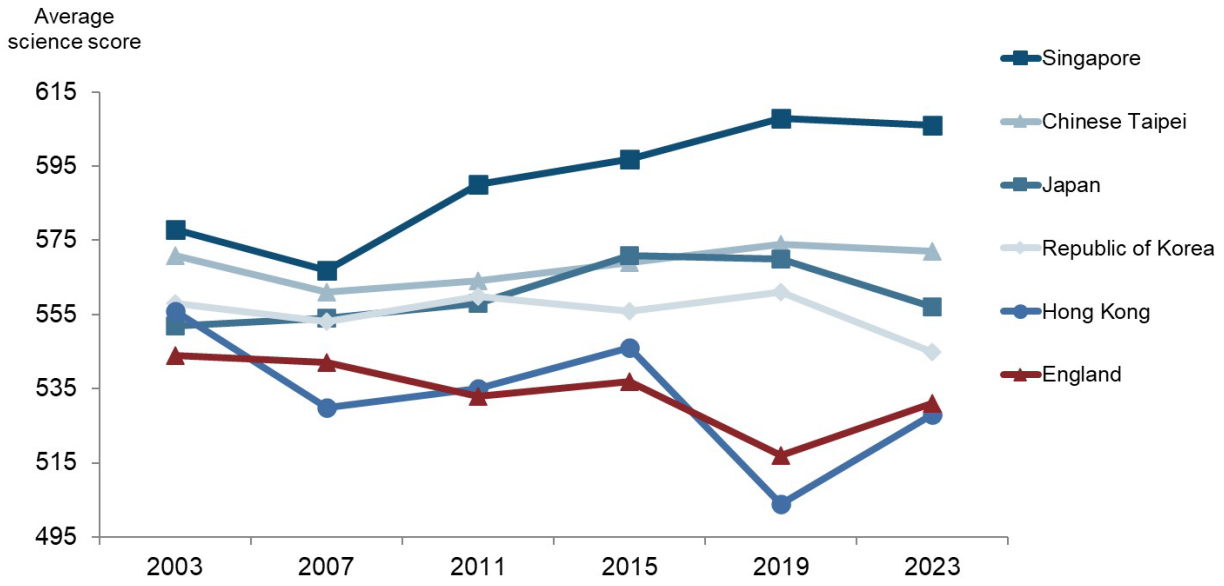
In this section, trends are shown for comparator countries with at least 2 cycles of assessment data since 2003.

In 2019, Hong Kong saw a significant decrease in its pupils' average achievement in science. However, it saw a significant increase in 2023 and has been retained as a highest-performing country due to performance in previous cycles.

The performance of year 9 pupils in England in 2023 was significantly below the performance of England's pupils in 2003. This was also the case for Hong Kong and the Republic of Korea, while similar performance over this timescale was seen in Chinese Taipei and Japan. Only Singapore has seen a significant improvement in its pupils' performance across this 20-year period. Hong Kong's trend has fluctuated more than those of other countries, with significant improvement in pupils' performance in 2015 and 2023 but significant decreases in this in 2007 and 2019. Pupils in each of these countries, with the exception of Hong Kong, performed significantly above their peers in England in 2023. However, only pupils in Hong Kong and England achieved significantly higher average scores in 2023 compared to 2019 with Singapore's being similar and those for pupils in both Japan and the Republic of Korea being significantly lower. Figure 33 and Table 52 below show these trends.

[52] See Appendix B for discussion of the difficulty of making easy comparisons across countries, or even within country and across years.

**Figure 33: Trends in year 9 science performance between 2003 and 2023 for England and highest-performing countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.

**Table 52: Year 9 average science scores between 2003 and 2023 for England and highest-performing comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 544 | 542 | 533 | 537 | 517 | 531 |
| Chinese Taipei | 571 | 561 | 564 | 569 | 574 | 572 |
| Hong Kong | 556 | 530 | 535 | 546 | 504 | 528 |
| Japan | 552 | 554 | 558 | 571 | 570 | 557 |
| Republic of Korea | 558 | 553 | 560 | 556 | 561 | 545 |
| Singapore | 578 | 567 | 590 | 597 | 608 | 606 |

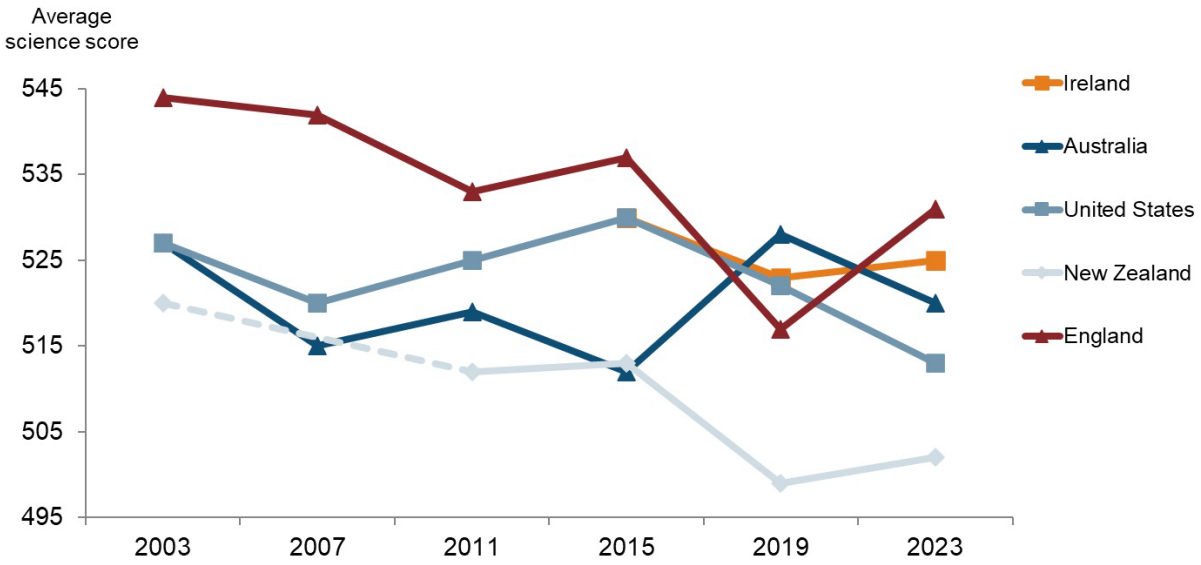
Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003

As in England, the performance of year 9 pupils in 2023 in both the United States and New Zealand was significantly below their performance in 2003. The performance of

pupils in Australia was similar across this period. However, the average score for pupils in England was significantly above that achieved by their Australian peers having been below this in 2019. Ireland's pupils did not participate in TIMSS between 1999 and 2011 but their trend across the 3 most recent cycles has been stable. Figure 34 and Table 53 below show these trends.

**Figure 34: Trends in year 9 science performance between 2003 and 2023 for England and English-speaking comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: New Zealand did not participate in year 9 TIMSS in 2007.
Note 2: Ireland did not participate in year 9 TIMSS between 2003 and 2011.
Note 3: Comparator countries are only included if they have at least 2 cycles of data since 2003.

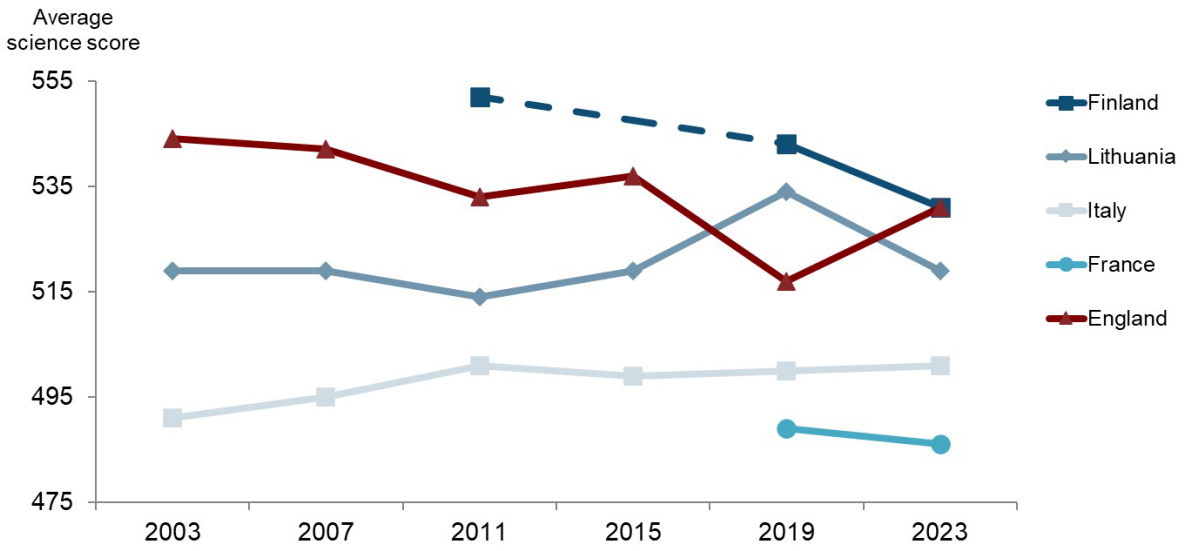
**Table 53: Year 9 average science scores between 2003 and 2023 for England and all English-speaking comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 544 | 542 | 533 | 537 | 517 | 531 |
| Australia | 527 | 515 | 519 | 512 | 528 | 520 |
| Ireland | No data | No data | No data | 530 | 523 | 525 |
| New Zealand | 520 | No data | 512 | 513 | 499 | 502 |
| United States | 527 | 520 | 525 | 530 | 522 | 513 |

Source: IEA TIMSS International Report 2023

Only 2 of the 5 European comparator countries have time series data from 2003: Italy and Lithuania (see Figure 35 and Table 54 below). The trend has been one of significant improvement for pupils in Italy over this period while it has been stable for pupils in Lithuania. Finland's pupils have seen a decrease in their performance between 2011 and 2023 (they did not participate before 2011 or in 2015). The performance of pupils in France has remained stable across the 2 TIMSS cycles in which they participated since 1995 (2019 and 2023).

**Figure 35: Trends in year 9 science performance between 2003 and 2023 for England and European comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Finland did not participate in 2003 and 2007. Nor did it participate in 2015.
Note 3: France did not participate in TIMSS 2003-2015.

**Table 54: Year 9 average science scores between 2003 and 2023 for England and European comparator countries (average scores)**

| | 2003 | 2007 | 2011 | 2015 | 2019 | 2023 |
|---|---|---|---|---|---|---|
| England | 544 | 542 | 533 | 537 | 517 | 531 |
| Finland | No data | No data | 552 | No data | 543 | 531 |
| France | No data | No data | No data | No data | 489 | 486 |
| Italy | 491 | 495 | 501 | 499 | 500 | 501 |
| Lithuania | 519 | 519 | 514 | 519 | 534 | 519 |

Source: IEA TIMSS International Report 2023

Note 1: Comparator countries are only included if they have at least 2 cycles of data since 2003.
Note 2: Finland did not participate in 2003 and 2007. Nor did it participate in 2015.
Note 3: France did not participate in TIMSS 2003-2015.

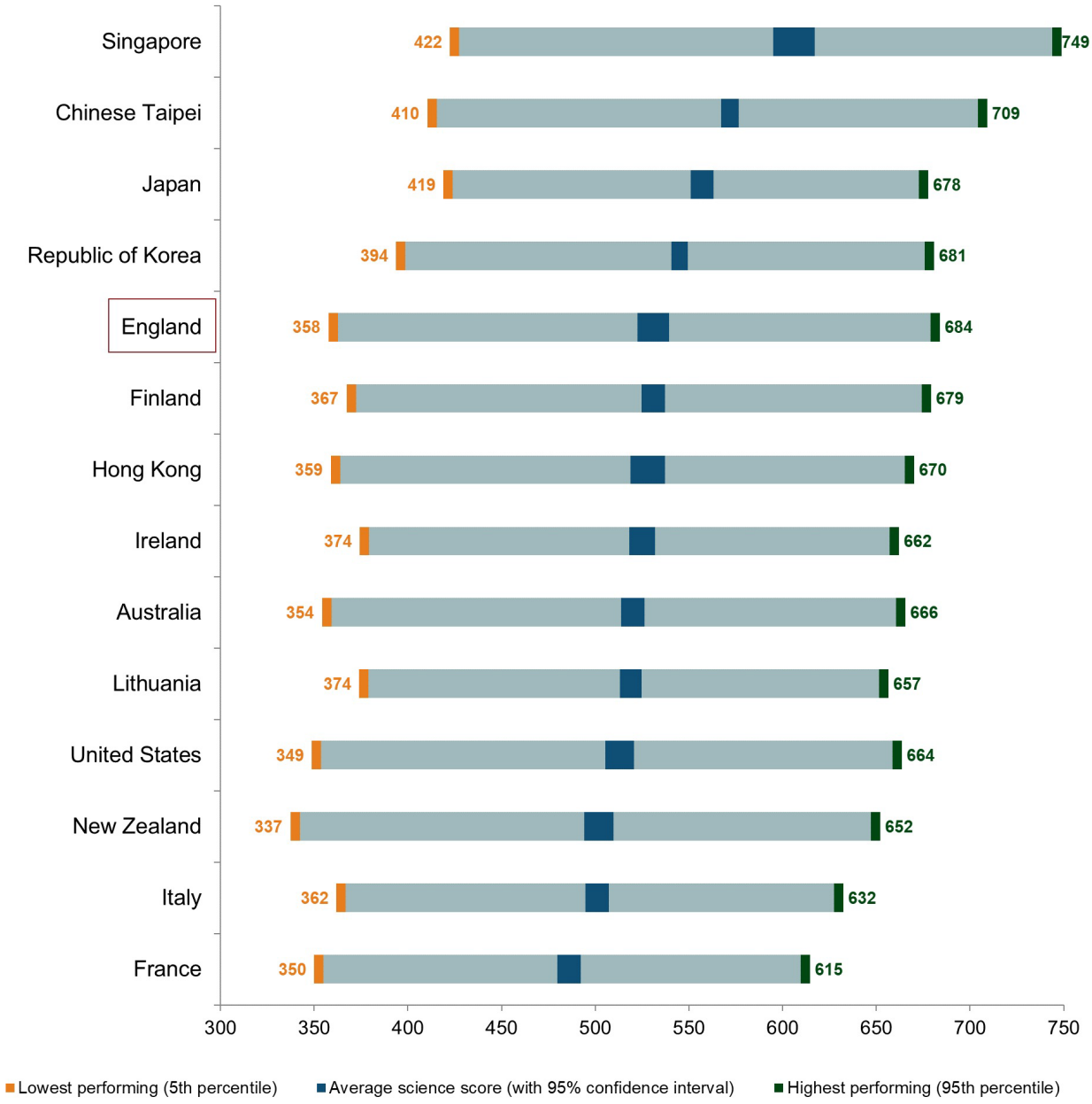
Figure 36 and Table 55 below show the range of year 9 science scores in England against the countries from the 3 comparator groups from the 5th percentile (lowest-performing pupils) to the 95th percentile (highest-performing pupils) on the distribution of scores in each country.

Year 9 pupils at the lower end of the distribution (the 5th percentile) achieved an average score of 356 in 2019 and 358 in 2023, a small increase of 2 scale points. However, this increase is in contrast to the 43 scale point decrease noted between 2015 (399) and 2019 (356). Pupils at the top end of the distribution (the 95th percentile) achieved an average score of 658 in 2019 and 684 in 2023, an increase of 26 scale points. The small increase in performance for lower-achieving pupils (2 scale points), combined with the larger increase for the higher-achieving pupils (26 scale points), meant the achievement gap was greater in 2023 (326) than in 2019 (302) by 24 scale points, driven by the change at the top end of the distribution. This represents a further widening of the gap from TIMSS 2015 when it was 266 scale points.

By contrast, in the highest-performing group, the ranges for pupils were smaller compared to the range for pupils in England, except for in Singapore where the range was the same. The ranges for pupils in each of the English-speaking and European comparator countries were also smaller than for their peers in England.

Data on all other participating countries is available in the *TIMSS International Report 2023*.

**Figure 36: Range of year 9 science achievement between the lowest and highest-achieving pupils across comparator countries (average scores)**




Source: IEA TIMSS International Report 2023

**Table 55: Range of year 9 science achievement between the lowest and highest-performing pupils across comparator countries (average scores)**

| | Average mathematics score | Lowest performing (5th percentile) | Highest performing (95th percentile) | Range between lowest and highest performing |
|---|---|---|---|---|
| Singapore | 606 | 422 | 749 | 326 |
| Chinese Taipei | 572 | 410 | 709 | 299 |
| Japan | 557 | 419 | 678 | 259 |
| Republic of Korea | 545 | 394 | 681 | 287 |
| England | 531 | 358 | 684 | 326 |
| Finland | 531 | 367 | 679 | 312 |
| Hong Kong | 528 | 359 | 670 | 311 |
| Ireland | 525 | 374 | 662 | 288 |
| Australia | 520 | 354 | 666 | 311 |
| Lithuania | 519 | 374 | 657 | 283 |
| United States | 513 | 349 | 664 | 315 |
| New Zealand | 502 | 337 | 652 | 315 |
| Italy | 501 | 362 | 632 | 271 |
| France | 486 | 350 | 615 | 265 |

Source: IEA TIMSS International Report 2023

## TIMSS international benchmarks

As shown in Figure 37 and Table 56 below, fewer pupils in England reached each benchmark compared to their peers in the highest-performing group of countries, except for Hong Kong. For example, nearly 3 times the percentage of year 9 pupils in the highest-performing country from this group, Singapore, reached the advanced benchmark compared with those in England (47% compared with 17%). However, in Japan and the Republic of Korea, the differences were much smaller, with 20% and 18% of pupils reaching the advanced benchmark respectively compared with 17% in England. In Singapore, 74% of pupils reached the high benchmark or above compared with 45% in England (a 29 percentage point difference). However, this reflected a narrowing of this performance gap compared with 2019 by 10 percentage points (77% of Singapore's

pupils compared with 38% of England's pupils in 2019: a 39 percentage point difference). A smaller percentage of pupils in England reached the low benchmark or above compared with their peers in each of these countries, except Hong Kong where it was the same (90%).

Nevertheless, compared with the international median across all participating countries, a larger percentage of pupils in England reached each benchmark[53].

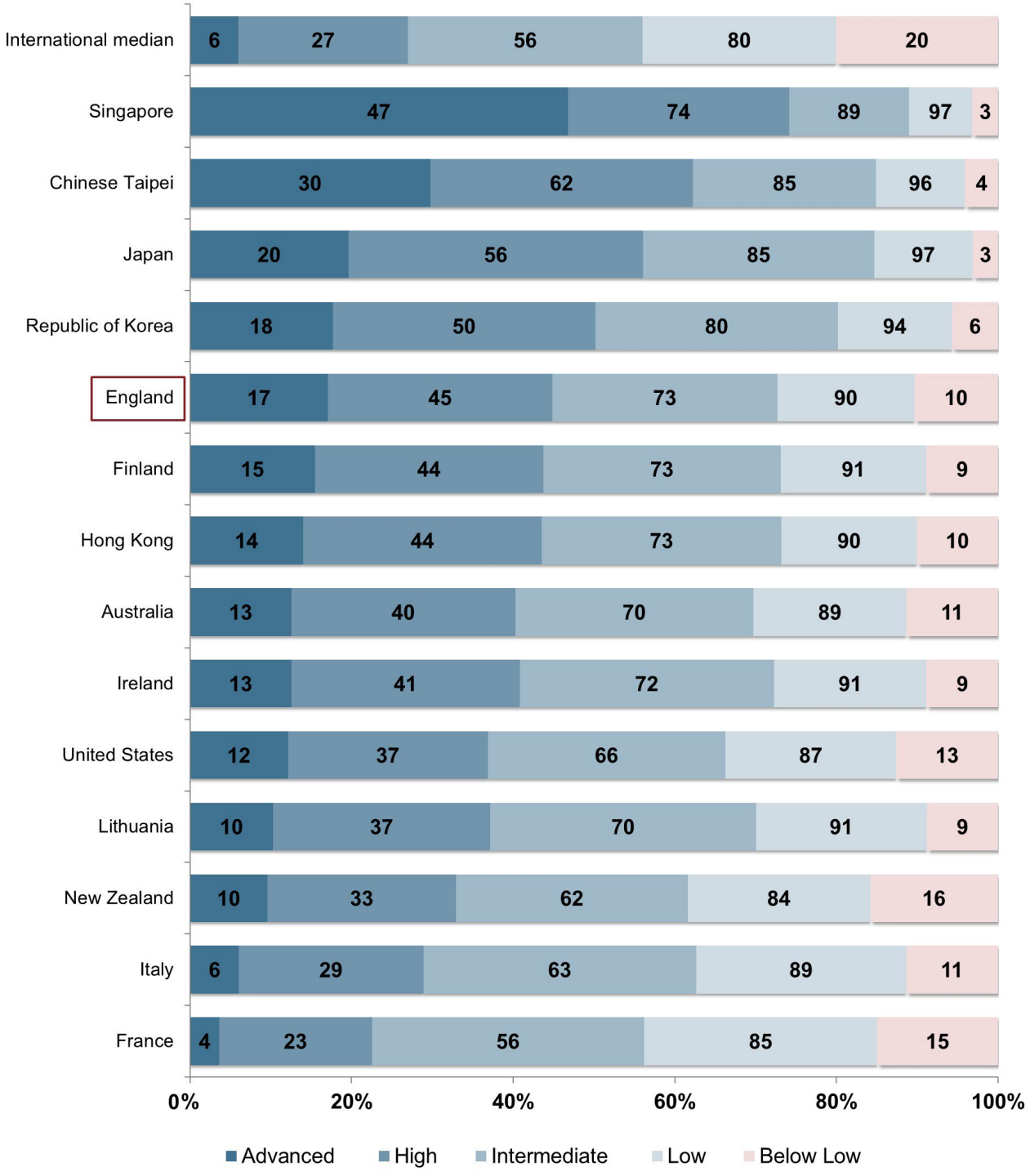
A larger percentage of pupils in England reached each benchmark than their peers in the 4 other English-speaking countries (Australia, Ireland, New Zealand and the United States), with one exception: a smaller percentage of pupils in England reached the low benchmark or above compared with their peers in Ireland (90% compared with 91%).

A larger percentage of pupils in England reached each of the benchmarks than their peers in the European comparator countries with the following exceptions. A larger percentage of pupils in Finland and Lithuania (both 91%) reached the lower benchmark or above (compared with 90% in England). The same proportion of pupils in Finland reached the intermediate benchmark or above (73%) as their peers in England. Figure 37 and Table 56 below show these findings.

Data on all other participating countries is available in the *TIMSS International Report 2023*.

[53] International medians rather than international averages are calculated for this data set.

**Figure 37: Percentage of year 9 pupils reaching the international benchmarks in science (England and comparator countries)**




Source: IEA TIMSS International Report 2023

**Table 56: Percentage of year 9 pupils reaching the international benchmarks in science in 2023 (England and comparator countries)**

| | Advanced benchmark | High benchmark and above | Intermediate benchmark and above | Low benchmark and above | Did not reach low benchmark |
|---|---|---|---|---|---|
| International median | 6 | 27 | 56 | 80 | 20 |
| Singapore | 47 | 74 | 89 | 97 | 3 |
| Chinese Taipei | 30 | 62 | 85 | 96 | 4 |
| Japan | 20 | 56 | 85 | 97 | 3 |
| Republic of Korea | 18 | 50 | 80 | 94 | 6 |
| England | 17 | 45 | 73 | 90 | 10 |
| Finland | 15 | 44 | 73 | 91 | 9 |
| Hong Kong | 14 | 44 | 73 | 90 | 10 |
| Australia | 13 | 40 | 70 | 89 | 11 |
| Ireland | 13 | 41 | 72 | 91 | 9 |
| United States | 12 | 37 | 66 | 87 | 13 |
| Lithuania | 10 | 37 | 70 | 91 | 9 |
| New Zealand | 10 | 33 | 62 | 84 | 16 |
| Italy | 6 | 29 | 63 | 89 | 11 |
| France | 4 | 23 | 56 | 85 | 15 |

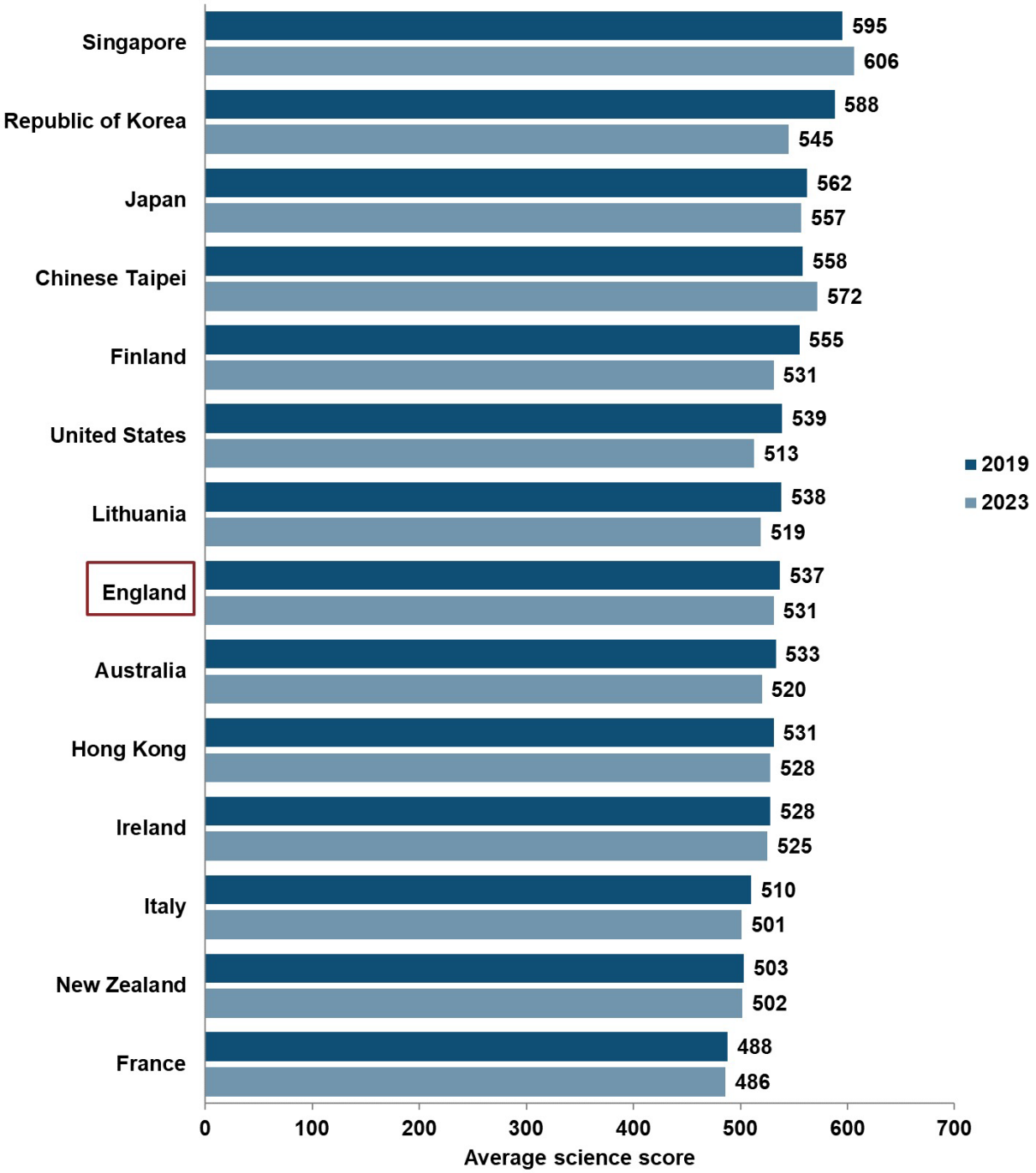
Source: IEA TIMSS International Report 2023

## 4.4 What does TIMSS tell us about pupil progress in science between years 5 and 9?

As the target year 9 cohort in 2023 was the same as the cohort of pupils who were in year 5 in 2019, it might be thought TIMSS allows for comparison of relative progress achieved by the cohort between grades. However, due to the sampling approach (see Section 1.3), the year 5 pupils who took the assessments in 2019 were from the same cohort but were not necessarily the same pupils as those sampled in year 9 in 2023. The assessments taken by year 5 and year 9 pupils, and frameworks from which these were taken, were also different, resulting in different international means and standard deviations. Taken together, these considerations mean it is not possible to make easy comparisons around the performance of the cohort as it moved from year 5 to year 9.

We do note, though, as in Figure 38 and Table 57 below, that the highest-performing cohorts of pupils in year 5 science in 2019 largely also performed highly in year 9 science in 2023, with England's pupils featuring in the next highest-performing group of countries in both cases.

**Figure 38: A comparison of the science performance of year 5 pupils in 2019 and year 9 pupils in 2023 (England and other countries from the comparator groups)**




Source: IEA TIMSS International Report 2023

**Table 57: A comparison of the science performance of year 5 pupils in 2019 and year 9 pupils in 2023 (England and other countries from the comparator groups)**

| Comparator country | 2019 year 5 average score | 2023 year 9 average score |
|---|---|---|
| Singapore | 595 | 606 |
| Republic of Korea | 588 | 545 |
| Japan | 562 | 557 |
| Chinese Taipei | 558 | 572 |
| Finland | 555 | 531 |
| United States | 539 | 513 |
| Lithuania | 538 | 519 |
| England | 537 | 531 |
| Australia | 533 | 520 |
| Hong Kong | 531 | 528 |
| Ireland | 528 | 525 |
| Italy | 510 | 501 |
| New Zealand | 503 | 502 |
| France | 488 | 486 |

Source: IEA TIMSS International Report 2023

# Chapter 5. Mathematics and science performance in subject and cognitive domains

TIMSS analysis enables a detailed comparison of pupils' mathematics and science performance in specific subject and cognitive domains. Each of the assessment questions is categorised according to the area of the curriculum it covers or the different cognitive skills it requires (referred to in TIMSS as content and cognitive domains respectively)[54].

In year 5 mathematics, there were 3 content domains: data; measurement and geometry; and number. In year 9, there were 4: algebra; data and probability; geometry and measurement (entitled geometry in 2019); and number.

In year 5 science, there were 3 content domains: Earth science; life science; and physical science. In year 9, there were 4: biology; chemistry; Earth science; and physics. The domain names for science have remained consistent from 2019.

Cognitive domains are common to both subjects and both year groups and are knowing, applying and reasoning.

To assess the relative strengths and weaknesses of year 5 and 9 pupils across the different TIMSS mathematics and science content and cognitive domains, our analysis compared their average score in each domain:

- to the TIMSS international average
- across TIMSS cycles
- to England's overall average score
- to the performance of other comparator group countries

The comparator countries referred to in this chapter are listed in Chapter 1.

This chapter covers pupils' performance first in the content domains in mathematics and science at years 5 and 9, then the cognitive domains in those subjects.

[54] See the TIMSS 2023 Frameworks: Mullis, I. V. S., Martin, M. O., and von Davier, M. (eds.). (2021). *TIMSS 2023 Assessment Frameworks*. Available at: https://timssandpirls.bc.edu/timss2023/frameworks/index.html

## 5.1 Main findings

The terms ‘stronger’ and ‘weaker’ in this chapter mean that there are 2 or more domains where the average score is either significantly above or below the overall mathematics or science average score. The terms ‘strongest’ or ‘weakest’ denote that only one domain is either significantly above or below the overall mathematics or science average score. When comparing average score differences between countries, reference is made to average scores being comparatively higher or lower; this does not mean such differences are statistically significant.

### Mathematics

In 2023:

- Year 5 and 9 pupils in England performed above the international averages in each of the content domains[55].
- As in 2015 and 2019, year 5 pupils in England were strongest in the data domain and weakest in the measurement and geometry domain. Their performance in number in 2023 was not significantly different from their overall mathematics average score.
- Year 5 pupils’ strength in data in England was in contrast to the majority of the highest-performing countries, which performed strongly in measurement and geometry.
- Year 5 pupils in England performed significantly above the international average in all 3 cognitive domains. They performed significantly higher in the knowing domain than their overall average mathematics score.
- The performance of England’s year 5 pupils was significantly below the performance of pupils in each of the countries from the highest-performing group in each cognitive domain. However, pupils in England mostly performed significantly above their peers in the other comparator countries.
- Year 9 pupils in England were stronger in data and probability and in number, and weaker in algebra and geometry and measurement. These relative strengths and weaknesses in 2023 mirrored the 2019 and 2015 outcomes.
- In year 9 the strengths of pupils in the highest-performing countries were mixed, lying across the data and probability, geometry and measurement and number domains.

[55] The average score for England’s pupils is significantly above the average of countries for which a score is reported in the international exhibits.

- Year 9 pupils in England performed significantly above the international averages in each of the cognitive domains. They performed significantly higher in the knowing and applying domains and significantly lower in the reasoning domain than their overall average mathematics score.
- Year 9 pupils in England performed significantly below their peers in the highest-performing countries in each cognitive domain. However, they mostly performed significantly above their peers in the other comparator countries.

## Science

In 2023:

- Pupils in England performed above the international averages in all science content and cognitive domains in both years 5 and 9.
- The performance of year 5 pupils in England in each content domain was not significantly different from the overall average science score, in contrast to 2015 and 2019 when pupils were weakest in the Earth science domain.
- In year 5, England's pupils' performance was significantly below that of their peers in 3 of the highest-performing group of countries in each content domain in 2023. However, pupils in England performed significantly above their peers in Hong Kong in Earth science and life science; the difference in their respective physical science scores was not significant. They also performed significantly above their peers in Japan in Earth science and life science, but the reverse was true for physical science.
- Year 5 pupils in England did not perform significantly differently from the overall science average score in any cognitive domain. This was the same as in 2015 but in contrast to 2019 when each of their domain average scores was significantly different from their overall science average score.
- The performance of year 9 pupils in England in each content domain (biology, chemistry, Earth science and physics) was not significantly different from their overall average science score. This mirrors year 9 pupils' performance in 2019.
- Year 9 pupils' average scores in all content domains were significantly higher in 2023 than in 2019. This was in line with England's higher overall science average score in 2023.
- In year 9, pupils in England largely performed significantly below their peers in the highest-performing group of countries except in 2 cases. In Hong Kong pupils' performance did not differ significantly from that in England. Pupils in England also performed significantly above their peers in the Republic of Korea in chemistry.

- Year 9 pupils’ average score for the knowing domain was not significantly different from their overall science average score, as in 2019. However, in contrast to both 2015 and 2019, pupils were weakest in applying in 2023. Pupils’ performance in the reasoning domain has fluctuated over the most recent 3 TIMSS cycles between this being the strongest (2015 and 2023) and weakest (2019) domain.

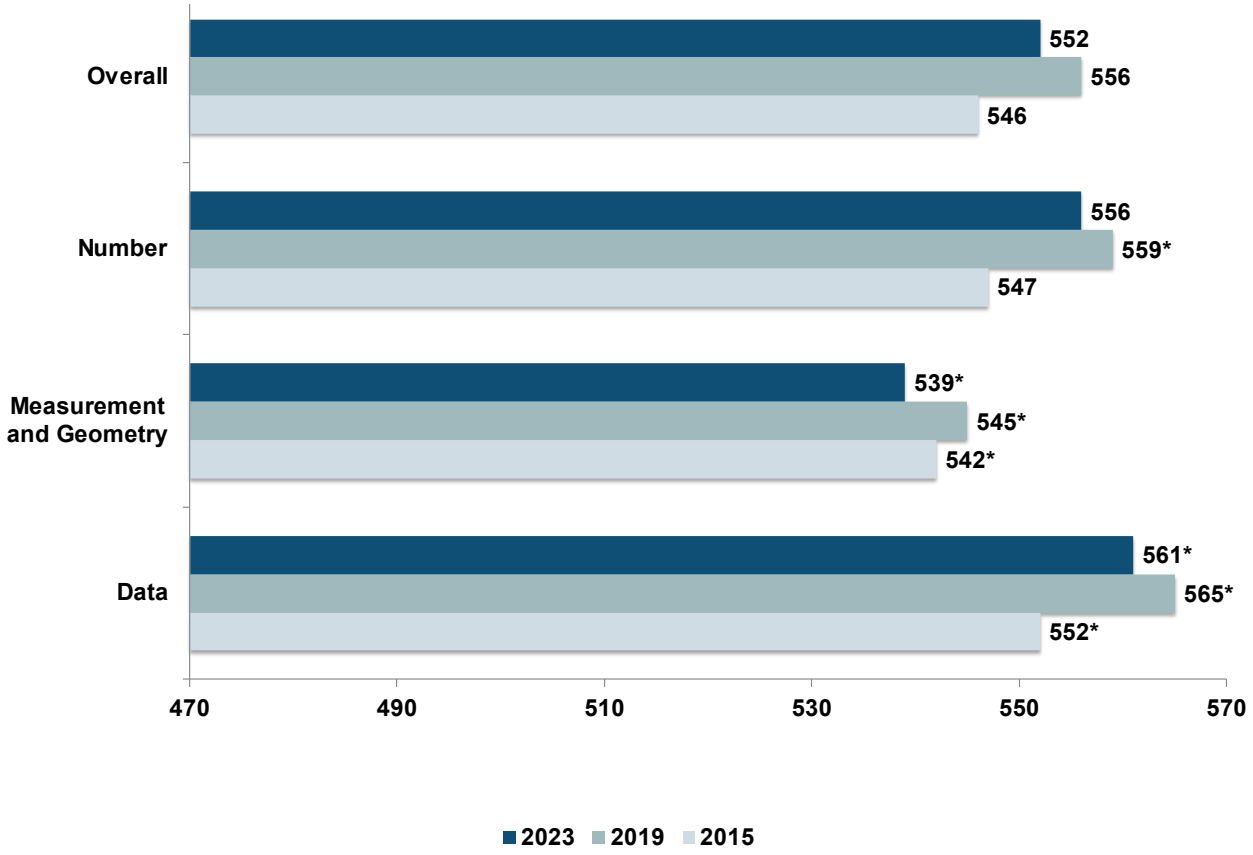
## 5.2 How did pupils in England perform across different content domains?

### 5.2.1 How did year 5 pupils in England perform across different mathematics content domains?

In 2023, year 5 pupils in England performed significantly above the international averages in each of the 3 domains[56].

In 2023, as in 2015 and 2019, year 5 pupils in England were strongest in the data domain and weakest in measurement and geometry domain (see Figure 39 and Table 58 below). Their performance in number in 2023 was not significantly different from their overall mathematics average score. This contrasts with 2019 when number was 1 of 2 stronger domains (alongside data). None of the 2023 content domain average scores was significantly different from the 2019 average scores.

**Figure 39: Average scores for 2015-2023 in different mathematics content domains compared with the overall mathematics average score (England, year 5)**




Sources: IEA TIMSS International Reports 2019 and 2023
Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score for that year.

[56] The average score for England's pupils is significantly above the average of countries for which a score is reported in the international exhibits.

**Table 58: Average scores for 2015-2023 in different mathematics content domains compared with the overall mathematics average score (England, year 5)**

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Number | 547 | 559 (above) | 556 |
| Measurement and geometry | 542 (below) | 545 (below) | 539 (below) |
| Data | 552 (above) | 565 (above) | 561 (above) |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions in brackets after average domain scores indicate those that were significantly above or below England's pupils' overall mathematics average score for that year.

Even in their strongest domains, year 5 pupils in England performed significantly below their peers from each of the highest-performing countries. This was in line with the relative performance in overall mathematics average scores.

In contrast to pupils in England, each of the highest-performing countries' pupils, except those in Hong Kong, were strongest in the measurement and geometry domain. Hong Kong's pupils were strongest in number, while for pupils in Chinese Taipei, Japan and the Republic of Korea, this was a weaker domain. For pupils in Singapore, as in England, performance in number was not significantly different from their overall mathematics average score. In both the Republic of Korea and Japan, pupils were stronger in the data domain, similar to in England where it was its pupils' strongest domain. In contrast, for pupils in Chinese Taipei data was a weaker domain and for those in Hong Kong their weakest domain.

Pupils in England performed significantly above their peers in each of the English-speaking countries except Ireland. Pupils in Ireland performed above their peers in England in measurement and geometry, but not significantly (541 compared with 539 respectively). Pupils in each of the English-speaking countries, except in Ireland, were stronger in data, as in England. Also, as in England, pupils from each country in this group, except Australia, were weaker in measurement and geometry.

England's pupils' performance in each domain was significantly above that of their peers in France and Italy from the European comparator countries. However, their performance was significantly below that of their peers in Lithuania in measurement and geometry. While pupils in Lithuania also performed above England's pupils in the remaining domains, their average scores were not significantly different. Pupils in England performed significantly above pupils in Finland in number and data but achieved the same average score in measurement and geometry. As in England, pupils in Lithuania were weakest in measurement and geometry and strongest in data. In contrast, pupils in

Finland were stronger, and in France strongest, in measurement and geometry. Pupils in both countries were weakest in number while pupils in Italy were weakest in data.

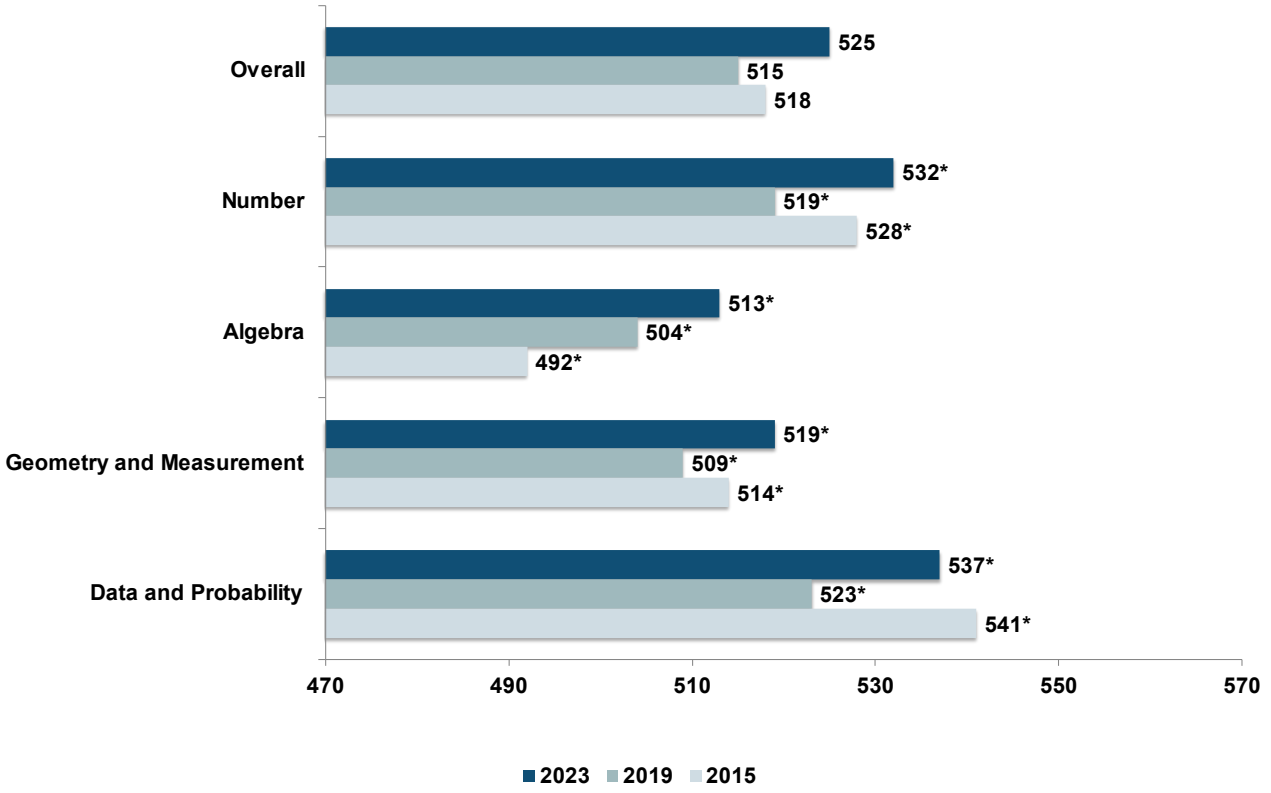
### 5.2.2 How did year 9 pupils in England perform across different mathematics content domains?

In 2023, year 9 pupils in England performed significantly above the international averages in each of the 4 domains.

In 2023, as in 2015 and 2019 (shown in Figure 40 and Table 59 below), year 9 pupils in England were stronger in both the data and probability and number domains. By contrast, also as in 2015 and 2019, they were weaker in the algebra and geometry and measurement domains. The pattern of relative strengths and weaknesses is therefore consistent over the last 3 TIMSS cycles (2015, 2019 and 2023).

Pupils' performance in 2023 for the strongest domain, data and probability (537), was not significantly different from the performance in 2019 (523).

**Figure 40: Average scores for 2015-2023 in different mathematics content domains compared with the overall mathematics average score (England, year 9)**




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score for that year.

**Table 59: Average scores for 2015-2023 in different mathematics content domains compared with the overall mathematics average score (England, year 9)**

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Number | 528 (above) | 519 (above) | 532 (above) |
| Algebra | 492 (below) | 504 (below) | 513 (below) |
| Geometry and measurement | 514 (below) | 509 (below) | 519 (below) |
| Data and probability | 541 (above) | 523 (above) | 537 (above) |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall mathematics average score for that year.

In 2023, year 9 pupils in England performed significantly below their peers from the highest-performing comparator countries in each domain. Like England's pupils, those in Chinese Taipei and the Republic of Korea were stronger in the number domain. Also, as in England, pupils in Japan were stronger in data and probability while pupils in Singapore were strongest in this domain. By contrast, pupils in Chinese Taipei, Hong Kong and the Republic of Korea were weakest in this domain. In contrast to pupils in England, pupils in Hong Kong were strongest in geometry and measurement and pupils in the Republic of Korea and Japan were stronger in this domain.

Pupils in England performed significantly above their peers in the 3 of the 4 other English-speaking countries (Australia, New Zealand and the United States) in each domain, except in one instance. The performance of pupils in Australia in data and probability was not significantly different from the performance of their peers in England[57]. None of the differences between the performance of England's pupils' and Ireland's pupils was significant. Like in England, pupils in each of the 4 countries were either stronger or strongest in data and probability and, except for those in the United States, weaker or weakest in algebra.

Pupils in England performed significantly above their peers in the European comparator countries in data and probability and number. They also performed significantly above their peers in each country in algebra, with the exception of Lithuania. In geometry and measurement, their performance was only significantly above that of pupils in France. Like in England, pupils in France and Italy were weaker in algebra while those in Finland were weakest in this domain. In contrast to pupils in England, their peers in Italy and

[57] Guidelines for minimum school participation rates in both New Zealand and the United States were not satisfied in 2023. See Appendix B for discussion of the difficulty of making easy comparisons across country, or even within country and across years.

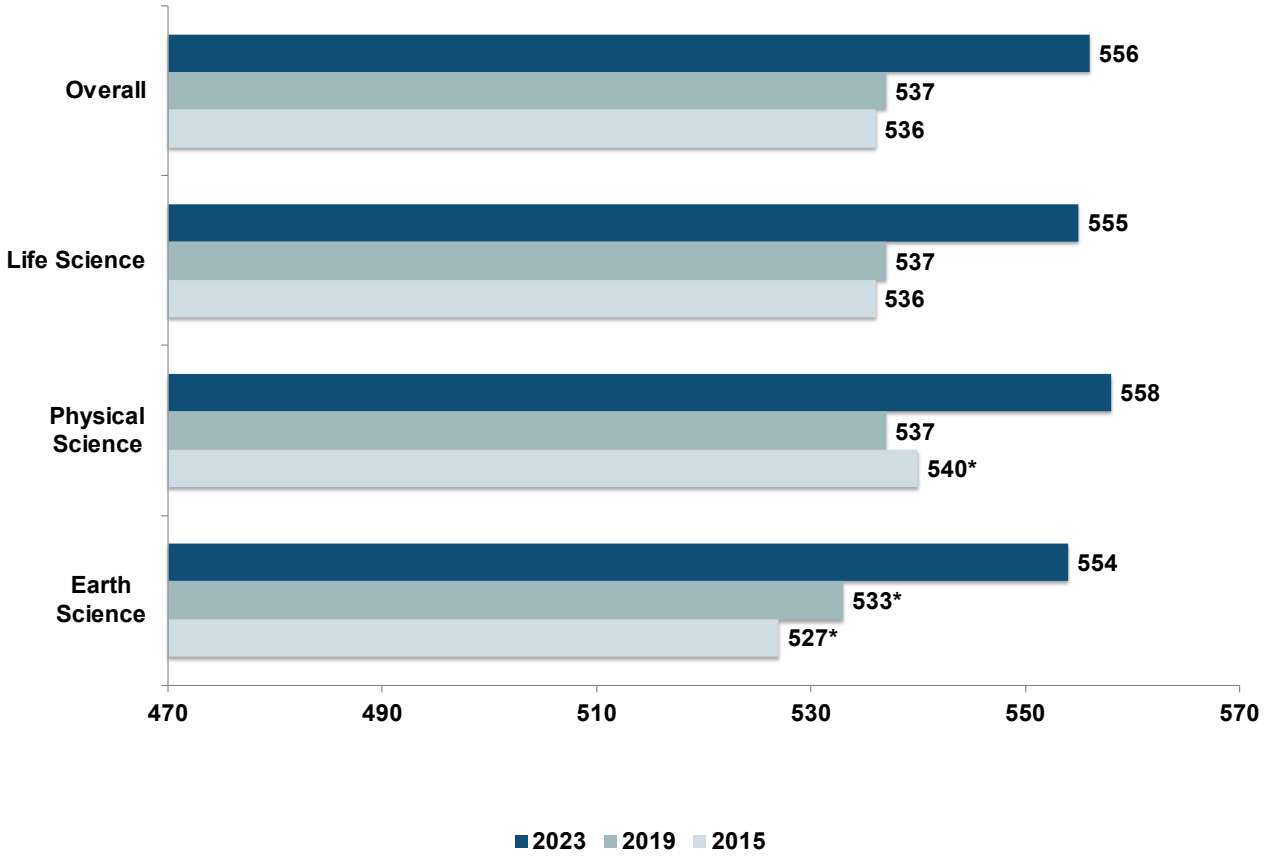
Lithuania were strongest in geometry and measurement while those in Finland were stronger in this domain.

### 5.2.3 How did year 5 pupils in England perform across different science content domains?

In 2023, as in 2019, year 5 pupils in England performed significantly above the international averages in each of the 3 content domains.

As shown in Figure 41 and Table 60 below, year 5 pupils' performance in each domain in 2023 was not significantly different from their overall average science score (556). This was in contrast to 2015 and 2019 when pupils were weakest in the Earth science domain, and in 2015 when pupils were relatively strong in Physical Science.

**Figure 41: Average scores for 2015–2023 in different science content domains compared with the overall science average score (England, year 5)**




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

**Table 60: Average scores for 2015–2023 in different science content domains compared with the overall science average score (England, year 5)**

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Life science | 536 | 537 | 555 |
| Physical science | 540 (above) | 537 | 558 |
| Earth science | 527 (below) | 533 (below) | 554 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

Year 5 pupils in England performed significantly below their peers in 3 of the highest-performing group of countries (Chinese Taipei, the Republic of Korea and Singapore) in each domain. Pupils in England performed significantly above pupils in Hong Kong in Earth science and life science, but the difference in their physical science average scores was not significant. They also performed significantly above their peers in Japan in Earth science and life science (both of which were weaker domains for Japan's pupils), but the reverse was true for physical science. Pupils in each of the highest-performing countries were strongest in physical science apart from in Singapore where they were stronger in this domain.

In 2023, the performance of England's year 5 pupils in each domain was significantly above that of their peers in each of the other English-speaking countries, apart from in one case. The average score differences between England's pupils and Australia's pupils for Earth science and life science were not significant. Pupils in each of the other 5 countries were weakest in physical science, in contrast to their peers in England where their performance in physical science was not significantly different from their overall science average score.

Pupils in England performed significantly above pupils in each of the European comparator countries in all domains, apart from in one case. The average score difference between England's pupils compared with Finland's pupils in Earth science was not significant. As with pupils in England, those in France and Italy did not have domains in which their average scores were significantly different from their overall science average score.

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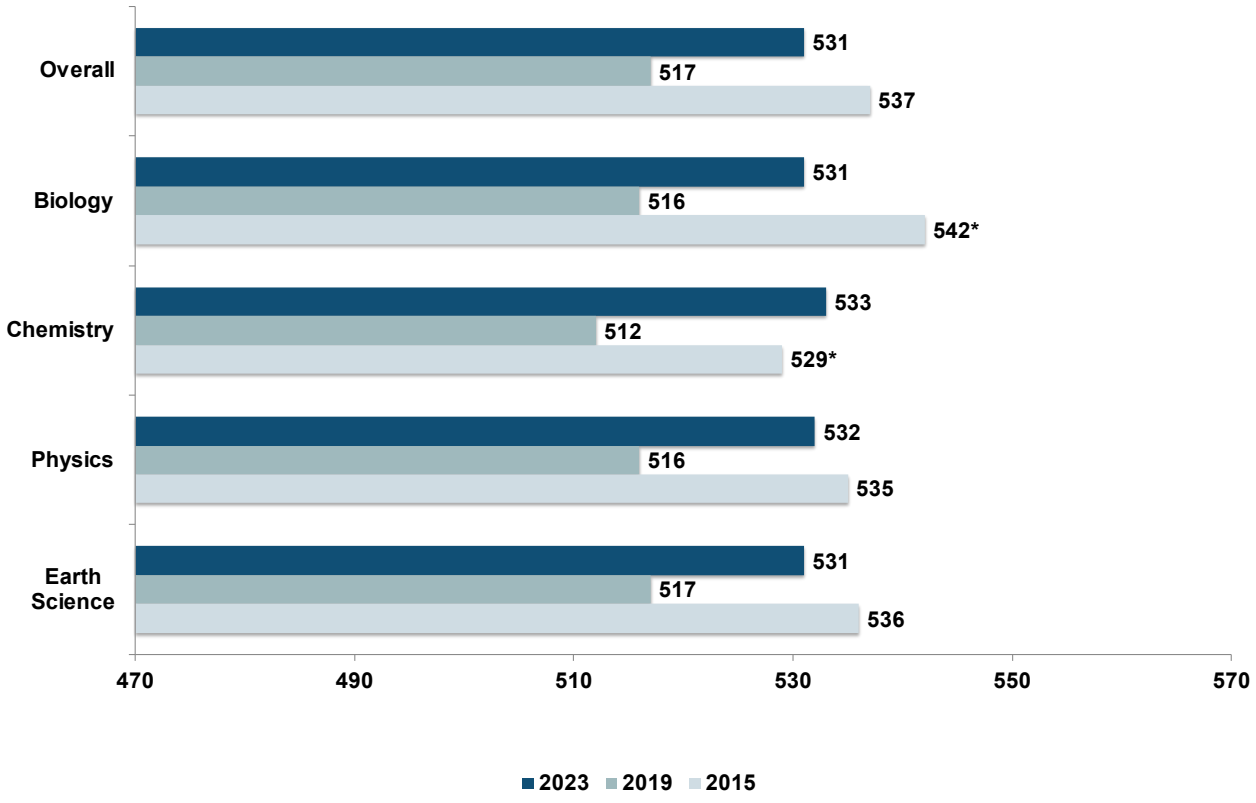
### 5.2.4 How did year 9 pupils in England perform across different science content domains?

As in 2015 and 2019, year 9 pupils in England performed significantly above the international average in each of the content domains.

In each domain, year 9 pupils' performance in 2023 was significantly above that achieved in 2019. This was in line with pupils' overall science average score being higher in 2023.

As shown in Figure 42 and Table 61 below, in 2023, the performance of year 9 pupils in England in each domain was not significantly different from their overall average science score (531). This mirrors year 9 pupils' across-domain performance in 2019, though at a higher level.

**Figure 42: Average scores for 2015–2023 in different science content domains compared with the overall science average score (England, year 9)**




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

**Table 61: Average scores for 2015–2023 in different science content domains compared with the overall science average score (England, year 9)**

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Biology | 542 (above) | 516 | 531 |
| Chemistry | 529 (below) | 512 | 533 |
| Physics | 535 | 516 | 532 |
| Earth science | 536 | 517 | 531 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

Year 9 pupils in England largely performed significantly below their peers in the highest-performing group of countries in 2023. There were 2 exceptions. Firstly, none of the average score differences between England's and Hong Kong's pupils was significant. Secondly, pupils in England performed significantly above their peers in the Republic of Korea in chemistry. However, their performance in the remaining domains was significantly below that of pupils in the Republic of Korea. Pupils in Japan, the Republic of Korea and Singapore were stronger in physics, while pupils in Chinese Taipei, Japan, the Republic of Korea were stronger in Earth science. Singapore's pupils saw a decrease of 34 scale points in Earth science making this their weakest domain.

Among the English-speaking countries, the performance of year 9 pupils in England in each domain was significantly above that of their peers in New Zealand and the United States. They also performed significantly above pupils in Australia in biology and chemistry and, in biology only, compared with pupils in Ireland. Pupils in Ireland and New Zealand were strongest in Earth science and weakest in biology, while pupils Australia were similarly stronger in Earth science and weaker in biology. Pupils in Australia were also weaker in chemistry while this was the weakest domain for pupils in the United States.

Among the European comparators, pupils in England performed significantly above their peers in France, Italy and Lithuania in each domain with one exception: the performance of pupils in Lithuania in chemistry was not significantly different from that of England's pupils. Pupils' performances in England were not significantly different in any domain compared with their peers in Finland. As in England, there were no domains in which pupils' performance in Lithuania was significantly different from their overall science average score. Pupils in Finland, France and Italy were stronger in Earth science.

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## 5.3 How did pupils in England perform in different cognitive domains?

In both mathematics and science, TIMSS assesses pupils' performance in 3 cognitive domains: applying, knowing and reasoning. The domains describe the kind of thinking that pupils do when engaged with both mathematics and science tests, although with different emphases depending on the subject and year group[58]. For example, there is more emphasis on the knowing and applying domains in year 5 science compared with year 9 science, but a greater emphasis on the reasoning domain in year 9 mathematics and science.

The descriptions of the 3 domains differ slightly between mathematics and science; broadly they are described as encompassing the following:

- applying: pupils' application of knowledge and conceptual understanding in a range of situations
- knowing: the facts, concepts, and procedures pupils need to know
- reasoning: in mathematics this 'involves the logical, systematic thinking that students need to use to generate and justify solutions to problems, make inferences, and deal with complex relationships between mathematical objects', while in science it 'includes using evidence and science understanding to analyse, synthesise, and generalise'[58]

### 5.3.1 How did year 5 pupils in England perform in the mathematics cognitive domains?

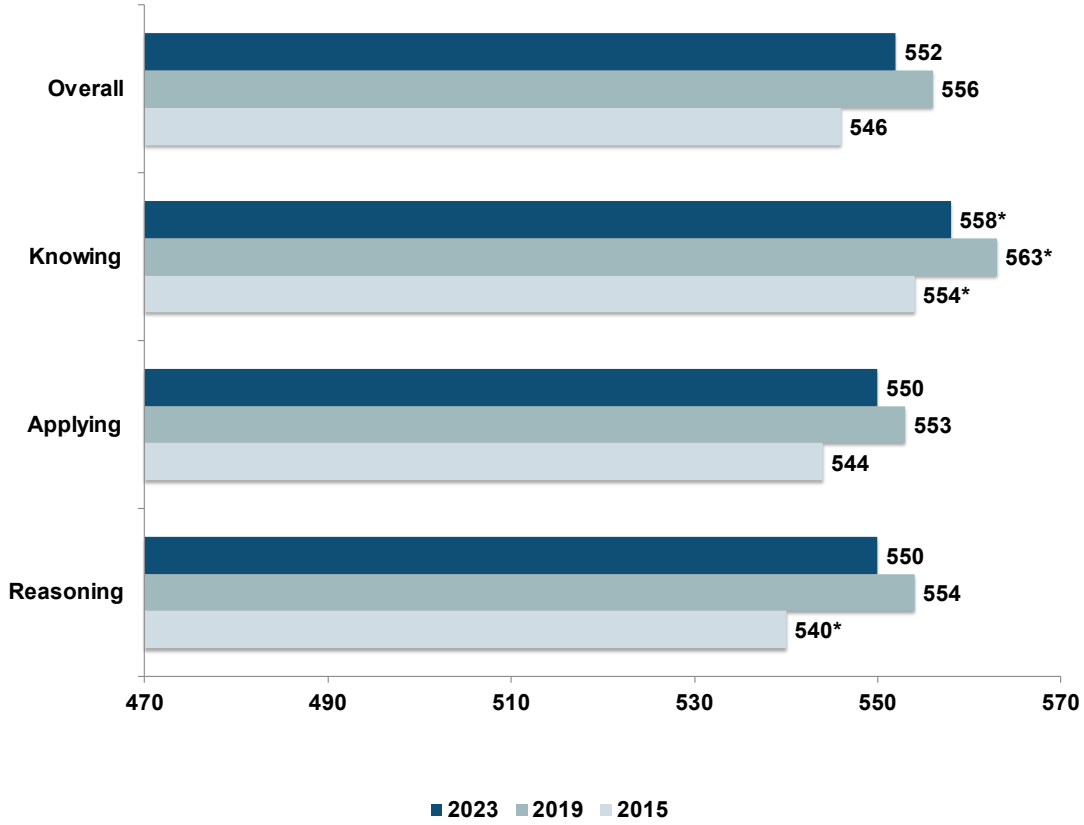
In 2023, year 5 pupils in England performed significantly above the international average in each of the 3 cognitive domains for mathematics.

As shown in Figure 43 and Table 62 below, year 5 pupils in England were strongest in the knowing domain in 2023, as they were in the previous 2 cycles (2015 and 2019). Their performance in the applying domain in 2023 was not significantly different from the overall mathematics average score, as in the previous 2 cycles. Similarly, their performance in reasoning was not significantly different from the overall mathematics average score, as in 2019.

None of the average score differences between 2019 and 2023 was significant.

[58] See the TIMSS 2023 Frameworks: Mullis, I. V. S., Martin, M. O., and von Davier, M. (eds.). (2021). *TIMSS 2023 Assessment Frameworks*. Available at: https://timssandpirls.bc.edu/timss2023/frameworks/index.html

## Figure 43: Average scores for 2015–2023 in mathematics cognitive domains compared with the overall mathematics average scale score (England, year 5 mathematics)




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

## Table 62: Average scores for 2015–2023 in mathematics cognitive domains compared with the overall mathematics average scale score (England, year 5)

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Knowing | 554 (above) | 563 (above) | 558 (above) |
| Applying | 544 | 553 | 550 |
| Reasoning | 540 (below) | 554 | 550 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

The performance of England's pupils in each cognitive domain was significantly below the performance of pupils in each of the countries from the highest-performing group. As in England, pupils in Hong Kong, the Republic of Korea and Singapore were strongest in the knowing domain while pupils in Chinese Taipei were stronger in this domain. Pupils in Chinese Taipei, Japan and Singapore were weakest in reasoning.

Pupils in England performed significantly above their peers in each of the English-speaking group of countries in each domain with one exception. While pupils in England performed significantly above their peers in Ireland in reasoning, the differences in the other cognitive domains were not significant. Pupils in Australia and Ireland achieved the highest overall mathematics scores of the English-speaking group after pupils in England and, like in England, these pupils were strongest in knowing. Pupils in Ireland and the United States were weakest in reasoning.

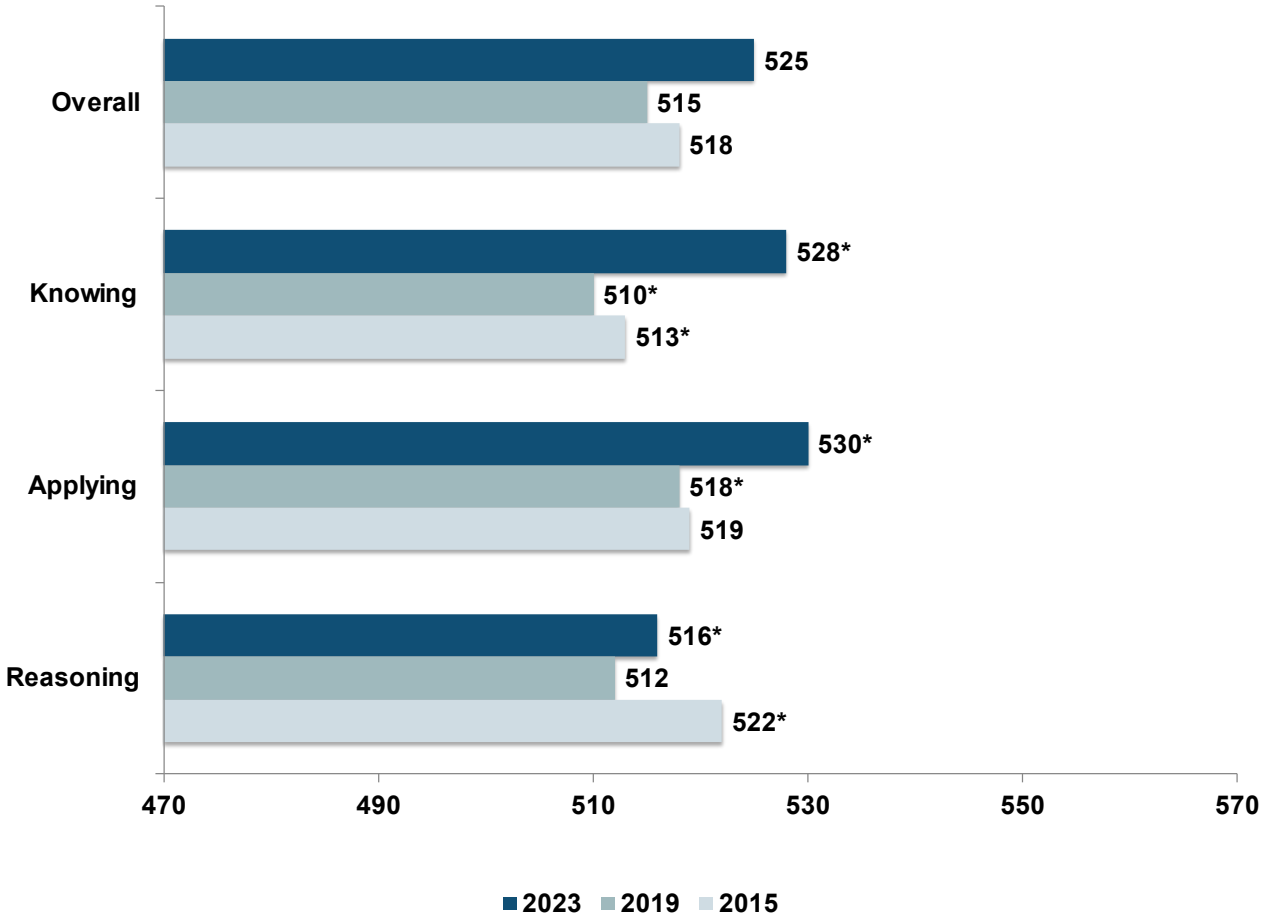
Pupils in England performed significantly above their peers in each of the European comparator group of countries in each cognitive domain with one exception. While pupils in England performed significantly below pupils in Lithuania in applying, the differences in the other domains were not significant. As in England, pupils in Finland were strongest in knowing while for their peers in Italy this was their weakest domain and for Lithuania's pupils, a weaker domain.

### 5.3.2 How did year 9 pupils in England perform in the mathematics cognitive domains?

In 2023, year 9 pupils in England performed significantly above the international averages in each of the domains.

As shown in Figure 44 and Table 63 below, year 9 pupils in England were stronger in the knowing and applying domains in 2023. Their performance in knowing was a significant improvement on England's pupils' performance in 2019. This strength in knowing is in contrast to the previous 2 cycles (2015 and 2019) when it was their weakest domain. Pupils' performance in reasoning has moved from being their strongest domain in 2015 to their weakest in 2023. Pupils' performance in knowing in 2023 was significantly above that in 2019 and 2015, but the other domain scores were not significantly different.

## Figure 44: Average scores for 2015–2023 in mathematics cognitive domains compared with the overall mathematics average score (England, year 9 mathematics)




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

## Table 63: Average scores for 2015–2023 in mathematics cognitive domains compared with the overall mathematics average score (England, year 9 mathematics)

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Knowing | 513 (below) | 510 (below) | 528 (above) |
| Applying | 519 | 518 (above) | 530 (above) |
| Reasoning | 522 (above) | 512 | 516 (below) |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

Pupils in England performed significantly below their peers in the highest-performing countries in each cognitive domain. There were some similarities between the performance of pupils in England with their peers from the majority of highest-performing countries in 2023. Firstly, pupils in Chinese Taipei, Hong Kong and the Republic of Korea were strongest in knowing, 1 of 2 domains in which pupils in England were stronger. Secondly, pupils in all countries except Chinese Taipei were weakest in reasoning. Pupils in all of these countries except Singapore achieved average scores in applying that were not significantly different from their overall mathematics average score.

Pupils in England performed significantly above their peers in each of the English-speaking countries in each cognitive domain, except in one case: their performance was not significantly different from that of their peers in Ireland. As in England, pupils from Australia and Ireland were weakest in the reasoning domain in 2023, while this was 1 of 2 weaker domains for the United States. Similarly to pupils in England, who were stronger in knowing, this was also the strongest domain for their peers in the United States.

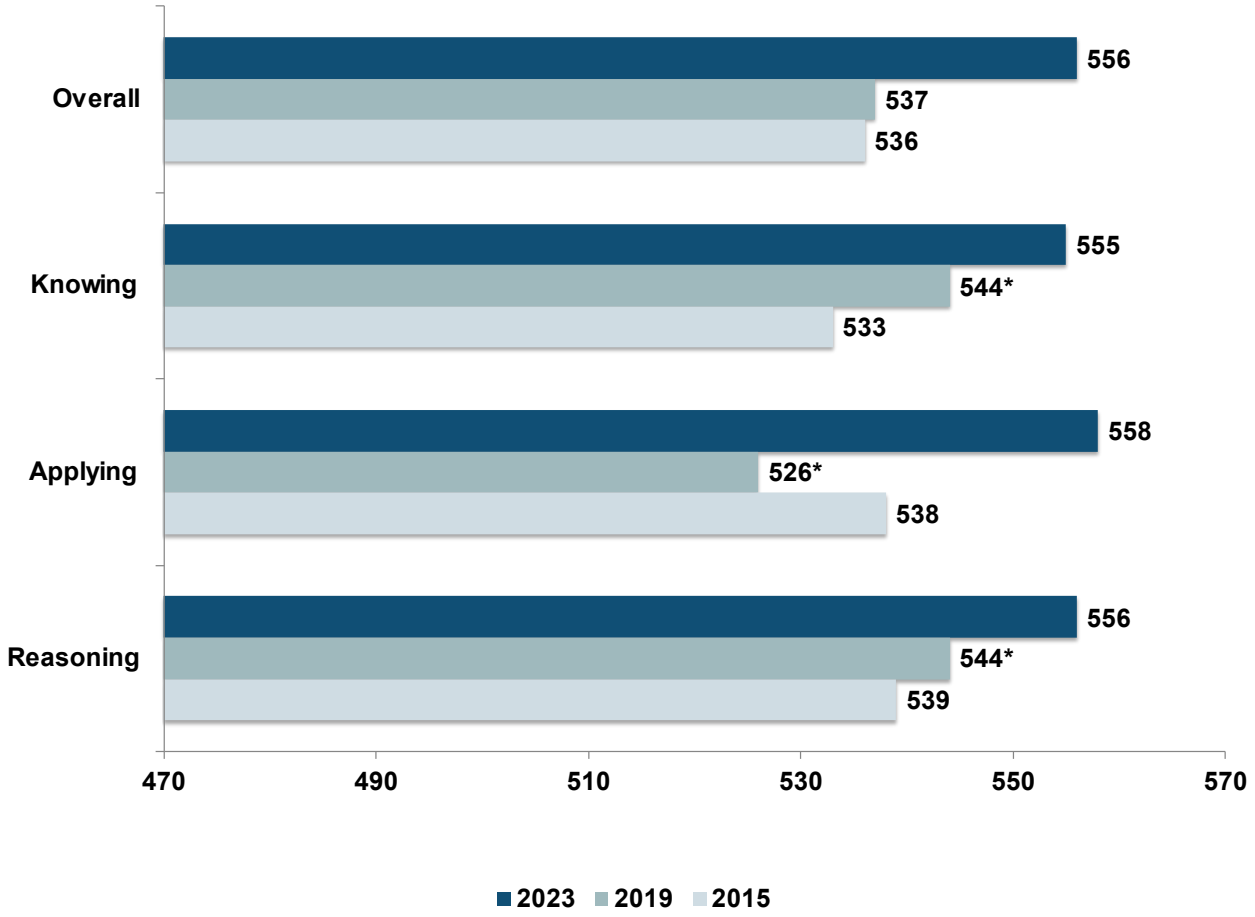
Among their European comparators, pupils in England performed significantly above their peers in Finland and France in each cognitive domain. They also performed significantly above their peers in Italy and Lithuania in applying and knowing, but differences in reasoning were not significant. In contrast to pupils in each of these countries, only in England did pupils have knowing as a stronger domain. In contrast to pupils in England, pupils in France and Italy were strongest in reasoning.

### 5.3.3 How did year 5 pupils in England perform in the science cognitive domains?

In 2023, year 5 pupils in England performed significantly above the international average in each of the 3 cognitive domains for science.

As shown in Figure 45 and Table 64 below, in 2023, year 5 pupils in England did not perform significantly differently from the overall science average score in any cognitive domain. This was the same as in 2015 but in contrast to 2019 when each of their cognitive domain average scores was significantly different from their overall science average score.

## Figure 45: Average scores for 2015–2023 in science cognitive domains compared to the overall science average score (England, year 5 science)




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

## Table 64: Average scores for 2015–2023 in science cognitive domains compared to the overall science average score (England, year 5 science)

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Knowing | 533 | 544 (above) | 555 |
| Applying | 538 | 526 (below) | 558 |
| Reasoning | 539 | 544 (above) | 556 |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

Compared with their peers in the highest-performing countries, pupils in England performed significantly below those in Chinese Taipei, the Republic of Korea and Singapore in each cognitive domain in 2023. They performed significantly above pupils in Japan in knowing, but below them in reasoning, while the difference in applying was not significant. They also performed significantly above pupils in Hong Kong in applying and reasoning, while the difference in knowing was not significant. Pupils in Hong Kong and the Republic of Korea, like their peers in England, did not perform significantly differently from the overall science average score in any domain. There were no other clear patterns of relative cognitive domain strengths or weaknesses.

Among pupils in the English-speaking countries, those in England performed significantly above their peers in each cognitive domain, except in one case. While their performance in applying was significantly above that of their peers in Australia, differences in knowing and reasoning were not significant. As in England, pupils in Australia, Ireland and New Zealand did not perform significantly differently from their overall science average score in any cognitive domain. Pupils in both Canada and the United States were weakest in reasoning.

Pupils in England performed significantly above their peers in each of the European comparator countries in each cognitive domain. Across the European comparator countries, there were no clear patterns of note beyond reasoning being the weakest domain for pupils in both France and Italy.

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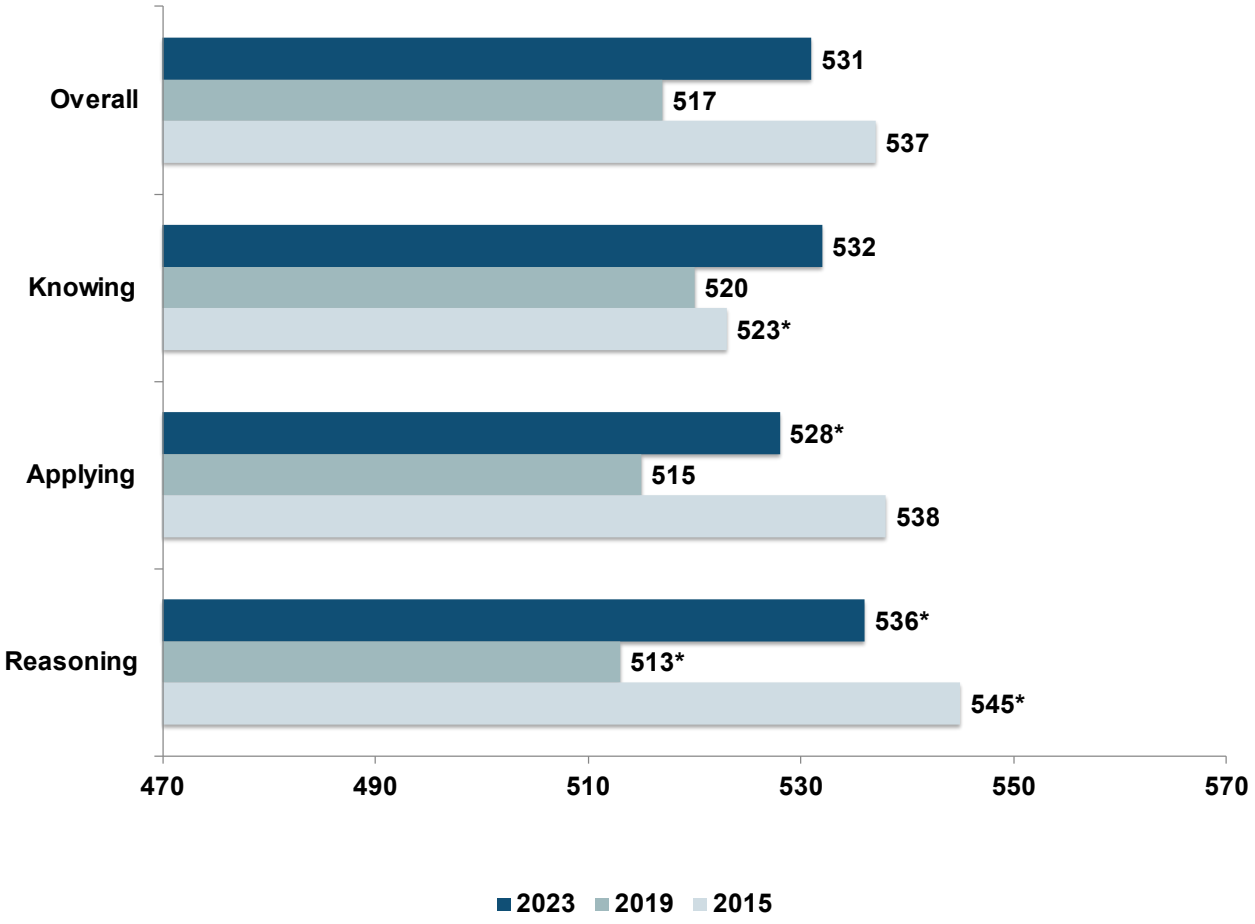
### 5.3.4 How did year 9 pupils in England perform in the science cognitive domains?

In 2023, year 9 pupils in England performed significantly above the international average in each of the 3 cognitive domains for science.

As shown in Figure 46 and Table 65 below, in 2023, year 9 pupils' performance in the knowing domain was not significantly different from the overall science average score, as in 2019. However, in contrast to both 2015 and 2019 (when there were no significant differences) pupils were weakest in applying in 2023. Pupils' performance in the reasoning domain has fluctuated over the most recent 3 TIMSS cycles between this being the strongest (2015 and 2023) and weakest (2019) domain.

In 2023, pupils' performance in the reasoning domain was significantly above that achieved in 2019 but not 2015. For the applying and knowing domains, the performance differences between 2023 and the previous 2 cycles were not significant. The difference between the average score for reasoning in 2023 and 2019 was 23 scale points, while it was 12 scale points for knowing and 13 for applying.

## Figure 46: Average scores for 2015–2023 in science cognitive domains compared to the overall science average score (England, year 9 science)




Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Asterisks (*) indicate domain average scores that were significantly different from England's overall average score in that year.

## Table 65: Average scores for 2015–2023 in science cognitive domains compared to the overall science average score (England, year 9 science)

| Domain | 2015 average score | 2019 average score | 2023 average score |
|---|---|---|---|
| Knowing | 523 (below) | 520 | 532 |
| Applying | 538 | 515 | 528 (below) |
| Reasoning | 545 (above) | 513 (below) | 536 (above) |

Sources: IEA TIMSS International Reports 2019 and 2023

Note 1: Descriptions after average domain scores indicate those that were significantly above or below England's pupils' overall science average score in that year.

Compared with pupils from the highest-performing countries, those in England performed significantly below their peers in Chinese Taipei, Japan and Singapore in each cognitive domain. This was also the case in comparison with pupils in the Republic of Korea for the applying and reasoning domains, while the difference in knowing was not significant. In each domain, the differences between the performance of England's pupils compared with Hong Kong's were not significant. In the highest-performing countries, there were no clear patterns of relative domain strengths or weaknesses beyond pupils being strongest in knowing in both Chinese Taipei and Singapore.

Pupils in England performed significantly above their peers in New Zealand and the United States in each domain. They also performed significantly above their peers in Australia and Ireland in knowing but other domain differences were not significant. As in England, pupils in each of the other English-speaking countries were strongest in the reasoning domain in 2023. Only pupils in England did not have knowing as their weakest domain.

The performance of England's pupils in each domain was significantly above that of their peers in France and Italy. They also performed significantly above their peers in Lithuania in knowing and reasoning, while the difference for applying were not significant. Compared with pupils in Finland, none of the differences was significant. As with pupils in England, those in France were strongest in reasoning and weakest in applying. In both Finland and Lithuania there were no cognitive domains in which pupils' average scores were significantly different from their overall science average score.

# Chapter 6: Interim summary and looking forward to the Volume 2 Report

This first part of the *TIMSS 2023 National Report for England* includes a range of evidence relating to pupils' performance in England in mathematics and science. The *TIMSS International Report 2023* and *TIMSS 2023 Encyclopedia* explore this data and the international evidence in complementary ways. This chapter concentrates on key performance issues and themes that have emerged from the TIMSS 2023 assessment cycle and highlights areas where further research might establish additional insights.

England has participated in TIMSS in every cycle over its 28 years, in both subjects and for both year groups[59].

## 6.1 Performance in mathematics

In mathematics, over the 20 year period from 2003 to 2023, year 5 and 9 pupils' performance in England has improved significantly. Notably, average pupil performance in 2023 remained significantly above the TIMSS centrepoint as well as significantly above the 2023 international average for both year groups. Average performance in year 5 in 2023 dropped from the all-time high achieved in 2019, but that drop was not statistically significant and was less than that in many other countries. The percentage of year 5 pupils reaching the low benchmark or above remained stable from 2015 to 2023; there was an increased range of performance. In year 9, performance in mathematics has been relatively stable since 2007; performance in 2023 was higher than in 2019, but not significantly so. An increased range in performance in year 9, to the highest recorded in England in TIMSS, was driven by the scores of higher attaining pupils. Stagnation in performance at the lower end is likely to be disproportionately borne by disadvantaged pupils[60] and that merits further exploration. We analyse the issue further in Volume 2 of the National Report, together with analysis of performance by other pupil characteristics. Pupils in both cohorts have been taught according to the 2013 national curriculum[61] where that is applicable, and that has a good match with the *TIMSS 2023 Mathematics Framework*.

[59] The 1999 study was only run by the IEA for pupils in year 9.
[60] Education Policy Institute (2024) *Annual Report 2023: Executive Summary*. Available at: https://epi.org.uk/annual-report-2023-executive-summary/
[61] Department for Education (DfE) (2013) *National curriculum in England: primary curriculum*. Available at: https://www.gov.uk/government/publications/national-curriculum-in-england-primary-curriculum and DfE (2013) *National curriculum in England: secondary curriculum*. Available at: https://www.gov.uk/government/publications/national-curriculum-in-england-secondary-curriculum

## 6.2 Performance in science

Average scores of year 5 pupils in science increased significantly from 2019 to 2023 and were above those achieved in each previous TIMSS cycle. We know schools have been working hard to recover from the pandemic impact on learning, and in recent years organisations such as the Primary Science Teaching Trust and the Primary Science Quality Mark have invested heavily in supporting primary science, but it is possible there is also a methodological contribution such as a mode effect – or that the sample achieved in 2023 has quite different background characteristics from that for 2019. We therefore suggest further work should be done, comparing the sample from TIMSS 2019 to that in TIMSS 2023 in terms of observable characteristics via administrative data (for example free school meal, pupil absence rates) but also responses collected as part of the questionnaire data, at the individual pupil level. If the distributions look the same/similar, this would probably rule out non-response/sampling issues for example as a possible explanation.

In 2019 England's year 9 average performance in science dropped to a score significantly lower than in any previous TIMSS cycle. In particular, the percentage of pupils performing below the low benchmark doubled from 2015. Explanations for that drop were not clear at the time. Performance in science in 2023 at year 9 showed an encouraging significant improvement from 2019, though 10% of pupils did not achieve the low benchmark, and the average score remains the second lowest achieved over any cycle of TIMSS. Again, it would be worth comparing sample pupil level data for 2019 and 2023, to see whether, for example, that comparison offers any methodological insight into the 2019 dip.

## 6.3 Comparative performance

Although pupils from a group of mostly East Asian countries – Chinese Taipei, Hong Kong, Japan, Republic of Korea, Russia and Singapore – have consistently outperformed England's pupils[62] across both mathematics and science, England's pupils fared well when compared to their counterparts in other English-speaking countries, as well as when compared to pupils from the representative group of other European countries across subjects and year groups.

[62] With the exception of Hong Kong in science; note also that Russia did not participate in TIMSS 2023.

## 6.4 Impact of the pandemic

The disruption to education in England during the global pandemic of 2020 to 2022 has caused considerable concern, and a range of sources of evidence[63] suggests academic performance continues to be significantly impacted, particularly for more disadvantaged pupils. Some aspects of the findings in this report suggest that performance in TIMSS 2023 showed surprising resilience to the hiatus caused by the pandemic. The pleasing average levels of performance achieved in both subjects and by pupils in both year groups are testament to the enormous efforts invested by schools in recovering from the challenges of the pandemic years. It is important also to recognise the extensive and sustained work done by the National Centre for Excellence in the Teaching of Mathematics with its Maths Hubs, and comparable work in science. Importantly, though, average performance measures can mask the struggles of particular groups of pupils whose learning has been less resilient over recent years, and there are aspects of concern in the findings that require further exploration. We point to some such issues below.

## 6.5 Robustness of the sample

We note also the relatively robust sample achieved, for both year groups. The non-response bias analysis reported in Appendix E shows that the profile of the participating pupils in participating schools is similar to the original targeted sample in the key respects analysed. In year 9 there was a slightly lower percentage of pupils in the participating sample than the original sample who were eligible for SEN support and who were eligible for FSM for any period in the last 6 years. That slight bias would suggest the TIMSS performance data give a small over-estimate of whole population performance in year 9 – likely more than counterbalanced by the under-representation of independent schools within the year 9 sample. Overall, there is minimal potential for bias due to non-response. The outcomes underline the confidence with which findings around pupil performance in England should be viewed, even if the related findings for some comparator countries might be less secure (see Appendix B).

[63] What is the continued impact of Key Stage 1 school closures on later attainment and social skills? | NFER Classroom and EEF; Nuffield Foundation (2023) *The longer term impact of COVID-19 on pupil attainment and well-being.* Available at: https://The-longer-term-impact-of-COVID-19-on-pupil-attainment-and-well-being.pdf; House of Commons Committee of Public Accounts (2023) *Education recovery in schools in England.* Available at: https://committees.parliament.uk/publications/40220/documents/196416/default/; Education Policy Institute (2024) *Annual Report 2023: Executive Summary.* Available at: https://epi.org.uk/annual-report-2023-executive-summary/

## 6.6 Performance by domain

Performance across domains in mathematics at year 5 was broadly stable from 2019 to 2023 – with pupils' strongest performance in data and weakest performance in measurement and geometry. Early years and primary curricula in England for some years have featured a relatively low profile for work in space and shape, yet there is recent research pointing to its importance for longer-term mathematical development[64]. Measurement and geometry was a strong domain for most pupils in most high-performing countries. Year 5 pupils performed particularly strongly in knowing; strong mathematical development is underpinned by attention to all 3 cognitive domains[65]. In England in year 9 mathematics, while the overall average score increased, it was driven by performance in number and in data and probability; geometry and measurement was again relatively weak as was algebra, the foundation for much later mathematical development, including for computational thinking[66]. Year 9 pupils showed relatively weak performance in mathematical reasoning, which underpins work in problem solving[9].

The increase in performance in year 5 science was reflected across all content and cognitive domains; enhanced scores in year 9 science were evident across all content domains. Performance across science cognitive domains in year 9 was stronger than in 2019, with reasoning particularly strong, and applying relatively weak in 2023. In 2019 these relative patterns of cognitive performance were different. It is important that continued attention − from policymakers, curriculum resource providers and teachers − is given to all 3 cognitive domains, since all are needed for working scientifically[67].

## 6.7 Trends in progress issues

Progress issues were similar to those highlighted in 2019: between years 5 and 9 pupils' scores did not increase and at times fell back, although while the same cohort was tested in year 5 in 2019 and year 9 in 2023, these were not necessarily the same pupils. Fewer pupils in England reached the advanced benchmark or above, and high benchmark or above, than those in the highest-performing countries, and wide achievement gaps remained: the ranges of scores for year 9 in both science and mathematics were the biggest ever recorded for England, largely driven by an increase in performance among

[64] Hawes ZC, Gilligan-Lee KA and Mix KS (2022) Effects of spatial training on mathematics performance: A meta-analysis. *Developmental Psychology 58*(1): 112; Mix KS and Cheng Y-L (2012) The relation between space and math: Developmental and educational implications. *Advances in Child Development and Behavior 42,* 197–243.
[65] Hodgen, J., Foster, C., Marks, R., and Brown, M. (2018) *Improving Mathematics in Key Stages Two and Three: Evidence Review.* London: Education Endowment Foundation.
[66] Firetail (2022) *An evidence review on the changing nature and importance of mathematics in the 21st century.* London: Royal Society.
[67] For example Waller, N. (2021) Working scientifically in the primary classroom: progression of enquiry skills from EYFS to KS3. Centre for Industry Education Collaboration: University of York.

the highest-attaining pupils. It is important that all groups of pupils are able to benefit from the pleasing levels of performance achieved on average.

## 6.8 The Volume 2 report

Volume 2 of this report will present analysis of performance by pupil characteristics, including gender, socio-economic status and whether working in English as an additional language. It will also analyse home, school and classroom environment, pupil reported experiences and attitudes, and a brief discussion of pupil environmental awareness. This wider context is important for understanding young people's experiences. It also complements performance data in informing our understanding of pupils' persistence in using and participating in mathematics and science as they mature, and variations in that usage and participation by groups of pupils.

## 6.9 Comparison with performance in PISA

Given England's history of participating in the International Longitudinal Studies in Assessment (ILSAs), the research team has reflected on the TIMSS results alongside the recent outcomes from PISA 2022. As mentioned in chapter 1, the 2 sets of tests focus on different aspects of mathematics and science, with TIMSS concentrating more heavily on the intended curriculum and PISA on pupils' ability to address real-life challenges (literacy, 'mathematics literacy' and 'science literacy'). There is only 1 to 2 years' difference between the ages of pupils tested, with TIMSS testing 13 to 14 year olds and PISA testing 15 year olds. However, when comparing these data, it is important to note that England's pupils again scored significantly above the OECD average in PISA assessments in mathematics and science literacies in 2022, and also that direct score comparisons with TIMSS performance are not possible.

Mathematics scores in PISA 2022 were significantly lower than in 2018, though not significantly different from performance in earlier PISA cycles. Scores in science were lower than in 2018, and significantly lower than in 2015. Such patterns were seen across many education systems, and might be attributable to a pandemic effect. However, given the absence of an obvious pandemic impact on TIMSS performance in England in 2023, it will be interesting to see if performance in PISA 2025 recovers. Mathematics and science literacy draw heavily on applying and reasoning with the knowledge learned, underlining the importance of continued attention to all cognitive domains.

In both TIMSS and PISA, the East Asian countries, including Chinese Taipei, Japan, the Republic of Korea and Singapore, consistently do best overall, although pupils in other countries sometimes also perform strongly. Globally, there have been a number of attempts to identify the education system characteristics that support consistently relatively high achievement, though such characteristics do not transfer across cultures

unproblematically. The mastery-based approach promoted by NCETM and the Maths Hubs in England since 2014 represents one such attempt, and has been accompanied by significant increases in TIMSS performance in both year 5 and year 9. It is probably too early to have seen similar patterns in PISA mathematics scores. However, co-occurrence is not the same as causation, and mathematics education in England has in parallel seen significant investment, policy and public interest, as well as teacher professional development.

While noting the pre-eminence of average performance in these East Asian countries, across many countries there is variation in performance by social advantage, and often also by gender. Considerations of equity of access to effective mathematics and science education lead to a focus on such relationships and variation, including a comparative focus, in Volume 2.

## 6.10 Interim conclusion

Overall, compared with 2019, the 2023 TIMSS results saw stability in year 5 pupils' performance in mathematics and an increase of 10 points in year 9 mathematics, though this was not a significant change. Over the same period, there were significant increases in both year 5 and year 9 science. Such outcomes in the wake of considerable disruption to education over the extended pandemic period of 2020 to 2022 reflect schools' strong commitment to recovery. However, there are some caveats. Within these generally encouraging outcomes, continued attention should be given to the range of content and cognitive domains, noting the relatively weak performance in geometry and measurement in both year groups, as well as in algebra in year 9. Additionally, development of a consistently balanced and strong range of cognitive skills would support effective mathematical and scientific development. Increased ranges of performance in both subjects and at both levels were driven by enhanced scores of high-performing pupils; more work is needed to establish exactly which groups of pupils are not currently benefiting from these pleasing average performances. We embark on some of that work, as well as exploration of the contextual and attitudinal variables that impact continued productive mathematical and scientific functioning, in Volume 2.

# Appendices

# Appendix A: Background and Methodology

## Background to TIMSS

TIMSS 2023 is the 8th cycle of the IEA's[68] series of comparative surveys of mathematics and science achievements, administered every 4 years since 1995. TIMSS 2023 involved 66 participating jurisdictions/countries[69] and 6 benchmarking systems[70] taking part at one or both of the target grades: 4th and 8th. In England, these grades correspond to years 5 and 9, with pupils aged 9 to 10 and 13 to 14 respectively.

The 2023 survey provides an updated picture of participating countries' educational performances relative to the previous study in 2019 and to earlier cycles.

Section 1.1 of this report provides more detail on the 2023 Study and its participants while more information about the educational systems in each country can be found in the *TIMSS Encyclopedia*[71].

## TIMSS sampling methodology

The overall aim of the TIMSS methodology was to generate a sample of pupils, representative of the grade 4 and grade 8 populations in each participating country, to yield accurate, unbiased and internationally comparable estimates of mathematics and science attainment and attitudes.

A 2-stage sampling model was used. In stage 1, schools were sampled from a list of all schools, with the probability of being chosen increasing with year group cohort size. Schools were also grouped by type and attainment to ensure national characteristics were proportionally represented in the sample.

Each country had a main sample of schools and 2 matched replacement samples, which were included in the survey if the main sample schools declined to participate.

Stage 2 took the sample of schools and selected one or more classes at random, depending on the number of pupils in the school in the year group. Ninety-five per cent of

[68] International Association for the Evaluation of Educational Achievement (IEA). http://www.iea.nl
[69] For ease of reading, the term 'country' has been used in the report.
[70] States and provinces within countries that collect representative samples in TIMSS and so can provide comparative findings.
[71] Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). *TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882

classes selected were expected to participate and, within each class, 85% of pupils were expected to take part in the study.

The IEA's sampling referee inspected each country's samples and if they met specific criteria, they were accepted for TIMSS 2023. Table 66 below sets out the criteria that countries had to meet.

Countries that achieved either criterion A or B were deemed to have met their sampling requirements fully. Participants that achieved C were deemed to have achieved a sample that was suitably representative at national level, but data from the country would be annotated in the *TIMSS International Report 2023*, with a note to indicate that replacement schools were used. Countries were advised that they might be required to conduct an analysis of potential bias in the TIMSS pupil sample compared to the national pupil cohort. Participants not meeting the criteria, in condition D, would have results reported separately in the *International Report* and be expected to conduct a bias analysis.

**Table 66: Criteria for inclusion in TIMSS**

| Criteria fully met | Criteria partially met | Criteria not met |
|---|---|---|
| **A**. A minimum school participation rate of 85%, based on main sample schools<br>OR<br>**B**. A minimum combined school, classroom and student participation rate of 75%, based on main sample schools (although classroom and student participation rates include replacement schools) | **C**. At least 85% of schools, including replacements, with at least 50% from the main sample | **D**. Fewer than 85% of schools including replacements |

Source: TIMSS International Report 2023

It is important to note that although TIMSS was designed to test a nationally representative sample of pupils, the class group(s) within a school that take part are randomly selected, and might not necessarily be representative of all pupils in a sampled school (for example, in a secondary school where setting is used in mathematics and either the top or bottom set has been selected to complete the assessment). One implication of this approach is that robust analysis cannot be undertaken by school type – for example, an academy that might have its top set for mathematics selected cannot be compared with a maintained school where the bottom set is selected.

A second caveat to note is that the pupils who took TIMSS tests were selected from a stratified school sample rather than a stratified pupil sample. This means that it is not always possible to analyse TIMSS results for small sub-groups of pupils because it is likely that there are relatively few TIMSS pupils from some sub-groups.

The mathematics and science teachers for each class selected to take part in TIMSS, along with the headteachers from each of the participating schools, were asked to fill in a questionnaire. The National Report for England Volume 2 (scheduled for publication in March 2025) will analyse the TIMSS questionnaire data for England, including relative to the chosen comparator countries.

## England's TIMSS 2023 sample

All schools in England with pupils in year 5 (age 9 to 10) and in year 9 (age 13 to 14) on 31 August 2022 were within the target population for TIMSS sampling purposes. Schools with small year groups (fewer than 9 pupils in year 5, fewer than 25 pupils in year 9), special schools, pupil referral units and alternative provision schools were excluded.

Pupil exclusions were kept to a minimum: only pupils with significant special educational needs that would limit them in following the instructions of the TIMSS tests, and pupils unable to read and/or speak English, were excluded.

At school level, approximately 2% of the total eligible cohort of schools were excluded (with the majority coming from special schools). Within schools a further <2% of the eligible cohort was excluded in each year group.

A total of 4,091 year 5 pupils from 131 primary schools in England participated in TIMSS 2023, 79% of main sample schools.

A total of 4,239 year 9 pupils from 136 secondary schools in England participated in TIMSS 2023, 76% of main sample schools.

Although England's school participation rates did not meet Criterion A (see Table 66), class and pupil participation rates were very high, which meant England met Criterion B with overall participation rates of 79.1% for year 5 and 75.9% for year 9.

For more information on the schools and pupils that participated in TIMSS in England see Tables 10, 11 and 12 in Section 1.3.

## Survey administration

Ahead of the sample selection process, a field trial took place in March 2022 in which school recruitment, new assessment questions and each background questionnaire

(pupil, teacher and school) were trialled to identify whether the questions were likely to provide valuable information for the main study.

Test materials were provided by the IEA. Pearson adapted the test items for use in England, involving amendments to spellings from American English and changes to subject-specific terminology to terms used within classrooms in England. UCL IOE also undertook a curriculum matching exercise to identify which of the TIMSS test items pupils in English schools would have been expected to have studied by the time of taking the TIMSS tests.

Every participating school nominated a TIMSS school coordinator, who worked with a dedicated TIMSS test administrator from Pearson to ensure that tests were delivered to the IEA's exact requirements. Any discrepancies in test delivery methods between countries could introduce bias into the study.

Adherence to the study procedures to ensure consistency and fairness was monitored by quality monitors from the IEA and England, each visiting a non-overlapping 10% of schools in each year group.

For the main TIMSS assessment, pupils were asked to complete mathematics and science test items via an online portal. The background questionnaires for all sample pupils, headteachers and teachers were also completed online.

The main survey test period took place April to June 2023 for year 5 and March 2023 for year 9.

The TIMSS assessments and questionnaires were submitted online and data was transferred securely to a central IEA server. The data for England was submitted to the IEA for processing and checking before being merged with the other participating countries' data.

The IEA also commissioned a *TIMSS Encyclopedia* article from each participating nation, which contained an overview of the structure of local education systems in participating countries.

## Data analysis

The IEA analysed the international database of country results and the evidence from pupil, headteacher and teacher questionnaires. This analysis is available in the IEA's *TIMSS International Report 2023* published on 4 December 2024.

The IEA released the international database to country participants on 6 September 2024 and this data has been used to produce this report for England. The data for England has been linked to the to the National Pupil Database (NPD).

The international TIMSS 2023 database will be published for wider use on 6 February 2025.

## Sources of further information

For more information on sample design and implementation, instrument development, translation, quality assurance, and creation of the international database visit: https://timss2023.org/methods/

For documentation on methods and procedures in TIMSS 2023 refer to: https://timss2023.org/methods/

For the *TIMSS 2023 Encyclopedia* see: *Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882*

For the *TIMSS International Report* 2023 see: https://timssandpirls.bc.edu/timss2023/

# Appendix B: A cautionary note on interpretation of IEA data

TIMSS assesses students in participating countries in their 4th year of formal schooling, provided the mean age at the time of testing is at least 9.5 years, and in their 8th year of formal schooling, provided the mean age at the time of testing is 13.5 years. Because education systems vary in structure and in policies and practices with regard to age of starting school and promotion and retention, there are differences across countries in how the target grades are labelled and in the average age of students. Mean age, and curriculum already experienced, also differ according to when in the relevant year TIMSS assessments take place. The proportion of the TIMSS Assessment Framework judged 'relevant' to the in-country curriculum (that is, those areas judged likely to have been encountered by at least 50% of the relevant age group) also varies. Further, participating countries take different approaches to mandating or incentivising the participation of identified main sample schools, and to exclusion by school or pupil characteristics, with the result that the nature of the achieved sample, and participation by intended sample school and pupil, are also variable across countries. The *TIMSS 2023 International Report*[72] and the *TIMSS 2023 Encyclopedia*[73] taken together give considerable, though not exhaustive, detail of such background variation. However, the key point addressed in this appendix, especially in relation to those countries selected as comparators for England, is that meaningful comparison of performance in any one subject at any one grade level is often not straightforward, so that initial interpretation of data should usually be a starting point only, and a source for further questions.

For example, Turkey's average grade 4 performance in both mathematics and science looks impressive (553 in mathematics compared with England's 552, and 570 in science compared with England's 556), especially for a country with relatively low GDP. The *TIMSS 2023 International Report* flags Turkey's performance with an open circle because of the characteristics of the sample. The reader might think this is because of the year group sampled, since Turkey assessed the performance of pupils in grade 5 rather than grade 4. However, Turkey's grade 5 participating pupils had an average age of 10.9 years so were comparable in age with those in Denmark's grade 4 (also 10.9 years on average) or Sweden's (10.8 years on average), and younger than participating pupils in Romania (at 11.1 years on average). England's year 5 pupils had an average age of 10.3 years. Coverage of Turkey's national target population was, however, an issue, with its total exclusions (Exhibit B.2 in the *TIMSS International Report 2023*) unusually high, at 21.9% (the next highest rate was Canada at 14.3%, then Singapore at

[72] von Davier, M., Kennedy, A., Reynolds, K., Fishbein, B., Khorramdel, L., Aldrich, C., Bookbinder, A., Bezirhan, U., & Yin, L. (2024). *TIMSS 2023 International Results in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs6460

[73] Reynolds, K. A., Aldrich, C. E. A., Bookbinder, A., Gallo, A., von Davier, M., & Kennedy, A. (Eds.) (2024). *TIMSS 2023 Encyclopedia: Education Policy and Curriculum in Mathematics and Science.* Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs5882

13.5%, with the vast majority of participating countries excluding well under 10%: England, for example, excluded 5.5% of this age group). This is the percentage of the relevant cohort systematically excluded from participation by virtue of their or their school's characteristics, and that exclusion has the potential to skew the reported average achievement. That does not mean that Turkey's performance is not a matter of interest and potential learning, simply that any interpretation of data should be done with care.

Considering European comparators, France was chosen as a large country with some background characteristics similar to those in England; the alternative obvious European candidate was Germany, which in 2023 only participated at grade 4. However, France's participation in TIMSS is not longstanding – 2023 was only the third cycle for grade 4 and the second for grade 8, so sustained performance time series are not available. Consequently, it is not possible to make reliable comparisons of comparative performance over time.

The English-speaking comparators are self-defining, though particular care should be taken in interpreting performance in New Zealand and the United States. Both had difficulty in TIMSS 2023 in relation to participation rates: New Zealand did not satisfy guidelines for overall participation rate in grade 8 (34% before replacement and 53% after replacement); and in grade 4 achieved an overall participation rate of 56% (before replacement) and 78% (after replacement). Similarly, the United States met guidelines for grade 4 sample participation rates only after replacement schools were included, with an overall after-replacement participation rate of 76%. At grade 8 it did not satisfy guidelines for sample participation rates, achieving overall participation rate of 48% (before replacement) and 63% (after replacement). Such limitations can have an impact on the known representativeness of the performance evidenced. That can be analysed using statistical methods, comparing the characteristics of the achieved sample with those of the intended sample, or of the cohort population at school and/or pupil level if such data is available, but without such further analysis, straightforward comparisons have limited (and unknown) reliability.

England met guidelines for participation rates after replacement, but at both grade levels the national defined population covered only 90% to 95% of the national target population. The suggested bias analysis is not available for participating countries where the sample is inadequate in some way; however, in the case of England, Appendix E offers a non-response bias analysis at both school and pupil level, in relation to state-funded participation. England's independent (non-publicly funded) schools' data, representing about 7% of each cohort on average, is not available for such analysis; the likely impact of that is discussed in Appendix E. Taken together, the analysis in Appendix E suggests that any non-response bias in England's participation is likely to be minimal,

and that there is good reason to have a high degree of confidence in the average performances reported.

# Appendix C: TIMSS 2023 international benchmarks[74]

**Table 67: Summary of advanced international benchmarks of mathematics achievement at years 5 and 9. Pupils reaching the advanced international benchmark achieved a score of 625 or above**

| Year 5 | Year 9 |
|---|---|
| Students can select and relate information to implement appropriate operations to solve problems. They can interpret the results of computations given in problem contexts, formulate a variety of expressions and patterns, and relate fractions and decimals. They can estimate and relate measures, apply knowledge of two- and three-dimensional shapes, identify simple properties of lines and angles, and show a basic understanding of surface area and perimeter in simple shapes. Students can interpret data and make choices about data given in numerous contexts. | Students can extend their understanding beyond working with integers alone to solve a variety of problems in novel contexts. They can interpret relationships among fractions or decimals, negative numbers, or proportions and ratios in multistep problems. They can formulate expressions, solve algebraic equations, and demonstrate an understanding of linear functions. Students can use their knowledge of the properties of geometric figures to find missing measures and identify related shapes. Students can integrate information across data displays to represent data and justify a conclusion. Students can implement their understanding of probabilities to relate problem conditions and likelihood. |

[74] Source: *TIMSS International Report* 2023

**Table 68: Summary of high international benchmarks of mathematics achievement at years 5 and 9. Pupils reaching the high international benchmark achieved a score of 550 or above**

| Year 5 | Year 9 |
|---|---|
| Students relate concepts or representations in extended contexts. They can apply knowledge of properties of whole numbers to justify a solution. They show an understanding of the number line, multiples, factors, rounding numbers, and operations with fractions and decimals. Students can resolve measurement tasks across numerous contexts. They can relate two-dimensional shapes to unfamiliar three-dimensional figures and demonstrate basic understanding of angles. Students can interpret features of data representations and represent data in a variety of graphs. | Students can apply their conceptual understanding in a variety of relatively complex situations. They can relate magnitudes and differences between positive and negative integers, fractions, and decimals to solve problems. Students demonstrate an understanding of linear equations and can formulate algebraic expressions to represent a problem. They demonstrate a basic understanding of relationships represented as graphs on a Cartesian plane. They can apply basic properties of shapes to solve problems involving triangles, parallel lines, rectangles, and similar figures. Students can interpret data given in a variety of graphical representations to justify conclusions and solve problems involving outcomes and probabilities in familiar contexts. |

**Table 69: Summary of intermediate international benchmarks of mathematics achievement at years 5 and 9. Pupils reaching the intermediate international benchmark achieved a score of 475 or above**

| Year 5 | Year 9 |
|---|---|
| Students demonstrate mathematical knowledge in simple situations and relate representations. They can perform computations with three-digit whole numbers in a variety of situations. They can add and order simple decimals. Students can measure straight distances and describe three-dimensional shapes. They can use data from multiple sources to relate representations. | Students can apply mathematical knowledge in a variety of situations. They can solve problems across contexts involving whole numbers, negative numbers, fractions, decimals, and proportional relationships. They can interpret relationships given visually or in words to represent them algebraically. Students demonstrate some understanding of angle measures and in relating two-dimensional and three-dimensional shapes. They can read, interpret, and integrate across sources to represent data. |

**Table 70: Summary of low international benchmarks of mathematics achievement at years 5 and 9. Pupils reaching the low international benchmark achieved a score of 400 or above**

| Year 5 | Year 9 |
|---|---|
| Students demonstrate basic mathematical understanding. They can add and subtract whole numbers with up to three digits, multiply and divide single-digit whole numbers, and solve simple word problems. They can apply basic measurement ideas and properties of common geometric shapes. Students can read data from different representations and complete simple bar graphs. | Students have knowledge of integers, basic shapes, and visual representations. Students can apply basic properties of whole numbers. They demonstrate some knowledge of linear relationships. They can find the lengths of sides in polygons and relate views of solids. Students can read information from graphs and complete data representations. |

**Table 71: Summary of advanced international benchmarks of science achievement at years 5 and 9. Pupils reaching the advanced international benchmark achieved a score of 625 or above**

| Year 5 | Year 9 |
|---|---|
| Students can show, apply, and communicate their knowledge of life, physical, and Earth science, and engage in multiple scientific inquiry practices. Students show knowledge of the characteristics of living things, and they can construct and reason with representations of the relationships among organisms in ecosystems. They demonstrate knowledge of inheritance, killing germs, and environmental pollution. They show knowledge of properties of matter and of changes in states of matter, and they reason about dissolving rates in a laboratory setting. Students can communicate their understanding of Earth's physical characteristics and processes and of how humans use and impact the Earth's natural resources. They show knowledge of the motion and relative position of the Earth, Moon, and Sun. Students can design fair tests, predict outcomes, and evaluate possible conclusions. | Students can show, apply, and reason with knowledge of concepts related to biology, chemistry, physics, and Earth science in various contexts, and they can engage in more complex scientific practices. Students show knowledge of cellular respiration, photosynthesis, and natural disasters. They can apply knowledge about the human immune system and reason about ancestry. Students show and can apply knowledge of atoms, molecules, acids and bases, and chemical reactions, and can reason about separating mixtures. Students show knowledge about unbalanced forces and can apply knowledge about friction and the properties of sound. They can reason about shadows. They show knowledge about the composition of Earth's oceans and atmosphere, Earth's processes and history, and Earth's resources and their uses. Students can describe one limitation of a model and design a fair test with multiple variables. |

**Table 72: Summary of high international benchmarks of science achievement at years 5 and 9. Pupils reaching the high international benchmark achieved a score of 550 or above**

| Year 5 | Year 9 |
|---|---|
| Students show and apply knowledge of life, physical, and Earth science, and they engage in some scientific inquiry practices. They can distinguish between living and non-living things, they show knowledge about plant and animal reproduction and survival, and they can apply knowledge about some of the characteristics of plants and animals and their life cycles. Students can apply knowledge about the spread of germs. They can apply knowledge about states and properties of matter, magnets, sound, and heat and can reason using knowledge of dissolving rates in an everyday context. They show and can apply some knowledge of forces and motion. Students know various facts about the Earth's physical characteristics, and they apply their knowledge about Earth's different climates and changes over time. They can apply knowledge of the Earth-Sun system, and they show basic knowledge of the Moon's phases. Students describe observations and interpret models and graphical representations. | Students show and apply knowledge of concepts from biology, chemistry, physics, and Earth science, and they engage in multiple scientific practices. They show and apply knowledge of plant and animal cells, know simple facts about inheritance, and reason about simple population dynamics in an ecosystem. Students can apply knowledge of the human body and of the effects of human behaviour on the environment. Students show some knowledge of subatomic particles and of chemical notation and can reason about a chemical reaction. They can apply knowledge of properties of matter, electromagnets, light absorption and reflection, and the direction of common forces. They demonstrate knowledge about the states of matter, the transfer of thermal energy, and energy transformation. Students show knowledge about light from the Sun and about Earth's resources. They can apply knowledge about the relationship between climate and both weather and weathering. Students can interpret patterns in data, reason with data and graphical information, explore relationships between variables, and predict outcomes. |

**Table 73: Summary of intermediate international benchmarks of science achievement at years 5 and 9. Pupils reaching the intermediate international benchmark achieved a score of 475 or above**

| Year 5 | Year 9 |
|---|---|
| Students show and apply knowledge of some scientific concepts. Students show and apply some knowledge about plants and animals, and they have basic knowledge of human health. They show knowledge about properties of matter, energy, and light, and they apply basic knowledge about forces and motion. They show basic understanding of the Earth's surface. Students can provide partial descriptions of observations, and they can relate observations and data to scientific facts. | Students can apply understanding of some concepts from biology, chemistry, physics, and Earth science, and they engage in some scientific practices. They can apply knowledge about health, energy flow in ecosystems, interactions among living things and with their environment, and reproduction and inheritance. Students can apply knowledge of some chemistry concepts, such as thermal and electrical conductivity, concentration of a solution, and chemical reactions. They show basic knowledge of states of matter, motion, and forces, and they apply knowledge of properties of materials and of light. Students show some knowledge of the physical structure of the Earth, the Earth-Moon-Sun system, and the water cycle. They can reason about Earth's climate and demonstrate knowledge of ways to manage Earth's natural resources. Students create a simple experimental design and a basic mathematical model. They interpret tables, graphs, and pictures, and they draw conclusions. |

**Table 74: Summary of low international benchmarks of science achievement at years 5 and 9. Pupils reaching the low international benchmark achieved a score of 400 or above**

| Year 5 | Year 9 |
|---|---|
| Students show knowledge of some science facts. They demonstrate basic knowledge of plants, animals, and the environment. They show knowledge about some properties of matter in everyday situations, and they know that turbines provide electricity to some regions. They show some knowledge about Earth's characteristics, its changes over time, and its climate. | Students show and apply knowledge of some science facts. They show knowledge about cells, tissues, and organs and about some characteristics of animals. They apply some knowledge of ecosystems using models. Students distinguish between physical and chemical changes, and they show some knowledge related to dissolving. Students show basic knowledge about the physical properties of matter and about the form of energy a common device uses. Students know that ocean water contains salt and the Sun provides light and heat. Students can describe an observation and interpret a model. |

Sample items demonstrating tasks at each international benchmark are available in the TIMSS international exhibits[75]. A small number are included in Appendix D to this report.

[75] Source: *TIMSS International Report* 2023.

# Appendix D: Sample released items

The examples given below show a response earning full credit. They have been selected from items released by IEA to illustrate a range of benchmarking levels, and of cognitive and content domains, in order to give the reader an indication of the demands experienced by participating pupils. Such released items show the international format; items actually attempted by pupils in England were adapted to the usual spelling and vocabulary employed in English classrooms.

Further examples of released items are published in the TIMSS international exhibits[76] and a wider selection will be accessible from the TIMSS 2023 International website from early 2025; released items from previous years, with related facility scores across countries, can be found on the relevant IEA website, for example, for TIMSS 2019 from this page: https://timss2019.org/reports/achievement.

[76] Source: *TIMSS International Report* 2023.

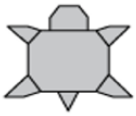
**Figure 47: Sample Item - Grade 4 Mathematics, Intermediate International Benchmark**

Content Domain: Data

Cognitive Domain: Applying

Description: Determines one or 2 out of 3 missing values in a table given conditions for the data (1 or 2 points)

Students in a class made three different origami animals using blue, red, and yellow paper. The table shows the number of animals that were made with each color paper.

| Animal | Color Paper | | |
|---|---|---|---|
| | Blue | Red | Yellow |
|  Tortoise | 8 | 4 | 3 |
|  Giraffe | 3 | 2 | 10 |
|  Fish | 10 | 6 | |

Complete the table by solving this puzzle:

- There are the same number of blue fish as yellow giraffes.
- There are the same number of red fish as the other two red animals combined.
- There are 24 yellow animals in all.

Source: IEA TIMSS International Report 2023

**Figure 48: Sample Item - Grade 4 Mathematics, Advanced International Benchmark**

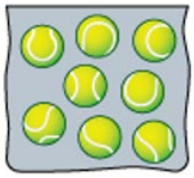
Content Domain: Number

Cognitive Domain: Applying

Description: Identifies an expression with division and addition that represents a situation

A sports coach needs to put 40 tennis balls and 10 soccer balls into bags.

Each bag can hold **either** 8 tennis balls **or** 2 soccer balls.



**or**

How can the sports coach calculate the total number of bags he will need?

**A** $40 + (10 \div 2)$

**B** $(40 \div 2) + (10 \div 8)$

**C** $(40 + 8) \div (10 + 2)$

**D** $(40 \div 8) + (10 \div 2)$

Source: IEA TIMSS International Report 2023

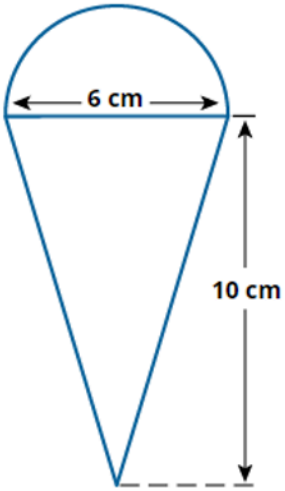
**Figure 49: Sample Item - Grade 8 Mathematics, High International Benchmark**

Content Domain: Geometry and Measurement

Cognitive Domain: Applying

Description: Solves a word problem involving circles and similar triangles

The design for an ice cream shop's logo is a semicircle on top of an isosceles triangle with the dimensions shown below.




The shop wants to make a larger version of the logo using a similar triangle with a height of 250 cm.

What will be the diameter of the semicircle for the larger version?

Answer: 150 cm

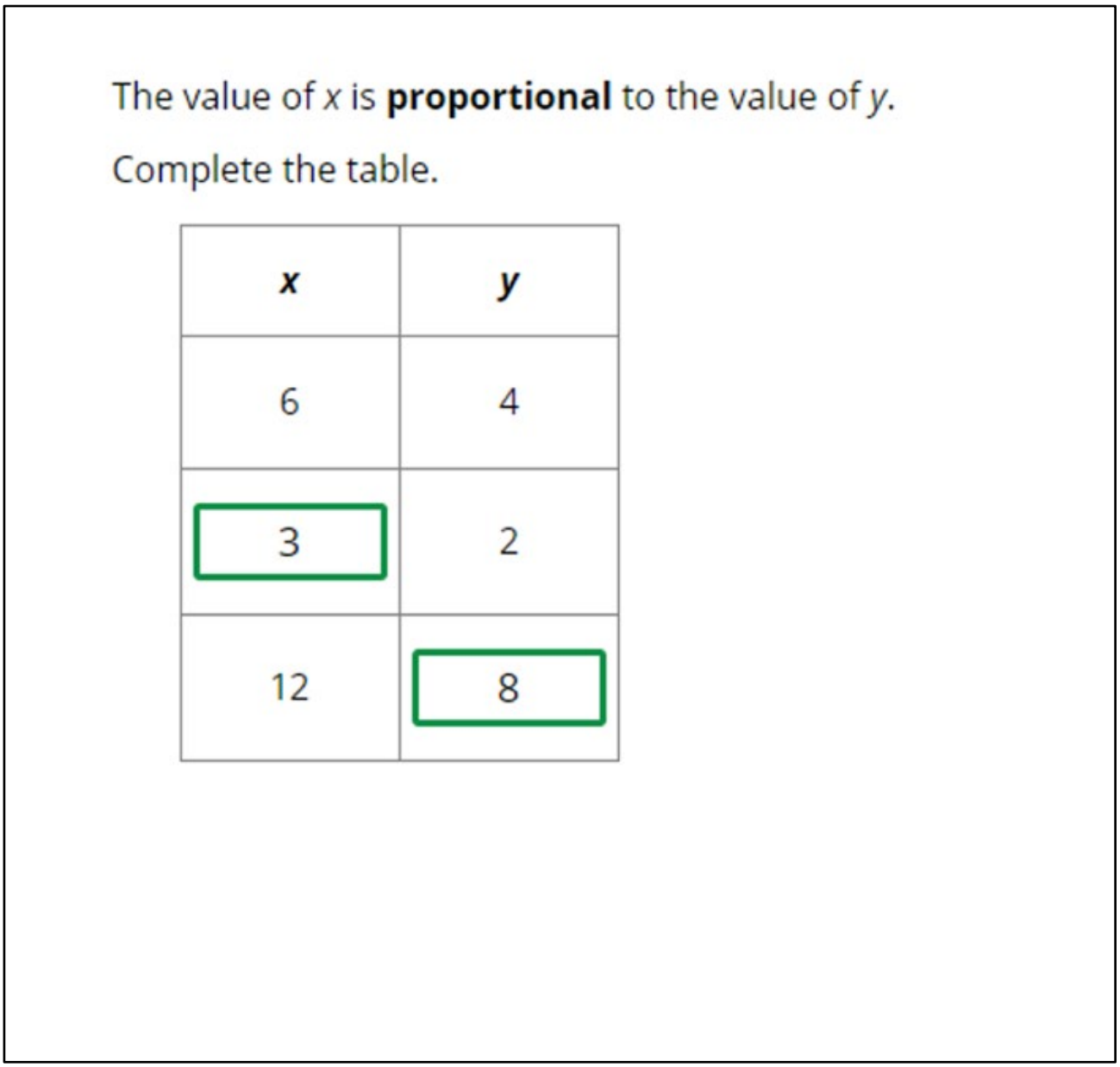
Source: IEA TIMSS International Report 2023

**Figure 50: Sample Item - Grade 8 Mathematics, Advanced International Benchmark**

Content Domain: Number

Cognitive Domain: Applying

Description: Given a ratio in a table, completes 2 equivalent ratios with one part missing in each



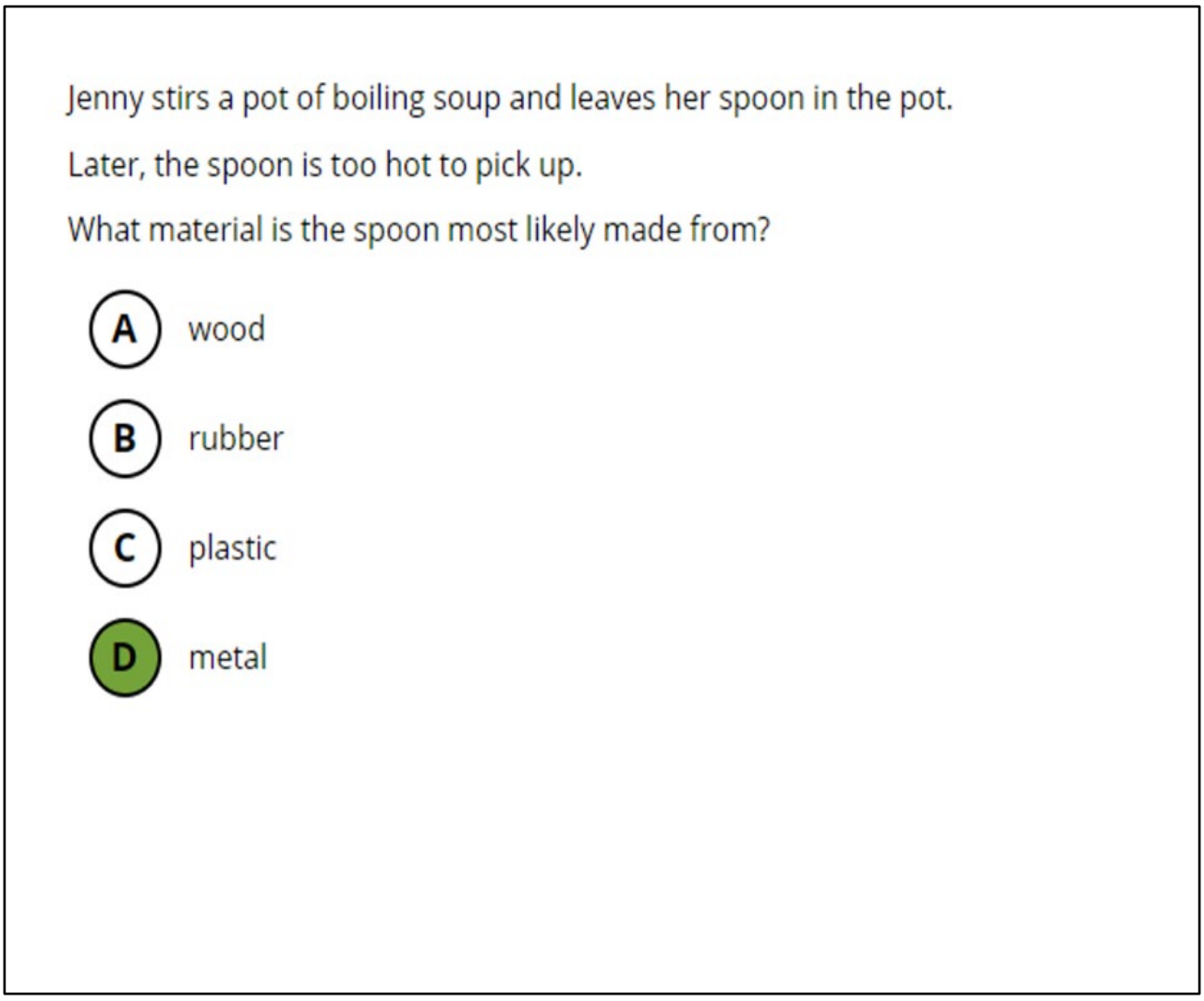

Source: IEA TIMSS International Report 2023

**Figure 51: Sample Item - Grade 4 Science Low International Benchmark**

Content Domain: Physical Science

Cognitive Domain: Applying

Description: Identifies the most likely material making up a spoon that gets hot sitting in a pot of boiling soup




Source: IEA TIMSS International Report 2023

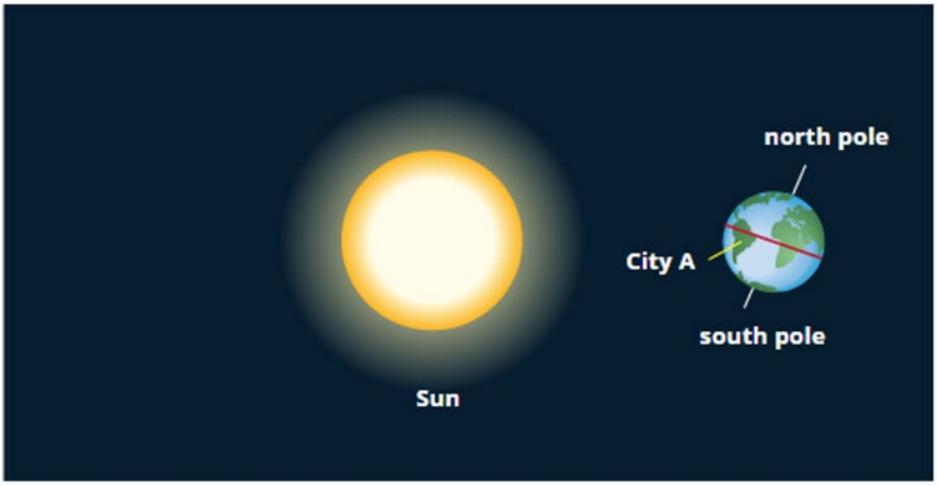
**Figure 52: Sample Item - Grade 4 Science High International Benchmark**

Content Domain: Earth Science

Cognitive Domain: Applying

Description: Interprets a diagram of the Sun and the Earth to identify the season in a labelled city

The diagram shows the Earth orbiting the Sun.




What season is it in City A in this diagram?

A winter

B spring

C summer

D autumn

Source: IEA TIMSS International Report 2023

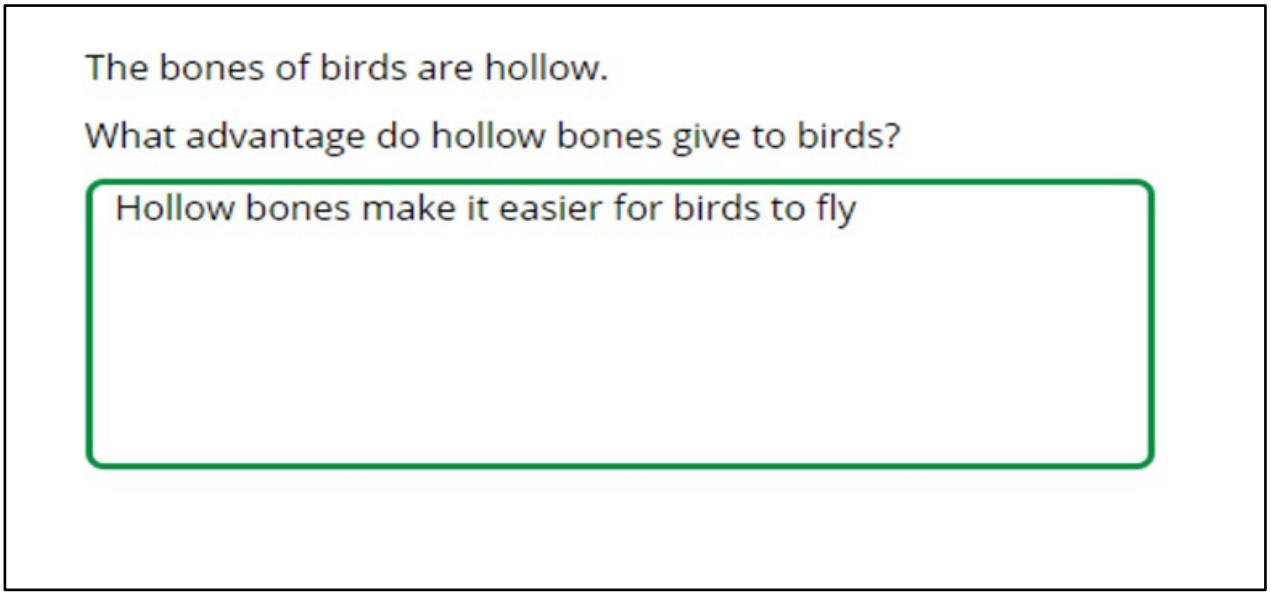
**Figure 53: Sample Item - Grade 8 Science Intermediate International Benchmark**

Content Domain: Biology

Cognitive Domain: Reasoning

Description: Justifies an advantage of hollow bones for birds

Note: The answer shown illustrates one type of response that would receive full credit. Other types of correct response are possible as defined by the item's unique scoring guide.




Source: IEA TIMSS International Report 2023

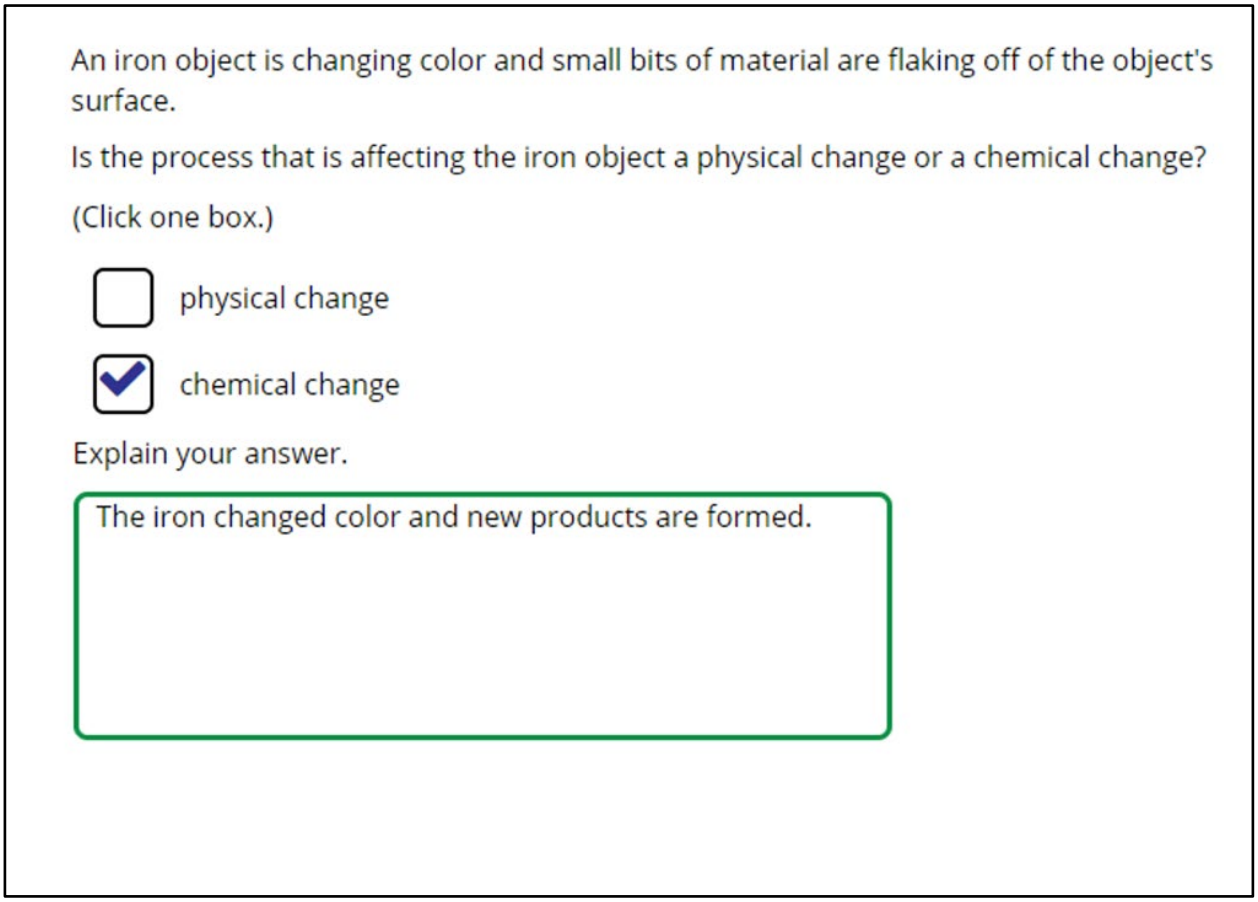
**Figure 54: Sample Item - Grade 8 Science Advanced International Benchmark**

Content Domain: Chemistry

Cognitive Domain: Applying

Description: Identifies and explains whether a described change is physical or chemical

Note: The answer shown illustrates one type of response that would receive full credit. Other types of correct response are possible as defined by the item's unique scoring guide.




Source: IEA TIMSS International Report 2023

# Appendix E: Non-Response Bias Analysis

## Introduction

The TIMSS sampling methodology for England is outlined in Appendix A. That sits within the international TIMSS 2023 methods as analysed in the *TIMSS 2023 Technical Report* at https://timss2023.org/methods/.

In this appendix we present a descriptive analysis for England that compares the original (targeted) sample of schools and pupils with the final achieved sample of participating schools and pupils. This provides an assessment of whether there are any potential sources of bias due to non-response and the extent to which the weight adjustments used to analyse the participating sample alleviate any bias that is found. Such analysis is important in giving the reader an indication of the confidence they can place in the reported data as representative of performance across the population, as a result of the sampling achieved. Overall, each analysis shows there is minimal potential for bias due to non-response.

## Methodology

The non-response bias analysis is carried out at both school and pupil level.

For each year group the original sample of schools is compared to participating schools using matched achievement data and school characteristics data from the Department for Education school performance tables.

For each year group the original sample of pupils in participating schools is compared to participating pupils in these schools using matched achievement data and pupil characteristic data from the National Pupil Database (NPD). These sources only include state-funded school data; characteristics of schools and pupils within the independent sector are excluded from consideration. As analysed in Table 10 (chapter 1), the independent sector represents 3.8% of the year 5 sample of schools, and 4.4% of the year 9 sample. This under-representation of the parent population in England (where the proportions of independent schools are, as in Table 10, 6.6% and 14.3% respectively) means that we would expect the average performance across the parent population to exceed that suggested by TIMSS data, especially at year 9.

For both year groups the non-response school-level analysis compares:

- the % of pupils eligible for Special Educational Needs (SEN) support
- the % of pupils with English as their first language and

- the % of pupils who have been eligible for free school meals (FSM) for any period in the last 6 years

The average achievement in schools is also compared:

- For year 5 we use the % of pupils achieving the expected standard in English reading, English writing and mathematics at the end of Key Stage 2 in 2023
- For year 9 schools we use the % of pupils achieving grade 5 or above in English and maths GCSEs in 2023

For both year groups the pupil-level analysis compares:

- the % of pupils who are female
- the % of pupils eligible for SEN support
- the % of pupils with English as their first language and
- the % of pupils who have been eligible for FSM for any period in the last 6 years

For the cohort of year 5 pupils in the TIMSS sample, Key Stage 1 assessments were not conducted due to COVID-19, so comparisons in terms of the prior achievement of these pupils is not possible. Similarly, for the cohort of year 9 pupils in the TIMSS sample, Key Stage 2 assessments were not conducted due to COVID-19. However, data from Key Stage 1 assessments for these pupils is available allowing a comparison of achievement in terms of the % of pupils achieving the expected standards in:

- reading
- writing
- mathematics and
- science

To assess the extent of school-level non-response bias, unweighted averages for the original (target) sample are compared with unweighted averages for participating schools. To assess the extent to which any bias is mitigated by the non-response adjusted weights applied to the TIMSS sample, unweighted averages for the original sample are compared with averages for participating schools weighted by the non-response adjustment part of the school weights.

To assess the extent of pupil-level non-response bias, unweighted averages for the original sample of pupils in participating schools are compared with unweighted averages

for participating pupils in these schools. To assess the extent to which any bias is mitigated by the non-response adjusted weights applied to the TIMSS sample, unweighted averages for the original sample of pupils in participating schools are compared with averages for participating pupils in these schools weighted by the non-response adjustment part of the pupil weights.

## Non-response bias analysis in Year 5 schools

The sample analysed excludes the 8 independent schools, of which 5 are in the final sample of schools, and excludes the pupils in those schools. The data required to conduct the bias analysis for these schools and pupils is not available.

Table 75 shows that on average 60.4% of pupils in the original sample of schools achieved the expected standard in English reading, English writing and mathematics at the end of Key Stage 2 in 2023, slightly higher than both the unweighted (60.2%) and weighted (60.1%) estimates for the participating schools. The low relative bias between the original sample and participating schools indicates minimal potential for bias due to non-response.

**Table 75: School average pupil achievement in original and participating schools: the percentage of pupils achieving the 'expected standard' in English reading, English writing and mathematics at the end of Key Stage 2 in 2023**

| | Original sample | Participating schools | Bias | Relative bias |
|---|---|---|---|---|
| Unweighted | 60.4 | 60.2 | 0.2 | 0.00 |
| Weighted | 60.4 | 60.1 | 0.0 | 0.01 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

Table 76 shows small differences in the average characteristics of pupils in these schools, again indicating minimal potential for bias due to non-response.

**Table 76: School average pupil characteristics in original and participating schools**

| School level pupil characteristics | Original (targeted) sample | Participating schools | Bias | Relative bias |
|---|---|---|---|---|
| Pupils eligible for SEN support − unweighted | 19.2 | 19.6 | -0.4 | -0.02 |
| Pupils eligible for SEN support − weighted | 19.2 | 19.7 | -0.5 | -0.02 |
| Pupils with English as their first language − unweighted | 78.7 | 78.5 | 0.2 | 0.00 |
| Pupils with English as their first language – weighted | 78.7 | 78.3 | 0.4 | 0.01 |
| Pupils who have been eligible for FSM for any period in the last 6 years − unweighted | 30.1 | 30.0 | 0.1 | 0.00 |
| Pupils who have been eligible for FSM for any period in the last 6 years − weighted | 30.1 | 30.2 | -0.1 | -0.00 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

Table 77 shows that the profile of the participating pupils in participating schools is similar to the overall sample of pupils in these schools in terms of the percentage who were female, the percentage who have English as their first language and the percentage eligible for FSM for any period in the last 6 years. There was a slightly lower percentage of pupils in the participating sample than the original sample who were eligible for SEN support. The non-response weighting adjustment has a very small impact on these numbers.

Overall there is minimal potential for bias due to non-response.

**Table 77: Pupil characteristics in original sample in participating schools and participating pupils in participating schools**

| Pupil characteristics | Original (targeted) sample | Participating pupils | Bias | Relative bias |
|---|---|---|---|---|
| Female − unweighted | 50.2 | 49.9 | 0.3 | 0.01 |

| Pupil characteristics | Original (targeted) sample | Participating pupils | Bias | Relative bias |
|---|---|---|---|---|
| Female − weighted | 50.2 | 49.8 | 0.4 | 0.01 |
| Pupils eligible for SEN support − unweighted | 17.2 | 15.9 | 1.3 | 0.08 |
| Pupils eligible for SEN support − weighted | 17.2 | 15.8 | 1.4 | 0.08 |
| Pupils with English as their first language − unweighted | 75.3 | 75.3 | 0.0 | 0.00 |
| Pupils with English as their first language – weighted | 75.3 | 75.2 | 0.1 | 0.00 |
| Pupils who have been eligible for FSM for any period in the last 6 years – unweighted | 28.2 | 27.4 | 0.8 | 0.03 |
| Pupils who have been eligible for FSM for any period in the last 6 years − weighted | 28.2 | 27.6 | 0.8 | 0.02 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

## Non-response bias analysis in Year 9 schools

The sample analysed excludes the 10 independent schools, of which 6 are in the final sample of schools and excludes the pupils in those schools The data required to conduct the bias analysis for these schools and pupils is not available.

Table 78 shows that on average 47.5% of pupils in the original sample of schools achieved grade 5 or above in English and mathematics GCSEs in 2023. This was slightly higher than both the unweighted (46.7%) and weighted (46.6%) estimates for the participating schools. The low relative bias between the original sample and participating schools indicates minimal potential for bias due to non-response.

**Table 78: School average pupil achievement in original and participating schools: the percentage of pupils achieving grade 5 or above in English and mathematics GCSEs in 2023**

| | Original (targeted) sample | Participating schools | Bias | Relative bias |
|---|---|---|---|---|
| Unweighted | 47.5 | 46.7 | 0.8 | 0.02 |
| Weighted | 47.5 | 46.6 | 0.9 | 0.02 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

Table 79 shows small differences in the average characteristics of pupils in these schools, again indicating minimal potential for bias due to non-response.

**Table 79: School average pupil characteristics in original and participating schools**

| School level pupil characteristics | Original (targeted) sample | Participating schools | Bias | Relative bias |
|---|---|---|---|---|
| Pupils eligible for SEN support − unweighted | 11.5 | 11.3 | 0.2 | 0.02 |
| Pupils eligible for SEN support – weighted | 11.5 | 11.3 | 0.2 | 0.02 |
| Pupils with English as their first language − unweighted | 81.2 | 82.3 | -1.1 | -0.01 |
| Pupils with English as their first language – weighted | 81.2 | 82.5 | -1.3 | -0.02 |
| Pupils who have been eligible for FSM for any period in the last 6 years − unweighted | 24.1 | 23.8 | 0.3 | 0.01 |
| Pupils who have been eligible for FSM for any period in the last 6 years − weighted | 24.1 | 23.7 | 0.4 | 0.01 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

Table 80 shows that participating pupils had higher Key Stage 1 achievement in all subjects than the overall sample of pupils in these schools. The non-response weighting adjustment reduces these differences a little, but for each indicator there is minimal potential for bias due to non-response.

**Table 80: Pupil average achievement in original sample in participating schools and participating pupils in participating schools: the percentage achieving the expected standard in Key Stage 1 assessments**

| Subject | Original (targeted) sample | Participating pupils | Bias | Relative bias |
|---|---|---|---|---|
| Reading – unweighted | 78.1 | 79.4 | -1.3 | -0.02 |
| Reading – weighted | 78.1 | 79.1 | -1.0 | -0.01 |
| Writing − unweighted | 70.5 | 72.0 | -1.5 | -0.02 |
| Writing − weighted | 70.5 | 71.6 | -1.1 | -0.02 |
| Mathematics – unweighted | 77.1 | 78.9 | -1.8 | -0.02 |
| Mathematics – weighted | 77.1 | 78.6 | -1.5 | -0.02 |
| Science − unweighted | 85.7 | 87.1 | -1.4 | -0.02 |
| Science − weighted | 85.7 | 86.9 | -1.2 | -0.01 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

Table 81 shows that the profile of the participating pupils in participating schools is similar to the overall sample of pupils in these schools in terms of the percentage who were female and the percentage who have English as their first language. There was a slightly lower percentage of pupils in the participating sample than the original sample who were eligible for SEN support and who were eligible for FSM for any period in the last 6 years. The non-response weighting adjustment does not change these numbers. The relative bias is 0.12 for SEN and 0.10 for FSM. That is unsurprising since pupils with SEN or eligible for FSM are over-represented in national absence statistics[77]. That slight bias would suggest the TIMSS performance data give a small over-estimate of whole

[77] Long, R. and Roberts, N. 2024. *School Attendance in England*. CBP-9710.pdf. Available at: commonslibrary.parliament.uk

population performance - likely more than counterbalanced by the under-representation of independent schools within the sample

Overall there is minimal potential for bias due to non-response.

**Table 81: Pupil characteristics in original sample in participating schools and participating pupils in participating schools**

| Pupil characteristics | Original (targeted) sample | Participating pupils | Bias | Relative bias |
|---|---|---|---|---|
| Female − unweighted | 48.6 | 48.7 | -0.1 | -0.00 |
| Female − weighted | 48.6 | 48.7 | -0.1 | -0.00 |
| Pupils eligible for SEN support − unweighted | 13.8 | 12.1 | 1.7 | 0.12 |
| Pupils eligible for SEN support − weighted | 13.8 | 12.1 | 1.7 | 0.12 |
| Pupils with English as their first language − unweighted | 80.3 | 79.7 | 0.6 | 0.01 |
| Pupils with English as their first language – weighted | 80.3 | 80.0 | 0.3 | 0.00 |
| Pupils who have been eligible for FSM for any period in the last 6 years − unweighted | 24.3 | 21.8 | 2.5 | 0.10 |
| Pupils who have been eligible for FSM for any period in the last 6 years − weighted | 24.3 | 21.8 | 2.5 | 0.10 |

Note 1: Bias is calculated as the difference between the estimates for the original sample and the sample of participating schools. Relative bias is calculated as the bias divided by the estimate from the original sample.
Note 2: Weighted estimates only applies to the participating schools and these estimates are weighted by the non-response adjustment factor element of the school weights.

That slight bias would suggest the TIMSS performance data give a small over-estimate of whole population performance. That is likely more than counterbalanced by the under-representation of independent schools within the sample: as noted, this bias analysis only compares data available in the National Pupil Database (‘matched data’). NPD data excludes that related to pupils at independent schools (and a small number of others, for various reasons). For both subjects, and in both year groups, attainment in the non-matched sample significantly exceeds that in the matched sample:

- For year 5 mathematics (average score 552), the matched sample average attainment was 547, with the non-matched sample significantly higher at 606.
- For year 9 mathematics (average score 525), the matched sample average attainment was 521, with the non-matched sample significantly higher at 551.
- For year 5 science (average score 556), the matched sample average attainment was 552, with the non-matched sample significantly higher at 606.
- For year 9 science (average score 531), the matched sample average attainment was 528, with the non-matched sample significantly higher at 555.

Overall, we conclude there is minimal potential for bias due to non-response.

# Appendix F: List of figures

# Appendix G: List of tables

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