# England

Dr. Tina Isaacs
Dr. Jennie Golding
Dr. Mary Richardson
*UCL Institute of Education*

## Introduction

### Overview of Education System

England's school system is directed centrally by the Department for Education (DfE). In 2023, there were 9.01 million students in 24,442 schools, 163 further education colleges, and 47 sixth form colleges.[1,2] Full-time education is compulsory from ages 5 to 16, after which young people are required to continue in full-time education, an apprenticeship or traineeship, or part-time education or training alongside paid or volunteer work through age 18.[3,4]

Most students move from primary to secondary school at age 11. State-funded schools include local authority–maintained schools, voluntary aided schools, academies, and free schools. All schools, state funded or independent, are required to provide a broad and balanced curriculum, and there are statutory requirements for particular subjects.

Exhibit 1 details the structure of education in England.

**Exhibit 1: Structure of School Education in England**

| Phase | Key Stage | Ages | School/College Structure | |
|---|---|---|---|---|
| Early Years | Early Years Foundation Stage | 0–5 | nursery schools, nursery classes in primary schools, children's centers, and registered child minders | |
| Primary | Key Stage 1 (Years 1–2) | 5–7 | infant school | commonly combined in a single primary school |
| | Key Stage 2 (Years 3–6) | 7–11 | junior school | |
| Secondary | Key Stage 3 (lower secondary Years 7–9) | 11–14 | secondary school (ages 11–18) | |
| | Key Stage 4 (upper secondary Years 10–11) | 14–16 | | |
| | Post-Sixteen (Years 12–13) | 16–18 | sixth form college (ages 16–18) | |
| | | | further education college (ages 16+, sometimes 14+) | |

Between 2014 and 2016, DfE introduced a new national curriculum. The curricula of academies and free schools are expected to be comparable in breadth and ambition to the national curriculum. Subjects are divided into programs of study for each key stage, which set out national performance expectations.

## Use and Impact of TIMSS

England has taken part in all TIMSS cycles, and results continue to demonstrate performance above the international average in mathematics, a significant improvement in scores at Year 5 mathematics between 2015 and 2019, improvement in Year 5 (international Grade 4) science, and, after a relatively stable performance, a decline in Year 9 (international Grade 8) science.

At the level of policy, findings from TIMSS (together with those from other international benchmark studies) have been used to identify high-performing and fast-improving countries that England may look to for ideas for improving policy and practice. Since 2010, DfE has reformed the mathematics curriculum and examinations system, moving toward a mastery approach that enables students to acquire a deep and long-term understanding of mathematics and the fluency to perform calculations. In 2013, DfE launched the Maths Hubs program, designed to improve the quality of mathematics instruction, and a network of 40 Maths Hubs now deliver the Teaching for Mastery program to help local schools across England improve the quality of their teaching based on best practice.

As in the case with mathematics, analysis in TIMSS and other international studies has informed science policy and practice, including the critique and development of appropriate aspects of the science curriculum programs of study for England. TIMSS has also been used to inform the development of national Key Stage 2 science sample tests by the Standards and Testing Agency. Additionally, the TIMSS report and questionnaires have been embedded into continuous professional development courses and materials developed for schools and science teachers by the National STEM Learning Centre and Network. These materials are available to help teachers make informed decisions about how to improve teaching and learning in mathematics and science.

TIMSS sample schools receive confidential feedback to support school and professional development. They are invited to a TIMSS schools' conference to discuss national results and share ideas for improvement. TIMSS findings (together with those from other international benchmark studies) have been used to identify priorities for improving policy and practice—for example, via the National Centre for Excellence in the Teaching of Mathematics (NCETM)[a] and the National STEM Learning Centre,[b] as described in the Special Initiatives in Mathematics and Science Education section.

a See https://www.ncetm.org.uk/ for more information.

b See https://www.stem.org.uk/ for more information.

# The Mathematics Curriculum in Primary and Lower Secondary Grades

Most students who participated in the TIMSS mathematics assessments had been taught under the national curriculum from September 2014, outlined below, since its inception.

The national curriculum for mathematics aims to ensure that all students become fluent in the fundamentals of mathematics, are able to reason mathematically, and can solve problems by applying mathematics. In addition, they should be able to communicate mathematical thinking effectively, make connections within mathematics, and apply their mathematical knowledge to science and other areas. The *National Curriculum in England: Mathematics Programmes of Study* document provides full details of the Years 5 and 9 curricula.[5]

## Fourth-Grade (Year 5) Mathematics Curriculum

The programs of study for mathematics are set out year by year for Key Stages 1 and 2. An indicative summary of the upper Key Stage 2 (Years 5 and 6) program follows. Each successive year subsumes the intended curriculum for previous years.

The principal focus of mathematics teaching in upper Key Stage 2 is to ensure that students extend their understanding of the number system, including place value. This objective supports students in developing connections across and between key operations with fractions, decimals, percentages, and ratios. By the end of Year 6, students should begin to extend their algebraic understanding of numbers to more formal algebra. Students develop their ability to solve a wider range of problems using increasingly complex properties of numbers and problems demanding efficient written and mental methods of calculation. Learning in geometry and measures consolidates and extends knowledge developed in numbers and ensures that students classify shapes with increasingly complex geometric properties. Students should also understand, read, spell, and pronounce mathematical vocabulary correctly.

Exhibit 2 lists the content areas and main curriculum elements for Grade 4 (Year 5).

**Exhibit 2: Indicative Summary Content—Mathematics Curriculum for Grade 4 (Year 5)**

| Content Area | Focus | Objectives |
|---|---|---|
| Number | number and place value | • read, write, order, and compare numbers to at least 1 million and determine the value of each digit<br>• count forward or backward in steps of powers of 10 for any given number up to 1 million<br>• interpret negative numbers in context, count forward and backward with positive and negative whole numbers, including through 0<br>• read Roman numerals to 1,000 (M) and recognize years written in Roman numerals |

**Exhibit 2: Indicative Summary Content—Mathematics Curriculum for Grade 4 (Year 5) (Continued)**

| Content Area | Focus | Objectives |
|---|---|---|
| Number | addition and subtraction | • add and subtract whole numbers with more than four digits, including using formal written methods (columnar addition and subtraction)<br>• add and subtract numbers mentally with increasingly large numbers<br>• use rounding to check answers to calculations and determine accuracy in the context of a problem<br>• solve multistep addition and subtraction problems in contexts, deciding which operations and methods to use and why |
| | multiplication and division | • identify multiples and factors, including finding all factor pairs of a number and common factors of two numbers<br>• solve problems involving multiplication and division, including using knowledge of factors and multiples, squares, and cubes<br>• solve problems involving addition, subtraction, multiplication, division, and a combination of these operations, including understanding the equal sign<br>• solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates |
| | fractions (including decimals and percentages) | • compare and order fractions whose denominators are all multiples of the same number<br>• identify, name, and write equivalent fractions to a given fraction, represented visually, including tenths and hundredths<br>• work with decimals to three places and begin to work with fraction, decimal, and percentage equivalences |
| Measurement | | • understand and use equivalences between metric and imperial units<br>• measure and calculate the perimeter of composite rectilinear shapes; work with simple areas and volumes, including estimations<br>• use all four operations to solve problems involving measure (for example, length, mass, volume, money) |

**Exhibit 2: Indicative Summary Content—Mathematics Curriculum for Grade 4 (Year 5) (Continued)**

| Content Area | Focus | Objectives |
|---|---|---|
| Geometry | properties of shapes | • identify three-dimensional shapes from two-dimensional representations<br>• know angles are measured in degrees; estimate and compare acute, obtuse, and reflex angles<br>• draw given angles and measure them in degrees<br>• begin to engage with two-dimensional geometrical reasoning around lengths and angles, and with two-dimensional reflections and translations |
| Statistics | | • solve comparison, sum, and difference problems using information presented in a line graph<br>• complete, read, and interpret information in tables, including timetables |

## Eighth-Grade (Year 9) Mathematics Curriculum

Grade 8 (Year 9) students taking TIMSS assessments will usually have met most of the Key Stage 3 mathematics program of study, which aims to ensure that all students

- become fluent in the fundamentals of mathematics, through varied and frequent practice with increasingly complex problems over time, so that students develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately;
- reason mathematically by following a line of inquiry; conjecturing relationships and generalizations; and developing an argument, justification, or proof using mathematical language; and
- can solve problems by applying mathematics to a variety of routine and nonroutine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

The curriculum is organized into distinct domains, and students build on learning achieved at Key Stage 2 and connections across mathematical ideas to develop fluency, mathematical reasoning, and competence in solving increasingly sophisticated problems with good written and mental arithmetic. The use of equipment such as calculators is recommended only as a supporting tool from near the end of Key Stage 2. Teachers and students use digital tools and materials for mathematics teaching and learning as teachers deem appropriate.

Exhibit 3 lists the content areas and main curriculum elements for Grade 8 (Year 9).

**Exhibit 3: Indicative Summary—Mathematics Curriculum for Grade 8 (Year 9)**

| Content Area | Objectives |
|---|---|
| Number | • understand and use place value for decimals, measures, and integers of any size<br>• order positive and negative integers, decimals, and fractions; use the number line as a model for ordering real numbers; use the symbols =, =/, <, >, ≤, and ≥<br>• use the four operations, including formal written methods, applied to positive and negative integers, decimals, proper and improper fractions, and mixed numbers<br>• use integer powers and associated real roots (square, cube, and higher); recognize powers of 2, 3, 4, and 5; and distinguish between exact representations of roots and their decimal approximations<br>• interpret and compare numbers in standard form $A \times 10^n$ for $1 \leq A < 10$, where $n$ is a positive or negative integer or 0<br>• work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 and $\frac{3}{8}$), with percentages, and with percentages and fractions as operators<br>• estimate and approximate answers appropriately<br>• appreciate the infinite nature of sets of integers, real numbers, and rational numbers |
| Algebra | • use and interpret algebraic notation<br>• substitute numerical values into formulas and expressions, including scientific formulas<br>• understand, manipulate, and use the concepts and vocabulary of expressions, equations, inequalities, terms, and factors<br>• reduce a given linear equation in two variables to the standard form y = mx + c; calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically, and algebraically<br>• find approximate solutions to contextual problems from given graphs of a variety of functions, including piecewise or simultaneous linear, quadratic, exponential, and reciprocal graphs<br>• recognize arithmetic and geometric sequences and appreciate other sequences that arise |
| Ratio, proportion, and rates of change | • change freely between related standard units (for example, time, length, area, volume/capacity, mass)<br>• use scale factors, scale diagrams, and maps<br>• express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1<br>• solve ratio and percent change, and direct and inverse proportion problems, making links across arithmetic, algebraic, and graphical representations<br>• use compound units such as speed, density, and unit pricing to solve problems |

**Exhibit 3: Indicative Summary—Mathematics Curriculum for Grade 8 (Year 9) (Continued)**

| Content Area | Objectives |
|---|---|
| Geometry and measures | • derive and apply formulas to calculate and solve problems involving perimeter and area of triangles, parallelograms, trapezoids, and circles, and volume of cuboids and other prisms<br>• work with standard geometric constructions and appropriate technologies to explore two-dimensional geometry<br>• apply standard angle properties, including in polygons and related to parallel lines, triangle congruence, similarity, and properties of quadrilaterals, to derive results about angles and sides, including the Pythagorean theorem, and use known results to obtain simple proofs<br>• use the Pythagorean theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles<br>• use the properties of faces, surfaces, edges, and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones, and spheres to solve problems involving three-dimensional shapes<br>• interpret mathematical relationships both algebraically and geometrically |
| Probability | • record, describe, and analyze the frequency of outcomes of simple probability experiments involving randomness, fairness, and equally and unequally likely outcomes, using appropriate language and the 0–1 probability scale<br>• understand that the sum of the probabilities of all possible outcomes equals 1<br>• generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes, and use them to calculate theoretical probabilities<br>• use and apply set notation and Venn diagrams |
| Statistics | • describe, interpret, and compare observed distributions of a single variable through appropriate graphical representation involving discrete, continuous, and grouped data, and appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)<br>• construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data<br>• describe simple mathematical relationships between two variables in observational and experimental contexts and illustrate using scatter graphs |

# The Science Curriculum in Primary and Lower Secondary Grades

In 2023, most students who participated in TIMSS science assessments had been taught under the national curriculum from September 2014, outlined below, since its inception.

The national curriculum for science aims to ensure that all students develop scientific knowledge and conceptual understanding of biology, chemistry, and physics, along with a comprehension of the uses and implications of science. Full details can be found in the *National Curriculum in England: Science Programmes of Study* document.[6]

## Fourth-Grade (Year 5) Science Curriculum

The program of study for science is set out year by year for Key Stages 1 and 2. The focus of the upper Key Stage 2 program of study is described here along with a summary of Year 5 curriculum content.

At upper Key Stage 2, students explore a wide range of scientific ideas and more systematically analyze functions, relationships, and interactions. They deal with abstract ideas and work toward understanding and predicting how the world operates, recognizing that scientific ideas can change over time. They select appropriate responses to scientific questions using different types of scientific inquiry, including observing, noticing patterns, grouping and classifying things, carrying out comparative and fair tests, and using a range of secondary sources. They draw conclusions based on data and observations, use evidence to justify ideas, and use scientific knowledge and understanding to explain findings. They also are expected to understand, read, spell, and pronounce an increasingly scientific vocabulary.

During Year 5, students expand their tools and approaches for working scientifically. They learn to use practical scientific methods, processes, and skills, including planning scientific inquiries, taking measurements using a range of equipment, recording data and results, using results to make predictions, testing those predictions fairly, reporting and presenting findings, and identifying scientific evidence that has been used to support or refute ideas or arguments.

Exhibit 4 lists content in Grade 4 (Year 5).

**Exhibit 4: Indicative Summary Content—Science Curriculum for Grade 4 (Year 5)**

| Content Area | Objectives |
|---|---|
| Living things and their habitats | • describe the differences in the life cycles of different animals<br>• describe the life process of reproduction |
| Animals, including humans | • describe the changes as humans develop to old age |
| Properties and changes of materials | • compare and group everyday materials based on their properties<br>• know that some materials dissolve in liquid to form a solution<br>• use knowledge of solids, liquids, and gases to separate mixtures<br>• demonstrate that dissolving, mixing, and changes of state are reversible<br>• explain that some changes result in the formation of new materials and are not usually reversible |

**Exhibit 4: Indicative Summary Content—Science Curriculum for Grade 4 (Year 5) (Continued)**

| Content Area | Objectives |
|---|---|
| Earth and space | • describe the movement of Earth, the Moon, and other planets<br>• describe the Sun, Earth, and the Moon as approximately spherical bodies<br>• use the idea of Earth's rotation to explain day and night |
| Forces | • identify effects of gravity, air/water resistance, and other friction<br>• recognize that some mechanisms, including pulleys, levers, and gears, can increase the effect of a force |

## Eighth-Grade (Year 9) Science Curriculum

The science program of study for Key Stage 3 students (to Grade 8/Year 9) focuses on developing a deeper understanding of a range of scientific ideas. Students learn about the "big ideas" underpinning scientific knowledge and understanding. They relate scientific explanations to phenomena in the world around them and use modeling and abstract ideas to develop and evaluate explanations.

Students refine their tools for and approaches to working scientifically. They learn that science includes working objectively, modifying explanations to account for new evidence and ideas, subjecting results to peer review, selecting appropriate types of scientific inquiry, and developing a deeper understanding of important factors in collecting, recording, and processing data. They evaluate their results and identify further questions arising from them. Students refine and use scientific nomenclature, vocabulary and units, and mathematical representations.

Working across biology, chemistry, and physics, students develop skills in the following areas:

- scientific attitudes
- experimentation and investigation
- analysis and evaluation
- measurement

Exhibit 5 lists a sample of the curriculum content in Grade 8 (Year 9).

**Exhibit 5: Indicative Summary Content—Science Curriculum for Grade 8 (Year 9)**

| Content Area | Focus | Elements |
|---|---|---|
| Biology | cells and organization | • plant and animal cells, including functions of cellular structures<br>• diffusion in and across cells<br>• structural adaptations of some unicellular organisms<br>• hierarchical organization of multicellular organisms |
| | the skeletal and muscular systems | • structure and function of the human skeleton<br>• biomechanics |
| | nutrition and digestion | • requirements in a healthy daily diet<br>• consequences of diet imbalances<br>• human digestive system<br>• how plants gain nutrients |
| | gas exchange systems | • structure and functions of the gas exchange system in humans<br>• mechanism of breathing<br>• impact of exercise, asthma, and smoking on the human gas exchange system<br>• role of leaf stomata in gas exchange in plants |
| | reproduction | • reproduction in humans and plants |
| | health | • effects of recreational drugs on behavior, health, and life processes |
| | photosynthesis | • reactants in, and products of, photosynthesis<br>• the dependence of almost all life on Earth on photosynthesis<br>• adaptations of leaves for photosynthesis |
| | cellular respiration | • aerobic and anaerobic respiration in living organisms<br>• process of anaerobic respiration in humans and microorganisms |
| | relationships in an ecosystem | • interdependence of organisms in an ecosystem<br>• importance of plant reproduction in human food security<br>• how organisms affect, and are affected by, their environment |
| | **Inheritance, Chromosomes, DNA, and Genes** | |
| | heredity | • a simple model of chromosomes, genes, and DNA<br>• differences between species<br>• natural selection<br>• the importance of biodiversity |

**Exhibit 5: Indicative Summary Content—Science Curriculum for Grade 8 (Year 9) (Continued)**

| Content Area | Focus | Elements |
|---|---|---|
| Chemistry | particulate nature of matter | • properties of the states of matter<br>• changes of state in terms of the particle model |
| | atoms, elements, and compounds | • a simple (Dalton) atomic model<br>• differences between atoms, elements, and compounds<br>• chemical symbols and formulas<br>• conservation of mass, changes of state, and chemical reactions |
| | pure and impure substances | • pure substances and mixtures, including dissolving<br>• diffusion in terms of the particle model<br>• simple techniques for separating mixtures |
| | chemical reactions | • chemical reactions as rearrangement of atoms<br>• representing chemical reactions using formulas and equations<br>• combustion, thermal decomposition, oxidation, and displacement reactions<br>• acids and alkalis<br>• the pH scale<br>• reactions of acids with metals and alkalis<br>• catalysts |
| | energetics | • energy changes on changes of state<br>• exothermic and endothermic chemical reactions |
| | the periodic table | • physical and chemical properties of different elements, including metals and nonmetals<br>• principles of the periodic table<br>• how patterns in reactions can be predicted with reference to the periodic table<br>• chemical properties of metal and nonmetal oxides |
| | materials | • order of metals and carbon in the reactivity series<br>• use of carbon in obtaining metals from metal oxides<br>• properties of ceramics, polymers, and composites |
| | Earth and atmosphere | • composition and structure of Earth<br>• rock cycle and the formation of rocks<br>• Earth as a source of limited resources<br>• composition of the atmosphere<br>• production of carbon dioxide by human activity and impact on climate |

**Exhibit 5: Indicative Summary Content—Science Curriculum for Grade 8 (Year 9) (Continued)**

| Content Area | Focus | Elements |
|---|---|---|
| Physics | **Energy** | |
| | calculation of fuel uses and costs in the domestic context | • comparing energy values of different foods<br>• comparing power ratings of appliances<br>• domestic fuel use and costs<br>• fuels and energy resources |
| | energy changes and transfers | • simple machines<br>• heating and thermal equilibrium<br>• other processes involving energy transfer |
| | changes in systems | • energy as a quantity that can be measured and calculated<br>• increases and decreases in energy associated with changes in systems |
| | **Motion and Forces** | |
| | describing motion | • relationship between speed, distance, and time<br>• relative motion |
| | forces | • using force arrows in diagrams<br>• turning effect of a force<br>• forces associated with deforming objects, springs, friction, pushing, resistance to motion of air, and water<br>• measurements of force<br>• force-extension linear relation; Hooke's Law<br>• work done and energy changes on deformation<br>• noncontact forces including gravity, magnets, and static electricity |
| | pressure in fluids | • pressure in liquids and atmospheric pressure<br>• pressure measured by ratio of force to area |
| | balanced forces | • opposing forces and equilibrium |
| | forces and motion | • forces needed to stop or start objects moving, or change speed or direction<br>• change depending on direction of force and its size |
| | **Waves** | |
| | observed waves | • waves on water as undulations that travel with transverse motion |
| | sound waves | • frequency, echoes, reflection, and absorption of sound<br>• speed of sound through different mediums<br>• sound production by vibration<br>• auditory range of humans and animals |
| | energy and waves | • pressure waves transferring energy |

**Exhibit 5: Indicative Summary Content—Science Curriculum for Grade 8 (Year 9) (Continued)**

| Content Area | Focus | Elements |
|---|---|---|
| Physics | light waves | • speed of light<br>• transmission of light through materials<br>• ray model of light<br>• light transferring energy<br>• color and light frequencies |
| | **Electricity and Electromagnetism** | |
| | current electricity | • electric current<br>• potential difference<br>• differences in resistance between conducting and insulating components |
| | static electricity | • separation of positive or negative charges when objects are rubbed together<br>• electric fields |
| | magnetism | • magnetic poles and fields, attraction and repulsion<br>• Earth's magnetism, compass, and navigation<br>• magnetic effect of a current, electromagnets, DC motors |
| | **Matter** | |
| | physical changes | • conservation of material and mass, and reversibility, in changes of state and dissolving<br>• similarities and differences between solids, liquids, and gases<br>• Brownian motion in gases<br>• diffusion in liquids and gases |
| | difference between chemical and physical changes—particle model | • the differences in arrangements of particles explaining changes of state, shape, and density<br>• atoms and molecules as particles |
| | energy in matter | • changes with temperature in motion and spacing of particles<br>• internal energy |
| | space physics | • gravity force, weight on Earth and other planets, gravity forces between Earth, the Sun, and the Moon<br>• the Sun as a star, other stars and galaxies<br>• seasons, day length<br>• light years |

## Teacher Professional Development Requirements and Programs

In 2022, there were 468,371 full-time equivalent teachers in state-funded schools in England.[7] Ninety-seven percent hold qualifications at degree level or higher. Following training, teachers become early career teachers (ECTs)[8] with qualified teacher status. In-school mentors support them; their development is assessed against a set of national standards during a statutory 2-year induction with reduced teaching commitments. There is no statutory requirement for annual continuous professional development (PD) or entitlement to subject-specific PD. However, the 2016 *Standard for Teachers' Professional Development* provides nonstatutory guidance on effective PD.[9]

Most primary teachers teach across the curriculum. Specialist teaching is employed as students progress through secondary school, although mathematics and physics, especially at Key Stage 3, are sometimes taught by nonspecialists. Recent reports confirm the importance of PD in mathematics, science, and computing.[10]

Within mathematics and science, DfE provides funding to organizations to offer subject-specific PD that equip teachers with specialist knowledge. For example, DfE funds a network of Science Learning Partnership schools, a Stimulating Physics Network, and the Subject Knowledge for Physics Teaching program. Such programs support the quality of teaching of science, technology, engineering, and mathematics (STEM) subjects across all key stages and aim to increase participation in STEM subjects for all students, including those from underrepresented groups.

Centrally funded PD is complemented by a range of opportunities available from professional associations and learned societies, local authorities, and independent education consultants. Universities also offer subject-specific short courses and accredited programs with or without a subject-specific focus (for example, for a master's degree or doctorate in education). Funding for such provision and any related release from teaching is at the employing school's discretion and competes with other budgetary priorities.

## Monitoring Student Progress in Mathematics and Science

Statutory national assessments take place at Key Stages 1 and 2. Key Stage 1 includes phonics screening (kindergarten/Year 1). Optional tests and teacher assessments in reading, writing, mathematics, and science are available at the end of Key Stage 1 (Grade 1/Year 2).

Grade 5 (Year 6) includes externally set and marked tests in English reading; grammar, punctuation, and spelling; and mathematics. Mathematics comprises two reasoning papers and one arithmetic paper. Teachers assess writing in English. Results are published at the school level and determine national attainment measures for primary schools. They are also published at the national and local authority level. A Multiplication Tables Check (MTC) was made statutory in the 2021–2022 academic year for students in Grade 3 (Year 4); results are published at the national and local authority level. The Reception Baseline Assessment (RBA), an activity-based assessment of language, communication, literacy, and mathematics for 5-year-olds, became

statutory in 2021 to provide the starting point for the primary progress measure. RBA data are not published. Students in Key Stage 3 are internally assessed only.

Most students age 16 take General Certification of Secondary Education (GCSE) examinations. Examinations are externally administered and graded by examination boards. GCSEs in mathematics and science are 100% externally assessed through timed written papers. Science students complete mandatory practical examinations that do not contribute to their grade, although examinations include related questions.

GCSEs are graded on a scale of 9 to 1, where 5 is considered a "strong pass" and 4 a "standard pass." On average, students take eight GCSEs.[11] The English Baccalaureate recognizes achievement of standard passes in English, mathematics, sciences, languages, and humanities. A school accountability measure (Progress 8) shows students' progress from Year 6 across English, mathematics, three other English Baccalaureate subjects, and three additional subjects. There is no national curriculum for students over 16, but those who have not attained a grade of 4+ in English or mathematics must continue to study that subject.

## Special Initiatives in Mathematics and Science Education

In academic years 2023–2024 and 2024–2025, eligible chemistry, computing, mathematics, and physics teachers in the first 5 years of their careers can apply for leveling up premium payments of £1500 to £3000.[12] Trainee mathematics and science teachers receive up to £29,000 during training.[13,14]

DfE funds high-quality continuing PD and leadership education for mathematics and science teachers. Of particular note is the large-scale mathematics Teaching for Mastery program, which focuses on depth of understanding and is characterized by whole-class teaching based on best practice from East Asia. This teaching style moves away from generic and superficial understanding and focuses instead on a method that enables students to acquire a deep and long-term understanding of mathematics and the fluency to problem solve. DfE intends to support the Maths Hubs' Teaching for Mastery program to reach 75% of primary schools and 65% of secondary schools by 2025.

Support for mathematics and science teachers in delivering the national curriculum is primarily provided by DfE-funded programs, including NCETM, the National STEM Learning Centre, and locally led science PD courses. The first operates the network of school-based Maths Hubs and forums to offer a targeted range of mathematics-specific, funded development opportunities and materials across early years/primary/secondary/postcompulsory education. These opportunities are often carried out through professional work groups and focus on nationally and locally identified priorities and especially developing practices aligned with approaches used in high-performing jurisdictions. The National STEM Learning Centre also operates an online bank of resources for science and technology teaching and learning for ages 3 to 18 and runs well-funded continuous PD[15] courses.

These and other smaller-scale initiatives target improved quality in teaching and student attainment and enhanced participation in science and mathematics qualifications and pathways at all levels. There is particular emphasis on participation by girls where gender imbalance is an issue and by students in historically disadvantaged schools or areas.

## Suggested Reading

Department for Education. (2019). *Attitudes to STEM subjects by gender at key stage 4*. Retrieved from https://www.gov.uk/government/publications/attitudes-to-stem-subjects-by-gender-at-key-stage-4

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