

1. Introduction

1.1 On 20 January 2011 the Secretary of State for Education, the Rt. Hon. Michael Gove MP, confirmed the Government's intention to review the National Curriculum in England.

1.2 This document sets out, for the purposes of public consultation, a revised framework for the National Curriculum that is the product of that review. This framework includes:

- contextual information about both the overall school curriculum and the statutory National Curriculum, including the statutory basis of the latter
- proposed aims for the statutory National Curriculum
- proposed statements on inclusion, and on the development of pupils' competence in language, literacy, and numeracy across the school curriculum
- revised programmes of study for all the National Curriculum subjects other than for Key Stage 4 English, mathematics and science. These are being published separately for information at www.education.gov.uk/nationalcurriculum, but formal consultation will follow once further details about the planned new Key Stage 4 qualifications in these subjects are available.

1.3 The consultation document that accompanies this framework asks a number of questions about the content and implementation of the National Curriculum. The deadline for responses to the consultation is 16 April 2013.

1.4 Subject to Ministers' final decisions, and to the approval of Parliament, it is the Government's intention that the final version of this framework will be published in the autumn of 2013, and that the elements that require statutory force will come into effect from September 2014.

2. The school curriculum in England

2.1 Every state-funded school must offer a curriculum which is balanced and broadly based¹ and which:

- promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society, and
- prepares pupils at the school for the opportunities, responsibilities and experiences of later life.

All state schools are also required to make provision for a daily act of collective worship and must teach religious education to pupils at every key stage and sex education to pupils in secondary education.

2.2 Maintained schools in England are legally required to follow the statutory National Curriculum which sets out in programmes of study, on the basis of key stages, subject content for core and other foundation subjects that should be taught to all pupils. All schools must publish their school curriculum by subject and academic year online.²

2.3 All schools should make provision for personal, social, health and economic education (PSHE), drawing on good practice. Schools are also free to include other subjects or topics of their choice in planning and designing their own programme of education.

¹ See Section 78 of the 2002 Education Act: <http://www.legislation.gov.uk/ukpga/2002/32/section/78> which applies to all maintained schools. Academies are also required to offer a broad and balanced curriculum in accordance with Section 1 of the 2010 Academies Act: <http://www.legislation.gov.uk/ukpga/2010/32/section/1>

² From September 2012, all schools are required to publish information in relation to each academic year, relating to the content of the school's curriculum for each subject and details about how additional information relating to the curriculum may be obtained: <http://www.legislation.gov.uk/uksl/2012/1124/made>.

3. The National Curriculum in England

Aims

- 3.1 The National Curriculum provides pupils with an introduction to the core knowledge that they need to be educated citizens. It introduces pupils to the best that has been thought and said; and helps engender an appreciation of human creativity and achievement.
- 3.2 The National Curriculum is just one element in the education of every child. There is time and space in the school day and in each week, term and year to range beyond the National Curriculum specifications. The National Curriculum provides an outline of core knowledge around which teachers can develop exciting and stimulating lessons.

Structure

- 3.3 Pupils of compulsory school age in community and foundation schools, including community special schools and foundation special schools, and in voluntary aided and voluntary controlled schools must follow the National Curriculum. It is organised on the basis of four key stages³ and twelve subjects, classified in legal terms as 'core' and 'other foundation' subjects.
- 3.4 The Secretary of State for Education is required by legislation to publish programmes of study for each National Curriculum subject, setting out the 'matters, skills and processes' to be taught at each key stage. Schools are free to choose how they organise their school day, as long as the content of National Curriculum programmes of study is taught to all pupils.

³ The Key Stage 2 programmes of study for English, mathematics and science are presented in this document as 'lower' (Years 3 and 4) and 'upper' (Years 5 and 6). This distinction is made as guidance for teachers and is not reflected in legislation. The legal requirement is to cover the content of the programmes of study for Years 3 to 6 by the end of Key Stage 2.

3.5 The proposed structure of the new National Curriculum, in terms of which subjects are compulsory at each key stage, is set out in the table below:

	Key Stage 1	Key Stage 2	Key Stage 3	Key Stage 4
Age	5 – 7	7 – 11	11 – 14	14 – 16
Year groups	1 – 2	3 – 6	7 – 9	10 – 11
Core subjects				
English	✓	✓	✓	✓
Mathematics	✓	✓	✓	✓
Science	✓	✓	✓	✓
Other foundation subjects				
Art and design	✓	✓	✓	
Citizenship			✓	✓
Computing ⁴	✓	✓	✓	✓
Design and technology	✓	✓	✓	
Foreign languages / modern foreign languages ⁵		✓	✓	
Geography	✓	✓	✓	
History	✓	✓	✓	
Music	✓	✓	✓	
Physical education	✓	✓	✓	✓

Figure 1 Proposed structure of the new National Curriculum

Key Stage 4 entitlement areas

3.6 The arts (comprising art and design, music, dance, drama and media arts), design and technology, the humanities (comprising geography and history) and modern foreign languages are not compulsory National Curriculum subjects after the age of 14, but all pupils have a statutory entitlement to be able to study a subject in each of those four areas.

⁴ Subject to the outcome of consultation on changing the subject from 'information and communication technology' to 'computing'.

⁵ At Key Stage 2 the subject title is 'foreign languages'; at Key Stage 3 it is 'modern foreign languages'.

3.7 The statutory requirements of the entitlement areas are:

- schools must provide access to a minimum of one course in each of the four entitlement areas
- schools must provide the opportunity for pupils to take a course in all four areas, should they wish to do so
- a course that meets the entitlement requirements must give pupils the opportunity to obtain an approved qualification.

4. Inclusion

Setting suitable challenges

4.1 Teachers should set high expectations for every pupil. They should plan stretching work for pupils whose attainment is significantly above the expected standard. They have an even greater obligation to plan lessons for pupils who have low levels of prior attainment or come from disadvantaged backgrounds. Teachers should use appropriate assessment to set targets which are deliberately ambitious.

Responding to pupils' needs and overcoming potential barriers for individuals and groups of pupils

4.2 Teachers should take account of their duties under equal opportunities legislation that covers disability, ethnicity, gender, sexual identity, gender identity, and religion or belief.

4.3 A wide range of pupils have special educational needs, many of whom also have disabilities. Lessons should be planned to ensure that there are no barriers to every pupil achieving. In many cases, such planning will mean that these pupils will be able to study the full National Curriculum. The SEN Code of Practice will include advice on approaches to identification of need which can support this. A minority of pupils will need access to specialist equipment and different approaches. The SEN Code of Practice will outline what needs to be done for them.

4.4 Many disabled pupils have little need for additional resources beyond the aids which they use as part of their daily life. Teachers must plan lessons so that these pupils can study every National Curriculum subject. Potential areas of difficulty should be identified and addressed at the outset of work.

4.5 Teachers must also take account of the needs of pupils whose first language is not English. Monitoring of progress should take account of the pupil's age, length of time in this country, previous educational experience and ability in other languages.

4.6 The ability of pupils for whom English is an additional language to take part in the National Curriculum may be in advance of their communication skills in English. Teachers should plan teaching opportunities to help pupils develop their English and should aim to provide the support pupils need to take part in all subjects.

5. Language, literacy and numeracy

5.1 Teachers should develop pupils' spoken language, reading and writing as integral aspects of the teaching of every subject. Fluency in the English language is an essential foundation for success in all subjects.

5.2 Teachers should also use every relevant subject to develop pupils' mathematical fluency. Confidence in numeracy and other mathematical skills is a precondition of success across the National Curriculum.

Spoken language

5.3 Pupils should be taught to speak clearly and convey ideas confidently using Standard English. They should learn to justify ideas with reasons; ask questions to check understanding; develop vocabulary and build knowledge; negotiate; evaluate and build on the ideas of others; and select the appropriate register for effective communication. They should be taught to give well-structured descriptions and explanations and develop their understanding through speculating, hypothesising and exploring ideas. This will enable them to clarify their thinking as well as organise their ideas for writing.

Reading and writing

5.4 Teachers should develop pupils' reading and writing in all subjects to support their acquisition of knowledge. Pupils should be taught to read fluently, understand extended prose, both fiction and non-fiction, and be encouraged to read for pleasure. Schools should do everything to promote wider reading. They should provide library facilities and set ambitious expectations for reading at home. Pupils should develop the stamina and skills to write at length, with accurate spelling and punctuation. They should be taught the correct use of grammar. They should build on what they have been taught to expand the range of their writing and the variety of the grammar they use. The writing they do should include narratives, explanations, descriptions, comparisons, summaries and evaluations: such writing supports them in rehearsing, understanding and consolidating what they have heard or read.

Numeracy and mathematics

5.5 Teachers should develop pupils' numeracy in all subjects so that they understand and appreciate the importance of mathematics. Pupils should be taught to apply arithmetic fluently to problems, understand and use measures, estimate when using calculators and other technologies to produce results, and then interpret them appropriately. Pupils should apply their geometric and algebraic understanding, and relate their understanding of probability to the notions of risk and uncertainty. They should also understand the cyclical process of collecting, presenting and analysing data. They should be taught to apply their mathematics to both routine and non-routine problems, including breaking down more complex problems into a series of simpler steps.

Mathematics

Introduction

Purpose of study

Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary in most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, and a sense of enjoyment and curiosity about the subject.

Aims

The National Curriculum for mathematics aims to ensure that all pupils:

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

The programmes of study are organised in a distinct sequence and structured into separate domains. Pupils should make connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge to science and other subjects.

Information and communication technology (ICT)

Calculators should not be used as a substitute for good written and mental arithmetic. They should therefore only be introduced near the end of Key Stage 2 to support pupils' conceptual understanding and exploration of more complex number problems, if written and mental arithmetic are secure. In both primary and secondary schools, teachers should use their judgement about when ICT tools should be used.

Spoken language

The National Curriculum for mathematics reflects the importance of spoken language in pupils' development across the whole curriculum – cognitively, socially and linguistically. The quality and variety of language that pupils hear and speak are key factors in developing their mathematical vocabulary and presenting a mathematical justification, argument or proof. They must be assisted in making their thinking clear to themselves as well as others and teachers should ensure that pupils build secure foundations by using discussion to probe and remedy their misconceptions.

School curriculum

The programmes of study for mathematics are set out year-by-year for Key Stages 1 and 2. Schools are, however, only required to teach the relevant programme of study by the end of the key stage. Within each key stage, schools therefore have the flexibility to introduce content earlier or later than set out in the programme of study. In addition, schools can introduce key stage content during an earlier key stage, if appropriate. All schools are also required to set out their school curriculum for mathematics on a year-by-year basis and make this information available online.

Attainment targets

By the end of each key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the relevant programme of study.

Key Stage 1

The principal focus of mathematics teaching in Key Stage 1 is to ensure that pupils develop confidence and mental fluency with whole numbers, counting and place value. This should involve working with numerals, words and the four operations, including with practical resources (e.g. concrete objects and measuring tools).

At this stage, pupils should develop their ability to recognise, describe, draw, compare and sort different shapes and use the related vocabulary. Teaching should also involve using a range of measures to describe and compare different quantities such as length, mass, capacity/volume, time and money.

By the end of Year 2, pupils should know the number bonds to 20 and be precise in using and understanding place value. An emphasis on practice at this early stage will aid fluency.

Pupils should read and spell mathematical vocabulary, at a level consistent with their increasing word reading and spelling knowledge at Key Stage 1.

Year 1

Year 1 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>Number and place value</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number <i>(From Year 2)</i> ▪ count, read and write numbers to 100 in numerals, count in different multiples including ones, twos, fives and tens <i>(From Year 2)</i> ▪ given a number, identify one more and one less ▪ identify and represent numbers using concrete objects and pictorial representations including the number line, and use the language of: equal to, more than, less than (fewer), most, least ▪ read and write numbers from 1 to 20 in digits and words. 	<p>Number and place value</p> <p>Pupils should practise counting (1, 2, 3), ordering (e.g. first, second, third), or to indicate a quantity (e.g. 3 apples, 2 centimetres), including solving simple concrete problems, until they are fluent.</p> <p>They should practise counting as reciting numbers and counting as enumerating objects, and counting in ones, twos, fives and tens from different multiples to develop their recognition of patterns in the number system (e.g. odd and even numbers). They connect these patterns with objects and with shapes, including through varied and frequent practice of increasingly complex questions.</p> <p>Pupils begin to recognise place value in numbers beyond 20 by reading, writing, counting and comparing numbers up to 100, supported by concrete objects and pictorial representations.</p>
<p>Addition and subtraction</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs ▪ represent and use number bonds and related subtraction 	<p>Addition and subtraction</p> <p>Pupils should memorise and reason with number bonds to 10 and 20 in several forms (e.g. $9 + 7 = 16$; $16 - 7 = 9$; $7 = 16 - 9$). They should realise the effect of adding or subtracting zero.</p> <p>Pupils should combine and increase numbers, counting forwards</p>

Year 1 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>facts within 20 (<i>From Year 2</i>)</p> <ul style="list-style-type: none"> ▪ add and subtract one-digit and two-digit numbers to 20 (9 + 9, 18 - 9), including zero ▪ solve simple one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems. 	<p>and backwards.</p> <p>They should discuss and solve problems in familiar practical contexts, including using quantities. Problems should include the terms put together, add, altogether, total, take away, distance between, more than and less than so that pupils develop the concept of addition and subtraction and are enabled to use these operations flexibly.</p>
<p>Multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve simple one-step problems involving multiplication and division, calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher. (<i>From Year 2</i>) 	<p>Multiplication and division</p> <p>Through grouping and sharing small quantities, pupils should begin to understand multiplication and division; doubling numbers and quantities, and finding simple fractions of objects, numbers and quantities.</p> <p>They should make connections between arrays, number patterns, and counting in twos, fives and tens.</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise, find and name a half as one of two equal parts of an object, shape or quantity ▪ recognise, find and name a quarter as one of four equal 	<p>Fractions</p> <p>Pupils should be taught $\frac{1}{2}$ and $\frac{1}{4}$ as operators on discrete and continuous quantities by solving problems using shapes, objects and quantities. For example, they could recognise and find half a length, quantity, set of objects or shape. Pupils connect halves and quarters to the equal sharing and grouping of sets of objects and to</p>

Year 1 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>parts of an object, shape or quantity.</p>	<p>measures, as well as recognising and combining halves and quarters as parts of a whole.</p>
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ compare, describe and solve practical problems for: <ul style="list-style-type: none"> ▪ lengths and heights (e.g. long/short, longer/shorter, tall/short, double/half) ▪ mass or weight (e.g. heavy/light, heavier than, lighter than) ▪ capacity/volume (full/empty, more than, less than, quarter) ▪ time (quicker, slower, earlier, later) ▪ measure and begin to record the following: <ul style="list-style-type: none"> ▪ lengths and heights ▪ mass/weight ▪ capacity and volume ▪ time (hours, minutes, seconds) ▪ recognise and know the value of different denominations of coins and notes ▪ sequence events in chronological order using language such as: before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening 	<p>Measures</p> <p>The terms mass and weight, volume and capacity are used interchangeably at this stage</p> <p>Pupils should move from using and comparing different types of quantities and measures using non-standard units, including discrete (e.g. counting) and continuous (e.g. liquid) measures, to using manageable common standard units. They should understand the difference between non-standard and standard units.</p> <p>In order to become familiar with standard measures, pupils begin to use measuring tools such as a ruler, weighing scales and containers.</p> <p>Pupils should use the language of time, including telling the time throughout the day, first using o'clock and then half past.</p>

Year 1 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<ul style="list-style-type: none"> ▪ recognise and use language relating to dates, including days of the week, weeks, months and years ▪ tell the time to the hour and half past the hour and draw the hands on a clock face to show these times. 	
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise and name common 2-D and 3-D shapes, including: <ul style="list-style-type: none"> ▪ 2-D shapes (e.g. rectangles (including squares), circles and triangles) ▪ 3-D shapes (e.g. cuboids (including cubes), pyramids and spheres). 	<p>Geometry: properties of shapes</p> <p>Pupils should handle common 2-D and 3-D shapes, naming these and related everyday objects fluently. They should recognise these shapes in different orientations and sizes, and know that rectangles, triangles, cuboids and pyramids can be different shapes.</p>

Year 1 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p data-bbox="138 264 674 297">Geometry: position, direction, motion</p> <p data-bbox="138 358 495 391">Pupils should be taught to:</p> <ul data-bbox="180 431 1020 594" style="list-style-type: none"> <li data-bbox="180 431 1020 505">▪ order and arrange combinations of objects and shapes in patterns <li data-bbox="180 516 1020 594">▪ describe position, directions and movements, including half, quarter and three-quarter turns. (<i>From Year 2</i>) 	<p data-bbox="1056 264 1598 297">Geometry: position, direction, motion</p> <p data-bbox="1056 358 1875 391">Pupils should create, copy, describe and reorganise patterns.</p> <p data-bbox="1056 431 1927 586">They should use the language of position, direction and motion, including: left and right, top, middle and bottom, on top of, in front of, above, between, around, near, close and far, up and down, forwards and backwards, inside and outside.</p> <p data-bbox="1056 626 1902 740">Pupils should make turns to show they understand half, quarter and three-quarter turns and routinely make these turns in a clockwise direction.</p>

Year 2

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>Number and place value</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ count in steps of 2, 3, and 5 from 0, and count in tens from any number, forward or backward (<i>From Year 3</i>) ▪ recognise the place value of each digit in a two-digit number (tens, ones) ▪ identify, represent and estimate numbers using different representations, including the number line ▪ compare and order numbers from 0 up to 100; use <, > and = signs ▪ read and write numbers to at least 100 in numerals and in words ▪ use place value and number facts to solve problems. 	<p>Number and place value</p> <p>Using materials and a range of representations, pupils should practise counting, reading, writing and comparing numbers to at least 100 and solving a variety of related problems to develop fluency. They should count in multiples of three to support their later understanding of a third.</p> <p>As they become more confident with numbers up to 100, pupils should be introduced to larger numbers to develop further their recognition of patterns within the number system and represent them in different ways, including spatial representations.</p> <p>Pupils should partition numbers in different ways (e.g. $23 = 20 + 3$ and $23 = 10 + 13$) to support subtraction. They become fluent and apply their knowledge of numbers to reason with, discuss and solve problems that emphasise the value of each digit in two-digit numbers. They begin to understand zero as a place holder.</p>
<p>Addition and subtraction</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve simple one-step problems with addition and subtraction: 	<p>Addition and subtraction</p> <p>Pupils should extend their understanding of the language of addition and subtraction to include sum and difference.</p> <p>Pupils should practise addition and subtraction to 20 to become</p>

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<ul style="list-style-type: none"> ▪ using concrete objects and pictorial representations, including those involving numbers, quantities and measures ▪ applying their increasing knowledge of mental and written methods ▪ recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100 ▪ add and subtract numbers using concrete objects, pictorial representations, and mentally, including: <ul style="list-style-type: none"> ▪ a two-digit number and ones ▪ a two-digit number and tens ▪ two two-digit numbers ▪ adding three one-digit numbers ▪ show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot ▪ recognise and use the inverse relationship between addition and subtraction and use this to check calculations and missing number problems. 	<p>increasingly fluent in deriving facts such as using $3 + 7 = 10$, $10 - 7 = 3$ and $7 = 10 - 3$ to calculate $30 + 70 = 100$, $100 - 70 = 30$ and $70 = 100 - 30$. They should check their calculations, including by adding to check subtraction and adding numbers in a different order to check addition (e.g. $5 + 2 + 1 = 1 + 5 + 2 = 1 + 2 + 5$).</p> <p>Recording addition and subtraction in columns supports place value and prepares for efficient written methods with larger numbers.</p>
<p>Multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and 	<p>Multiplication and division</p> <p>Pupils should use a variety of language to describe multiplication and division. They are taught multiplication and division with larger numbers through equal grouping and sharing out quantities, relating multiplication tables to arrays and repeated addition and</p>

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>even numbers</p> <ul style="list-style-type: none"> ▪ calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (\times), division (\div) and equals ($=$) signs ▪ recognise and use the inverse relationship between multiplication and division in calculations ▪ show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot ▪ solve one-step problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts. 	<p>finding more complex fractions of objects, numbers and quantities.</p> <p>Pupils should be introduced to the multiplication tables. They should practise to become fluent in the 2, 5 and 10 multiplication tables and connect them to each other. They connect the 10 multiplication table to place value, and the 5 multiplication table to the divisions on the clock face. They begin to use other multiplication tables and recall multiplication facts, including using related division facts to perform written and mental calculations.</p> <p>Pupils should work with a range of materials and contexts in which multiplication and division relate to grouping and sharing discrete and continuous quantities, relating these to fractions and measures (e.g. $40 \div 2 = 20$, 20 is a half of 40). They use commutativity and inverse relations to develop multiplicative reasoning (e.g. $4 \times 5 = 20$ and $20 \div 5 = 4$).</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise, find, name and write fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{4}$ and $\frac{3}{4}$ of a length, shape, set of objects or quantity (<i>From Year 3</i>) ▪ write simple fractions e.g. $\frac{1}{2}$ of 6 = 3 and recognise the equivalence of two quarters and one half. 	<p>Fractions</p> <p>Pupils should use additional fractions as operators on discrete and continuous quantities by solving problems using shapes, objects and quantities. They connect unit fractions to equal sharing and grouping, to numbers when they can be calculated, and to measures, finding fractions of lengths, quantity, a set of objects or shapes. They meet $\frac{3}{4}$ as the first example of a non-unit fraction.</p> <p>Pupils should count in fractions up to 10, starting from any number and using the $\frac{1}{2}$ and $\frac{2}{4}$ equivalence on the number line (e.g. $1\frac{1}{4}$,</p>

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
	$1\frac{2}{4}$, (or $1\frac{1}{2}$), $1\frac{3}{4}$, 2). This reinforces the concept of fractions as numbers and that they can add up to more than one.
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature (°C); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels <i>(From Year 3)</i> ▪ compare and order lengths, mass, volume/capacity and record the results using >, < and = ▪ read relevant scales to the nearest numbered unit ▪ recognise and use symbols for pounds (£) and pence (p); combine amounts to make a particular value and match different combinations of coins to equal the same amounts of money; add and subtract money of the same unit, including giving change ▪ solve simple problems in a practical context involving addition and subtraction of money ▪ compare and sequence intervals of time ▪ tell and write the time to five minutes, including quarter past/to the hour and draw the hands on a clock face to show these times. <i>(From Year 3)</i> 	<p>Measures</p> <p>Pupils should use standard units of measurement with increasing accuracy, using their knowledge of the number system. They should use the appropriate language and record using standard abbreviations.</p> <p>They should become fluent in telling the time on analogue clocks and recording it.</p> <p>Pupils should also become fluent in counting and recognising coins. They should use the symbols £ and p accurately and say the amounts of money confidently.</p>

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ identify and describe the properties of 2-D shapes, including the number of sides and symmetry in a vertical line ▪ identify and describe the properties of 3-D shapes, including the number of edges, vertices and faces ▪ identify 2-D shapes on the surface of 3-D shapes, for example a circle on a cylinder and a triangle on a pyramid ▪ compare and sort common 2-D and 3-D shapes and everyday objects. 	<p>Geometry: properties of shapes</p> <p>Pupils should handle and name a wider variety of common 2-D and 3-D shapes including: quadrilaterals and cuboids, prisms, cones and polygons, and identify the properties of each shape (e.g. number of sides, number of faces). Pupils identify, compare and sort shapes on the basis of their properties and use vocabulary precisely, such as sides, edges, vertices and faces.</p> <p>Pupils should read and write names for shapes that are appropriate for their word reading and spelling.</p> <p>Pupils should draw lines and shapes using a straight edge.</p>
<p>Geometry: position, direction, motion</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ order and arrange combinations of mathematical objects in patterns ▪ use mathematical vocabulary to describe position, direction and movement, including distinguishing between rotation as a turn and in terms of right angles for quarter, half and three-quarter turns (clockwise and anti-clockwise), and movement in a straight line. 	<p>Geometry: position, direction, motion</p> <p>Pupils should work with patterns of shapes, including those in different orientations.</p> <p>Pupils should use the concept and language of angles to describe 'turn' by applying rotations, including in practical contexts (e.g. pupils themselves moving in turns, giving instructions to other pupils to do so, and programming robots using instructions given in right angles).</p>

Year 2 programme of study (statutory requirements)	Notes and Guidance (non-statutory)
<p>Data</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ interpret and construct simple pictograms, tally charts, block diagrams and simple tables ▪ ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity ▪ ask and answer questions about totalling and compare categorical data. 	<p>Data</p> <p>At this stage, pupils' recording and interpretation become more sophisticated as they collate, organise and compare information (e.g. using many-to-one correspondence in pictograms and using simple ratios 2, 5, 10).</p>

Lower Key Stage 2 – Years 3-4

The principal focus of mathematics teaching in lower Key Stage 2 is to ensure that pupils become increasingly fluent with whole numbers and the four operations, including number facts and the concept of place value. This should ensure that pupils develop efficient written and mental methods and perform calculations accurately with increasingly large whole numbers.

At this stage, pupils should develop their ability to solve a range of problems, including with simple fractions and decimal place value. Teaching should also ensure that pupils draw with increasing accuracy and develop mathematical reasoning so they can analyse shapes and their properties, and confidently describe the relationships between them. It should ensure that they can use measuring instruments with accuracy and make connections between measure and number.

By the end of Year 4, pupils should have memorised their multiplication tables up to and including the 12 multiplication table and show precision and fluency in their work.

Pupils should read and spell mathematical vocabulary correctly and confidently, using their growing word reading knowledge and their knowledge of spelling.

Year 3

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Number, place value and rounding</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none">▪ count from 0 in multiples of 4, 8, 50 and 100; finding 10 or 100 more or less than a given number (<i>From Year 4</i>)▪ recognise the place value of each digit in a three-digit number (hundreds, tens, ones)▪ compare and order numbers up to 1000▪ identify, represent and estimate numbers using different representations▪ read and write numbers to at least 1000 in numerals and in words▪ solve number problems and practical problems involving these ideas.	<p>Number, place value and rounding</p> <p>Pupils should work with larger numbers, applying partitioning related to place value using varied and increasingly complex problems, building on work in Year 2 (e.g. $46 = 40$ and 6, $46 = 30$ and 16).</p> <p>Using a variety of representations, including those related to measure, pupils should continue to count in ones, tens and hundreds, so that they become fluent in the order and place value of numbers to 1000.</p>
<p>Addition and subtraction</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none">▪ add and subtract numbers mentally, including:<ul style="list-style-type: none">▪ a three-digit number and ones▪ a three-digit number and tens	<p>Addition and subtraction</p> <p>Pupils should practise solving varied addition and subtraction questions. For mental calculations with two-digit numbers, the answers could exceed 100.</p> <p>Pupils should use their understanding of place value and partitioning, and practise using columnar addition and subtraction</p>

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ a three-digit number and hundreds ▪ add and subtract numbers with up to three digits, using the efficient written methods of columnar addition and subtraction (From Year 4) ▪ estimate the answer to a calculation and use inverse operations to check answers ▪ solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction. 	<p>with increasingly large numbers up to three digits to become fluent.</p>
<p>Multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables (From Year 4) ▪ write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to efficient written methods (From Year 4) ▪ solve problems, including missing number problems, involving multiplication and division, including integer scaling problems and correspondence problems in which n objects are connected to m objects. 	<p>Multiplication and division</p> <p>Pupils should continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency. Through doubling, they connect the 2, 4 and 8 multiplication tables.</p> <p>Pupils should develop efficient mental methods, for example, using commutativity (e.g. $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$) and multiplication and division facts (e.g. using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$) to derive related facts ($30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$).</p> <p>Pupils should develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the efficient written methods of</p>

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory)
	<p>short multiplication and division.</p> <p>Pupils should solve simple problems in contexts, deciding which of the four operations to use and why, including measuring and scaling contexts, and correspondence problems in which m objects are connected to n objects (e.g. 3 hats and 4 coats, how many different outfits; 12 sweets shared equally between 4 children; 4 cakes shared equally between 8 children).</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ count up and down in tenths; recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10 ▪ recognise, find and write fractions of a discrete set of objects: unit fractions and non-unit fractions with small denominators ▪ recognise and use fractions as numbers: unit fractions and non-unit fractions with small denominators ▪ recognise and show, using diagrams, equivalent fractions with small denominators ▪ add and subtract fractions with the same denominator within one whole (e.g. $\frac{5}{7} + \frac{1}{7} = \frac{6}{7}$) ▪ compare and order unit fractions with the same denominator 	<p>Fractions</p> <p>Pupils should connect tenths to place value and decimal measures, not restricted to decimals between 0 and 1 inclusive and to division by 10.</p> <p>They should begin to understand unit and non-unit fractions as numbers on the number line, and deduce relations between them, such as size and equivalence. They should go beyond the [0, 1] interval, and $\frac{1}{4} + \frac{3}{4} = 1$ for example, relating this to measure.</p> <p>Pupils should understand the relation between unit fractions as operators and division by integers.</p> <p>They should continue to recognise fractions in the context of parts of a whole, numbers, measurements, a shape, or unit fractions as a division of a quantity.</p> <p>Pupils should practise adding and subtracting fractions with the</p>

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ solve problems that involve all of the above. 	<p>same denominator through a variety of increasingly complex problems to improve fluency.</p>
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml) (From Year 4) ▪ measure the perimeter of simple 2-D shapes (From Year 4) ▪ add and subtract amounts of money to give change, using both £ and p in practical contexts ▪ tell and write the time from an analogue clock, including using Roman numerals from I to XII, and 12-hour and 24-hour clocks (From Year 4 and Year 5) ▪ estimate and read time with increasing accuracy to the nearest minute; record and compare time in terms of seconds, minutes, hours and o'clock; use vocabulary such as a.m./p.m., morning, afternoon, noon and midnight (From Year 4) ▪ know the number of seconds in a minute and the number of days in each month, year and leap year ▪ compare durations of events, for example to calculate the time taken by particular events or tasks. 	<p>Measures</p> <p>Pupils should continue to measure using the appropriate tools and units, progressing to using a wider range of measures, including comparing and using mixed units (e.g. 1 kg and 200g) and simple equivalents of mixed units (e.g. 5m = 500cm).</p> <p>The comparison of measures should also include simple scaling (e.g. a given quantity or measure is twice as long or five times as high) and connect this to multiplication.</p> <p>Pupils should continue to become fluent in recognising the value of coins, by adding and subtracting amounts, including mixed units, and giving change using manageable amounts. They should record £ and p separately. The decimal recording of money is introduced formally in Year 4.</p> <p>Pupils should use both analogue and digital 12-hour clocks and record their times. In this way they become fluent in and prepared for using digital 24-hour clocks in Year 4.</p>

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ draw 2-D shapes and make 3-D shapes using modelling materials; recognise 3-D shapes in different orientations; and describe them with increasing accuracy ▪ recognise angles as a property of shape and associate angles with turning ▪ identify right angles, recognise that two right angles make a half-turn, three make three quarters of a turn and four a complete turn; identify whether angles are greater than or less than a right angle ▪ identify horizontal, vertical, perpendicular and parallel lines in relation to other lines. <i>(From Year 4 and Year 5)</i> 	<p>Geometry: properties of shapes</p> <p>Pupils' knowledge of the properties of shapes is extended at this stage to symmetrical and non-symmetrical polygons and polyhedra. Pupils extend their use of the properties of shapes. They should be able to describe the properties of 2-D and 3-D shapes using accurate language, including lengths of lines and acute and obtuse for angles greater or lesser than a right angle.</p> <p>Pupils should draw and measure straight lines in centimetres.</p>
<p>Data</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ interpret and present data using bar charts, pictograms and tables ▪ solve one-step and two-step questions such as 'How many more?' and 'How many fewer?' using information presented in scaled bar charts and pictograms and tables. 	<p>Data</p> <p>Pupils should understand and use simple scales (e.g. 2, 5, 10 units per cm) in pictograms and bar charts with increasing accuracy.</p> <p>They should continue to interpret data presented in many contexts.</p>

Year 4

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p data-bbox="138 350 632 378">Number, place value and rounding</p> <p data-bbox="138 440 485 467">Pupils should be taught to</p> <ul data-bbox="184 509 1031 1170" style="list-style-type: none"><li data-bbox="184 509 768 537">▪ count in multiples of 6, 7, 9, 25 and 1000<li data-bbox="184 557 806 584">▪ find 1000 more or less than a given number<li data-bbox="184 604 1010 670">▪ count backwards through zero to include negative numbers <i>(From Year 5)</i><li data-bbox="184 690 1031 756">▪ recognise the place value of each digit in a four-digit number (thousands, hundreds, tens, and ones)<li data-bbox="184 776 785 803">▪ order and compare numbers beyond 1000<li data-bbox="184 823 968 889">▪ identify, represent and estimate numbers using different representations<li data-bbox="184 909 879 937">▪ round any number to the nearest 10, 100 or 1000<li data-bbox="184 956 999 1023">▪ solve number and practical problems that involve all of the above and with increasingly large positive numbers<li data-bbox="184 1042 1010 1170">▪ read Roman numerals to 100 (I to C) and understand how, over time, the numeral system changed to include the concept of zero and place value.	<p data-bbox="1062 350 1551 378">Number, place value and rounding</p> <p data-bbox="1062 440 1934 630">Using a variety of representations, including measures, pupils should become fluent in the order and place value of numbers beyond 1000, including counting in tens and hundreds, and maintaining fluency in other multiples through varied and frequent practice.</p> <p data-bbox="1062 675 1919 784">They begin to extend their knowledge of the number system to include the decimal numbers and fractions that they have met so far.</p> <p data-bbox="1062 829 1934 980">Roman numerals should be put in their historical context so pupils understand that there have been different ways to write whole numbers and that the important concepts of zero and place value were introduced over a period of time.</p>

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Addition and subtraction</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ add and subtract numbers with up to 4 digits using the efficient written methods of columnar addition and subtraction where appropriate ▪ estimate and use inverse operations to check answers to a calculation ▪ solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why. 	<p>Addition and subtraction</p> <p>Pupils should continue to practise both mental methods and columnar addition and subtraction with increasingly large numbers to aid fluency.</p>
<p>Multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recall multiplication and division facts for multiplication tables up to 12×12 ▪ use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers ▪ recognise and use factor pairs and commutativity in mental calculations ▪ multiply two-digit and three-digit numbers by a one-digit number using formal written layout (<i>From Year 5</i>) 	<p>Multiplication and division</p> <p>Pupils should continue to practise recalling and using multiplication tables and related division facts to aid fluency.</p> <p>Pupils should practise mental methods and extend this to three-digit numbers to derive facts, for example $200 \times 3 = 600$ into $600 \div 3 = 200$, to become fluent.</p> <p>Pupils should practise to become fluent in the efficient written method of short multiplication for multiplying using multi-digit numbers, and short division with exact answers when dividing by a one-digit number.</p> <p>Pupils should write statements about the equality of expressions</p>

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ solve problems involving multiplying and adding, including using the distributive law and harder multiplication problems such as which n objects are connected to m objects. 	<p>(e.g. use the distributive law $39 \times 7 = 30 \times 7 + 9 \times 7$ and associative law $(2 \times 3) \times 4 = 2 \times (3 \times 4)$).</p> <p>Pupils should solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as three cakes shared equally between 10 children.</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ count up and down in hundredths; recognise that hundredths arise when dividing an object by a hundred and dividing tenths by ten ▪ solve problems involving increasingly harder fractions to calculate quantities, and fractions to divide quantities, including non-unit fractions where the answer is a whole number ▪ identify, name and write equivalent fractions of a given fraction, including tenths and hundredths ▪ add and subtract fractions with the same denominator. 	<p>Fractions</p> <p>Pupils should connect hundredths to tenths and place value and decimal measure.</p> <p>They should extend the use of the number line to connect fractions, numbers and measures.</p> <p>Pupils should understand the relation between non-unit fractions and multiplication and division of quantities, with particular emphasis on tenths and hundredths.</p> <p>Pupils should associate fractions of a length, of a shape and as a representation of one whole or set of quantities. Pupils should use factors and multiples to recognise equivalent fractions and simplify where appropriate (e.g. $\frac{6}{9} = \frac{2}{3}$ or $\frac{1}{4} = \frac{2}{8}$).</p> <p>Pupils should continue practice in adding and subtracting fractions with the same denominator, to become fluent through a variety of</p>

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
	<p>increasingly complex problems beyond one whole.</p> <p>They should practise counting using simple fractions and decimal fractions, both forwards and backwards.</p>
<p>Decimals and fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise and write decimal equivalents of any number of tenths or hundredths ▪ recognise and write decimal equivalents to $\frac{1}{4}$; $\frac{1}{2}$; $\frac{3}{4}$ ▪ find the effect of dividing a one- or two-digit number by 10 and 100, identifying the value of the digits in the answer as units, tenths and hundredths ▪ round decimals with one decimal place to the nearest whole number (From Year 5) ▪ compare numbers with the same number of decimal places up to two decimal places ▪ solve simple measure and money problems involving fractions and decimals to two decimal places. 	<p>Decimals and fractions</p> <p>Pupils should be taught throughout that decimals and fractions are different ways of expressing numbers.</p> <p>Pupils' understanding of the number system and decimal place value is extended at this stage to tenths and then hundredths. This includes relating the decimal notation to division of whole numbers by 10 and later 100.</p> <p>Pupils should learn decimal notation and the language associated with it, including in the context of measurements. They make comparisons and order decimal amounts and quantities that are expressed to the same number of decimal places. They should be able to represent numbers with one or two decimal places in multiple ways, such as on number lines.</p>

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ convert between different units of measure (e.g. kilometre to metre; hour to minute) <i>(From Year 5)</i> ▪ measure and calculate the perimeter of a rectilinear figure (including squares) in centimetres and metres ▪ find the area of rectilinear shapes by counting ▪ estimate, compare and calculate different measures, including money in pounds and pence ▪ read, write and convert time between analogue and digital 12 and 24-hour clocks <i>(From Year 5)</i> ▪ solve problems involving converting from hours to minutes; minutes to seconds; years to months; weeks to days. 	<p>Measures</p> <p>Pupils should use multiplication and their knowledge of place value to convert from larger to smaller units.</p> <p>They should relate area to arrays and multiplication.</p> <p>Pupils should build on their understanding of decimal notation to record measures.</p>
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ compare and classify geometric shapes, including quadrilaterals and triangles, based on their properties and sizes ▪ identify acute and obtuse angles and compare and order angles up to two right angles by size ▪ identify lines of symmetry in 2-D shapes presented in 	<p>Geometry: properties of shapes</p> <p>Pupils should continue to classify shapes using geometrical properties, extending to classifying different triangles (e.g. isosceles, equilateral, scalene) and quadrilaterals (e.g. parallelogram, rhombus, trapezium).</p> <p>Pupils should compare and order angles in preparation for using a protractor and compare lengths and angles to decide if a polygon is regular or irregular.</p>

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>different orientations</p> <ul style="list-style-type: none"> complete a simple symmetric figure with respect to a specific line of symmetry. 	<p>Pupils should draw symmetric patterns using a variety of media to become familiar with different orientations of lines of symmetry; and recognise line symmetry in a variety of diagrams.</p>
<p>Geometry: position, direction, motion</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> describe positions on a 2-D grid as coordinates in the first quadrant <i>(from Year 5)</i> describe movements between positions as translations of a given unit to the left/right and up/down <i>(From Year 5)</i> plot specified points and draw sides to complete a given polygon. <i>(From Year 6)</i> 	<p>Geometry: position, direction, motion</p> <p>Pupils should draw a pair of axes in one quadrant, with equal scales and integer labels. They should read, write and use pairs of coordinates (2, 5), including using coordinate-plotting ICT tools.</p>
<p>Data</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> interpret and present discrete data using bar charts and continuous data using line graphs <i>(From Year 5)</i> solve comparison, sum and difference problems using information presented in bar charts, pictograms, tables and simple line graphs. <i>(From Year 5)</i> 	<p>Data</p> <p>Pupils should understand and use a greater range of scales in their representations. Pupils should begin to relate the graphical representation of data to recording change over time.</p>

Upper Key Stage 2 – Years 5-6

The principal focus of mathematics teaching in upper Key Stage 2 is to ensure that pupils extend their understanding of the number system and place value to include larger integers. This should develop the connections that pupils make between multiplication and division with fractions, decimals, percentages and ratio.

At this stage, pupils should develop their ability to solve a wider range of problems, including increasingly complex properties of numbers and arithmetic, and problems demanding efficient written and mental methods of calculation. With this foundation in arithmetic, pupils are introduced to the language of algebra as a means for solving a variety of problems. Teaching in geometry and measures should consolidate and extend knowledge developed in number. Teaching should also ensure that pupils classify shapes with increasingly complex geometric properties and that they learn the vocabulary they need to describe them.

By the end of Year 6, pupils should be fluent in written methods for all four operations, including long multiplication and division, and in working with fractions, decimals and percentages.

Pupils should read, spell and pronounce mathematical vocabulary correctly.

Year 5

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Number, place value, approximation and estimation</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit ▪ count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000 ▪ interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers through zero ▪ round any number up to 1 000 000 to the nearest 10, 100, 1000, 10 000 and 100 000 ▪ solve number problems and practical problems that involve all of the above ▪ read Roman numerals to 1000 (M) and recognise years written in Roman numerals. 	<p>Number, place value, approximation and estimation</p> <p>Pupils should identify the place value in large whole numbers.</p> <p>They should continue to use number in context, including measurement. Pupils extend and apply their understanding of the number system to the decimal numbers and fractions that they have met so far.</p> <p>They should recognise and describe linear number sequences, including those involving fractions and decimals, and find the term-to-term rule.</p>
<p>Addition and subtraction</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ add and subtract whole numbers with more than 4 digits, including using efficient written methods (columnar addition and subtraction) 	<p>Addition and subtraction</p> <p>Pupils should practise using the efficient written methods of columnar addition and subtraction with increasingly large numbers to aid fluency.</p> <p>They should practise mental calculations with increasingly large</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ add and subtract numbers mentally with increasingly large numbers ▪ use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy ▪ solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why. <i>(From Year 6)</i> 	<p>numbers to aid fluency (e.g. $12\ 462 - 2\ 300 = 10\ 162$).</p>
<p>Multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ identify multiples and factors, including finding all factor pairs ▪ solve problems involving multiplication and division where larger numbers are used by decomposing them into their factors ▪ know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers <i>From Year 6)</i> ▪ establish whether a number up to 100 is prime and recall prime numbers up to 19 <i>(From Year 6)</i> ▪ multiply numbers up to 4 digits by a one- or two-digit number using an efficient written method, including long multiplication for two-digit numbers <i>(From Year 6)</i> ▪ multiply and divide numbers mentally drawing upon known facts ▪ divide numbers up to 4 digits by a one-digit number using 	<p>Multiplication and division</p> <p>Pupils should practise and extend their use of the efficient written methods of short multiplication and short division. They apply all the multiplication tables and related division facts frequently, commit them to memory and use them confidently to make larger calculations.</p> <p>They should use and understand the terms factor, multiple and prime, square and cube numbers.</p> <p>Pupils should interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding (e.g. $98 \div 4 = 24\ r\ 2 = 24\frac{1}{2} = 24.5 \approx 25$).</p> <p>Pupils use multiplication and division as inverses to support the introduction of ratio in Year 6, for example, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>the efficient written method of short division and interpret remainders appropriately for the context</p> <ul style="list-style-type: none"> ▪ multiply and divide whole numbers and those involving decimals by 10, 100 and 1000 ▪ recognise and use square numbers and cube numbers, and the notation for squared (²) and cubed (³) ▪ solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign ▪ solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates. 	<p>kilometres and metres.</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ compare and order fractions whose denominators are all multiples of the same number (<i>From Year 6</i>) ▪ recognise mixed numbers and improper fractions and convert from one form to the other ▪ add and subtract fractions with the same denominator and related fractions; write mathematical statements >1 as a mixed number (e.g. $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$) ▪ multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams. 	<p>Fractions</p> <p>Pupils should connect equivalent fractions >1 that simplify to integers with division and fractions >1 to division with remainders, using the number line and other models, and hence move from these to improper and mixed fractions.</p> <p>Pupils should connect multiplication by a fraction to using fractions as operators, and to division, building on work from previous years. This relates to scaling by simple fractions.</p> <p>They should extend their knowledge of fractions to thousandths and connect to decimals and measures. Pupils continue to develop their understanding of fractions as numbers, measures and</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
	<p>operators by finding fractions of numbers and quantities, writing remainders as a fraction.</p> <p>Pupils should practise adding and subtracting fractions to become fluent through a variety of increasingly complex problems. They should extend their understanding of adding and subtracting fractions to calculations that exceed 1 as a mixed number.</p> <p>Pupils should read and write proper fractions and mixed numbers accurately and continue to practise counting forwards and backwards with mixed fractions.</p>
<p>Decimals and fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ read and write decimal numbers as fractions (e.g. $0.71 = \frac{71}{100}$) ▪ recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents (From Year 6) ▪ round decimals with two decimal places to the nearest whole number and to one decimal place ▪ read, write, order and compare numbers with up to three decimal places (From Year 6) ▪ solve problems involving number up to three decimal places. (From Year 6) 	<p>Decimals and fractions</p> <p>Pupils extend counting from Year 4, using decimals and fractions including bridging zero, for example on a number line.</p> <p>They should add and subtract decimals including a mix of whole numbers and decimals, decimals with different numbers of decimal places, and complements of 1 (e.g. $0.83 + 0.17 = 1$).</p> <p>They should mentally add and subtract tenths, and one-digit whole numbers and tenths.</p> <p>Pupils should say, read and write decimal fractions and related tenths, hundredths and thousandths accurately and be confident in checking the reasonableness of their answers to problems.</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
	Pupils should go beyond the measurement and money models of decimals, for example by solving puzzles involving decimals.
<p>Percentages, decimals and fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise the per cent symbol (%) and understand that per cent relates to “number of parts per hundred”, and write percentages as a fraction with denominator hundred, and as a decimal fraction ▪ solve problems which require knowing percentage and decimal equivalents of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{4}{5}$ and those with a denominator of a multiple of 10 or 25. 	<p>Percentages, decimals and fractions</p> <p>Pupils should be taught throughout that percentages, decimals and fractions are different ways of expressing numbers.</p> <p>Pupils should make connections between percentages, fractions and decimals (e.g. 100% represents a whole quantity and 1% is $\frac{1}{100}$, 50% is $\frac{50}{100}$, 25% is $\frac{25}{100}$) and relate this to finding ‘fractions of’. They recognise that percentages are proportions of quantities as well as operators on quantities.</p>
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ convert between different units of measure (e.g. kilometre and metre; metre and centimetre; centimetre and millimetre; kilogram and gram; litre and millilitre) <i>(Involving two decimal places from Year 6)</i> ▪ understand and use basic equivalences between metric and common imperial units and express them in approximate terms <i>(From Year 6)</i> ▪ measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres 	<p>Measures</p> <p>Pupils should use their knowledge of place value and multiplication and division to convert between standard units.</p> <p>Pupils should calculate the perimeter of rectangles and related composite shapes, including using the relations of perimeter or area to find unknown lengths. Missing number questions such as these are the beginning of algebraic understanding. They should also calculate the area of scale drawings using given measurements.</p> <p>Pupils should use all four operations in problems involving time and</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ calculate and compare the area of squares and rectangles including using standard units, square centimetres (cm²) and square metres (m²) and estimate the area of irregular shapes (From Year 6) ▪ recognise and estimate volume (e.g. using 1 cm³ blocks to build cubes and cuboids) and capacity (e.g. using water) ▪ solve problems involving converting between units of time ▪ solve problems involving addition and subtraction of units of measure (e.g. length, mass, volume, money) using decimal notation. 	<p>money, including conversions (e.g. days to weeks, leaving the answer as weeks and days).</p>
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ identify 3-D shapes, including cubes and cuboids, from 2-D representations ▪ know angles are measured in degrees; estimate and measure them and draw a given angle, writing its size in degrees (°) ▪ identify: <ul style="list-style-type: none"> ▪ multiples of 90° ▪ angles at a point on a straight line and ½ a turn (total 180°) ▪ angles at a point and one whole turn (total 360°) (From Year 6) ▪ reflex angles, and (From Year 6) 	<p>Geometry: properties of shapes</p> <p>Pupils should become accurate in drawing lines with a ruler to the nearest millimetre, and measuring with a protractor. They use conventional markings for parallel lines and right angles.</p> <p>Pupils should use the term diagonal and make conjectures about the angles formed by diagonals and sides, and other properties of quadrilaterals, for example using dynamic geometry ICT tools. Pupils should use angle sum facts and other properties to make deductions about missing angles and relate these to missing number problems.</p>

Year 5 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ compare different angles ▪ draw shapes using given dimensions and angles ▪ state and use the properties of a rectangle (including squares) to deduce related facts ▪ distinguish between regular and irregular polygons based on reasoning about equal sides and angles. 	
<p>Geometry: position, direction, motion</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed. 	<p>Geometry: position, direction, motion</p> <p>Pupils should recognise and use reflection and translation in a variety of diagrams, including continuing to use a 2-D grid and coordinates in the first quadrant. Reflection should be in lines that are parallel to the axes.</p>
<p>Data</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve comparison, sum and difference problems using information presented in line graphs ▪ complete, read and interpret information in tables, including timetables. 	<p>Data</p> <p>Pupils should connect their work on coordinates and scales to their interpretation of time graphs using ICT tools, except where data are easily calculable.</p> <p>They should begin to decide which representations of data are most appropriate and why.</p>

Year 6

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Number, place value and rounding</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none">▪ read, write, order and compare numbers up to 10 000 000 and determine the value of each digit▪ round any whole number to a required degree of accuracy▪ use negative numbers in context, and calculate intervals across zero▪ solve number problems and practical problems that involve all of the above.	<p>Number, place value and rounding</p> <p>Pupils should use the whole number system, including saying, reading and writing numbers accurately.</p>
<p>Addition, subtraction, multiplication and division</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none">▪ multiply multi-digit numbers up to 4 digits by a two-digit whole number using the efficient written method of long multiplication▪ divide numbers up to 4 digits by a two-digit whole number using the efficient written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context▪ perform mental calculations, including with mixed operations and large numbers	<p>Addition, subtraction, multiplication and division</p> <p>Pupils should practise addition, subtraction, multiplication and division for larger numbers, using the efficient written methods of columnar addition and subtraction, short and long multiplication, and short and long division.</p> <p>They should undertake mental calculations with increasingly large numbers and more complex calculations.</p> <p>Pupils should continue to use all the multiplication tables to calculate mathematical statements in order to maintain their fluency.</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ identify common factors, common multiples and prime numbers ▪ use their knowledge of the order of operations to carry out calculations involving the four operations ▪ solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why ▪ solve problems involving addition, subtraction, multiplication and division ▪ use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy. 	<p>Pupils should round answers to a specified degree of accuracy.</p> <p>Pupils explore the order of operations using brackets; for example, $2 + 1 \times 3 = 5$ and $(2 + 1) \times 3 = 9$.</p> <p>Common factors can be related to finding equivalent fractions.</p>
<p>Fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ use common factors to simplify fractions; use common multiples to express fractions in the same denomination ▪ compare and order fractions, including fractions >1 ▪ associate a fraction with division to calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. $\frac{3}{8}$) ▪ add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions ▪ multiply simple pairs of proper fractions, writing the answer in its simplest form (e.g. $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$) ▪ divide proper fractions by whole numbers (e.g. $\frac{1}{3} \div 2 = \frac{1}{6}$). 	<p>Fractions</p> <p>Pupils should use their understanding of the relationship between unit fractions and division to work backwards by multiplying a quantity that represents a unit fraction to find the whole quantity (e.g. if $\frac{1}{4}$ of a length is 36cm, then the whole length is $36 \times 4 = 144$cm).</p> <p>They should practise with simple fractions and decimal fraction equivalents to aid fluency, including listing equivalent fractions to identify fractions with common denominators. Denominators of given fractions should not exceed 12, with the exception of 100 and 1000.</p> <p>Pupils can explore and make conjectures about converting a</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
	<p>simple fraction to a decimal fraction (e.g. $3 \div 8 = 0.375$). For simple fractions with recurring decimal equivalents, pupils should learn about rounding the decimal to three decimal places.</p> <p>Pupils should practise, use and understand the addition and subtraction of fractions with different denominators by identifying equivalent fractions with the same denominator. They should start with fractions where the denominator of one fraction is a multiple of the other (e.g. $\frac{1}{2} + \frac{1}{8} = \frac{5}{8}$) and progress to varied and increasingly complex problems.</p> <p>Pupils should use a variety of images to support their understanding of multiplication with fractions. This follows earlier work about fractions as operators, as numbers, and as equal parts of objects, for example as parts of a rectangle.</p>
<p>Decimals and fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ identify the value of each digit to three decimal places and multiply and divide numbers by 10, 100 and 1000 where the answers are up to three decimal places ▪ multiply one-digit numbers with up to two decimal places by whole numbers ▪ use written division methods in cases where the answer has up to two decimal places 	<p>Decimals and fractions</p> <p>Pupils should begin to multiply and divide numbers with up to two decimal places by one-digit and two-digit whole numbers. Pupils multiply decimals by whole numbers, starting with the simplest cases, such as $0.4 \times 2 = 0.8$, and in practical contexts, such as measures and money.</p> <p>Pupils should also be introduced to the division of decimal numbers by one-digit whole numbers and, initially, in practical contexts involving measures and money. They should recognise division</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ solve problems which require answers to be rounded to specified degrees of accuracy. 	<p>calculations as the inverse of multiplication.</p> <p>Pupils should also develop their skills of rounding and estimating as a means of predicting and checking the order of magnitude of their answers to decimal calculations. This includes rounding answers to a specified degree of accuracy and checking the reasonableness of their answers.</p>
<p>Percentages, decimals and fractions</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve problems involving the calculation of percentages of whole numbers or measures such as 15% of 360 and the use of percentages for comparison ▪ recall and use equivalences between simple fractions, decimals and percentages, including in different contexts. 	<p>Percentages, decimals and fractions</p> <p>Pupils should understand that calculating a percentage of a quantity is the same as calculating a fraction of a quantity.</p>
<p>Ratio and proportion</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve problems involving the relative sizes of two quantities, including similarity ▪ solve problems involving unequal sharing and grouping. 	<p>Ratio and proportion</p> <p>Pupils should consolidate their understanding of ratio when comparing quantities, sizes and scale drawings by solving a variety of problems. They may use the notation a:b to record their work.</p> <p>Pupils should recognise proportionality in contexts when the relations between quantities are in the same ratio (e.g. similar shapes, recipes).</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Algebra</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ express missing number problems algebraically ▪ use simple formulae expressed in words ▪ generate and describe linear number sequences ▪ find pairs of numbers that satisfy number sentences involving two unknowns. 	<p>Algebra</p> <p>Pupils should be introduced to the use of symbols and letters to represent variables and unknowns in mathematical situations that they already understand, such as:</p> <ul style="list-style-type: none"> ▪ missing numbers, lengths, coordinates and angles ▪ formulae in mathematics and science ▪ arithmetical rules (e.g. $a + b = b + a$) ▪ generalisations of number patterns ▪ number puzzles (e.g. what two numbers can add up to).
<p>Measures</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve problems involving the calculation and conversion of units of measure, using decimal notation to three decimal places where appropriate ▪ use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to three decimal places ▪ convert between miles and kilometres ▪ recognise that shapes with the same areas can have different perimeters and vice versa 	<p>Measures</p> <p>Using the number line, pupils should use, add and subtract positive and negative integers for measures such as temperature.</p> <p>They should know approximate conversions and be able to tell if an answer is sensible.</p> <p>They should relate the area of rectangles to parallelograms and triangles, and be able to calculate their areas, understanding and using the formula to do this.</p> <p>Pupils could be introduced to other compound units for speed, such as miles per hour, and apply their knowledge in science or other subjects as appropriate.</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none"> ▪ calculate the area of parallelograms and triangles ▪ recognise when it is necessary to use the formulae for area and volume of shapes ▪ calculate, estimate and compare volume of cubes and cuboids using standard units, including centimetre cubed (cm^3) and cubic metres (m^3) and extending to other units, such as mm^3 and km^3. 	
<p>Geometry: properties of shapes</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ recognise, describe and build simple 3-D shapes, including making nets ▪ compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons ▪ illustrate and name parts of circles, including radius, diameter and circumference ▪ find unknown angles where they meet at a point, are on a straight line, and are vertically opposite. 	<p>Geometry: properties of shapes</p> <p>Pupils should draw shapes and nets accurately, using measuring tools and conventional markings and labels for lines and angles.</p> <p>Pupils should describe the properties of shapes and explain how unknown angles and lengths can be derived from known measurements.</p>

Year 6 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<p>Geometry: position, direction, motion</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ describe positions on the full coordinate grid (all four quadrants) ▪ draw and translate simple shapes on the coordinate plane, and reflect them in the axes. 	<p>Geometry: position, direction, motion</p> <p>Pupils should draw and label a pair of axes in all four quadrants with equal scaling. This extends their knowledge of one quadrant to all four quadrants, including the use of negative numbers.</p> <p>Pupils should draw and label rectangles (including squares), parallelograms and rhombuses, specified by coordinates in the four quadrants, predicting missing coordinates using the properties of shapes.</p>
<p>Data</p> <p>Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ interpret and construct pie charts and line graphs and use these to solve problems ▪ calculate and interpret the mean as an average. 	<p>Data</p> <p>Pupils should connect their work on angles, fractions and percentages to the interpretation of pie charts.</p> <p>Pupils should both encounter and draw graphs relating two variables, arising from their own enquiry and in other subjects. They should connect conversion from kilometres to miles in measure to its graphical representation.</p> <p>Pupils should know when it is appropriate to find the mean of a data set.</p>

Key Stage 3

Introduction

Through the mathematics content, pupils should be taught to:

Develop fluency

- consolidate their numerical understanding from Key Stage 2
- apply appropriate calculation strategies and degrees of accuracy to increasingly complex problems
- extend their understanding of the number system to include all fractions and surds
- substitute values in expressions; rearrange and simplify expressions, and solve equations
- calculate with fractions and surds as exact numbers
- begin to develop algebraic and graphical fluency and understand linear and quadratic functions
- interpret relations algebraically and graphically
- begin to use the precise language and properties of 2-D and 3-D shapes
- begin to use the concept, language and representation of probability.

Reason mathematically

- extend their understanding of the number system, make connections between number relationships, and algebraic and graphical representations
- extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and in formulating proportional relations algebraically
- identify variables and express relations between them algebraically and graphically
- establish when to use proportional reasoning from the underlying structure of a problem when working numerically
- begin to reason deductively in geometry
- develop reasoning in different areas of mathematics and begin to express their arguments formally.

Solve problems

- develop their use of formal mathematical knowledge to solve and devise problems within and outside mathematics, including financial mathematics
- begin to model realistic situations mathematically and express the results of their investigations using a range of formal mathematical representations
- apply elementary knowledge to multi-step and increasingly sophisticated problems
- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes.

Subject content

Number: calculation and accuracy

Pupils should be taught to:

- use place value, including for decimals, measures and for any size of integers, the language of larger and smaller numbers, and ordering numbers, including the correct use of =, ≠, <, >, ≤, ≥
- use the four operations, including efficient written methods, applied to integers, decimal fractions, simple fractions (proper and improper) and mixed numbers, all both positive and negative
- understand and use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals
- use mass, length, time, money and other measures, including with decimal quantities
- compare, order and convert between fractions and decimals
- interpret percentages and percentage changes as a fraction or a decimal, and calculate these multiplicatively
- interpret and compare numbers in standard form $A \times 10^n$ where n is positive or negative
- estimate number, measures and approximate answers, including using these to check other calculation methods
- round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures), including simple error intervals, using standard interval and inequality notation
- use a calculator and other technologies to calculate results accurately and then interpret them appropriately.

Number theory

Pupils should be taught to:

- know and use prime numbers, common factors and common multiples for whole numbers with two and three digits, including highest common factor and lowest common multiple, understanding these as the intersection and union of the prime factors, and other classifications of number, including product notation
- know and use integer powers and associated roots (square, cube and higher), including the use of surd notation (e.g. $\sqrt{8}$), and distinguish between exact answers and decimal approximations.

Algebra: expressing relations

Pupils should be taught to:

- read and interpret algebraic notation
- express known relations algebraically within and outside mathematics, using accurate notation, including prioritisation of operations
- manipulate equivalent algebraic expressions, including expanding products of binomials; collect like terms and simplify expressions involving sums of products and powers
- recognise an arithmetic progression, and find the n th term
- make and test conjectures about recursive and long-term behaviour of geometric, quadratic and other sequences that arise within and outside mathematics
- recognise, sketch and produce graphs of linear and quadratic functions of one variable with appropriate scaling, using equations in x and y and the cartesian plane
- interpret mathematical relationships both algebraically and geometrically.

Algebra: using equations and functions

Pupils should be taught to:

- use formulae by substitution to calculate the value of a variable, including for scientific formulae
- begin to model simple contextual and subject-based problems algebraically
- solve linear equations in one variable in a variety of contexts, including subject-based problems, using algebraic methods
- use linear and quadratic graphs to estimate values of y for given values of x and vice versa and approximate solutions of simultaneous equations
- use given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs, to approximate solutions to contextual problems.

Ratio, proportion and rate of change

Pupils should be taught to:

- use ratio and scale factor notation and methods involving conversion, mixing, measuring, scaling, comparing quantities and concentrations
- calculate missing quantities and totals using given ratios, including reduction to simplest form
- solve problems involving percentage change, including: percentage increase and decrease and original value problems, simple interest in financial mathematics and repeated growth
- use multiplicative reasoning where two quantities have a fixed product or fixed ratio represented graphically and algebraically
- solve problems with constant rates of change involving distance and speed.

Geometry and measures

Pupils should be taught to:

- solve problems involving perimeter and area of triangles, circles and composite shapes; and cross-sectional areas, surface area and volume of cubes, cuboids, prisms, cylinders and composite solids
- use compound units such as speed, unit pricing and density to solve problems
- use concrete and digital instruments to measure line segments and angles in geometric figures, including interpreting scale drawings
- illustrate by sketching, constructing and drawing on coordinate axes: point, line, vertex, parallel, perpendicular, right angle, regular, symmetric and irregular polygons, using conventional terms and notations
- identify properties, e.g. equal lengths, circles, triangles, quadrilaterals and other plane figures, using appropriate language
- identify and construct congruent triangles, and construct similar shapes by enlargement
- know and use angle relations in parallel lines to deduce unknown angles
- apply angle facts, triangle congruence, similarity and properties of named quadrilaterals to derive results about angles and sides, using transformational, axiomatic and property-based logical reasoning
- use Pythagoras' Theorem and side ratios in similar triangles to solve problems in right-angled triangles
- identify face, edge and vertex properties of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres
- interpret mathematical relationships both algebraically and geometrically.

Probability

Pupils should be taught to:

- record and describe the outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes using appropriate language and the 0-1 scale
- enumerate sets and combinations of sets systematically, using tabular, grid and Venn diagrams
- generate theoretical possibility spaces for single and combined events with equally likely, mutually exclusive outcomes; use these to calculate theoretical probabilities and know that the probabilities of an exhaustive set of mutually exclusive outcomes sum to one.

Statistics

Pupils should be taught to:

- describe and compare univariate empirical distributions through: appropriate graphical representation involving discrete, continuous and grouped data and appropriate measures of central tendency and spread
- describe simple mathematical relationships between two variables in observational and experimental contexts
- identify appropriate questions, data collection, presentation, analysis and interpretation to conduct exploratory data analysis, including in science and geography.