Mathematics Progression of Knowledge, Skills, and Vocabulary

EYFS to KS1 progression

Organisation of Knowledge	Number	Measurement	Geometry
ELG	**ELG: Number** • Have a deep understanding of number to 10, including the composition of each number. • Subitise (recognise quantities without counting) up to 5. • Automatically recall (without reference to rhymes, counting and other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts. **ELG: Number patterns** • Verbally count beyond 20, recognising the pattern of the counting system. • Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity. • Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally.		
KS1 Readiness objective	• To count confidently. • To show a deep understanding of numbers up to 10. • To match numerals with a group of objects to show how many there are (up to 10). • To be able to identify relationships and patterns between numbers up to 10. • To show an awareness that numbers are made up of smaller numbers, exploring partitioning in different ways. • To add and subtract one in practical activities.	• To measure themselves and everyday objects using a mixture of non-standard and standard measurements. • To develop spatial reasoning using measures. • To begin to order and sequence events using everyday language related to time. • To begin to measure time with timers (e.g. digital stopwatches and sand timers) and calendars. • To explore the use of different measuring tools in everyday experiences and play.	• To use informal language (e.g., heart-shaped, hand-shaped) and some mathematical language to describe shapes around them. • To use spatial language, including following and giving directions, using relative terms. • To develop spatial reasoning with shape and space. • To compose and decompose shapes, and understanding which shapes can combine to make another shape.

Mathematics Progression: National Curriculum Programme of Study

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 for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Aims of the National Curriculum

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 develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- 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.

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programmes of study are, by necessity, organised into apparently distinct domains, but pupils should make rich 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.

The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace. However, decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content. Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice, before moving on.

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.

Schools are not required by law to teach the example content in [square brackets] or the content indicated as being 'non-statutory'.

Mathematics Progression: Subject Content in KS1 and KS2

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 [for example, 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.

Lower Key Stage 2

- 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.

Upper Key Stage 2

- 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.

Mathematics Progression: Number and Place Value

Year 1 Statutory Requirements

- count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number.
- count, read and write numbers to 100 in numerals; count in multiples of twos, fives and tens.
- given a number, identify one more and one less.
- identify and represent numbers using 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 numerals and words.

Year 3 Statutory Requirements

- count from 0 in multiples of 4, 8, 50 and 100; find 10 or 100 more or less than a given number.
- recognise the place value of each digit in a 3-digit number (100s, 10s, 1s).
- compare and order numbers up to 1,000.
- identify, represent and estimate numbers using different representations.
- read and write numbers up to 1,000 in numerals and in words.
- solve number problems and practical problems involving these ideas.

Year 4 Statutory Requirements

- count in multiples of 6, 7, 9, 25 and 1,000.
- find 1,000 more or less than a given number.
- count backwards through 0 to include negative numbers.
- recognise the place value of each digit in a four-digit number (1,000s, 100s, 10s, and 1s).
- order and compare numbers beyond 1,000.
- identify, represent and estimate numbers using different representations.
- round any number to the nearest 10, 100 or 1,000.
- solve number and practical problems that involve all of the above and with increasingly large positive numbers.
- read Roman numerals to 100 (I to C) and know that over time, the numeral system changed to include the concept of 0 and place value.

<table>
<tr>
<td rowspan="2">Year 2 Statutory Requirements
• count in steps of 2, 3, and 5 from 0, and in tens from any number, forward and backward.
• 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.</td>
<td>Year 5 Statutory Requirements
• 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, including through 0.
• round any number up to 1,000,000 to the nearest 10, 100, 1,000, 10,000 and 100,000.
• solve number problems and practical problems that involve all of the above.
• read Roman numerals to 1,000 (M) and recognise years written in Roman numerals.</td>
</tr>
<tr>
<td>Year 6 Statutory Requirements
• 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 0
• solve number and practical problems that involve all of the above</td>
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</table>

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	Have a deep understanding of number to 10, including the composition of each number.	• The last number counted of a group is the total. • One object can be represented by another. • Zero comes before one. • Zero comes before one. • One more is the number after. • One less is the number before. • Equal means the same in amount, size or number. More than means greater in amount or size. Less than means smaller in amount or size. Most means the biggest number or amount of something. Least means the smallest number or amount of something. • The less than sign (<) shows that the value to the left of it is lower than the value to the right of it. The greater than sign (>) shows that the value to the left of it is higher than the value to the right of it. • Know that, when comparing numbers, they should compare the highest place value column first (tens), then move onto the ones if the tens are equal. • Ordinal numbers give the position on a list 1st, 2nd, 3rd and so on. • 10 and 20 have just 10s and no ones. 11 to 19 have one 10 and some ones. • One more is one more one, not one more 10. • The less than sign (<) shows that the value to the left of it is lower than the value to the right of it. The greater than sign (>) shows that the value to the left of it is higher than the value to the right of it. • Know that one 10 is equal to 10 ones. • Equal means the same in amount, size or number. More than means greater in amount or size. Less than means smaller in amount or size. Most means the biggest number or amount of something. Least means the smallest number or amount of something. • The less than sign (<) shows that the value to the left of it is lower than the value to the right of it. The greater than sign (>) shows that the value to the left of it is higher than the value to the right of it. • Know that, when comparing numbers, they should compare the highest place value column first (10s), then move onto the ones if the tens are equal. • When comparing three or more numbers, inequality symbols, such as < and >, should not be used.	• 10 and 20 have just 10s and no ones. 11 to 19 have one 10 and some ones. • Know that one 10 is equal to 10 ones. • Place value refers to the amount a digit is worth due to its position in a number. For example, the digit 2 in 25 is worth 20 (two tens). • The less than sign (<) shows that the value to the left of it is lower than the value to the right of it. The greater than sign (>) shows that the value to the left of it is higher than the value to the right of it.	• 10 10s make 100 and 100 ones make 100. • Three-digit numbers are made up of 10s, hundreds and ones. • Ascending is increasing in size. Descending is decreasing in size.	• Three-digit numbers are made up of 10s, hundreds and ones. • Rounding to the nearest 10 is adjusting the digits in a number, either up or down, to the nearest 10. For two or more-digit numbers, if the number to the right of the place value number that you are rounding is equal to or greater than five, round up. If the number to the right of the place value number that you are rounding is less than five, round down. This means, when rounding to the nearest 10, look at the ones digit. • Rounding to the nearest hundred is adjusting the digits in a number either up or down to the nearest hundred. For two or more-digit numbers, if the number to the right of the place value number that you are rounding is equal to or greater than five, round up. If the number to the right of the place value number that you are rounding is less than five, round down. This means, when rounding to the nearest 100, look at the tens digit. • 1000 is made up of 10 hundreds. • 1000 is made up of 10 hundreds. • Rounding to the nearest thousand is adjusting the digits in a number either up or down to the nearest thousand. For two or more-digit numbers, if the number to the right of the place value number that you are rounding is equal to or greater than five, round up. If the number to the right of the place value number that you are rounding is less than five, round down. This means, when rounding to the nearest thousand, look at the hundreds digit. • There are two 25s in 50 and four 25s in 100. • The numbers below zero, negative numbers, have a '-' sign in front of them. • In Roman numerals, I=1, V=5, X=10, L=50 and C=100. All numbers between one and 100 can be written using a combination of these numerals. If a lower value numeral is placed after a higher value numeral, it indicates that they should be added together. For example, VI=6 (5+1). If a lower value is placed before a higher value numeral, it should be subtracted from the higher value. For example, IX=9 (10–1).	• Rounding to the nearest 10 is adjusting the digits in a number either up or down to the nearest 10. For two or more-digit numbers, if the number to the right of the place value number that you are rounding is equal to or greater than five, round up. If the number to the right of the place value number that you are rounding is less than five, round down. This means, when rounding to the nearest 10, look at the ones digit. • Rounding to the nearest 100 is adjusting the digits in a number either up or down to the nearest hundred. For two or more-digit numbers, if the number to the right of the place value number that you are rounding is equal to or greater than five, round up. If the number to the right of the place value number that you are rounding is less than five, round down. This means, when rounding to the nearest 100, look at the 10s digit. • The term-to-term rule allows you to find the next number in a sequence if you know the previous term or terms. • Focus on the highest place value when comparing numbers. • In Roman numerals, I=1, V=5, X=10, L=50, C=100, D=500 and M=1000. All numbers can write using a combination of these. Years are sometimes written in Roman numerals. For example, 2020 is MMXX. • Multiplying or dividing by 10 twice has the same effect as multiplying or dividing by 100 and multiplying or dividing by 10 three times has the same effect as multiplying or dividing by 1,000.	Multiplying or dividing by 10 twice has the same effect as multiplying or dividing by 100 and multiplying or dividing by 10 three times has the same effect as multiplying or dividing by 1,000.

Skills	•Subitise (recognise quantities without counting) up to 5. •Automatically recall (without reference to rhymes, counting and other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts. •Verbally count beyond 20, recognising the pattern of the counting system. •Compare quantities up to 10 in different contexts, recognising when one quantity is greater than, less than or the same as the other quantity.	• Sort objects into groups by characteristics. • Begin to count objects that have been sorted into groups from one to 10. • Count objects that have been sorted into groups from one to 10. • Identify and represent numbers using concrete objects and pictorial representations. • Find consecutive and non-consecutive missing numbers in sequences counting forwards. • Find consecutive and non-consecutive missing numbers in sequences counting backwards. • Identify one more than a given number within 10. • Identify one less than a given number within 10. • Match one object with another. • Compare groups of objects using the language of equal to, more, more than, greater than, less, less than and fewer. • Use <, > and = signs to compare numbers within 10. • Compare numbers using the language: 'greatest, largest, smallest, more than, less than, least, most' and 'equal to'. Justify the order of numbers using their counting, sorting and grouping knowledge. • Order three groups of objects and use the language 'greatest and smallest'. • Order numbers within 10 using the language 'greatest, largest, smallest, more than, less than, least, most' and 'equal to'. Justify the order of numbers using their place value knowledge. • Use ordinal numbers to compare position. • Use a number line to 10 to: * Count to 10 * See one more/one less * See greater than/less than statements * Order numbers • Find consecutive and non-consecutive missing numbers in sequences, counting forwards and backwards, including numbers 11 to 20. • Represent numbers 11 to 20 in different ways. • Read and write numbers to 20 in numerals and words. • Partition number 11 to 19 into a 10 and ones. • Identify one more and one less than a given number within 20. • Use vocabulary of comparison such as: greater than, less than and equal to compare groups of objects including those greater than 10. • Use <, > and = signs to compare numbers within 20. • Order up to three groups of objects within 20. • Order up to three abstract digits from 0 to 20. • Count to 50, beginning with 0 or 1, or from any given number. • Count forwards and backwards to and from 50 from any given number. • Represent numbers to 50 and partition a two digit number into 10s and ones. • Identify one more or less than a given number, using numbers to 50. • Use the language of equal to, more than, less than (fewer), most and least in various mathematical contexts. • Use <, > and = signs to compare numbers within 50. • Order numbers within 50 using the language 'largest, smallest, more than, less than, least, most' and 'equal to', and justify the order of numbers using their place value knowledge. • Count in multiples of two from 20 to 50. Count in multiples of five from 20 to 50. Count to 100, beginning with zero or one, or from any given number. • Group in 10s to identify how many 10s and ones are within numbers up to 100. • Use <, > and = signs and language to begin comparing numbers up to 100. • Compare numbers and amounts using <, > and = signs and language 'more than, less than' and 'equal to'. • Order sets of objects and numbers from smallest to largest and largest to smallest, using the language 'most, bigger, biggest, larger, largest, smaller, smallest' and 'least'. Identify one more or less than a given number, using numbers to 100.	• Consolidate finding consecutive and non-consecutive missing numbers in sequences, counting forwards and backwards, including numbers 11 to 20. • Consolidate partitioning number 11 to 19 into a 10 and ones • Consolidate counting to 50, beginning with zero or one, or from any given number. • Consolidate represent numbers to 50 and partition a two digit number into 10s and ones. • Consolidate using <, > and = signs to compare numbers within 50. • Read and write numbers to at least 100 in numerals and words. • Recognise the place value of each digit in a two-digit number (ones and tens). • Partition numbers in a variety of ways, not just as 10s and ones. For example, 58 is made up of five 10s and eight ones or four 10s and 18 ones, or two 10s and 38 ones. • Explore how 10s and ones can be partitioned and recombined to make a total. • Use concrete, pictorial and abstract representations correctly in a place value chart. • Identify and find the position of numbers on number lines. • Estimate the position of numbers on number lines and the value of a given position on a number line. • Compare a variety of groups of objects using the language 'equal to, more, more than, greater than, less, less than, fewer' and the symbols <, > and =. • Use <, > and = signs to write number sentences. • Compare and order numbers from zero up to 100. • Consolidate counting in multiples of two. • Consolidate counting in multiples of five. • Consolidate count in multiples of 10. • Count in multiples of three	• Consolidate recognising the place value of each digit in a two digit number (ones and 10s). • Consolidate exploring how tens and ones can be partitioned and recombined to make a total. • Explore 100. • Demonstrate using base 10, concrete and pictorial representations, including place value grids, how hundreds are bigger than 10s and how 10s are bigger than ones. • Partition numbers to 1,000 into hundreds, tens and ones, and know the value of any given digit in a 3-digit number. • Flexibly partition numbers to 1,000 in different ways, for example, 367 can be partitioned as 200 + 160 + 7, or 220 +130 + 17. • Read and write three digit numbers on a place value grid. • Estimate, work out and write numbers on a number line to 100. • Estimate, work out and write numbers on a number line to 1000. • Find 10 and 100 more or less than a given number. • Use <, > and = signs to compare objects and numbers up to 1000. • Compare and order numbers up to 1000. • Count in steps of 50 from any multiple of 50, both forwards and backwards.	• Consolidate, using base 10 concrete and pictorial representations, including place value grids, the understanding of how hundreds are bigger than 10s and how 10s are bigger than ones. • Consolidate reading and writing three digit numbers on a place value grid. • Consolidate estimating, working out and writing numbers on a number line to 1000. • Round any three digit number to the nearest 10. • Round any three digit number to the nearest hundred. • Explore 1000. • Explore numbers beyond 1000, up to 10,000. • Represent numbers to 10,000 using a range of concrete materials. • Partition numbers in a variety of ways, not just as thousands, hundreds, 10s and ones. For example, 5000 + 300 + 20 + 9 is equal to 4000 + 1300 + 10 + 19. • Recognise the place value of each digit in a four digit number (thousands, hundreds, tens and ones). • Estimate, work out and write numbers on a number line to 10,000. • Consolidate finding 10 and 100 more or less than a given number. • Find 1000 more or less than a given number. • Compare and order numbers beyond 1000, up to 10,000. • Round any four digit number to the nearest 1000. • Round any number to the nearest 10, 100 or 1000. • Use number facts to count in 25s. • Count backwards through zero to include negative numbers. • Explore Roman numerals up to 100 (I to C).	• Consolidate representing numbers to 10,000 using a range of concrete materials. • Represent numbers to 10,000, adding and subtracting 10, 100 and 1000 and discussing what happens to the place value columns. • Consolidate rounding any three digit number to the nearest 10. • Consolidate rounding any three digit number to the nearest 100. • Round any four digit number to the nearest 10, hundred or thousand. • Represent numbers on a place value grid to 100,000 and use a number line to find numbers between two points. Place a number and estimate where larger numbers will be. • Find numbers 10/100/1,000/10,000/100,000 more or less than a given number. • Partition numbers to 1,000,000 in the standard way (thousands, hundreds, tens and ones) as well as in more flexible ways, for example 15,875 = 14,875 + 1,000 and 15,875 = 13,475 + 2,400. • Explore number lines up to 1,000,000. • Compare and order numbers up to 100,000. • Round any number to 100,000 using understanding of multiples of 10, 100, 1000 and 10,000. • Read, write and represent numbers to 1,000,000. • Complete number sequences using counting forwards and backwards in powers of 10 up to 1,000,000. • Use <, > and = signs and language to compare and order numbers up to 1,000,000. • Round numbers to six digits, including rounding to the nearest 100,000, and explain where rounding in context is different than expected. • Explore negative numbers and their position on a number line. Count back through zero and use negative numbers in context, such as temperature. • Read Roman numerals up to 1000 (M) and recognise years written in Roman numerals.	• Consolidate representing numbers to 10,000, adding and subtracting 10, 100 and 1000 and discussing what happens to the place value columns. • Consolidate representing numbers on a place value grid to 100,000 and use a number line to find numbers between two points. Place a number and estimate where larger numbers will be. • Consolidate reading, writing and representing numbers to 1,000,000. • Read, write and represent numbers to ten million in different ways. • Use place value knowledge to identify integers 10, 100, 1,000 times the size, one-tenth, one-hundredth, or one-thousandth the size of other integers. • Explore the the number line to 10,000,000. • Compare and order numbers, presented in different ways, up to ten million. • Consolidate rounding any four digit number to the nearest 10, hundred or thousand. • Round any whole number to 10,000,000. • Understand negative numbers through counting forwards and backwards through zero. Find intervals across zero in relevant contexts.
Vocabulary	count subitise order/ordinal compare forwards backwards numerals digit one more one less equal to greater/more than less than (fewer) Largest Smallest Least Most	sort represent multiples partitioning ones tens two digit	count in steps count in multiples place value estimate compare >,<	ascending descending 10 or 100 more 10 or 100 less Hundreds Three digit numbers	negative numbers roman numerals 1000 more 1000 less thousands round Four- digit numbers	ten thousands one hundred thousands powers of integer five digit number	Millions ten millions

Mathematics Progression: Addition and Subtraction

Year 1 Statutory Requirements

- read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 =___ – 9.

Year 2 Statutory Requirements

solve problems with addition and subtraction:

- 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:
- a two-digit number and ones
- a two-digit number and ten
- 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 solve missing number problems.

Year 3 Statutory Requirements

- add and subtract numbers mentally, including:
- a three-digit number and 1s
- a three-digit number and 10s
- a three-digit number and 100s
- add and subtract numbers with up to 3 digits, using formal written methods of columnar addition and subtraction
- 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

Year 4 Statutory Requirements

- add and subtract numbers with up to 4 digits using the formal 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/

Year 5 Statutory Requirements

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- 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.

Year 6 Statutory Requirements

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers
- use their knowledge of the order of operations to carry out calculations involving the 4 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, an appropriate degree of accuracy

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	• Have a deep understanding of number to 10, including the composition of each number.	• Whole is all of something. Parts or groups are amounts which, when added together, makes up the whole of something. • Altogether is when everything, every item in a part or group, is added together. • A number can be partitioned into two or more parts. • '+' represents add or plus and ' =' represents is equal to (equals). • Adding two numbers in a different order gives the same answer. • Adding parts together gives a total. • Know that they are adding to what they already have and should not include their start number when counting on. • Know that they are adding to what they already have and should not include their start number when counting on. • When nothing is taken away, the whole remains the same. • The '-' symbol represents taking away. When nothing is taken away, the whole remains the same. • Know that when nothing is taken away, the start number remains the same, or when the whole group is taken away, there will be nothing left. • 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are one digit numbers. One digit numbers are made up of one digit or number. Two digit numbers are made up of two digits, such as 12 or 20. • Addition (+) is putting two or more numbers or objects together to give a larger number (the total). Subtraction (–) is removing or taking away numbers or objects. What is left is the difference between the two numbers. The equals sign (=) shows that things on both sides of it have the same value. • Addition and subtraction are inverse operations. Addition is commutative but subtraction is not. The less than sign (<) shows that the value to the left of it is lower than the value to the right of it. The greater than sign (>) shows that the value to the left of it is higher than the value to the right of it.	• 10 ones is the same as one 10. • Add the ones first when using the column method. 10 ones is the same as one 10.	• Adding a 10 can change the 10s and hundreds columns. • Estimate means to quickly find, with some thought of the calculation, an approximate value close to the right answer. • Inverse operations are opposites that reverse the effect of the other operation. Addition and subtraction are inverse operations.		Adding two numbers in a different order gives the same answer - commutative. Addition is commutative, subtraction is not.	Adding two numbers in a different order gives the same answer - commutative. Addition is commutative, subtraction is not.
Skills	• Automatically recall (without reference to rhymes, counting and other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts.	• Separate a whole number of items into two parts (groups). • Count the items in two parts or groups to make a whole. • Separate a whole number of items into two parts (groups) and count the items in two parts to demonstrate how many there are altogether. • Count the items in two parts to find how many there are altogether. • Create a number sentence using '+' and '='. • Add two numbers within 10 and recognise that addition is commutative. • Break numbers into different parts. • Partition numbers into parts systematically. • Explore number bonds to 10 through a variety of representations, including fingers. • Compare numbers bonds using the '=' , '<' and '>' symbols. • Use '+' and '=' accurately when solving simple additions within 10. • Add by counting on. • Find all number bonds of numbers within 10. • Count on from a given part to the whole to find the missing part. • Add by counting on. • Consolidate exploring number bonds to 10 through a variety of representations, including fingers. • Use number bonds to 10 to find number bonds to 20. • Add numbers within 20 using knowledge of number bonds. • Use the language of subtraction in real life contexts. • Complete subtraction number sentences using the '-' symbol. • Break apart a number into two parts, using concrete and pictorial representations to support. • Count backwards to subtract by 'putting the start number in our head and counting backwards'. • Find the difference by counting back, counting on or making both amounts to visually show how many more/less. • Recognise and use the subtraction symbol within 20, not crossing 10. • Use the strategy of partitioning to make ten to support subtraction crossing 10. • Subtract one digit and two digit numbers within 20, crossing 10. • Complete addition and subtraction using a number line. • Read, write and interpret simple mathematical statements involving addition (+), subtraction (–) and equals (=) signs. • Use concrete manipulatives and drawn images to complete inequality and 'equal to' statements, involving comparing a simple statement to an integer. • Compare two calculations, both addition and subtraction, using the symbols <, > and =. • Explore addition and subtraction fact families for numbers within 20. • Use <, > and = signs to compare numbers within 20. • Solve simple age-appropriate problems with addition and subtraction, using concrete objects, pictorial representations, and missing number problems.	• Demonstrate knowledge of all number bonds to 10. • Identify multiples of 10 bonds to 100, recognising the link between single digit bonds and 10s bonds. • Consolidate adding numbers within 20 using knowledge of number bonds. • Consolidate using number bonds to 10 to find number bonds to 20. • Find number bonds to 100 with tens and ones. • Add three one digit numbers, using commutativity to increase efficiency. • Consolidate using the strategy of partitioning to make ten to support subtraction crossing 10. • Identify, using +, - and = symbols, number facts within 20. • Discuss and share strategies, including using the inverse to check addition and subtraction calculations. • Use <, > and = sign to compare number sentences. • Find missing values in number sentences with familiar number within 20 using structure and spotting patterns. • Use related number facts of 10s and ones' to solve addition and subtraction calculations. • Recognise the pattern of digits when add and subtract one. • Explore, on a 100 square, where the 10s digit changes when the ones digit stays the same. • Add and subtract 10s from a given number within 100. • Apply their increasing knowledge of mental and written methods to solve simple problems with addition and subtraction, using concrete objects and pictorial representations, including those involving numbers, quantities and measures. • Add two digits and one digit including crossing 10. • Add two digit numbers not crossing 10, including column method. • Add two digit numbers crossing 10, using partitioning and exchange. • Subtract one digit from two digits, including crossing ten. • Subtract a two digit number from a two digit number, without crossing ten. • Subtract a two digit number from a two digit number crossing ten.	• Recall all the number bonds to and within 10 in a variety of contexts, and consolidate using number bonds to 10 to recall number bonds to 100. • Consolidate adding two digits and one digit, including crossing ten. • Find complements to 100. • Consolidate subtracting one digit from two digits, including crossing 10. • Apply prior understanding of adding and subtracting ones and 10s to adding and subtracting multiples of 100. • Consolidate recognising the pattern of digits when adding and subtracting one. • Add and subtract three digit and one digit numbers, not crossing 10. • Observe and explore what happens when a multiple of 10 is added or subtracted from a three digit number. • Add and subtract 100s. • Focus on the position of numbers and place value to add and subtract two digit and three digit numbers. • Predict answers and develop number sense by looking for patterns between calculations. • Solve problems, including missing number problems, using number facts, place value and more complex addition and subtraction. • Add three digit and two digit numbers, including crossing 10. • Add multiples of 10 to a three digit number with an exchange. • Consolidate adding two digit numbers crossing 10, using partitioning and exchange. • Add two digit and three digit numbers, including exchanging in more than one column. • Add two three digit numbers with no exchange. • Add two three digit numbers with an exchange. • Subtract one digit from three digits, including crossing 10. • Subtract multiples of 10 from a three digit number, with an exchange. • Consolidate subtracting a two digit number from a two digit number, crossing 10. • Focus on the position of numbers and place value to subtract two digits from three digits using the column method. • Subtract three digits from three digits, including the use of column subtraction. • Subtract three digits from three digits, including exchanging, for example, in more than one column. Estimate the answer to a calculation and use inverse operations to check answers. • Use inverse operations to check answers.	• Add and subtract 1000s. • Consolidate adding two three digit numbers with no exchange. • Add two four digit numbers with no exchange. • Consolidate adding two three digit numbers with an exchange. • Add two four digit numbers with an exchange. • Add two four digit numbers with more than one exchange. • Consolidate subtracting three digits from three digits, including the use of column subtraction. • Subtract two four digit numbers with no exchange. • Consolidate subtracting three digits from three digits, including exchanging in more than one column. • Subtract two four digit numbers with one exchange. • Subtract two 4-digit numbers with more than one exchange. • Find the most efficient methods for subtractions by comparing column subtraction and mental methods. • Round to the nearest 10, 100 and 1000 to estimate answers. • Use inverse operations to check answers, working with increasingly large numbers.	• Add and subtract numbers using mental strategies with increasingly large numbers. • Solve addition and subtraction multistep problems in different contexts. • Consolidate adding two four digit numbers with an exchange. • Consolidate adding two four digit numbers with more than one exchange. • Add numbers with more than four digits, using place value to line the numbers up correctly for column addition. • Consolidate subtracting two four digit numbers with one exchange. • Consolidate subtracting two four digit numbers with more than one exchange. • Subtract numbers with more than four digits, including exchange using the formal column method. • Round numbers to support estimating answers for calculations using the term approximate. • Use inverse operations to check addition and subtraction answers.	• Add and subtract integers with any number of digits using the formal column method or mental strategies, applying their understanding of place value. • Consolidation of solving addition and subtraction multistep problems in different contexts. • Solve addition and subtraction multistep problems in different contexts, deciding which operations and methods to use and explaining their choices. • Consolidate adding numbers with more than four digits, using place value to line the numbers up correctly for column addition. • Consolidate subtracting numbers with more than four digits, including exchange using the formal column method. • Consolidate using inverse operations to check addition and subtraction answers.
Vocabulary	add plus altogether total take away /minus number bonds part whole digit	addition/add subtraction difference equals facts problems missing number problems 2-digit number inverse	sum 3-digit number commutative	column addition column subtraction exchange estimate	4-digit number operations methods		

Mathematics Progression: Multiplication and Division

Year 1 Statutory Requirements

Pupils should be taught to:

- solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations, and arrays with the support of the teacher.

Year 2 Statutory Requirements

Pupils should be taught to:

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Year 3 Statutory Requirements

Pupils should be taught to:

- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- 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 formal written methods
- solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects

Year 4 Statutory Requirements

Pupils should be taught to:

- 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 3 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
- solve problems involving multiplying and adding, including using the distributive law to multiply two-digit numbers by 1 digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects

Year 5 Statutory Requirements

Pupils should be taught to:

- identify multiples and factors, including finding all factor pairs of a number, and common factors of 2 numbers.
- know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers.
- establish whether a number up to 100 is prime and recall prime numbers up to 19.
- multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers.
- multiply and divide numbers mentally, drawing upon known facts..
- divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1,000.
- recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3})
- solve problems involving multiplication and division, including using their knowledge of factors and multiples, squares and cubes.
- 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.

Year 6 Statutory Requirements

Pupils should be taught to:

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context.
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context.
- perform mental calculations, including with mixed operations and large numbers.
- identify common factors, common multiples and prime numbers.
- use their knowledge of the order of operations to carry out calculations involving the 4 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, an appropriate degree of accuracy.

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	• Have a deep understanding of number to 10, including the composition of each number	• In an array, a row is across and a column is down. • Double is two groups of a number or amount. Doubling is adding the same number to itself.	• In an array, a row is across and a column is down. • Know and recognise the multiplication symbol and that multiplication is repeated addition. • An array is an arrangement of objects, numbers or pictures in columns and rows. • Double is two groups of a number or amount. Doubling is adding the same number to itself. • Know and recognise the division symbol. • Know and recognise the division symbol. • Division is the opposite of multiplication. • Grouping and counting in 10s is more efficient than sharing into 10 equal groups.	• Doubling and doubling again is the same as multiplying by four. • Halving and halving again is the same as dividing by four. • Each multiple of eight is double its equivalent multiple of four. • Know and recognise the division symbol. • A remainder is the whole number left over after a division calculation when one number does not divide exactly into another. • A remainder is the whole number left over after a division calculation when one number does not divide exactly into another. • Multiplication is the opposite of division. • Grouping and counting in 10s is more efficient than sharing into 10 equal groups. • One number in the calculation, 10 times bigger, will result in the answer being 10 times bigger.	• 'Ten times bigger' is the same as 'multiply by 10'. • Each multiple of six is double its equivalent multiple of three. • Each multiple of nine is one less than the equivalent multiple of 10. • The 'Associative Law' is that, in addition and multiplication, it does not matter how the numbers are grouped. • A factor is a whole number that multiplies by another number to make a product, such as 3×5=15, factor × factor = product. Factor pairs are two numbers that multiply together to make a particular number. For example, 2x4=8, so two and four are a factor pair of eight. • A remainder is the whole number left over after a division calculation when one number does not divide exactly into another. • Multiplication and division are inverse operations. • A remainder is the whole number left over after a division calculation when one number does not divide exactly into another. • Scaling involves multiplying or dividing measures or integers to increase or decrease a measurement or quantity.	• Factors are the whole numbers that you multiply together to get another whole number (factor × factor = product). Factors come in pairs. • Numbers have the same factors these are called common factors. • Prime numbers have exactly two factors, one and itself. One is not a prime number because it does not have exactly two factors (it only has one factor). • Square numbers have an odd number of factors and are the result of multiplying a whole number by itself. The notation for squared is ^{2}. • A cube number is the result of multiplying a whole number by itself three times. The notation for squared is ^{3}.	• Numbers that are not prime numbers are called composite numbers. • The dividend is the number being divided. The divisor is the number that the dividend is being divided by. • In mixed operation calculations, calculations are not carried out from left to right. No operation sign means multiply. 4(2+1) means 4x(2+1).
Skills	• Automatically recall (without reference to rhymes, counting and other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts. • Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally	• Revise counting in multiples of two, up to 50. • Revise counting in multiples of five, up to 50. • Count in multiples of 10. • Explore making equal groups and write statements, such as 'there are __ groups of __.' • Add equal groups to find a total, counting equal groups of two, five and 10, and explore this within 50. • Make arrays. • Double small quantities, using concrete objects and pictorial representations. • Make groups of an equal amount from a given total. • Share concrete objects into equal groups, observe that sometime the number of objects cannot be shared equally.	• Mentally calculate mathematical statements for multiplication within the two times tables. • Mentally calculate mathematical statements for multiplication within the five times tables. • Mentally calculate mathematical statements for multiplication within the 10 times tables. • Recognise and make equal groups and write statements, such as 'there are __ groups of __.' • Redistribute from unequal to equal groups. • Consolidate adding equal groups to find a total, counting equal groups of two, five and 10, and explore this within 50. • Consolidate making arrays. • Make equal groups. • Add equal groups, connecting this to repeated addition. • Link repeated addition and multiplication together. • Use the multiplication symbol and work out the total from pictures. Interpret a multiplication word problem by drawing images to help solve it. • See, using arrays, that multiplication facts are commutative. • Consolidate doubling small quantities, using concrete objects and pictorial representations. • Consolidate making groups of an equal amount from a given total. • Continue to make groups of an equal amount from a given total and consolidate sharing concrete objects into equal groups, observe that sometimes the number of objects cannot be shared equally. • Divide by sharing objects into equal groups with concrete objects then pictorial representations. • Divide by making equal groups, then count on to find the total number of groups. • Use grouping and sharing to be able to solve simple division problems. • Explore odd and even numbers and their structure using concrete manipulatives. • Use grouping or sharing to answer questions and use the five times table to support division by five. • Use grouping and sharing, depending on the context of the problem, to divide by 10.	• Consolidate identifying multiples of 2, 5 and 10, showing fluency with the facts in the 2,5 and 10 times-tables. • Consolidate mentally calculating mathematical statements for multiplication within the two times tables. • Consolidate mentally calculating mathematical statements for multiplication within the five times tables. • Explore problems involving multiplying by three using knowledge of counting in threes. • Mentally calculate mathematical statements for multiplication within the three times tables. • Mentally calculate mathematical statements for division within the three times tables. • Mentally calculate mathematical statements for multiplication within the four times tables. • Mentally calculate mathematical statements for division within the four times tables. • Mentally calculate mathematical statements for multiplication within the eight times tables. • Mentally calculate mathematical statements for division within the eight times tables. • Consolidate mentally calculating mathematical statements for multiplication within the two, four and eight times tables. • Recognise, add and make equal groups. • Consolidate linking repeated addition and multiplication together. • Consolidate using arrays to see that multiplication facts are commutative. • Consolidate dividing by sharing objects into equal groups with concrete objects and pictorial representations. • Consolidate dividing by making equal groups, then count on to find the total number of groups. • Consolidate using grouping and sharing to be able to solve simple division problems. • Multiply two digits by one digit using the formal method of column multiplication with no exchange. • Multiply two digits by one digit using the formal method of column multiplication with exchange. • Divide two digit numbers by a one digit number by partitioning into 10s and ones and sharing into equal groups, using numbers that do not involve exchange or remainders. • Divide two digit numbers by a digit number by partitioning into 10s and ones and sharing into equal groups, using numbers that involve exchanging between the 10s and ones. The answers do not have remainders. • Divide 100 into two, four, five and 10 equal parts. • Explore division with remainders using concrete objects, pictorial representations and arrays. • Divide two digit numbers by a one digit number by partitioning into 10s and ones and sharing into equal groups, using numbers that involve exchanging between the 10s and ones and give answers with remainders. • Consolidate using grouping or sharing to answer questions and use the five times table to support division by five. • Consolidate using grouping and sharing, depending on the context of the problem to divide by 10. • Compare multiplication and division facts using inequality symbols. • Solve multiplication problems using known multiplication facts. • Solve simple scaling problems using the vocabulary 'times as many'. • List systematically, then calculate without listing, the possible combinations resulting from two groups of objects.	• Mentally calculate mathematical statements for multiplication within the 10 times tables. • Explore problems involving multiplying by three, using knowledge of counting in threes and consolidate mentally calculating mathematical statements for division within the three times tables. • Consolidate mentally calculating mathematical statements for multiplication within the three times tables. • Mentally calculate mathematical statements for multiplication and division within the six times tables. • Mentally calculate mathematical statements for multiplication and division within the nine times tables. • Explore the 11 times-table. • Explore the 12 times-table. • Recall and use multiplication and division facts for all times tables up to 12 (12x12). • Multiply by 100, exploring the links with multiplying by 10 and what is happening to the value of the digits. • Multiply by one and zero exploring the results. • Multiply together three numbers. • Change the order of numbers in multiplication to group them more efficiently through an understanding of commutativity and the 'Associative Law' • Demonstrate an understanding of factor pairs using concrete resources. • Use partitioning of two digit numbers into 10s and ones, or into factor pairs, in order to multiply one and two digit numbers. • Divide by 10, with whole number answers, exploring what is happening to the value of the digits. • Divide by 100, with whole number answers. • Demonstrate how both the sharing and grouping structures of division can be used to divide a number by one or itself. • Use a variety of informal written methods to multiply a two digit and a one digit number, understanding when to use a mental method to multiply and when to represent thinking by showing working. • Consolidate multiplying two digits by one digit using the formal method of column multiplication with no exchange. • Apply knowledge of exchanging 10 ones for one 10 in multiplication, including exchanging multiple groups of 10s in moving towards the formal short multiplication method. • Multiply two digit and three digit numbers by any one digit number, using a formal written method. • Consolidate dividing two digit numbers by a one digit number by partitioning into 10s and ones and sharing into equal groups. Divide numbers that involve exchanging between the 10s and ones. The answers do not have remainders. • Divide two digit numbers by a one digit number by sharing into equal groups where the 10s and ones are divisible by the divisor. Divide numbers that involve exchanging between the 10s and ones. • Use place counters to divide two digit numbers by one digit numbers involving remainders. • Use place counters to divide three digit numbers by one digit numbers with and without remainders. • Solve multiply and divide by 6 problems using knowledge of equal groups, with concrete and pictorial supporting methods. • Solve multiply and divide by 9 problems. • Solve multiply and divide by seven problems, exploring commutativity. • Apply multiplication facts, including the seven times table, to solve problems. • Consolidate solving division problems linking division with repeated subtraction. Include problems with a remainder. • Solve increasingly challenging integer scaling and correspondence problems, in which n objects are connected to m objects.	• Consolidate mentally calculating mathematical statements for multiplication within the 10 times tables. • Find multiples of whole numbers. • Use arrays to show the relationship between multiplication and division. • Find the common factors of two numbers, compare with arrays and display results in a Venn diagram. • Establish if a number up to 100 is prime and recall all prime numbers up to 19 (2, 3, 5, 7, 11, 13, 17 & 19). • Establish if a number is a square number using arrays. • Establish if a number is a cube number. • Consolidate multiplying by 100, exploring the links with multiplying by 10 and what is happening to the value of the digits. • Multiply by 1000, explaining the number of places to the left on a place value grid. Digits move when multiplied by different multiples of 10. • Use understanding of multiples of zero, 100 and 1000 to answer related questions. • Consolidate dividing by 10, with whole number answers, exploring what is happening to the value of the digits. • Consolidate dividing by 100, with whole number answers. • Divide by 10, 100 and 1000 explaining the number of places to the right on a place value grid. Digits move when dividing by different powers of 10. • Consolidate applying knowledge of exchanging 10 ones for one 10 in addition in multiplication, including exchanging multiple groups of 10s in moving towards the formal short multiplication method. • Consolidate multiplying two digit and three digit numbers by any one digit number, using a formal written method. • Multiply numbers with up to four digits by one digit numbers, using a formal written method. • Use the area model of multiplication. • Multiply two digits by two digits using a formal written method. • Multiply three digits by two digits using a formal written method. • Multiply four digits by two digits using a formal written method. • Consolidate dividing two digit numbers by a one digit number by sharing into equal groups where the 10s and ones are divisible by the divisor. Divide numbers that involve exchanging between the tens and ones. • Consolidate using place counters to divide two digit numbers by one digit numbers involving remainders. • Consolidate using place counters to divide three digit numbers by one digit numbers with and without remainders. • Divide up to four digit numbers by a one digit number. • Use place counters to partition and then group numbers to develop short division method with remainders.	• Consolidate using arrays to show the relationship between multiplication and division. • Find the common factors of two numbers, using mental methods and knowledge of multiples and display results in Venn diagrams and tables. • Find common multiples of numbers. • Find the prime factors of numbers. • Develop the understanding of square and cube numbers. • Explore divisibility strategies, for example, by looking for patterns in times tables or using knowledge of factors and repeated division. • Use knowledge of factors to explain the relationship between dividend and divisor. • Consolidate multiplying numbers with up to four digits by a one-digit numbers, using a formal written method. • Consolidate using the area model of multiplication. • Consolidate multiplying two digits by two digits using a formal written method. • Consolidate multiplying three digits by two digits using a formal written method. • Multiply numbers with up to four digits by a two-digit number using the formal written method of long multiplication. • Consolidate dividing up to four digit numbers by a one digit number. • Consolidate using place counters to partition and then group numbers to develop short division method with remainders. • Divide up to four digit numbers by up to two digit numbers using the short division method. • Divide three digit numbers by a two digit number without remainders, starting with a more expanded method (with multiples shown), before progressing to the more formal long division method. • Divide four digit numbers by two digit numbers using the long division method. • Divide using long division method where answers have remainders, checking that the remainder is smaller than the divisor. • Divide four digit numbers using long division method where answers have remainders, interpreting the remainder as appropriate or not applicable depending on context. • Solve multiplication problems in different contexts. • Solve division problems in different contexts. • Complete mixed operation calculations. • Select the appropriate mental strategy over computational methods to improve efficiency. • Determine, by using known facts from one calculation and an understanding of commutativity and inverse operations, the answer of similar calculation without starting afresh. • Use mental strategies and estimation to check answers to calculations.
Vocabulary	double half twice as many equal unequal share group odd even	multiplication division arrays	multiplication tables commutative repeated addition	exchange mathematical statements missing number problems integer scaling problems correspondence problems derived facts	factor pairs formal written layout distributive law remainders	multiples factors prime numbers square numbers cube numbers short division product dividend divisor quotient operations	multi-digit numbers long division

Mathematics Progression: Fractions (including decimals LKS2 & decimals and percentages UKS2)

Year 1 Statutory Requirements

Pupils should be taught to:

- 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 parts of an object, shape or quantity.

Year 3 Statutory Requirements

Pupils should be taught to:

- 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 [for example, $\frac{5}{7} + \frac{1}{7} = \frac{6}{7}$]
- compare and order unit fractions, and fractions with the same denominators
- solve problems that involve all of the above

Year 4 Statutory Requirements

Pupils should be taught to:

- recognise and show, using diagrams, families of common equivalent fractions
- count up and down in hundredths; recognise that hundredths arise when dividing an object by 100 and dividing tenths by 10
- 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
- add and subtract fractions with the same denominator
- recognise and write decimal equivalents of any number of tenths or hundreds
- 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 ones, tenths and hundredths
- round decimals with 1 decimal place to the nearest whole number
- compare numbers with the same number of decimal places up to 2 decimal places
- solve simple measure and money problems involving fractions and decimals to 2 decimal places

Year 2 Statutory Requirements

Pupils should be taught to:

- 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
- write simple fractions for examples, $\frac{1}{2}$ of 6 = 3 and recognise the equivalences of 2/4 and $\frac{1}{2}$.

Year 5 Statutory Requirements

Pupils should be taught to:

- compare and order fractions whose denominators are all multiples of the same number
- identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths
- recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number [for example, $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$]
- add and subtract fractions with the same denominator, and denominators that are multiples of the same number
- multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
- read and write decimal numbers as fractions [for example, 0.71 = $\frac{71}{100}$]
- recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- round decimals with 2 decimal places to the nearest whole number and to 1 decimal place
- read, write, order and compare numbers with up to 3 decimal places
- solve problems involving number up to 3 decimal places
- recognise the per cent symbol (%) and understand that per cent relates to 'number of parts per 100', and write percentages as a fraction with denominator 100, 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 fractions with a denominator of a multiple of 10 or 25

	Year 6 Statutory Requirements Pupils should be taught to: • use common factors to simplify fractions; use common multiples to express fractions in the same denomination • compare and order fractions, including fractions >1 • 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 [for example, $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$] • divide proper fractions by whole numbers [for example, $\frac{1}{3} \div 2 = \frac{1}{6}$] • associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, $\frac{3}{8}$] • identify the value of each digit in numbers given to 3 decimal places and multiply and divide numbers by 10, 100 and 1,000 giving answers up to 3 decimal places • multiply one-digit numbers with up to 2 decimal places by whole numbers • use written division methods in cases where the answer has up to 2 decimal places • solve problems which require answers to be rounded to specified degrees of accuracy • recall and use equivalences between simple fractions, decimals and percentages, including in different contexts

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	• Have a deep understanding of number to 10, including the composition of each number	• A half is one of two equal parts of a whole object or shape. • A half is one of two equal parts of a quantity. • A quarter is one of four equal parts of a whole object or shape. • A quarter is one of four equal parts of a quantity.	• A whole is one object or one quantity. A fraction is part of an object, shape or quantity that has been split into equal parts or groups. • Halving is splitting a whole into two equal parts. The numerator of a fraction is the top number and shows how many parts of a whole there are. The denominator of a fraction is the bottom number and shows into how many equal parts the item or number is divided. • Halving is the same as dividing by two. • One quarter is equal to one part out of four equal parts. • One third is equal to one part out of three equal parts. • The numerator of a fraction is the top number and shows how many parts of a whole there are. Unit fractions have a numerator of 1. The denominator of a fraction is the bottom number and shows into how many equal parts the item or number is divided. • The numerator and the denominator are the same when the fraction is equivalent to one whole. Non-unit fractions have a numerator greater than 1. • A fraction is part of an object, shape or quantity that has been split into equal parts or groups. The top number of a fraction shows the number of parts we are dealing with and the bottom number shows the number of equal parts into which something has been split. A quarter ($\frac{1}{4}$) is one of four equal parts of a whole object, shape or quantity. A half ($\frac{1}{2}$) is one of two equal parts. Two-quarters ($^{2}/_{4}$) is two of four equal parts. A third ($\frac{1}{3}$) is one of three equal parts.	• A whole is one object or one quantity. A fraction is part of an object, shape or quantity that has been split into equal parts or groups. • Halving is splitting a whole into two equal parts. The numerator of a fraction is the top number, and shows how many parts of a whole there are. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • Halving is the same as dividing by 2. • One quarter is equal to one part out of four equal parts. • One third is equal to one part out of three equal parts. • The numerator of a fraction is the top number, and shows how many parts of a whole there are. Unit fractions have a numerator of one. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • The numerator and the denominator are the same when the fraction is equivalent to one whole. Non-unit fractions have a numerator greater than one. • A fraction is part of an object, shape or quantity that has been split into equal parts or groups. The top number of a fraction shows the number of parts that we are dealing with, and the bottom number shows the number of equal parts into which something has been split. A quarter ($\frac{1}{4}$) is one of four equal parts of a whole object, shape or quantity. A half ($\frac{1}{2}$) is one of two equal parts. Two quarters ($^{2}/_{4}$) is two of four equal parts. A third ($\frac{1}{3}$) is one of three equal parts. • The numerator of a fraction is the top number, and shows how many parts of a whole there are. Unit fractions have a numerator of one. Non-unit fractions have a numerator greater than one. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • Equivalence means of equal (the same) value. Equivalent fractions are fractions that have the same value. For example, $\frac{1}{2}$ and $\frac{1}{4}$, $\frac{1}{3}$ and $^{2}/_{6}$ or $\frac{1}{4}$ and $^{9}/_{12}$. The numerator of a fraction is the top number, and shows how many parts of the whole there are. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • Dividing something into more equal parts makes each part smaller. • When adding fractions with the same denominator, only the numerator is added. The denominators stay the same. • When subtracting fractions with the same denominator, only the numerators are subtracted. • A tenth is one divided by 10 ($\frac{1}{10}$). A tenth is one of 10 equal parts of an object, shape or quantity, and is written as 1/10. Tenths are calculated by dividing an object into ten equal parts or dividing a quantity by 10. For example, one tenth of 50 is 50 ÷ 10 =5. The number system extends to the right of the decimal point, into the tenths column.	• The numerator of a fraction is the top number, and shows how many parts of a whole there are. Unit fractions have a numerator of one. Non-unit fractions have a numerator greater than one. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • The numerator of a fraction is the top number, and shows how many parts of a whole there are. Unit fractions have a numerator of one. Non-unit fractions have a numerator greater than one. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • A tenth is one divided by 10 ($\frac{1}{10}$). A tenth is one of 10 equal parts of an object, shape or quantity and is written as $\frac{1}{10}$. Tenths are calculated by dividing an object into ten equal parts or dividing a quantity by 10. For example, one tenth of 50 is 50÷10=5. The number system extends to the right of the decimal point into the tenths column. • Equivalence means of equal (the same) value. Equivalent fractions are fractions that have the same value. For example, $\frac{1}{2}$ and $\frac{1}{4}$, $\frac{1}{3}$ and $^{2}/_{6}$ or $\frac{1}{4}$ and $^{9}/_{12}$. The numerator of a fraction is the top number, and shows how many parts of the whole there are. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • A family of equivalent fractions is a group of fractions that all have the same value but are written differently. For example, 1/2, 2/4, 4/8 and 3/6 are a family, and 3/4, 6/8 and 9/12 are a family. • The numerator of a fraction is the top number, and shows how many parts of a whole there are. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. Unit fractions have a numerator of one. Non-unit fractions have a numerator greater than one. • A proper fraction has a numerator less than the denominator. An improper fraction has a numerator equal to or greater than the denominator. A mixed number is the combination of a whole number (integer) and a proper fraction. • When adding fractions, only the numerators are added. The denominators stay the same. • When adding fractions, only the numerators are added. The denominators stay the same. • When subtracting fractions, only the numerators are subtracted. The denominators stay the same. • When subtracting fractions, only the numerators are subtracted. The denominators stay the same. • A tenth is one divided by 10 ($\frac{1}{10}$). A tenth is one of 10 equal parts of an object, shape or quantity, and is written as 1/10. Tenths are calculated by dividing an object into ten equal parts or dividing a quantity by 10. For example, one tenth of 50 is 50÷10=5. The number system extends to the right of the decimal point into the tenths column. • Ten hundredths are equivalent to one tenth. • A tenth is a part of a whole split into 10 equal parts. • A hundredth is one divided by 100 ($^{1}/_{100}$). A hundredth is one of 100 equal parts of an object, shape or quantity, and is written as 1/100. Hundredths are calculated by dividing an object into 100 equal parts or by dividing a quantity by 100. • The tenths column is to the right of the decimal • When dividing by 10, the number is being split into 10 equal parts and is 10 times smaller. Moving digits is an effective way of dividing by 10. • Moving digits is an effective way of dividing by 10. • The hundredths column is to the right of the decimal point and the tenths column. • Moving digits is an effective way of dividing by 100. • Look at the digit in the tenths column to understand whether to round a number up or not. If a number is exactly halfway, then by convention, we round up to the next integer.	• The numerator of a fraction is the top number, and shows how many parts of a whole there are. Unit fractions have a numerator of one. Non-unit fractions have a numerator greater than one. The denominator of a fraction is the bottom number, and shows into how many equal parts the item or number is divided. • A family of equivalent fractions is a group of fractions that all have the same value but are written differently. For example, 1/2, 2/4, 4/8 and 3/6 are a family, and 3/4, 6/8 and 9/12 are a family. • A proper fraction has a numerator less than the denominator. An improper fraction has a numerator equal to or greater than the denominator. A mixed number is the combination a whole number (integer) and a proper fraction. • A proper fraction has a numerator less than the denominator. An improper fraction has a numerator equal to or greater than the denominator. A mixed number is the combination a whole number (integer) and a proper fraction. • When the denominator or numerator of two or more fractions is the same, it is called a common denominator or common numerator. • When multiplying fractions the denominator remains the same, whilst the numerator is multiplied by the integer. • The order of a multiplication can change when using integers or fractions without changing the product. • % is the symbol for percent, which is the number of parts per hundred. • The thousandths column is to the right of the decimal point, the tenths and the hundredths columns. • The word term is used to describe an unknown number in a sequence. • All digits move to the left when multiplying by 10, 100 and 1000. • All digits move to the right when dividing by 10, 100 and 1000. • A complement is something that you add to make a defined whole.	• A half is one of two equal parts of a whole object or shape. • A half is one of two equal parts of a quantity. • A quarter is one of four equal parts of a whole object or shape. • A quarter is one of four equal parts of a quantity. • If the denominators are the same, the larger the numerator, the larger the fraction. • If the numerators are the same, the larger the denominator, the smaller the fraction. • The denominator is the number of parts that the amount is being divided into, and the numerator is the amount of those parts that we need to know about. • Know common fractions, such as thirds, quarters, fifths and eighths, as decimals. • % is the symbol for percent, which is the number of parts per hundred. • Percent' means 'out of 100'. • 0.1 is 10%, 0.01 is 1%. • 50% = $\frac{1}{2}$, 25% = $\frac{1}{4}$, 10% = $\frac{1}{10}$ and 1% = $^{100}/_{1000}$ • Digits move to the left when they are multiplying, and zero is used as a place holder. The decimal point does not move. • Know that, for example, 2.4 and 2.40 are the same. Similarly, 12 and 12.0 are equivalent.

Skills	Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally	• Make a half. • Make a whole. • Recognise, find and name a half as one of two equal parts of an object or shape. • Recognise, find and name a half as one of two equal parts of a quantity. • Recognise, find and name a quarter as one of four equal parts of an object or shape. • Recognise, find and name a quarter as one of four equal parts of a quantity.	• Recognise equal and unequal parts of real life objects and pictorial representations of a variety of shapes and quantities. • Explore halves in different contexts and use the ½ notation alongside half or halves. • Find half of a set of objects or quantity. • Recognise a quarter, explore splitting wholes into quarters and see that a quarter is half of a half. • Find quarters of shapes, objects and quantities. • Recognise a third, explore splitting wholes into thirds. • Find thirds of shapes, objects and quantities. • Recognise a unit fraction as one equal part of a whole. • Recognise ⅓ and ¾ as non-unit fractions. See fractions where the whole is shaded and how these fractions are written. • Recognise, find, name and write the fractions ¼, ½, ²⁄₄, ¾ and ⅓ of a length, shape, set of objects or quantity. • Explore the equivalence of two quarters and one half of the same whole and demonstrate that they are the same.	• Consolidate recognition of equal and unequal parts of real life objects and pictorial representations of a variety of shapes and quantities. • Consolidate exploring halves in different contexts, and use the ½ notation alongside half or halves. • Consolidate finding half of a set of objects or quantity. • Consolidate recognition of a quarter, explore splitting wholes into quarters and see that a quarter is half of a half. • Consolidate finding quarters of shapes, objects and quantities. • Consolidate recognition of a third, explore splitting wholes into thirds. • Consolidate finding thirds of shapes, objects and quantities. • Consolidate recognition of a unit fraction as one equal part of a whole. • Consolidate the recognition of ⅓ and ¾ as non-unit fractions. See fractions where the whole is shaded and how these fractions are written. • Consolidate recognising, finding, naming and writing the fractions ¼, ½, ²⁄₄, ¾ and ⅓ of a length, shape, set of objects or quantity. • Recognise unit and non-unit fractions and fractions with denominators other than two, three and four. • Explore the equivalence of two quarters and one half of the same whole, and demonstrate that they are the same. • Recognise and show, using diagrams, equivalent fractions with small denominators. • Recognise how a number line divided into different amounts can represent equivalent fractions. • Use proportional reasoning to link pictorial images with abstract methods to find equivalent fractions. Find patterns and missing numerators and denominators when exploring equivalent fractions. • Compare unit fractions or fractions with the same denominator. • Order unit fractions or fractions with the same denominator. • Solve problems involving Y3 fractions skills, such as adding and subtracting fractions with the same denominator within one whole. • Recognise, find and write fractions of a discrete set of objects, using unit fractions with small denominators. • Recognise, find and write fractions of a discrete set of objects, using unit and non-unit fractions with small denominators. • Add two or more fractions with the same denominator, where the total is less than one, using practical equipment and pictorial representations • Subtract fractions with the same denominator where the total is less than one, using practical equipment and pictorial representations • Count up and down in tenths, recognising that tenths arise from dividing an object into 10 equal parts and in dividing one digit numbers or quantities by 10. • Read and represent tenths on a place value grid. • Read and represent tenths on a number line and link this to measurement, looking at measuring in cm and mm. • Demonstrate on a place value chart how the digits move when dividing by 10, and the importance of zero as a place holder. • Demonstrate how two digit numbers move on a place value chart when dividing by 10. • Read and represent hundredths on a place value grid. • Demonstrate how two digit numbers move on a place value chart when dividing by 100. • Revise number bonds to 10 and 100. • Make a whole from any number of tenths and hundredths. • Read and write numbers with up to two decimal places and understand the value of each digit. • Compare numbers with up to two decimal places. • Order numbers with up to two decimal places. • Round numbers with one decimal place to the nearest whole number.	• Consolidate recognition of unit and non-unit fractions and fractions with denominators other than two, three and four. • Explore fractions of shapes, quantities and a number line. • Consolidate counting up and down in tenths, recognising that tenths arise from dividing an object into 10 equal parts and in dividing one digit numbers or quantities by 10. • Recognise and show, using diagrams, equivalent fractions with small denominators. • Recognise how a number line divided into different amounts can represent equivalent fractions. • Recognise and show, using diagrams, families of common equivalent fractions. • Find equivalent fractions using the method of multiplying the numerators and denominators by the same number. • Demonstrate that the number of equal parts that make a whole is dependent on the number of equal parts altogether. • Compare and order unit fractions or non-unit fractions with the same denominators. • Find three quarters of a quantity. • Count up in halves, thirds and quarters from any number up to 10. • Solve simple problems involving fractions. • Consolidate adding fractions with the same denominator within one whole ($^5/_7 + ⅐ = {}^6/_7$). • Add 2 or more fractions. • Consolidate subtracting fractions with the same denominator within one whole ($^5/_7 - ⅐ = {}^4/_7$). • Subtract 2 or more fractions. • Subtract fractions from whole amounts. • Consolidate counting up and down in tenths, recognising that tenths arise from dividing an object into 10 equal parts and in dividing one digit numbers or quantities by 10. • Recognise tenths or hundredths using a hundreds square. Use a part-whole model to partition a fraction into tenths and hundredths. • Recognise the relationship between 1/10 and 0.1. Write any number of tenths as a decimal and represent them using concrete and pictorial representations. • Count up and down in hundredths, recognising that hundredths arise when dividing an object or number by 100 and dividing tenths by 10. • Write hundredths as decimals and as fractions. • Write ½, ¼ and ¾ as decimals linking to hundredths. • Use place value counters and a place value grid to make numbers with up to two decimal places, and begin to explore three decimal places, reading and writing the decimal numbers and explaining the value of each digit. • Read and represent thousandths on a place value grid. • Round decimals with two decimal places to the nearest whole number and to one decimal place (380.64 → 380.6; 34.65 → 34.7; 1456.54 → 1457). • Read, write, order and compare numbers with up to three decimal places. • Create simple rules for given decimal sequences. • Multiply numbers with decimals by 10, 100 and 1000. • Divide numbers with decimals by 10, 100 and 1000.	• Consolidate exploring fractions of shapes, quantities and fractions of a number line. • Recognise and show, using diagrams, families of common equivalent fractions. • Identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths. • Consolidate demonstrating that the number of equal parts that make a whole is dependent on the number of equal parts altogether. • Convert improper fractions to mixed numbers. • Convert mixed numbers to improper fractions using concrete and pictoral methods. • Compare and order fractions less than one, where the denominators are multiples of the same number. Find common denominators and common numerators. • Compare and order fractions greater than one, including improper fractions and mixed numbers. • Count up and down in a given fraction and find missing fractions in a sequence. • Consolidate finding non-unit fractions of a quantity. • Solve problems involving Y5 fractions skills. • Add fractions where one denominator is a multiple of the other. • Add more than 2 fractions where two denominators are a multiple of the other. • Use pictorial methods to explore adding two or more proper fractions where the total is greater than one. • Add two fractions where one or both are mixed numbers or improper fractions. • Subtract fractions where one denominator is a multiple of the other. • Subtract proper fractions from mixed numbers. • Subtract two fractions where one is a mixed number, and you need to break one of the wholes up. • Use different strategies to subtract two mixed numbers. • Add and subtract fractions with the same denominator. • Multiply unit fractions by whole numbers, supported by materials and diagrams. • Multiply non-unit fractions by whole numbers, supported by materials and diagrams. • Multiply mixed numbers by whole numbers. • Improve calculation efficiency by changing the order of fractions and whole numbers when multiplying them. • Convert fractions to decimals and explore their relationship. • Represent more complex decimal numbers and fractions as fractions and decimals. • Explore the links between tenths, hundredths and thousandths in both decimal and fraction form. • Recognise the percent symbol (%), knowing that percent relates to 'number of parts per hundred'. • Write percentages as a fraction with the denominator 100 and as a decimal. • Recall the fraction and decimal equivalents of 50%, 25%, 20%, 40% and 80%. • Consolidate using place value counters and a place value grid to make numbers with up to two decimal places, reading and writing the decimal numbers and explaining the value of each digit. • Consolidate reading and represent thousandths on a place value grid. • Use place value counters and a place value grid to make numbers with up to three decimal places, reading and writing the decimal numbers and explaining the value of each digit. • Identify the value of each digit in numbers given to three decimal places and multiply the numbers by 10, 100 and 1000, giving answers up to three decimal places. • Identify the value of each digit in numbers given to three decimal places and divide the numbers by 10, 100 and 1000, giving answers up to three decimal places. • Use concrete resources to multiply decimals, explore what happens when exchanges take place. Make links to money and measures. • Use concrete resources to divide decimals. Explore what happens when exchanges take place. • Add decimals within one whole. • Find the complements which sum to make one. • Add decimals crossing the whole, using complements. • Add numbers greater than one with the same number of decimal places. • Add numbers with different numbers of decimal places. • Subtract decimals within one whole. • Subtract numbers with the same number of decimal places. • Subtract decimals with different numbers of decimal places. • Solve problems involving adding and subtracting decimals with the same number of decimal places. • Solve problems involving adding and subtracting decimals with a different number of decimal places. • Add and subtract numbers with decimals from whole numbers.	• Use number lines to count backwards and forwards in fractions and to find equivalent fractions. • Consolidate the identification, naming and writing of equivalent fractions of a given fraction, represented visually, including tenths and hundredths. • Simplify fractions through an understanding of the highest common factor. • Consolidate converting improper fractions to mixed numbers. • Consolidate converting mixed numbers to improper fractions using concrete and pictoral methods. • Compare and order fractions with the same denominator or denominators that are multiples of the same number and find the difference between fractions using a number line. • Compare and order fractions where denominators are not multiples of the same number. Find the lowest common multiple of the denominators in order to find equivalent fractions with the same denominators, then compare the numerators to find the larger or smaller fraction. • Compare and order fractions by finding a common numerator, then compare the denominators to find the larger or smaller fraction. • Solve problems that involve adding and subtracting fractions and mixed numbers. • Solve problems that combine the four operations and fractions using understanding of the order of operations. • Calculate fractions of an amount. • Find the whole amount from the known value of a fraction. • Consolidate adding two fractions where one or both are mixed numbers or improper fractions. • Add mixed numbers and fractions with any denominators, simplifying answers and converting between improper fractions and whole numbers when calculating. • Consolidate subtracting proper fractions from mixed numbers. • Use different strategies to subtract mixed numbers, including exchanging wholes for fractions and subtracting the wholes and fractions separately and converting the mixed number to an improper fraction. • Add and subtract fractions within 1 where the denominators are multiples of the same number. • Add and subtract fractions where the denominators are not multiples of the same number, finding equivalent fractions to find a common denominator. • Multiply fractions and mixed numbers by integers. • Multiply simple pairs of proper fractions, writing the answer in its simplest form. • Divide fractions where the numerator is a multiple of the integer dividing by. • Divide fractions where the numerator is not a multiple of the integer dividing by. • Explore the links between tenths, hundredths and thousandths. Consider decimal and mixed number equivalences. • Convert decimals to fractions and explore their relationship and simplify fractions to help show patterns. • Explore how finding an equivalent fraction where the denominator is 10, 100 or 1000 makes it easier to convert from a fraction to a decimal. • Find fractions as decimals by dividing the numerator by the denominator. • Consolidate the recognition of the percent symbol (%), knowing that percent relates to 'number of parts per hundred'. • Convert fractions to equivalent fractions where the denominator is 100 in order to find the percentage equivalent. • Use knowledge of common equivalent fractions and decimals to find the equivalent percentage. • Convert between fractions, decimals and percentages to order and compare them. • Use known fractional equivalences, such as 50%, 25%, 10% and 1%, to find percentages of amounts. • Explore different methods of finding certain percentages. Find 20% by dividing by 10 and multiplying by 2 or by dividing by 5. Find 5% by finding half of 10%. Using these methods, build up to find other percentages, such as 35%. • Use their understanding of percentages to find the missing whole or a missing percentage when the other values are given • Read and represent tenths on a place value grid. • Read and represent tenths on a number line and link this to measurement, looking at measuring in cm and mm. • Demonstrate on a place value chart how the digits move when dividing by 10, and the importance of zero as a place holder. • Demonstrate how two digit numbers move on a place value chart when dividing by 10. • Read and represent hundredths on a place value grid. • Demonstrate how two digit numbers move on a place value chart when dividing by 100. • Revise number bonds to 10 and 100. • Make a whole from any number of tenths and hundredths. • Read and write numbers with up to two decimal places and understand the value of each digit. • Compare numbers with up to two decimal places. • Order numbers with up to two decimal places. • Round numbers with one decimal place to the nearest whole number. • Use understanding of division to solve problems where the answer has up to two decimal places.
Vocabulary		whole half quarter equal parts	three quarters third equivalent fractions unit fractions non unit fractions numerator denominator one whole	tenths	decimal equivalence hundredths convert proper fractions improper fractions decimal point	fifth thousandths mixed numbers per cent % factors integer complements	

Mathematics Progression: Measurement

Year 1 Statutory Requirements

Pupils should be taught to:

- compare, describe and solve practical problems for:
- lengths and heights [for example, long/short, longer/shorter, tall/short, double/half]
- mass/weight [for example, heavy/light, heavier than, lighter than]
- capacity and volume [for example, full/empty, more than, less than, half, half full, quarter]
- time [for example, quicker, slower, earlier, later]
- measure and begin to record the following:
    - 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 [for example, before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening]
- 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.

Year 2 Statutory Requirements

Pupils should be taught to:

- 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
- compare and order lengths, mass, volume/capacity and record the results using >, < and =
- recognise and use symbols for pounds (£) and pence (p); combine amounts to make a particular value
- find different combinations of coins that equal the same amounts of money
- solve simple problems in a practical context involving addition and subtraction of money of the same unit, including giving change
- 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
- know the number of minutes in an hour and the number of hours in a day.

Year 3 Statutory Requirements

Pupils should be taught to:

- measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml)
- measure the perimeter of simple 2-D shapes
- 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
- estimate and read time with increasing accuracy to the nearest minute; record and compare time in terms of seconds, minutes and hours; use vocabulary such as o'clock, am/pm, morning, afternoon, noon and midnight
- 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]

Year 4 Statutory Requirements

Pupils should be taught to:

- convert between different units of measure [for example, kilometre to metre; hour to minute]
- measure and calculate the perimeter of a rectilinear figure (including squares) in centimetres and metres
- find the area of rectilinear shapes by counting squares
- 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
- solve problems involving converting from hours to minutes, minutes to seconds, years to months, weeks to days

Year 5 Statutory Requirements

Pupils should be taught to:

- convert between different units of metric measure [for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre]
- understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints
- measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres
- calculate and compare the area of rectangles (including squares), including using standard units, square centimetres (cm^2) and square metres (m^2), and estimate the area of irregular shapes
- estimate volume [for example, using 1 cm^3 blocks to build cuboids (including cubes)] and capacity [for example, using water]
- solve problems involving converting between units of time
- use all four operations to solve problems involving measure [for example, length, mass, volume, money] using decimal notation, including scaling

Year 6 Statutory Requirements

Pupils should be taught to:

- solve problems involving the calculation and conversion of units of measure, using decimal notation up to 3 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 up to 3 decimal places
- convert between miles and kilometres
- recognise that shapes with the same areas can have different perimeters and vice versa
- recognise when it is possible to use formulae for area and volume of shapes
- calculate the area of parallelograms and triangles
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [for example, mm^3 and km^3]

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	• Length is a measure of how long something is from end to end. Height is a measure of how high something is from head to foot or top to base. • Length is a measure of how long something is from end to end. Height is a measure of how high something is from head to foot or top to base. • Events can be sequenced using these words: before, after, now, next, first, morning, afternoon and evening. • There are seven days in a week: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday. There are twelve months in a year: January, February, March, April, May, June, July, August, September, October, November and December. The past refers to events that have already happened, the present refers to events that are happening now and the future refers to events that haven't happened yet. • The hour hand is the shorter hand on a clock, and the minute hand is the longer hand. On an analogue clock, the minute hand points to 12 when it is an o'clock time. • At half past the hour, the minute hand has travelled half way around the clock and is pointing at the six, while the hour hand is half way between the hours. • Time can be measured using hours, minutes and seconds. • When someone wins a race, the length of time will be shorter. If someone takes longer, the length of time will be larger. • Mass or weight is the measure of the amount of something and how heavy it is. • Mass or weight is the measure of the amount of something and how heavy it is. • When using non-standard units of measure the units must stay the same.	• Length is a measure of how long something is from end to end. Height is a measure of how high something is from head to foot or top to base. • Length is a measure of how long something is from end to end. Height is a measure of how high something is from head to foot or top to base. Non-standard units used must be of equal length. • Measure from zero, rather than the end of the ruler or tape measure. • Capacity is how much a container can hold. Volume is the space that water takes up in a container. • The hour hand is the shorter hand on a clock and the minute hand is the longer hand. On an analogue clock, the minute hand points to 12 when it is an o'clock time. • At half past the hour, the minute hand has travelled half way around the clock and is pointing at the six, while the hour hand is half way between the hours. • The hour hand moves along with the minute hand. Therefore, when the time is quarter past the hour, the hour hand will be just past the hour and when the time is quarter to, the hour hand will be just before the hour. • An analogue clock face can be divided into 60 minutes, using the numbers from one to 12 on the face. Once the minute hand gets past six, the time is described as 'to' the next hour, rather than 'past' the hour. A clock face often shows five minute intervals as well. • There are 24 hours in a day and 60 minutes in an hour. • Duration is how long something lasts. • Mass, or weight, is the measure of the amount of something and how heavy it is. • Mass or weight is the measure of the amount of something and how heavy it is. • Mass can be measured in kilograms (kg) or grams (g). There are 1000g in 1kg. • Change is the money returned to someone when they have paid for an item with an amount that is greater than the price. 100p=£1 The temperature is higher when it is warmer. A thermometer measures temperature and temperature is measured in degrees Celsius or Centigrade (℃). 0℃ is the freezing point of water and 100℃ is the boiling point of water.	• Capacity is how much a container can hold. Volume is the space that water takes up in a container. • Capacity is how much a container can hold. Volume is the space that water takes up in a container. • Capacity and volume can be measured in litres (l) or millilitres (ml). There are 1000 ml in 1 l. • The hour hand moves along with the minute hand. Therefore, when the time is quarter past the hour, the hour hand will be just past the hour, and when the time is quarter to, the hour hand will be just before the hour. • There are 365 days in a year and 366 in a leap year, which occurs every fourth year. The twelve months of the year are January (31 days), February (28 or 29 days), March (31 days), April (30 days), May (31 days), June (30 days), July (31 days), August (31 days), September (30 days), October (31 days), November (30 days) and December (31 days). • There are 24 hours in a day. • In Roman numerals, I=1, II=2, III=3, IV=4, V=5, VI=6, VII=7, VIII=8 IX=9, X=10, XI=11 and XII=12. • An analogue clock face can be divided into five minute intervals using the numbers 1 to 12, with 1 denoting 5 minutes past the hour and 11 denoting 5 minutes to the next hour. • There are 60 seconds in a minute. • Money can be recorded using mixed units (£ and p). Pounds and pence are recorded with a decimal point between them. When an amount of money is recorded in this way, the pence sign (p) is usually omitted. For example £5.00, £7.25 or £10.01 • The temperature is higher when it is warmer. A thermometer measures temperature and temperature is measured in degrees Celsius or Centigrade (℃). 0℃ is the freezing point of water and 100℃ is the boiling point of water. • £1 is 100p. • 100cm is equivalent to 1m. • 10mm is equivalent to 1cm. The perimeter is the total distance around the edge of a shape. The perimeter can be found by counting squares or measuring with a ruler.	• Capacity and volume can be measured in litres (l) or millilitres (ml). There are 1000 ml in 1 l. • Capacity is how much a container can hold. Volume is the space that water takes up in a container. • The capacity is the amount of liquid a container can hold and the volume is how much liquid is in the container. • In Roman numerals, I=1, II=2, III=3, IV=4, V=5, VI=6, VII=7, VIII=8 IX=9, X=10, XI=11 and XII=12. • 100cm is equivalent to 1m. • 10mm is equivalent to 1cm. • 1000m is equal to 1km. • £1 is 100p. • 60 minutes in an hour and 60 seconds in a minute. • 365 days in a year and 364 in a leap year, which occurs every fourth year. Twelve months in a year. Approximately 52 weeks in a year and 4 weeks in a month. 7 days in a week. • Digital time is written in 4-digit format e.g. 09:30 am not 9:30. • The perimeter is the total distance around the edge of a shape. The perimeter can be found by counting squares or measuring with a ruler. • A rectilinear shape is a 2-D shape whose sides all meet at right angles. • A rectilinear shape is a 2-D shape whose sides all meet at right angles. • Area is the amount of space taken up by a 2D shape or surface. • Area is the amount of space taken up by a 2D shape or surface, and some ways are better than others for finding the area of a shape or surface. • A rectilinear shape is a 2-D shape whose sides all meet at right angles. A rectilinear shape is a 2-D shape whose sides all meet at right angles.	• The prefix kilo means 1000. • The prefix kilo means 1000. • The prefix milli means $^{1}/_{1000}$ • Divide by different multiples of 10 to convert between the different measurements. • Imperial units of measurement were used in Britain from the 1820s to the 1960s, when the metric system, using multiples of 10, was adopted. * 1 inch=2.5cm * 1 foot=12 inches=30cm (approximately) * 1 yard=3 feet=914cm (approximately 1m) * 1 mile=1760 yards=1.6km * 1 ounce=28g * 1 pound=16 ounces=454g (approximately 1/2kg. 1 kg is sometimes seen as approximating to 2.2 lbs) * 1 stone=14 pounds=6.4kg * 1 pint=568ml (approximately 1/2L) * 1 gallon=8 pints=4.5L • Time is not decimal, so some methods may not be effective for conversions. • A rectilinear shape is a 2-D shape whose sides all meet at right angles. • A rectilinear shape is a 2-D shape whose sides all meet at right angles. • A compound or composite shape is made of two or more rectilinear shapes.	• Volume is the amount of solid space that something takes up, while capacity is the amount that a container can hold. • Containers can be different shapes but still hold the same capacity. The word capacity, rather than volume, is often used when referring to liquid • Capacity is the amount an object can contain. Volume is the amount actually in an object. • Know that 5 miles is approximately equal to 8 km. • Imperial measure * 1 foot is equal to 12 inches * 1 pound is equal to 16 ounces * 1 stone is equal to 14 pounds * 1 gallon is equal to 8 pints * 1 inch is approximately 2.5 cm • A right-angled triangle with the same length and perpendicular height as a rectangle will have an area half the size.

Skills	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	• Compare, describe and solve practical problems for lengths and heights (long or short; longer or shorter; tall or short and double or half). • Measure and begin to record lengths and heights, using pictorial representations, numbers or words. • Measure and begin to record lengths and heights, using a ruler. • Solve simple problems that involve all Y1 elements of measurement, using concrete objects, pictorial representations and number lines. • Compare the volume in a container by describing whether it is full, nearly full, empty or nearly empty. • Measure and begin to record capacities and volumes, using pictorial representations, numbers or words. • Compare capacity using non-standard units of measure including the vocabulary of more, less and equal to, and the symbols <, > and =. • Describe, sort and order events using sequencing language, such as before, after, next, first, today, yesterday, tomorrow, morning, afternoon and evening. • Recognise and use language relating to dates, including days of the week, weeks, months and years and talk about events using today, yesterday and tomorrow. • Tell the time to the hour using an analogue clock. • Tell the time, to the half hour, using an analogue clock, understanding the language 'half past'. • Measure and begin to record time (hours, minutes and seconds), using pictorial representations, numbers or words. • Compare amounts of time using the language faster, slower, earlier and later. • Hold and describe objects using vocabulary such as heavy, light, heavier than, lighter than, then use scales to check. Investigate to see if larger objects are always heavier than smaller objects. • Measure and begin to record masses or weights, using pictorial representations, numbers or words. • Use non-standard units and balance scales to weigh objects and compare whether they are heavier or lighter. • Hold and describe objects using vocabulary such as heavy, light, heavier than, lighter than, then use scales to check. Investigate to see if larger objects are always heavier than smaller objects. • Measure and begin to record masses or weights, using pictorial representations, numbers or words. • Use non-standard units and balance scales to weigh objects and compare whether they are heavier or lighter. • Recognise and know the value of different denominations of coins, including 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2. • Recognise and know the value of different denominations of notes. • Begin to count in 1p, 2p, 5p and 10p coins.	• Consolidate comparing, describing and solving practical problems for lengths and heights (long or short; longer or shorter; tall or short and double or half). • Consolidate measuring and recording lengths and heights, using pictorial representations, numbers or words. • Consolidate measuring and recording lengths and heights, using a ruler. • Measure both length and height to the nearest cm with a ruler and tape measure. • Measure larger objects using metres. • Compare lengths in the same unit of objects using comparison language (such as longer than, shorter than, taller than, longest, shortest and tallest) and symbols. • Order given lengths, as well as ordering objects by measuring each length using the language 'shorter, shortest, longer and longest' to describe the order. • Solve one-step and two-step problems relating to length • Solve problems involving mass. • Solve problems involving volume. • Consolidate comparing the volume in a container by describing whether it is full, nearly full, empty or nearly empty. • Consolidate measuring and recording capacities and volumes, using pictorial representations, numbers or words. • Compare the volume of containers using <, > and =, including the use of language: quarter, half and three quarters full. • Measure and estimate the volume of containers using millimetres (ml). • Recognise the difference between measuring in millilitres and litres and when it is more efficient to use litres to measure liquid rather than millilitres. • Consolidate telling the time to the hour using an analogue clock. • Consolidate telling the time, to the half hour using an analogue clock, understanding the language 'half past'. • Read and write times, using o'clock and half past, from analogue clocks. • Read and draw the times 'quarter to' and 'quarter past'. • Read and show analogue time to five minute intervals. • Consolidate measuring and recording time (hours, minutes and seconds), using pictorial representations, numbers or words. • Use clocks to convert minutes to hours and minutes. • Identify the start and end time of an event and use the times to work out the duration. • Consolidate holding and describing objects using vocabulary, such as heavy, light, heavier than and lighter than, then use scales to check. Investigate to see if larger objects are always heavier than smaller objects. • Consolidate measuring and recording masses or weights, using pictorial representations, numbers or words. • Compare mass using < and > and order objects based on their masses. • Feel the mass of gram weights and use grams when reading weighing scales. • Feel the mass of a 1kg, weight and use kilograms when reading weighing scales. • Consolidate holding and describing objects using vocabulary, such as heavy, light, heavier than and lighter than, then use scales to check. Investigate to see if larger objects are always heavier than smaller objects. • Consolidate measuring and recording masses or weights, using pictorial representations, numbers or words. • Compare mass using < and > and order objects based on their masses. • Feel the mass of gram weights and use grams when reading weighing scales. • Feel the mass of a 1kg, weight and use kilograms when reading weighing scales. • Consolidate the recognition of different denominations of coins, including 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2 and know their value. • Consolidate the recognition of different denominations of notes and know their value. • Count in 1p, 2p, 5p and 10p coins. • Count in £1 and £2 coins and £5, £10 and £20 notes. • Count in pounds and pence. • Select coins to make an amount. • Find different combinations of coins that equal the same amounts of money. • Compare two different values in either pounds or pence. • Add money using different methods such as, count on, partitioning and regrouping. • Find the difference between two amounts of money including the use of the strategies of counting on and counting back. • Find change from a given amount converting £1 into 100p when necessary. • Solve simple problems in a practical context, involving addition and subtraction of money of the same unit and giving change. • Read temperature on different thermometer scales.	• Recognise millimetres and build on their understanding of centimetres and metres using different measuring equipment including rulers, tape measures, metre sticks and trundle wheels. • Consolidate measuring larger objects using metres. • Consolidate comparing lengths in the same unit of objects using comparison language, such as longer than, shorter than, taller than, longest, shortest and tallest and symbols. • Subtract lengths by taking away and finding the difference. • Solve problems involving time. • Compare mixed measurements using the inequality symbols. • Add and subtract mass using a range of mental and written methods. • Add and subtract volumes and capacities, using a range of mental and written methods depending on the context. • Recognise the difference between measuring in millilitres and litres and when it is more efficient to use litres to measure liquid rather than millilitres. • Consolidate comparing the volume of containers, using <, > and =, including the use of the language quarter, half and three quarters full. • Explore capacity in litres or millilitres. • Explore capacity in litres and millilitres. Record measurements as '__L' and '__ml'. For example, '5L' and '500ml'. • Compare actual numerical measures of capacity, including mixed measurements, using the inequality symbols. • Consolidate reading and writing times, o'clock and half past, from analogue clocks. • Consolidate reading and drawing the times 'quarter to' and 'quarter past'. • Investigate the concept of years and months. • Explore language around day and the difference between day-time and day. • Tell the time to the nearest five minutes on an analogue clock using past and to, including reading Roman numerals up to 12 (I to XII). • Tell the time to the nearest minutes on an analogue clock using past and to. • Use language morning, afternoon, am and pm to describe the time of day. • Compare analogue and digital clocks. • Find the durations of events using both analogue and digital clocks. • Compare durations of time using analogue and digital clocks. • Find start and end times to the nearest minute using both analogue and digital times. • Measure and compare durations of time in seconds. Write durations of time in different ways e.g. 80 seconds is the same as 1 minute and 20 seconds. • Consolidate comparing mass using < and >, and order objects based on their masses. • Consolidate feeling the mass of gram weights and use grams when reading weighing scales. • Read a range of scales, in kilograms or grams, to measure mass, including scales with missing intervals. • Measure the mass of objects and record them as a mixed measurement in kilograms and grams. • Consolidate comparing mass using < and >, and order objects based on their masses. • Consolidate feeling the mass of gram weights and use grams when reading weighing scales. • Read a range of scales, in kilograms or grams, to measure mass, including scales with missing intervals. • Measure the mass of objects and record them as a mixed measurement in kilograms and grams. • Consolidate counting in 1p, 2p, 5p and 10p coins. • Consolidate counting in £1 and £2 coins and £5, £10 and £20 notes. • Add and subtract amounts of money to give change, using both £ and pence, in practical contexts, including using formal written methods. • Add two amounts of money using pictorial representations to support them. • Use different methods to subtract money. • Use a number line and a part-whole model to subtract to find change. • Consolidate reading temperature on different thermometer scales. • Convert between pounds and pence. • Convert multiples of 100cm into metres and vice versa. Partition lengths not in multiples of 100 into metres and centimetres. • Convert multiples of 10 mm into centimetres and vice versa. Partition lengths not in multiples of 10 into centimetres and millimetres. • Convert, compare and order lengths based on measurements in mm, cm and m. • Add lengths given in different units of measurement, converting to the same unit of length to improve efficiency. • Measure and compare the perimeter of simple 2-D shapes. • Calculate the perimeter of simple 2-D shapes.	• Consolidate subtracting lengths by taking away and finding the difference. • Solve simple problems with money, involving all four operations. • Consolidate telling the time to the nearest five minutes on an analogue clock, using past and to. • Consolidate telling the time to the nearest minutes on an analogue clock using past and to. Read Roman numerals up to 12 (I to XII). • Consolidate the use of the language morning, afternoon, am and pm to describe the time of day. • Consolidate comparing analogue and digital clocks. • Hold and describe objects using vocabulary such as heavy, light, heavier than, lighter than, then use scales to check. Investigate to see if larger objects are always heavier than smaller objects. • Measure and begin to record masses or weights, using pictorial representations, numbers or words. • Use non-standard units and balance scales to weigh objects and compare whether they are heavier or lighter. • Convert between different units of money using decimal notation. • Compare and order amounts of money. • Round amounts of money written in decimal notation to the nearest pound. Estimate totals with more than two amounts, discussing over and under estimation. • Consolidate adding two amounts of money, using pictorial representations to support them. • Consolidate using different methods to subtract money. • Consolidate using a number line and a part-whole model to subtract to find change. • Consolidate converting multiples of 100cm into metres and vice versa. Partition lengths not in multiples of 100 into metres and centimetres. • Consolidate converting multiples of 10mm into centimetres and vice versa. Partition lengths not in multiples of 10 into centimetres and millimetres. • Multiply and divide by 1000 to convert between kilometres and metres and find two lengths that add to a whole number of kilometres. • Consolidate adding lengths given in different units of measurement, converting to the same unit of length to improve efficiency. • Consolidate converting between pounds and pence. • Convert between units of time, such as hours to minutes. • Convert between units of time, such as years, months, weeks and days. • Convert between analogue and digital times, using a format up to 12 hours, using am and pm to distinguish between times in the morning and afternoon. • Convert between analogue and digital times using a 24 hour clock. • Consolidate measuring and comparing the perimeter of simple 2-D shapes. • Calculate the perimeter of rectilinear shapes by counting squares on a grid. • Explore different ways of how to calculate perimeter and find missing lengths. • Calculate perimeter of rectilinear shapes, without using squared paper, using addition and subtraction to calculate the missing sides. • Demonstrate how different shapes can have the same area. • Explain what the term 'area' means and explore different ways of finding the area of a shape, realising that some ways are better than others, for example, by counting squares. • Count the number of squares in a shape to measure and compare the areas of rectilinear shapes. • Make rectilinear shapes using a given number of squares. • Compare and order shapes by the size of area using < and >.	• Compare, describe and solve practical problems for lengths and heights (long or short; longer or shorter; tall or short and double or half). • Measure and begin to record lengths and heights, using pictorial representations, numbers or words. • Measure and begin to record lengths and heights, using a ruler. • Use timetables to retrieve information and solve problems, convert between different units of time where necessary and create timetables. • Investigate how volume is different from capacity. • Compare and order different solids that are made of cubes. • Estimate volume and capacity of different solids and objects. • Estimate capacity using practical equipment. • Consolidate multiplying and dividing by 1000 to convert between kilometres and metres and find two lengths that add to a whole number of kilometres. • Convert from metres to kilometres (km), grams to kilograms (kg) and vice versa. • Convert from metres to millimetres (mm), litres to millilitres (ml) and vice versa. • Convert between different units of length and choose the appropriate unit for measurement. • Use approximate equivalences between metric units and common imperial units , such as inches, pounds (lbs) and pints. • Convert between different units of time, including years, months, weeks, days, hours, minutes and seconds. • Measure the perimeter of rectilinear shapes from diagrams without grids. • Consolidate calculating the perimeter of rectilinear shapes by counting squares on a grid. • Consolidate calculating perimeter of rectangles (including squares) that are not on a squared grid. • Consolidate calculating perimeter of rectilinear shapes, without using squared paper, using addition and subtraction to calculate the missing sides. • Find the perimeter of shapes with and without grids and unknown side lengths. • Consolidate counting the number of squares in a shape to measure and compare the areas of rectilinear shapes. • Find the area of a rectangle by counting squares and using a formula. • Calculate the area of compound shapes by splitting into smaller shapes. • Find the approximate area of irregular shapes by counting squares using knowledge of fractions to combine part-covered squares.	• Solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate. • Write and use formulae when calculating area and perimeter of rectilinear shapes. • Consolidate, through further investigation, how volume is different from capacity. • Count cubic units (1 cm^3) to find the volume of 3-D shapes, then use cubes to build models and describe their volume. • Demonstrate the link between counting cubes and the formula (*l*x*w*x*h*) for calculating the volume of cuboids. • Read, write and recognise all metric measures for length, mass and capacity. • Convert between units of length, mass and capacity using skills of multiplying and dividing by 10, 100 and 1000. • Find approximate conversions from miles to km and from km to miles. • Use knowledge of imperial and metric measurements to perform related conversions, both within imperial measures and between imperial and metric. • Draw rectilinear shapes that have the same area, and use knowledge of factors to draw rectangles with different areas, recognising the connections between side lengths and factors. • Approximate and estimate the area of a triangle by counting squares, seeing the link between the area of a triangle and the area of a rectangle or square. • Find the area of a rectangle then halve it to find the area of a triangle. • Use the formula, base *x* perpendicular height÷2 to calculate the area of a variety of triangles where different side lengths are given and where more than one triangle makes up a shape. • Investigate the link between the area of a rectangle and parallelogram by cutting a parallelogram so that it can be rearranged into a rectangle. Find the area of a parallelogram using knowledge of finding the area of a rectangle.

Vocabulary	measure wide(er) narrow(er) compare long(er)(est) short(er)(est) length height long(er)/short(er) tall(er)/short(er) weight capacity heavy/light heavier than lighter than big/bigger/biggest full/empty more than less than half/half full time quicker slower earlier later before after first next today yesterday tomorrow morning afternoon evening day week hour minutes	compare mass volume chronological order *days of the week* *months of the year* month year o'clock half past second money coins notes pounds £ pence p	standard units estimate order record results centimetre cm metre m kilogram kg gram g quarter full three quarters full litres l millilitres ml temperature Celsius intervals of time quarter past/to duration value change	millimetre mm perimeter analogue clock roman numerals 12-hour clock 24-hour clock a.m./p.m. noon midnight leap year digital	kilometres km rectilinear figure area convert	decimal notation scaling metric units imperial units inches compound shape irregular shapes square centimetres square metres cubic centimetre pounds pints	conversion miles formulae parallelograms triangles feet cubic metre cubic millimetre cubic kilometre gallons stones ounces

Mathematics Progression: Geometry – properties of shapes

Year 1 Statutory Requirements

Pupils should be taught to:

- recognise and name common 2-D and 3-D shapes, including:
- 2-D shapes [for example, rectangles (including squares), circles and triangles] ♣ 3-D shapes [for example, cuboids (including cubes), pyramids and spheres].

Year 2 Statutory Requirements

Pupils should be taught to:

- identify and describe the properties of 2-D shapes, including the number of sides and line 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.

Year 3 Statutory Requirements

Pupils should be taught to:

- draw 2-D shapes and make 3-D shapes using modelling materials; recognise 3-D shapes in different orientations and describe them
- recognise angles as a property of shape or a description of a turn
- identify right angles, recognise that 2 right angles make a half-turn, 3 make three-quarters of a turn and 4 a complete turn; identify whether angles are greater than or less than a right angle
- identify horizontal and vertical lines and pairs of perpendicular and parallel lines

Year 4 Statutory Requirements

Pupils should be taught to:

- 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 2 right angles by size
- identify lines of symmetry in 2-D shapes presented in different orientations
- complete a simple symmetric figure with respect to a specific line of symmetry

Year 5 Statutory Requirements

Pupils should be taught to:

- identify 3-D shapes, including cubes and other cuboids, from 2-D representations
- know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles
- draw given angles, and measure them in degrees (°)
- identify:
    - angles at a point and 1 whole turn (total 360°)
    - angles at a point on a straight line and half a turn (total 180°)
    - other multiples of 90°
- use the properties of rectangles to deduce related facts and find missing lengths and angles
- distinguish between regular and irregular polygons based on reasoning about equal sides and angles

Year 6 Statutory Requirements

Pupils should be taught to:

- draw 2-D shapes using given dimensions and angles
- 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 and know that the diameter is twice the radius
- recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	• Common 3-D shapes are: cuboids, cubes, cylinders, pyramids, cones and spheres. Common 2-D shapes are: squares, rectangles, circles, triangles, pentagons, hexagons and octagons.	• Know that 2-D shapes are actually flat. • Know that a vertex is where two lines meet at a point and that more than one vertex are called vertices. The word vertex should be used in place of the word corner. • A shape has symmetry in a vertical line if a line can be drawn down the middle of it and the left side is a mirror image of the right. • A three-dimensional (3-D) shape has three measurements and can be held. These are common 3-D shapes: cuboids, cubes, spheres, cones, cylinders, pyramids, triangular-based pyramid, square-based pyramid and triangular prism. The flat surface of a 3-D shape is called a face. The faces of a cuboid can be rectangles and squares. The faces on a cube are squares. Two of the faces on a cylinder are circles. One of the faces on a pyramid may be a circle, square or rectangle. • An edge is where two faces meet or where a face and a curved surface meet. • A vertex is where two or more edges meet. 3-D shapes can be sorted in different ways e.g. faces, shapes of faces, edges, vertices, if they roll, if they stack…	• A curved surface is not a face. A cylinder has 2 circular faces and a curved surface. Horizontal lines go across. Vertical lines go up and down.	• A polygon is any 2-D shape with straight sides. 'Tri' is derived from Latin and Greek, meaning three. An equilateral triangle has three equal sides and angles and three lines of symmetry. An isosceles triangle has two equal sides and angles. A scalene triangle has no equal sides and no equal angles. A right-angled triangle has a 90° angle. The angles in any triangle add up to 180°. • A quadrilateral is a four-sided shape. 'Quad' is derived from the Latin word for four, and lateral is related to sides. A square has four equal sides, four right angles (90°) and four lines of symmetry. A rectangle or oblong has two sets of two equal sides, four right angles (90°) and two lines of symmetry. A parallelogram has two sets of two equal sides, two sets of two equal angles and usually no lines of symmetry. A rhombus has four equal sides, two sets of two equal angles and two lines of symmetry. A trapezium has two parallel sides and can have pairs of equal angles and a line of symmetry. • Horizontal lines go across. Vertical lines go up and down. • A shape may be symmetrical, but if the pattern on the shape isn't symmetrical then the diagram isn't symmetrical. A shape may be symmetrical, but if the pattern on the shape isn't symmetrical then the diagram isn't symmetrical.	• A polygon is any 2-D shape with straight sides. 'Tri' is derived from Latin and Greek, meaning three. An equilateral triangle has three equal sides and angles and three lines of symmetry. An isosceles triangle has two equal sides and angles. A scalene triangle has no equal sides and no equal angles. A right-angled triangle has a 90° angle. The angles in any triangle add up to 180°. • A quadrilateral is a four-sided shape. 'Quad' is derived from the Latin word for four, and lateral is related to sides. A square has four equal sides, four right angles (90°) and four lines of symmetry. A rectangle or oblong has two sets of two equal sides, four right angles (90°) and two lines of symmetry. A parallelogram has two sets of two equal sides, two sets of two equal angles and usually no lines of symmetry. A rhombus has four equal sides, two sets of two equal angles and two lines of symmetry. A trapezium has two parallel sides and can have pairs of equal angles and a line of symmetry. • Regular means that all of the sides and angles in a shape are equal. An equilateral triangle and a square are regular, but a rectangle with unequal sides and an isosceles triangle are irregular polygons. • A shape may be symmetrical, but if the pattern on the shape isn't symmetrical then the diagram isn't symmetrical. A shape may be symmetrical, but if the pattern on the shape isn't symmetrical then the diagram isn't symmetrical.	
Skills	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	• Recognise and name common 3-D shapes, including cuboids, cubes, cylinders, pyramids, cones and spheres, in different orientations and sizes, and relate them to everyday objects. • Sort and group 3-D shapes according to simple properties, including type, size and colour. • Recognise and name common 2-D shapes, including rectangles, squares, circles and triangles, in different orientations and sizes, and relate them to everyday objects. • Sort and group 2-D shapes according to simple properties, including type, size and colour. Complete and make simple patterns with 2-D and 3-D shapes.	• Recognise and name 2-D and 3-D shapes in different orientations and proportions, and differentiate between them. • Count sides of 2-D shapes by marking each side as they count. • Identify and count vertices of 2-D shapes. • Draw 2-D shapes. • Explore shapes being halved along their vertical line of symmetry. • Recognise and sort 2-D shapes, including a circle, square, triangle, rectangle, pentagon, hexagon and octagon, using a range of different orientations. • Create patterns with 2-D shapes. • Identify and describe 2-D shapes of faces on 3-D shapes. • Identify edges on 3-D shapes. • Identify vertices on 3-D shapes. • Compare and sort 3-D shapes and everyday objects. Create patterns with 3-D shapes.	• Recognise, describe and draw 2-D shapes accurately. • Recognise and describe 3-D shapes in different orientations, using properties, such as the number of faces, edges, vertices and curved surfaces. • Make 3-D shapes (cubes, cuboids, prisms, cylinders, pyramids, cones and spheres) using construction materials. Identify horizontal and vertical lines of symmetry in shapes and symbols.	• Consolidate recognising, describing and drawing 2-D shapes accurately. • Compare and classify triangles using the names isosceles, scalene and equilateral. • Name and describe properties of quadrilaterals, including a square, rectangle, rhombus, parallelogram and trapezium. • Consolidate identifying horizontal and vertical lines of symmetry in shapes and symbols. • Identify lines of symmetry within 2-D shapes using mirrors, tracing paper and paper folding activities. Complete 2-D shapes and patterns using knowledge of symmetry and equipment, such as squared paper, mirrors or tracing paper, to help them to accurately complete figures.	• Consolidate comparing and classifying triangles, using the names isosceles, scalene and equilateral. • Consolidate naming and describing properties of quadrilaterals including a square, rectangle, rhombus, parallelogram and trapezium. • Distinguish between regular and irregular polygons. • Identify 3-D shapes, including cubes and cuboids, from their 2-D nets. • Consolidate identifying lines of symmetry within 2-D shapes using mirrors, tracing paper and paper folding activities. Consolidate completing 2-D shapes and patterns using knowledge of symmetry and equipment, such as squared paper, mirrors or tracing paper, to help them to accurately complete figures.	• Recognise and name common 3-D shapes, including cuboids, cubes, cylinders, pyramids, cones and spheres, in different orientations and sizes, and relate them to everyday objects. • Sort and group 3-D shapes according to simple properties, including type, size and colour. • Recognise and name common 2-D shapes, including rectangles, squares, circles and triangles, in different orientations and sizes, and relate them to everyday objects. • Sort and group 2-D shapes according to simple properties, including type, size and colour. Complete and make simple patterns with 2-D and 3-D shapes.
Vocabulary	2-d shapes rectangle square circle triangle characteristics 3-d shapes cuboids cubes cone spheres curved straight flat	sides corners properties pyramids faces	pentagon hexagon line of symmetry properties cylinder edges vertices vertex	right-angle triangle heptagon octagon polygon properties prism orientations angles acute angle obtuse angle turn right angles half turn three quarters of a turn greater than right angle less than right angle horizontal lines vertical lines perpendicular lines parallel lines	isosceles equilateral scalene trapezium rhombus parallelogram kite geometric shapes quadrilaterals	regular polygon irregular polygon reflex angles degrees one whole turn angles on straight line angles around a point vertically opposite missing angles	radius diameter circumference dimensions

Mathematics Progression: Geometry – position and direction

Year 1 Statutory Requirements
Pupils should be taught to:
- describe position, direction and movement, including whole, half, quarter and three- quarter turns.

Year 2 Statutory Requirements
Pupils should be taught to:
- order and arrange combinations of mathematical objects in patterns and sequences
- use mathematical vocabulary to describe position, direction and movement, including movement in a straight line and distinguishing between rotation as a turn and in terms of right angles for quarter, half and three-quarter turns (clockwise and anti- clockwise).

Year 3 Statutory Requirements

Year 4 Statutory Requirements
Pupils should be taught to:
- describe positions on a 2-D grid as coordinates in the first quadrant
- describe movements between positions as translations of a given unit to the left/right and up/down
- plot specified points and draw sides to complete a given polygon

Year 5 Statutory Requirements
Pupils should be taught to:
- 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

Year 6 Statutory Requirements
Pupils should be taught to:
- describe positions on the full coordinate grid (all 4 quadrants)
- draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	Position and movement can be described using these words: top, middle, bottom, on top of, in front of, above, between, around, near, close, far, up, down and turn Direction can be described using these words: forwards, backwards, left and right. Position can be described using these words: top, in between, bottom, above and below.	• Direction can be described using these words: forwards, backwards, left and right. • Position can be described using these words: top, in between, bottom, above and below.Direction can be described using these words: forwards, backwards, up, down, left and right.	• An angle is created when two straight lines meet at a point. • A right angle is a quarter turn, two right angles make a half turn, three right angles make three quarters of a turn and four right angles make a complete turn. • An acute angle is less than a right angle and an obtuse angle is greater than a right angle. • Perpendicular lines are lines that form a right angle where they meet. Parallel lines never meet or cross, they are always the same distance apart.	• Read the *x*-axis first, then the *y*-axis. • In shape translation, when vertex A on the object translates to vertex A on the image, these are corresponding vertices. • An angle is created when two straight lines meet at a point. • A right angle is a quarter turn. Two right angles make a half turn, three right angles make three quarters of a turn and four right angles make a complete turn. • An acute angle is less than a right angle and an obtuse angle is greater than a right angle. • An acute angle is more than 0 degrees and less than 90 degrees, a right angle is exactly 90 degrees and an obtuse angle is more than 90 degrees but less than 180 degrees.	• Read the *x*-axis first then the *y*-axis. • The origin on a coordinates grid is (0,0). The first number represents the *x*-coordinate and the second number represents the *y*-coordinate. Coordinates are fixed whereas, a point can be plotted as different coordinates. • Shapes do not change size nor orientation when translated. • An acute angle is more than zero degrees and less than 90 degrees, a right angle is exactly 90 degrees and an obtuse angle is more than 90 degrees but less than 180 degrees. • A full turn is 360 degrees, a half turn is 180 degrees and a quarter turn (or right angle) is 90 degrees. A reflex angle is greater than 180 degrees. • A straight line is a half of a turn. Two right angles, 180 degrees, are equivalent to a straight line. The angles on a straight line add up to 180 degrees. • A full turn is equivalent to 360 degrees.	• Both the *x* and *y* coordinates are positive in the first quadrant. • A full coordinate grid has four quadrants (first, second, third and fourth). The first quadrant is the top right, the second is the top left, the third is the bottom left and the fourth is the bottom right. • There are two right angles on a straight line and four right angles around a point. • A straight line is a half of a turn. Two right angles, 180 degrees, are equivalent to a straight line. The angles on a straight line add up to 180 degrees. • A full turn is equivalent to 360 degrees. • Vertically opposite angles, angles opposite each other when two lines cross, share a vertex and are always equal. • The interior angles of a triangle will add up to 180 degrees. • Hatch marks are used to notate equal lengths. The interior angles of any quadrilaterals will add up to 360 degrees.
Skills	There are no early learning goals that directly relate to shape, space and measure objectives. However, children will have experienced rich opportunities to develop their spatial reasoning skills in shape, space and measure.	Describe position and movement, including whole, half, quarter and three quarter turns. Describe direction and movement, including forwards, backwards, left and right. Describe position, including top, in between, bottom, above and below.	• Consolidate describing direction and movement including forwards, backwards, left and right. • Consolidate describing position, including top, in between, bottom, above and below. • Solve problems involving position. • Give and then write directions for routes, including recording routes on 2-D grids. • Describe turns using the language full, half, quarter, three quarter turns, clockwise and anticlockwise. • Describe and record directions involving movement and turns. • Describe and create patterns that involve direction and turns using the language clockwise, anticlockwise, quarter, half and three quarters.	• Recognise angles as a measure of a turn. Practice making $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$ and whole turns from different starting points, in both clockwise and anticlockwise directions, in practical contexts. • Explore right angles and define with respect to turn. • Identify whether an angle is greater than or less than a right angle in shapes and turns • Measure and draw straight lines accurately in centimetres and millimetres. • Identify and find parallel and perpendicular lines in a range of practical contexts. Use the arrow notation to represent parallel lines and the right angle notation for perpendicular lines.	• Read, write and use pairs of coordinates in the first quadrant, reading the axes in the correct order. • Plot given coordinates on a 2-D grid and read, write and use pairs of coordinates. • Move shapes and points on a coordinate grid following specific directions using language such as left/right and up/down. • Describe the movement of shapes and points on a coordinate grid using specific language, such as left/right and up/down. • Consolidate recognising angles as a measure of a turn, and practise making $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$ and whole turns from different starting points in both clockwise and anticlockwise directions in practical contexts. • Consolidate exploring right angles and define with respect to turn. • Consolidate identifying whether an angle is greater than or less than a right angle in shapes and turns • Compare acute and obtuse angles with a right angle. Compare and order angles in ascending and descending order.	• Consolidate reading, writing and using pairs of coordinates in the first quadrant, reading the axes in the correct order. • Consolidate plotting given coordinates on a 2-D grid and read, write and use pairs of coordinates. • Read coordinates in the first quadrant. • Translate shapes on a grid. • Translate and describe translations of coordinates. • Reflect objects using lines that are parallel to the axes, using a 2-D grid and coordinates in the first quadrant • Record the coordinates of the vertices of objects and its reflected image. • Consolidate comparing acute and obtuse angles with a right angle. • Consolidate comparing and ordering angles in ascending and descending order. • Recognise and define angles in terms of degrees and as fractions of a full turn. • Use a protractor to measure acute angles. • Use a protractor to measure obtuse angles. • Use a protractor to draw angles of a given size. • Calculate missing angles on a straight line. • Calculate missing angles and know when to measure an angle and when to calculate from given facts. • Identify right angles in squares and rectangles on a grid.	• Read and plot coordinates in the first quadrant. • Read and plot coordinates in all four quadrants. • Draw and translate simple shapes in all four quadrants of a coordinates grid and describe the translations using directional language. • Reflect shapes in both the *x*-axis and *y*-axis. • Use a protractor to measure angles given in different orientations, identifying which side of the scale to read. • Consolidate using a protractor to draw angles of a given size. • Make links between right angles and turns, and apply these links in different contexts, such as time and on a compass. • Consolidate calculating missing angles on a straight line. • Consolidate calculating missing angles and know when to measure an angle and when to calculate from given facts. • Calculate unknown angles. • Explore vertically opposite angles. • Explore interior angles of a triangle. • Calculate unknown angles in triangles using known properties including length of sides. • Solve missing angle problems. • Explore interior angles of quadrilaterals, including a parallelogram, rhombus and trapezium. • Partition shapes into triangles from a single vertex to work out the sum of the angles in polygons. Calculate exterior angles using knowledge of angles on a straight line summing to 180 degrees.
Vocabulary	over under between around through on into next to behind beneath order repeat patterns on top of	position direction movement whole turn quarter turn half turn three-quarter turn	clockwise/anti-clockwise straight line rotation arrange sequences		co-ordinates first quadrant grid translation plot polygon axis	reflection	four quadrants co-ordinate plane

Mathematics Progression: Statistics

Year 1 Statutory Requirements

Year 2 Statutory Requirements
Pupils should be taught to:
- 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 comparing categorical data.

Year 3 Statutory Requirements
Pupils should be taught to:
- interpret and present data using bar charts, pictograms and tables
- solve one-step and two-step questions [for example 'How many more?' and 'How many fewer?'] using information presented in scaled bar charts and pictograms and tables

Year 4 Statutory Requirements
Pupils should be taught to:
- interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs
- solve comparison, sum and difference problems using information presented in bar charts, pictograms, tables and other graphs

Year 5 Statutory Requirements
Pupils should be taught to:
- solve comparison, sum and difference problems using information presented in a line graph
- complete, read and interpret information in tables, including timetables

Year 6 Statutory Requirements
Pupils should be taught to:
- interpret and construct pie charts and line graphs and use these to solve problems
- calculate and interpret the mean as an average

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge			• Information, also known as data, can be recorded in tally charts. These charts make information easier for others to read and understand. A tally chart is a method of collecting information quickly and uses lines, called tally marks, to represent information. Tally marks are written in groups of five.	• Information, also known as data, can be recorded in tally charts. These charts make information easier for others to read and understand. A tally chart is a method of collecting information quickly and uses lines, called tally marks, to represent information. Tally marks are written in groups of five. • The words most, least, fewer, altogether and total can be used in questions about data. Most means the group with the biggest number or amount. Least means the group with the smallest number or amount. Altogether, or the total, is the whole of something.	• Information, also known as data, can be recorded in tally charts. These charts make information easier for others to read and understand. A tally chart is a method of collecting information quickly and uses lines, called tally marks, to represent information. Tally marks are written in groups of five.	• Information, also known as data, can be recorded in tally charts. These charts make information easier for others to read and understand. A tally chart is a method of collecting information quickly and uses lines, called tally marks, to represent information. Tally marks are written in groups of five.	• Information, also known as data, can be recorded in tally charts. These charts make information easier for others to read and understand. A tally chart is a method of collecting information quickly and uses lines, called tally marks, to represent information. Tally marks are written in groups of five. • A line graph is used to display information that is connected in some way, such as change over time. • A circle is a 2-D shape. A circle's perimeter (the total distance around the edge of a shape) is called the circumference. The diameter of a circle is the straight line that passes through the centre. The radius is a straight line from the centre to the circumference of a circle and is half of the diameter. • The whole of a pie chart totals 100%. • Angles around a point total 360 degrees. This represents 100% of the data within a pie chart.
Skills			• Construct simple tally charts. • Construct simple pictograms. • Interpret simple pictograms. Ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity. • Construct more complex pictograms where part symbols are used. • Interpret more complex pictograms. • Ask and answer questions about totalling and comparing categorical data for simple block diagrams.	• Consolidate constructing simple tally charts. • Consolidate constructing more complex pictograms where part symbols are used. • Consolidate interpreting simple pictograms. Ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity. • Interpret data from bar charts, pictograms and tables.	• Interpret and present discrete data in bar charts, pictograms and tables including data gathered using tally charts. Use an appropriate scale when drawing bar charts. • Read a time line graph accurately and create their own line graphs to represent continuous data. • Solve comparison, sum and difference problems using discrete data, including gathered data, with a range of scales. • Solve comparison, sum and difference problems using continuous data with a range of scales. Ask and answer questions relating to collected data.	• Consolidate interpreting and presenting discrete data in bar charts, pictograms and tables including data gathered using tally charts. Use an appropriate scale when drawing bar charts. • Consolidate reading a time line graph accurately and create their own line graphs to represent continuous data. • Read horizontal and vertical axes of a line graph, including estimating the values between intervals. • Represent data in a line graph, drawing axes with appropriate scale. • Read tables to extract information and answer questions. • Read, answer questions on and complete two-way tables. • Read timetables to extract information and answer questions. • Consolidate solving comparison, sum and difference problems using discrete data, including gathered data, with a range of scales. • Solve comparison, sum and difference problems using information presented in a line graph.	• Use knowledge of scale to read line graphs accurately. • Read and interpret line graphs, including those that show more than one set of data. Draw line graphs selecting the most appropriate scales and intervals to use. • Read, interpret and draw lines graphs. Use line graphs to solve problems. • Calculate and interpret the mean as an average. • Illustrate and name the parts of a circle, including the radius, diameter and circumference, and know that the radius is half of the diameter. • Calculate fractions of amounts to interpret simple pie charts, and use a clear understanding what the whole of the pie chart represents when solving problems. • Calculate percentages of amounts to interpret pie charts, recognising fractions in order to read the pie chart more efficiently. • Draw pie charts using a protractor.
Vocabulary			pictograms tally chart block diagram category sorting totaling comparing horizontal vertical	table bar chart one-step problem two-step problem	time graph discrete data continuous data line graph comparison problem sum problem difference problem calculate interpret	timetable two-way tables	pie chart mean

Mathematics Progression: Ratio and proportion

Year 1 Statutory Requirements

Year 3 Statutory Requirements

Year 4 Statutory Requirements

Year 2 Statutory Requirements

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Year 5 Statutory Requirements

Year 6 Statutory Requirements

Pupils should be taught to:

- solve problems involving the relative sizes of 2 quantities where missing values can be found by using integer multiplication and division facts
- solve problems involving the calculation of percentages [for example, of measures and such as 15% of 360] and the use of percentages for comparison
- solve problems involving similar shapes where the scale factor is known or can be found
- solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledge							• Ratio shows the relationship between two values and can describe how one is related to another. • The term 'scale factor' relates to enlarging shapes to make them two, three or more times bigger. • 'Similar' shape in mathematics means that one shape is an exact enlargement of the other, not just that they have some common properties.
Skills							• Make simple comparisons between two different quantities. • Use objects and diagrams to compare ratios and fractions. • Recognise the colon notation as relating to the order of parts. Use the language 'for every…, there are…' and read ratios, such as 3:5 as 'three to five'. • Draw bar models to represent problems, clearly labelling the information given and what is to be calculated. • Draw 2-D shapes on a grid to a given scale factor and be able to use vocabulary, such as 'Shape A is three times as big as shape B'. • Use multiplication and division fact to calculate missing information and scale factors. • Apply learned ratio skills and knowledge to a wide range of problems in different contexts.
Vocabulary							relative size missing values integer multiplication percentages scale factor unequal sharing & grouping

Mathematics Progression: Algebra

Year 1 Statutory Requirements

Year 3 Statutory Requirements

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Year 4 Statutory Requirements

Year 2 Statutory Requirements

-

Year 5 Statutory Requirements

Year 6 Statutory Requirements

Year 6 Statutory Requirements

Pupils should be taught to:

- use simple formulae
- generate and describe linear number sequences
- express missing number problems algebraically
- find pairs of numbers that satisfy an equation with 2 unknowns
- enumerate possibilities of combinations of 2 variables

Year group	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Core Knowledg							• Know simple algebraic conventions, such as *y* x 4 as 4*y*. • The same expression can have different values depending on what has been substituted. Expressions like *x* + 5, can take different values depending on the value of *x*, but an equation like *x* + 5 = 11.2 *x* is a specific unknown value.
Skills							• Explore one-step function machines, giving an output to an input, and work backwards to give an input from an output. • Explore two-step function machines, recording inputs and outputs in the form of a table. • Use simple algebraic inputs, such a *y*, to form expressions, such as *y* + 4. • Substitute into simple expressions to find a particular value. • Substitute into familiar formulae such as those for area and volume and use simple formulae to work out values of everyday activities such as the cost of a taxi or the amount of medicine to take given a person's age. • Use algebraic notation to form one-step equations. • Solve simple one-step equations involving the four operations. • Solve two-step equations involving the four operations. • Find pairs of numbers that satisfy an equation involving two unknowns, such as 2*p* + *q* = 12. Find possible solutions to equations which involve multiples of one or more unknown.
Vocabulary							formulae linear number sequences algebraically equation unknowns combinations variables

What will our pupils go on to learn?

Mathematics Progression: Programme of Study KS3 & KS4

KS3

Working mathematically

Through the mathematics content, pupils should be taught to:

Develop fluency

- consolidate their numerical and mathematical capability from key stage 2 and extend their understanding of the number system and place value to include decimals, fractions, powers and roots
- select and use appropriate calculation strategies to solve increasingly complex problems
- use algebra to generalise the structure of arithmetic, including to formulate mathematical relationships
- substitute values in expressions, rearrange and simplify expressions, and solve equations
- move freely between different numerical, algebraic, graphical and diagrammatic representations [for example, equivalent fractions, fractions and decimals, and equations and graphs]
- develop algebraic and graphical fluency, including understanding linear and simple quadratic functions
- use language and properties precisely to analyse numbers, algebraic expressions, 2-D and 3-D shapes, probability and statistics

Reason mathematically

- extend their understanding of the number system; make connections between number relationships, and their 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 variables algebraically and graphically
- make and test conjectures about patterns and relationships; look for proofs or counter-examples
- begin to reason deductively in geometry, number and algebra, including using geometrical constructions
- interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning
- explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally

Solve problems

- develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics
- begin to model situations mathematically and express the results using a range of formal mathematical representations
- select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems
- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems

KS4

Working Mathematically

Through the mathematics content pupils should be taught to:

Develop fluency

- consolidate their numerical and mathematical capability from key stage 3 and extend their understanding of the number system to include powers, roots {and fractional indices}
- select and use appropriate calculation strategies to solve increasingly complex problems, including exact calculations involving multiples of π {and surds}, use of standard form and application and interpretation of limits of accuracy
- consolidate their algebraic capability from key stage 3 and extend their understanding of algebraic simplification and manipulation to include quadratic expressions, {and expressions involving surds and algebraic fractions}
- extend fluency with expressions and equations from key stage 3, to include quadratic equations, simultaneous equations and inequalities
- move freely between different numerical, algebraic, graphical and diagrammatic representations, including of linear, quadratic, reciprocal, {exponential and trigonometric} functions
- use mathematical language and properties precisely

Reason mathematically

- extend and formalise their knowledge of ratio and proportion, including trigonometric ratios, in working with measures and geometry, and in working with proportional relations algebraically and graphically
- extend their ability to identify variables and express relations between variables algebraically and graphically
- make and test conjectures about the generalisations that underlie patterns and relationships; look for proofs or counter-examples; begin to use algebra to support and construct arguments {and proofs}
- reason deductively in geometry, number and algebra, including using geometrical constructions
- interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning
- explore what can and cannot be inferred in statistical and probabilistic settings, and express their arguments formally
- assess the validity of an argument and the accuracy of a given way of presenting information

Solve problems

- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems
- develop their use of formal mathematical knowledge to interpret and solve problems, including in financial contexts
- make and use connections between different parts of mathematics to solve problems
- model situations mathematically and express the results using a range of formal mathematical representations, reflecting on how their solutions may have been affected by any modelling assumptions
- select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems; interpret their solution in the context of the given problem

Mathematics Progression: Subject Content KS3& KS4

KS3

Number

Pupils should be taught to:

- understand and use place value for decimals, measures and integers of any size
- order positive and negative integers, decimals and fractions; use the number line as a model for ordering of the real numbers; use the symbols =, ≠, <, >, ≤, ≥
- use the concepts and vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation property
- use the 4 operations, including formal written methods, applied to integers, decimals, proper and improper fractions, and mixed numbers, all both positive and negative
- use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals
- recognise and use relationships between operations including inverse operations
- use integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 and distinguish between exact representations of roots and their decimal approximations
- interpret and compare numbers in standard form $A \times 10^n$ $1 \leq A < 10$, where n is a positive or negative integer or 0
- work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 and $\frac{3}{8}$)
- define percentage as 'number of parts per hundred', interpret percentages and percentage changes as a fraction or a decimal, interpret these multiplicatively, express 1 quantity as a percentage of another, compare 2 quantities using percentages, and work with percentages greater than 100%
- interpret fractions and percentages as operators
- use standard units of mass, length, time, money and other measures, including with decimal quantities
- round numbers and measures to an appropriate degree of accuracy [for example, to a number of decimal places or significant figures]
- use approximation through rounding to estimate answers and calculate possible resulting errors expressed using inequality notation $a < x \leq b$

KS4

Number

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- apply systematic listing strategies, {including use of the product rule for counting}
- {estimate powers and roots of any given positive number}
- calculate with roots, and with integer {and fractional} indices
- calculate exactly with fractions, {surds} and multiples of π {simplify surd expressions involving squares [for example $\sqrt{12} = \sqrt{(4 \times 3)} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$] and rationalise denominators}
- calculate with numbers in standard form $A \times 10n$, where $1 \leq A < 10$ and n is an integer
- {change recurring decimals into their corresponding fractions and vice versa}
- identify and work with fractions in ratio problems
- apply and interpret limits of accuracy when rounding or truncating, {including upper and lower bounds}

Algebra

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- simplify and manipulate algebraic expressions (including those involving surds {and algebraic fractions}) by:
  - factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of 2 squares; {factorising quadratic expressions of the form $ax^2 + bx + c$}
  - simplifying expressions involving sums, products and powers, including the laws of indices
- know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments {and proofs}
- where appropriate, interpret simple expressions as functions with inputs and outputs; {interpret the reverse process as the 'inverse function'; interpret the succession of 2 functions as a 'composite function'}

- use a calculator and other technologies to calculate results accurately and then interpret them appropriately
- appreciate the infinite nature of the sets of integers, real and rational numbers

Algebra

Pupils should be taught to:

- use and interpret algebraic notation, including:
  - ab in place of a × b
  - 3y in place of y + y + y and 3 × y
  - a^2 in place of a × a, a^3 in place of a × a × a; a^2b in place of a × a × b
  - $\frac{a}{b}$ in place of a ÷ b
  - coefficients written as fractions rather than as decimals
  - brackets
- substitute numerical values into formulae and expressions, including scientific formulae
- understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors
- simplify and manipulate algebraic expressions to maintain equivalence by:
  - collecting like terms
  - multiplying a single term over a bracket
  - taking out common factors
  - expanding products of 2 or more binomials
- understand and use standard mathematical formulae; rearrange formulae to change the subject
- model situations or procedures by translating them into algebraic expressions or formulae and by using graphs
- use algebraic methods to solve linear equations in 1 variable (including all forms that require rearrangement)
- work with coordinates in all 4 quadrants
- recognise, sketch and produce graphs of linear and quadratic functions of 1 variable with appropriate scaling, using equations in x and y and the Cartesian plane
- interpret mathematical relationships both algebraically and graphically
- reduce a given linear equation in 2 variables to the standard form y = mx + c; calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically
- use linear and quadratic graphs to estimate values of y for given values of x and vice versa and to find approximate solutions of simultaneous linear equations
- find approximate solutions to contextual problems from given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs
- generate terms of a sequence from either a term-to-term or a position-to-term rule
- recognise arithmetic sequences and find the nth term
- recognise geometric sequences and appreciate other sequences that arise

Ratio, proportion and rates of change

Pupils should be taught to:

- change freely between related standard units [for example time, length, area, volume/capacity, mass]
- use scale factors, scale diagrams and maps
- express 1 quantity as a fraction of another, where the fraction is less than 1 and greater than 1
- use ratio notation, including reduction to simplest form
- divide a given quantity into 2 parts in a given part:part or part:whole ratio; express the division of a quantity into 2 parts as a ratio
- understand that a multiplicative relationship between 2 quantities can be expressed as a ratio or a fraction
- relate the language of ratios and the associated calculations to the arithmetic of fractions and to linear functions
- solve problems involving percentage change, including: percentage increase, decrease and original value problems and simple interest in financial mathematics
- solve problems involving direct and inverse proportion, including graphical and algebraic representations
- use compound units such as speed, unit pricing and density to solve problems

Geometry and measures

Pupils should be taught to:

- derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)
- calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes
- draw and measure line segments and angles in geometric figures, including interpreting scale drawings
- derive and use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); recognise and use the perpendicular distance from a point to a line as the shortest distance to the line
- describe, sketch and draw using conventional terms and notations: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons that are reflectively and rotationally symmetric
- use the standard conventions for labelling the sides and angles of triangle ABC, and know and use the criteria for congruence of triangles
- derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures [for example, equal lengths and angles] using appropriate language and technologies
- identify properties of, and describe the results of, translations, rotations and reflections applied to given figures
- identify and construct congruent triangles, and construct similar shapes by enlargement, with and without coordinate grids
- apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
- understand and use the relationship between parallel lines and alternate and corresponding angles
- use the form y = mx + c to identify parallel {and perpendicular} lines; find the equation of the line through 2 given points, or through 1 point with a given gradient
- identify and interpret roots, intercepts and turning points of quadratic functions graphically; deduce roots algebraically {and turning points by completing the square}
- recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, {the exponential function $y = k^x$ for positive values of k, and the trigonometric functions (with arguments in degrees) y = sin x, y = cos x and y = tan x for angles of any size}
- {sketch translations and reflections of the graph of a given function}
- plot and interpret graphs (including reciprocal graphs {and exponential graphs}) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration
- {calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as distance-time graphs, velocity-time graphs and graphs in financial contexts}
- {recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point}
- solve quadratic equations {including those that require rearrangement} algebraically by factorising, {by completing the square and by using the quadratic formula}; find approximate solutions using a graph
- solve 2 simultaneous equations in 2 variables (linear/linear {or linear/quadratic}) algebraically; find approximate solutions using a graph
- {find approximate solutions to equations numerically using iteration}
- translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or 2 simultaneous equations), solve the equation(s) and interpret the solution
- solve linear inequalities in 1 {or 2} variable {s}, {and quadratic inequalities in 1 variable}; represent the solution set on a number line, {using set notation and on a graph}
- recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a positive rational number {or a surd}) {and other sequences}
- deduce expressions to calculate the nth term of linear {and quadratic} sequences.

Ratio, proportion and rates of change

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- compare lengths, areas and volumes using ratio notation and/or scale factors; make links to similarity (including trigonometric ratios)
- convert between related compound units (speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts
- understand that X is inversely proportional to Y is equivalent to X is proportional to $\frac{1}{Y}$; {construct and} interpret equations that describe direct and inverse proportion
- interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion
- {interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of instantaneous and average rate of change (gradients of tangents and chords) in numerical, algebraic and graphical contexts}
- set up, solve and interpret the answers in growth and decay problems, including compound interest {and work with general iterative processes}

Geometry and measures

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- interpret and use fractional {and negative} scale factors for enlargements
- {describe the changes and invariance achieved by combinations of rotations, reflections and translations}
- identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
- {apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results}
- construct and interpret plans and elevations of 3D shapes
- interpret and use bearings
- calculate arc lengths, angles and areas of sectors of circles
- calculate surface areas and volumes of spheres, pyramids, cones and composite solids
- apply the concepts of congruence and similarity, including the relationships between lengths, {areas and volumes} in similar figures
- apply Pythagoras' Theorem and trigonometric ratios to find angles and lengths in right-angled triangles {and, where possible, general triangles} in 2 {and 3} dimensional figures
- know the exact values of sin θ and cos θ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tan θ for θ = 0°, 30°, 45°, 60°
- {know and apply the sine rule, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$, and cosine rule, $a^2 = b^2 + c^2 - 2bc \cos A$, to find unknown lengths and angles}
- {know and apply Area = $\frac{1}{2}$ ab sin C to calculate the area, sides or angles of any triangle}
- describe translations as 2D vectors
- apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; {use vectors to construct geometric arguments and proofs}

- derive and use the sum of angles in a triangle and use it to deduce the angle sum in any polygon, and to derive properties of regular polygons
- apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem, and use known results to obtain simple proofs
- use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles
- use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres to solve problems in 3-D
- interpret mathematical relationships both algebraically and geometrically

Probability

Pupils should be taught to:

- record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale
- understand that the probabilities of all possible outcomes sum to 1
- enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams
- generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities

Statistics

Pupils should be taught to:

- describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, continuous and grouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)
- construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data
- describe simple mathematical relationships between 2 variables (bivariate data) in observational and experimental contexts and illustrate using scatter graphs

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Probability

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to 1
- use a probability model to predict the outcomes of future experiments; understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size
- calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions
- {calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams}

Statistics

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling
- interpret and construct tables and line graphs for time series data
- {construct and interpret diagrams for grouped discrete data and continuous data, ie, histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use}
- interpret, analyse and compare the distributions of data sets from univariate empirical distributions through:
  - appropriate graphical representation involving discrete, continuous and grouped data, {including box plots}
  - appropriate measures of central tendency (including modal class) and spread {including quartiles and inter-quartile range}
- apply statistics to describe a population
- use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing.