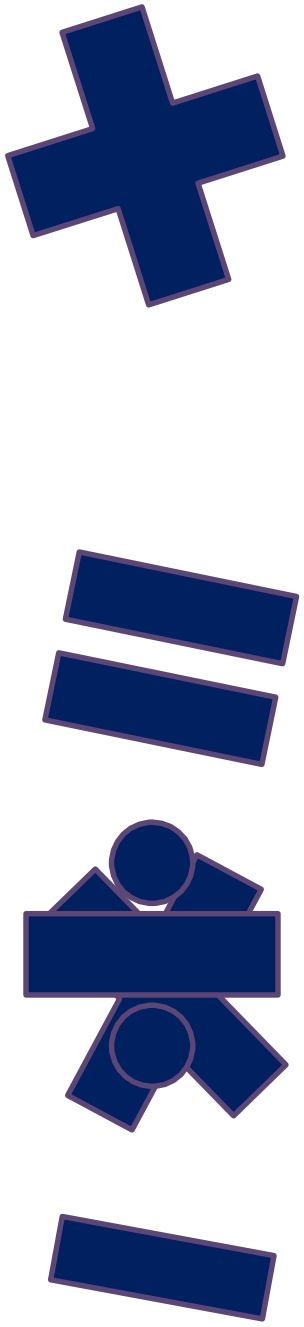
Year 1-6 Progression Long Term Plans Key Concepts

National Curriculum 2014



Purpose of Study – National Curriculum 2014

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

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

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

Who is this book for?

The purpose of this booklet is to outline the expected progression for each year group from the new framework for mathematics. It is important that this is used to ensure that the correct pitch of lessons is achieved alongside suitable differentiation for learning. It is designed to support the 2014 National Curriculum for Mathematics at Key Stages 1 and 2.

This booklet will be relevant and useful for all the following at Brodetsky Jewish Primary School:

- Class Teacher
- Teaching Assistants/Learning Support Assistants
- Volunteers
- Supply Staff
- Parents

Resources

In Year 1 and 2 the pupils will use 'Inspire Maths' one of the DfE approved textbooks, which combines the Singapore pedagogy with leading UK expertise and is correlated to the new National Curriculum.

In Years 3-6 planning will be based on the White Rose Maths Hub mastery schemes of learning.

Overview of Progression in Year 1

Number and place value

During the Foundation Stage, children counted and estimated groups of up to 10 objects. In Year 1, children extend their use of counting numbers to at least 100. They develop recognition of patterns in the number system (including odd and even numbers) by counting in ones, twos, fives and tens. Children use first, second, third for example when ordering items.

Children do not need to recognise the place value of each digit in a two-digit number as they will do this in Year 2. However, they should understand that they can tell whether a number is larger than another by looking at the first digit as well as the second digit.

Addition and subtraction

During the Foundation Stage, children related addition to combining two groups and subtraction to *taking away* when doing practical activities. In Year 1, children use mathematical statements to record addition and subtraction. They read, interpret and write the symbols +, – and =.

Through practice of addition and subtraction, children learn the number trios for numbers to 20 (8 + 5 = 13, 13 – 8 = 5, 13 – 5 = 8). They use different strategies to help them derive number facts, such as adding numbers in any order, or finding a difference by counting up.

Multiplication and division

In Year 1, children are introduced to the concepts of multiplication and division, although they may not use the standard signs (× and ÷) until Year 2. In practical activities, using arrays and physical objects such as blocks, children solve multiplication and division problems using small quantities. With support, children investigate the links between arrays, number patterns and their experience of counting in twos, fives and tens.

Fractions

Children learn to identify halves and quarters by solving practical problems – for example, finding half of a set of ten blocks or a quarter of a square. They learn that the concepts of a half and a quarter apply to objects and quantities as well as to shapes. They link the idea of halves and quarters back to the concepts of sharing and grouping, which they use in their work on multiplication and division. They will build on this in Year 2 when they learn to write simple fractions.

Measurement

In Year 1, children begin to use some common standard units, including measuring objects using rulers, weighing scales and jugs. They accurately use comparative language for length, weight, volume and time, such as longer/shorter, heavier than/lighter than, more/less, and quicker/slower. Children read the time on analogue clocks to the hour and half-hour, and they learn to recognise different coins and notes. In Year 2, children will use standard units more independently and gain experience in telling the time and doing simple calculations with money.

Geometry: properties of shapes

In Year 1, children become familiar with a range of common 2D and 3D shapes, including rectangles, circles and triangles, cuboids, pyramids and spheres. They recognise these shapes in different orientations, sizes and contexts.

Geometry: position and direction

Children continue to use positional language accurately when describing where people or objects are in the environment. They experience the differences between half, quarter and three-quarter turns by practising making these turns in a clockwise direction.

Year 1 Long Term Planning

Number and place value

- Children should practise counting (1, 2, 3), ordering (first, second, third), or to indicate a quantity (3 apples, 2 centimetres), including solving simple concrete problems, until they are fluent.
- They should begin to recognise place value in numbers beyond 20 by reading, writing, counting and comparing numbers up to 100, supported by concrete objects and pictorial representations.
- They should practise counting as reciting numbers and counting as enumerating objects, and counting in ones, twos, fives and tens from different multiples to develop their recognition of patterns in the number system (odd and even numbers). They connect these patterns with objects and with shapes, including through varied and frequent practice of increasingly complex questions.
- They recognise and create repeating patterns with objects and with shapes.

Multiplication and division

- Through grouping and sharing small quantities, children should begin to understand: multiplication and division; doubling numbers and quantities; and finding simple fractions of objects, numbers and quantities.
- They should make connections between arrays, number patterns, and counting in twos, fives and tens.

Measurement

- The pairs of terms mass and weight, volume and capacity, are used interchangeably at this stage.
- Children should move from using and comparing different types of quantities and measures using non-standard units, including discrete (e.g. counting) and continuous (e.g. liquid) measures, to using manageable common standard units.
- In order to become familiar with standard measures, children begin to use measuring tools such as a ruler, weighing scales and containers.
- Children should use the language of time, including telling the time throughout the day, first using o'clock and then half past.

Addition and subtraction

- Children should memorise and reason with number bonds to 10 and 20 in several forms (9 + 7 = 16; 16 – 7 = 9; 7 = 16 – 9). They should realise the effect of adding or subtracting zero. This establishes addition and subtraction as related operations.
- Children should combine and increase numbers, counting forwards and backwards.
- They should discuss and solve problems in familiar practical contexts, including using quantities. Problems should include the terms put together, add, altogether, total, take away, distance between, more than and less than, so that pupils develop the concept of addition and subtraction and are enabled to use these operations flexibly.

Fractions

- Children should be taught half and quarter as 'fractions of' discrete and continuous quantities by solving problems using shapes, objects and quantities. For example, they could recognise and find half a length, quantity, set of objects or shape. Children connect halves and quarters to the equal sharing and grouping of sets of objects and to measures, as well as recognising and combining halves and quarters as parts of a whole.

Geometry: position and direction

- Children should use the language of position, direction and motion, including: left and right, top, middle and bottom, on top of, in front of, above, between, around, near, close and far, up and down, forwards and backwards, inside and outside.
- Children should make half, quarter and three-quarter turns and routinely make these turns in a clockwise direction.

Geometry: properties of shapes

- Children should handle common 2D and 3D shapes, naming these and related everyday objects fluently. They should recognise these shapes in different orientations and sizes, and know that rectangles, triangles, cuboids and pyramids can be different shapes.

Key Maths Concepts in Year 1

Using practical activities to reinforce concepts of number, place value and calculation

In Year 1, children begin to extend their understanding of number, building on concrete, exploratory approaches used in the Foundation Stage. Practical activities and the physical exploration of concepts continue to play an important part in children's mathematical work in Year 1 and beyond. Children start to use more abstract approaches to mathematical problem solving, including using mathematical statements that involve symbols such as +, – and =.

Working with numbers to 100 and beyond

It can be difficult for young children to grasp larger numbers. They will have learned to work with numbers and groups of objects up to 10, but envisaging numbers greater than this can prove more challenging. Providing children with opportunities to see larger numbers in different contexts will help them to become more familiar with the names and relative values. For example, noticing house numbers as they walk along the street will help them to recognise that number 12 is a long way from number 78. They can also be encouraged to use numbers for practical purposes, such as recording and comparing the numbers of children at school on different days, or comparing the number of paint brushes in a pot to the number of writing pencils, for example.

Place value

By comparing numbers, children will begin to see that it is helpful to look at the first digit in two-digit numbers when comparing numbers for size – for example, 23 is less than 32, because 23 has the first digit 2, whereas 32 has the first digit 3. Using hundred squares and number lines to compare numbers will help children identify the decades that numbers belong to, and so build their understanding of how numbers compare in size. This will help build a firm foundation for the further work on place value which children will undertake in Year 2.

Addition and subtraction

To help children remember the addition and subtraction number bonds to 20, provide them with opportunities to add and subtract in many different contexts, such as dice games, puzzles and differences in race times. Also, use addition and subtraction throughout the school day, for example – *Have we got enough pencils for this group? How many more pencils do we need? Yes, 6 take away 4 is 2. We need two more pencils.*

Overview of Progression in Year 2

Number and place value

In Year 2, children develop their understanding of place value from Year 1, learning the place value of each digit in a two-digit number; for example, 23 means two tens and three ones. They begin to understand the use of 0 as a place holder. They will build on this when they consider place value in three-digit numbers in Year 3. Children learn to count in 3s, which will help develop the concept of a third. They order numbers from 0 to 100 and use the <, > and = signs. They become more independent in partitioning numbers in different ways, and this helps to support their work in addition and subtraction.

Addition and subtraction

Children use mental methods to solve problems using addition and subtraction, as well as using objects and pictorial representations. They begin to record addition and subtraction in columns, reinforcing their knowledge of place value. They independently use addition and subtraction facts to 20, and this helps them derive number facts up to 100, such as seeing the parallels between 2 + 6 = 8 and 20 + 60 = 80. They add and subtract different combinations of numbers, including two two-digit numbers. They understand the inverse relationship between addition and subtraction (that one operation undoes the other), and use this to check their calculations.

Multiplication and division

In Year 2, children learn the 2, 5 and 10 multiplication tables, and use these facts in calculations. They recognise that multiplication and division have an inverse relationship, and begin to use the × and ÷ symbols. They learn that multiplication is commutative (2 × 10 is the same as 10 × 2) whereas division is not (10 ÷ 2 is not the same as 2 ÷ 10).

Fractions

Children extend their understanding of fractions to $^1/_3$ and $^3/_4$ and learn that $^1/_2$ is equivalent to $^2/_4$. They read and write the symbols $^1/_2$, $^1/_4$ for example. As well as experimenting practically with fractions and connecting unit fractions to the concepts of sharing and grouping, they begin to write simple fractions, such as $^1/_4$ of 8 = 2. They will develop this in Year 3 when they learn about tenths and begin to find out more about non-unit fractions.

Measurement

Children learn to independently choose the appropriate standard units for a particular measurement and use a range of different measuring instruments. They recognise and use the £ and p symbols for money (but do not use mixed notation, such as £5.72), and undertake addition and subtraction using money. They learn to tell the time to 5 minutes, including quarter past and quarter to the hour.

Geometry: properties of shapes

By handling common 2D and 3D shapes (including quadrilaterals and cuboids, prisms, cones and polygons) children identify their properties, using the terms *sides, edges, vertices* and *faces*. They compare and sort shapes using their properties.

Geometry: position and direction

Children experiment with making patterns using shapes and begin to use the concept of right angles to describe quarter, half and three-quarter turns. They will develop this concept further in Year 3.

Statistics

Children are introduced to pictograms, tally charts, block diagrams and tables, using these to collate and compare information, and to ask and answer simple questions (for example, finding the number of items in a category, perhaps using one-to-many correspondence, or comparing different categories by quantity).

Year 2 Long Term Planning

Number and place value

- Using materials and a range of representations, children should practise counting, reading, writing and comparing numbers to at least 100 and solving a variety of related problems to develop fluency. They should count in multiples of three to support their later understanding of a third.
- As they become more confident with numbers up to 100, children should be introduced to larger numbers to develop further their recognition of patterns within the number system and represent them in different ways, including spatial representations.
- Children should partition numbers in different ways to support subtraction. They become fluent and apply their knowledge of numbers to reason with, discuss and solve problems that emphasise the value of each digit in two-digit numbers. They begin to understand zero as a place holder.

Multiplication and division

- Children should use a variety of language to describe multiplication and division.
- Children should be introduced to the multiplication tables. They practise to become fluent in the 2, 5 and 10 multiplication tables and connect them to each other. They connect the 10 multiplication table to place value, and the 5 multiplication table to the divisions on the clock face. They begin to use other multiplication tables and recall multiplication facts, including using related division facts to perform written and mental calculations.
- Children should work with a range of materials and contexts in which multiplication and division relate to grouping and sharing discrete and continuous quantities, relating these to fractions and measures (e.g. 40 ÷ 2 = 20, 20 is a half of 40). They use commutativity and inverse relations to develop multiplicative reasoning (e.g. 4 × 5 = 20 and 20 ÷ 5 = 4).

Measurement

- Children should use standard units of measurement with increasing accuracy, using their knowledge of the number system. They should use the appropriate language and record using standard abbreviations.
- They should become fluent in telling the time on analogue clocks and recording it.
- Children should also become fluent in counting and recognising coins. They should read and say amounts of money confidently and use the symbols £ and p accurately, recording pounds and pence separately.

Geometry: position and direction

- Children should work with patterns of shapes, including those in different orientations.
- Children should use the concept and language of angles to describe *turn* by applying rotations, including in practical contexts (e.g. children themselves moving in turns, giving instructions to other children to do so, and programming robots using instructions given in right angles).

Fractions

- Children should use additional fractions as 'fractions of' discrete and continuous quantities by solving problems using shapes, objects and quantities. They connect unit fractions to equal sharing and grouping, to numbers when they can be calculated, and to measures, finding fractions of lengths, quantity, a set of objects or shapes. They meet $^{3}/_{4}$ as the first example of a non-unit fraction.
- Children should count in fractions up to 10, starting from any number and using the $^{1}/_{2}$ and $^{2}/_{4}$ equivalence on the number line ($^{11}/_{4}$, $^{12}/_{4}$, (or $^{11}/_{2}$), $^{13}/_{4}$, 2). This reinforces the concept of fractions as numbers and that they can add up to more than one.

Addition and subtraction

- Children should extend their understanding of the language of addition and subtraction to include sum and difference.
- Children should practise addition and subtraction to 20 to become increasingly fluent in deriving facts such as using 3 + 7 = 10, 10 – 7 = 3 and 7 = 10 – 3 to calculate 30 + 70 = 100, 100 – 70 = 30 and 70 = 100 – 30. They should check their calculations, including by adding to check subtraction and adding numbers in a different order to check addition (5 + 2 + 1 = 1 + 5 + 2 = 1 + 2 + 5). This establishes commutativity and associativity of addition.
- Recording addition and subtraction in columns supports place value and prepares for formal written methods with larger numbers.

Geometry: properties of shapes

- Children should handle and name a wider variety of common 2D and 3D shapes and identify the properties of each shape. Children identify, compare and sort shapes on the basis of their properties and use vocabulary precisely, such as sides, edges, vertices and faces.
- Children should read and write names for shapes that are appropriate for their word reading and spelling.
- Children should draw lines and shapes using a straight edge.

Statistics

- Children should record, interpret, collate, organise and compare information (e.g. using many-to-one correspondence with simple ratios 2, 5, 10).

Key Maths Concepts in Year 2

Commutative and non-commutative operations

Commutative operations are those where changing the order of the numbers in the calculation doesn't affect the answer (for example, 2 + 4 = 6, and 4 + 2 = 6). In Year 2, children meet the idea that some mathematical operations are commutative, whereas others are not. It's helpful to give children lots of examples so that they can begin to understand and make this connection for themselves, using objects and pictorial representations as well as written calculations.

Addition and multiplication are commutative:

- 6 + 5 = 11, and 5 + 6 = 11
- 4 × 3 = 12, and 3 × 4 = 12

Children can be encouraged to check that this is true for a wide range of multiplication and addition facts. Using concrete objects such as blocks is a good way to demonstrate that the outcome of addition is always the same, whether you start with for example with 6 blocks and add 5 blocks or vice versa. Similarly, for multiplication, make an array of 4 rows of 3 blocks and then walk around it to see that it is also 3 rows of 4 blocks.

Subtraction and division are non-commutative:

- 5 – 3 does not come to the same as 3 – 5
- 6 ÷ 2 does not come to the same as 2 ÷ 6

As children haven't met negative numbers yet, it isn't necessary to go into detail about the results which give answers in negative numbers – you could say *oh, we haven't got enough to take away five'* or *we'll have to cut the sweets up is we want to divide two sweets between six people*.

Inverse relationships

If two mathematical operations have an inverse relationship, this means that one operation 'undoes' the other (for example, 3 × 6 = 18 can be undone by performing the operation 18 ÷ 6 = 3). This is a concept which children first meet in Year 2, when the idea is introduced that there is an inverse relationship between addition and subtraction, and between multiplication and division.

Children should become familiar with the idea that, for example, you can check the answer to a statement like 2 × 10 = 20 by calculating 20 ÷ 2 = 10, or 20 ÷ 10 = 2. In the same way, you could check 2 + 10 = 12 by calculating 12 – 2 = 10 or 12 – 10 = 2. Plenty of practice is helpful in ensuring that children become fluent in using inverse relationships to check their calculations, and it helps to use concrete objects to demonstrate what is happening visually.

Linking division with fractions

In Year 1, children encountered the idea that division is related to the concept of grouping and sharing quantities (for example, 12 can be divided into 4 groups of 3, or 3 people can share 12 things by getting 4 things each). The idea of sharing can also be used to make a link between division and fractions – so 16 divided (or shared) by 2 is 8, and 8 is half of 16. Again, it will help to use concrete objects to demonstrate this, so children can see that dividing a number of objects by 2 is the same as splitting the group of objects into two halves.

Overview of Progression in Year 3

Number and place value

In Year 2, children learned about place value in two-digit numbers. In Year 3, they will extend their understanding to include the place value of three-digit numbers – for example, 232 is two hundreds, three tens and two ones. They learn to count in 4s, 8s, 50s and 100s, and work with numbers up to 1000. They begin to use estimation when dealing with number problems involving larger numbers.

Addition and subtraction

In Year 3, children practise mentally adding and subtracting combinations of numbers, including three- digit numbers. When using written methods for addition and subtraction, children learn to write the digits in columns, using their knowledge of place value to align the digits correctly. Children begin to use estimation to work out the rough answer to calculations in advance, and use inverse operations to check their final answers – for example, checking 312 + 43 = 355 by working out 355 – 43 = 312.

Multiplication and division

In Year 3, children learn the 3, 4 and 8 multiplication tables, and use their knowledge of doubling to explore links between the 2, 4 and 8 multiplication tables. They use facts from these new multiplication tables to solve multiplication and division problems. Building on their work with written mathematical statements in Year 2, they begin to develop more formal written methods of multiplication and division. They will extend this in Year 4 when they work with more complex multiplication and division problems.

Fractions

Building on work from Year 2, children learn about tenths, and confidently count up and down in tenths. They begin to make links between tenths and place value (ten units make a ten; ten tens make a hundred) and explore connections between tenths and decimal measures. Children extend their understanding of fractions to include more non-unit fractions (that is those with digits other than 1 as their numerator – for example, $^{1}/_{5}$ is a unit fraction, and $^{2}/_{5}$ is a non-unit fraction). They also begin to add and subtract fractions with the same denominator up to one whole, such as $^{3}/_{5} + {}^{3}/_{5} = {}^{4}/_{5}$, $^{4}/_{7} - {}^{2}/_{7} = {}^{2}/_{7}$.

Measurement

Children will learn to tell the time from analogue 24-hour clocks as well as 12-hour clocks. They will move on to use digital 24-hour clocks in Year 4. They will extend their work on money from Year 2, including working out correct change. They will also learn to measure the perimeter of 2D shapes and solve addition and subtraction problems involving length, mass and volume.

Geometry: properties of shapes

In Year 3, children begin to learn about angle as a property of shapes, and they connect the concept of angles with the idea of turning – for example, realising that two right angles equal a half-turn. They can identify whether a given angle is greater or less than a right angle (obtuse or acute). They can accurately describe lines as horizontal, vertical, perpendicular or parallel.

Statistics

In Year 2, children were introduced to pictograms, tally charts, block diagrams and tables, and this year they use these diagrams to answer an increasing range of questions, including two-step questions (in other words, those where there is a hidden question that needs to be answered before the main question can be tackled) For example, in order to work out *how many more cupcakes did Jon eat than Janie*, children first need to find out how many cakes each person ate.

Year 3 Long Term Planning

Number and place value

- Children should now be using multiples of 2, 3, 4, 5, 8, 50 and 100.
- Children should use larger numbers to at least 1000, applying partitioning related to place value using varied and increasingly complex problems, building on work in Year 2 (e.g. 146 = 100 and 40 and 6, 46 = 30 and 16).
- Using a variety of representations, including those related to measure, children should continue to count in ones, tens and hundreds, so that they become fluent in the order and place value of numbers to 1000

Multiplication and division

- Children should continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency. Through doubling, they connect the 2, 4 and 8 multiplication tables.
- Children should develop efficient mental methods, for example, using commutativity (e.g. $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$) and multiplication and division facts (e.g. using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$) to derive related facts ($30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$).
- Children should develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division.
- Children should solve simple problems in contexts, deciding which of the four operations to use and why, including measuring and scaling contexts, and correspondence problems in which *m* objects are connected to *n* objects (e.g. 3 hats and 4 coats, how many different outfits; 12 sweets shared equally between 4 children; 4 cakes shared equally between 8 children).

Measurement

- Children should continue to measure using the appropriate tools and units, progressing to using a wider range of measures, including comparing and using mixed units (1 kg and 200g) and simple equivalents of mixed units (5m = 500cm).
- The comparison of measures should also include simple scaling and this should connect to multiplication.
- Children should continue to become fluent in recognising the value of coins, by adding and subtracting amounts, including mixed units, and giving change using manageable amounts. They should record £ and p separately. The decimal recording of money is introduced formally in Year 4.
- Children should use both analogue and digital 12- hour clocks and record their times. In this way they become fluent in and prepared for using digital 24- hour clocks in Year 4.

Addition and subtraction

- Children should practise solving varied addition and subtraction questions. For mental calculations with two-digit numbers, the answers could exceed 100.
- Children should use their understanding of place value and partitioning, and practise using columnar addition and subtraction with increasingly large numbers up to three digits to become fluent (see National Curriculum Appendix 1).

Fractions

- Children should connect tenths to place value and decimal measures, not restricted to decimals between 0 and 1 inclusive and to division by 10.
- They should begin to understand unit and non-unit fractions as numbers on the number line, and deduce relations between them, such as size and equivalence. They should go beyond the [0, 1] interval, and $\frac{1}{4} + \frac{3}{4} = 1$ for example, relating this to measure.
- Children should understand the relation between unit fractions as operators and division by integers.
- They should continue to recognise fractions in the context of parts of a whole, numbers, measurements, a shape, or unit fractions as a division of a quantity.
- Children should practise adding and subtracting fractions with the same denominator through a variety of increasingly complex problems to improve fluency.

Geometry: properties of shapes

- Children's' knowledge of the properties of shapes is extended at this stage to symmetrical and non-symmetrical polygons and polyhedra. Children extend their use of the properties of shapes. They should be able to describe the properties of 2D and 3D shapes using accurate language, including lengths of lines and acute and obtuse for angles greater or lesser than a right angle.
- Children should draw and measure straight lines in centimetres.

Statistics

- Children should understand and use simple scales (e.g. 2, 5, 10 units per cm) in pictograms and bar charts with increasing accuracy.
- They should continue to interpret data presented in many contexts.

Key Maths Concepts in Year 3

Adding and subtracting fractions with the same denominator within one whole

Children should begin to recognise fractions as numbers that can be used in calculations. Using practical apparatus and examples such as slices of a cake or parts of a sandwich, demonstrate how to add and subtract fractions with the same denominator. Begin with different ways of making one whole by using fractions that have the same denominator, such as a cake that is cut into 8 slices:

$1 = \frac{1}{8} + \frac{7}{8}$

$1 = \frac{2}{8} + \frac{6}{8}$

$1 = \frac{3}{8} + \frac{5}{8}$

$1 = \frac{4}{8} + \frac{4}{8}$

$1 = \frac{5}{8} + \frac{3}{8}$

$1 = \frac{6}{8} + \frac{2}{8}$

$1 = \frac{7}{8} + \frac{1}{8}$

Ask children to explain the pattern in the calculations in the answers. *What stays the same and what changes each time?* (The numerators change but the denominator stays the same.) Emphasise that we're recording how many eighths we have each time. Repeat for other fractions, such as sixths, fifths, tenths, and quarters.

In a similar way, discuss subtraction of fractions with the same denominator from one whole:

$1 = \frac{1}{8} + \frac{7}{8}$

$1 = \frac{2}{8} + \frac{6}{8}$

$1 = \frac{3}{8} + \frac{5}{8}$

$1 = \frac{4}{8} + \frac{4}{8}$

$1 = \frac{5}{8} + \frac{3}{8}$

$1 = \frac{6}{8} + \frac{2}{8}$

$1 = \frac{7}{8} + \frac{1}{8}$

$1 - \frac{8}{8} = 0$

Roman numerals from I to XII on clock faces

In Year 2, children will have had practice of telling the time to 5 minutes on analogue clock faces. When introducing Roman numerals on clock faces in Year 3, children can make the link between the number positions that they already know and the new symbols.

The Roman numerals for numbers 1 to 12 are:

1 = I

2 = II

3 = III

4 = IV (literally, 5 – 1)

5 = V

6 = VI (5 + 1)

7 = VII (5 + 2)

8 = VIII (5 + 3)

9 = IX (10 – 1)

10 = X

11 = XI (10 + 1)

12 = XII (10 + 2)

However, many clock faces use IIII for 4. Discuss with children why this might be.

Also, bear in mind that whereas 1, 2, 3 are usually shown upright all around a clock face, Roman numerals tend to be shown with their bases pointing towards the centre of the clock face. This can be confusing for children as the symbols can appear to be reversed. For example, 6 = VI, but is often shown upside down on a clock face as IΛ. You could demonstrate how the numbers radiate out from the centre of the clock face by turning the clock around to show the symbols right way up.

Overview of Progression in Year 4

Number and place value

In Year 4, children use place value in four-digit numbers, such as 3742 is three thousands, seven hundreds, four tens and two ones. They learn to count in 6s, 7s, 9s, 25s and 1000s, and say 1000 more or less than a specific number. They encounter negative numbers by counting back past zero on number lines, and continue work on rounding (to the nearest 10, 100 or 1000) and estimation. Children are introduced to Roman numerals to 100 and find out how the number system has changed over time.

Addition and subtraction

Children extend previous years' work by adding and subtracting numbers with up to four digits, using mental and written methods, including columnar addition and subtraction. They keep practising mental methods of addition and subtraction as well as written methods, performing calculations increasingly quickly and confidently. They continue using estimation as well as inverse operations to help check answers.

Multiplication and division

Children learn the remaining multiplication tables up to the 12 multiplication table, and use facts from the tables to solve increasingly complex multiplication and division problems. They build on their work with mental methods of calculation in Year 3, using their knowledge of place value and number facts to multiply and divide confidently. They begin to use a formal written layout for multiplication when multiplying two-digit and three-digit numbers by one-digit numbers.

Fractions (including decimals)

Developing ideas from Year 3, children confidently count up and down in hundredths. They learn about and recognise equivalent fractions, simplifying them when necessary (for example, understanding that $^1/_3 = {}^2/_6 = {}^4/_{12}$). They move on to understand and show families of equivalent fractions. They build on earlier work, practising adding and subtracting fractions with the same denominator ($^2/_3 + {}^7/_9 = 1{}^1/_9$). Children also work with decimal equivalents of tenths and hundredths and of $^1/_2$, $^1/_4$, $^3/_4$, understanding that decimals and fractions are different ways of expressing numbers. They round numbers with one decimal place to the nearest whole number, and compare numbers with the same number of decimal places, up to two decimal places. They use fractions and decimals to solve straightforward money and measure problems.

Measurement

In Year 3, children learned to measure the perimeter of 2D shapes; they now extend this, calculating the perimeter of rectilinear shapes including squares. They work out the area of rectilinear shapes by counting. Children compare digital clocks and analogue clocks, reading, writing and converting time between the two systems. They begin using £ and p notation to record money.

Geometry: properties of shapes

Children learn about a wider range of geometric shapes, including different types of triangles and quadrilaterals. They develop work on acute and obtuse angles from Year 3, comparing and ordering angles up to two right angles. They work with lines of symmetry in 2D shapes.

Geometry: position and direction

Children begin to work with a coordinate grid (first quadrant only), using coordinates to describe positions on a grid.

Statistics

Children are introduced to the difference between discrete and continuous data, using bar charts for discrete data (numbers of children travelling to school by different methods) and line graphs for continuous data (children's heights). Children will build further on their work with line graphs in Year 5.

Year 4 Long Term Planning

Number and place value

- Using a variety of representations, including measures, children should become fluent in the order and place value of numbers beyond 1000, including counting in tens and hundreds, and maintaining fluency in other multiples through varied and frequent practice.
- They begin to extend their knowledge of the number system to include the decimal numbers and fractions that they have met so far.
- They connect estimation and rounding numbers to the use of measuring instruments.
- Roman numerals should be put in their historical context so children understand that there have been different ways to write whole numbers and that the important concepts of zero and place value were introduced over a period of time.

Addition and subtraction

- Children should continue to practise both mental methods and columnar addition and subtraction with increasingly large numbers to aid fluency (see National Curriculum Appendix 1).

Multiplication and division

- Children should continue to practise recalling and using multiplication tables and related division facts to aid fluency.
- Children should practise mental methods and extend this to three-digit numbers to derive facts, for example 200 × 3 = 600 into 600 ÷ 3 = 200.
- Children should practise to become fluent in the formal written method of short multiplication for multiplying using multi-digit numbers, and short division with exact answers when dividing by a one-digit number (see Appendix 1).
- Children should write statements about the equality of expressions (e.g. use the distributive law 39 × 7 = 30 × 7 + 9 × 7 and associative law (2 × 3) × 4 = 2 × (3 × 4)). They combine their knowledge of number facts and rules of arithmetic to solve mental and written calculations, e.g. 2 × 6 × 5 = 10 × 6.
- Children should solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the number of choices of a meal on a menu, or three cakes shared equally between 10 children.

Statistics

- Children should understand and use a greater range of scales in their representations and should begin to relate the graphical representation of data to recording change over time.

Geometry: position and direction

- Children should draw a pair of axes in one quadrant, with equal scales and integer labels. They should read, write and use pairs of coordinates (2, 5), including using coordinate-plotting ICT tools.

Fractions (including decimals)

- Children should connect hundredths to tenths and place value and decimal measure.
- Children should extend the use of the number line to connect fractions, numbers and measures.
- Children should understand the relation between non-unit fractions and multiplication and division of quantities, with particular emphasis on tenths and hundredths.
- Children should make connections between fractions of a length, of a shape and as a representation of one whole or set of quantities. Children should use factors and multiples to recognise equivalent fractions and simplify where appropriate.
- Children should continue practice in adding and subtracting fractions with the same denominator, to become fluent through a variety of increasingly complex problems beyond one whole. Children should be taught throughout that decimals and fractions are different ways of expressing numbers and proportions.
- Children's understanding of the number system and decimal place value should be extended at this stage to tenths and then hundredths. This includes relating the decimal notation to division of whole number by 10 and later 100.
- Children should practise counting using simple fractions and decimal fractions, both forwards and backwards.
- Children should learn decimal notation and the language associated with it, including in the context of measurements. They should make comparisons and order decimal amounts and quantities that are expressed to the same number of decimal places. They should be able to represent numbers with one or two decimal places in several ways, such as on number lines.

Measurement

- Children should build on their understanding of place value and decimal notation to record measures, including money. They should use multiplication to convert from larger to smaller units.
- They should relate area to arrays and multiplication. Perimeter can be expressed algebraically as 2(a + b) where a and b are the dimensions in the same unit.

Geometry: properties of shapes

- Children should continue to classify shapes using geometrical properties, extending to classifying different triangles and quadrilaterals.
- Children should compare and order angles in preparation for using a protractor and compare lengths and angles to decide if a polygon is regular or irregular.
- Children should draw symmetric patterns using a variety of media to become familiar with different orientations of lines of symmetry; and recognise line symmetry in a variety of diagrams, including where the line of symmetry does not dissect the reflected shape.

Key Maths Concepts in Year 4

Introducing Roman numerals and the history of the number system

In Year 4, children will learn more about Roman numerals (which they first met in Year 3, in the context of analogue clock faces with Roman numerals).

By this stage, children will be familiar with the concept of place value, and the way that our number system allows us to represent any number using only the ten digits 0 to 9. Children will learn that most ancient civilisations (including the Greeks, Romans and Egyptians) used different number systems to ours, which is called the Hindu-Arabic number system.

In the Roman number system, letters were used to represent numbers, with I standing for units, V for fives, X for tens, C for hundreds and M for thousands. Because these letters were repeated to show quantity (such as, III represents 3, XXXVII represents 37 and CCCXXXIII represents 333) many numbers were represented by long and cumbersome chains of letters which are relatively hard to compare and use in written calculations. The Roman system did not include a concept of zero. Our understanding of zero within our current number system was originally developed in India. The Hindu word for zero is 'sunya'.

Children do not need to learn in detail about the different number systems that have prevailed in different times and places throughout history, but it is very helpful for them to get a sense that our current system is a relatively recent development. It's now used throughout the world, however, because of the efficient way it represents larger numbers and can enable us to record mathematical operations efficiently.

Understanding the difference between discrete and continuous data

In Year 3, children met a range of different formats for recording data, including bar charts. They now extend this to include line graphs, and they will need to begin to understand the different circumstances when it is appropriate to use line graphs rather than bar charts.

This involves understanding the difference between discrete data (which can be effectively recorded using bar charts) and continuous data (which is more effectively shown on line graphs).

As a rule of thumb, discrete data can be counted, whereas continuous data can be measured. So the number of spots on a ladybird would be discrete data (since ladybirds can only have a whole number of spots) and children could use a bar chart to record the number of spots observed on a group of ladybirds. The chart would clearly show that, for example, 7 ladybirds had five spots, 4 had two spots, 3 had three spots and none had four spots or one spot. Discrete data has units that cannot be split up.

Continuous data is data that can take any value within a range. So, for example, a person could be 152 cm, 152.1 cm, 152.17 cm and so on. Continuous data could be shown on a number line, and every point on the line would have meaning (whereas with discrete data, only certain points have meaning).

Continuous data is shown best on a line graph (or time graph) because it usually shows how a quantity changes over time. For example, children might use a time graph to record how a kitten's weight increased over time, or to record the height of a sunflower plant from seedling to full height.

Overview of Progression in Year 5

Number and place value

Children work with numbers up to at least 1,000,000, using knowledge of place value to work out the value of digits. They continue working with negative numbers in different contexts, and practise reading Roman numerals to 1000 (M), which helps them work out years written in Roman numerals. They continue using techniques introduced in earlier years for approximation and estimation.

Addition and subtraction

Children use columns in written addition and subtraction, accurately adding and subtracting numbers with more than four digits. They use mental methods to add and subtract increasingly large numbers, and use rounding to check their answers. With support they choose appropriate operations and methods, and work out the level of accuracy required to answer a particular problem. They will continue to develop this work in Year 6.

Multiplication and division

Children identify multiples and factors, and find all the factor pairs of a given number. With support, they use factors to help solve multiplication and division problems involving larger numbers, and they confidently use written methods to multiply and divide large numbers. They extend their mathematical vocabulary and understanding, beginning to work with prime numbers, prime factors, composite (non-prime) numbers, square and cubed numbers.

Fractions (including decimals and percentages)

Children compare fractions with denominators that are multiples of the same number (comparing $^{3}/_{7}$ with $^{6}/_{14}$). They also identify equivalent fractions of a given fraction including tenths and hundredths. They learn about mixed numbers and improper fractions, and understand how mixed numbers could be converted to improper fractions, and vice versa. With support and using practical equipment and diagrams, they multiply proper fractions and mixed numbers by whole numbers.

Children convert decimal numbers into fractions (0.65 = $^{65}/_{100}$). Extending their work from previous years, they use thousandths and make connections between these and tenths, hundredths and their decimal equivalents. They round decimals to the nearest whole number, and to one decimal place, and begin to work with numbers with three decimal places. Children begin to work with percentages and find solutions to problems using percentage and decimal equivalents of $^{1}/_{2}$, $^{1}/_{4}$, $^{1}/_{5}$, $^{2}/_{5}$, $^{4}/_{5}$, for example. This forms a basis for further work on percentages in Year 6.

Measurement

In Year 4, children calculated the perimeter of rectilinear shapes; they now extend this to composite (or compound) rectilinear shapes, and calculate the area of squares and rectangles. They begin to understand and estimate volume and capacity, and compare metric with common imperial units. They will build on this work in Year 6.

Geometry: properties of shapes

Children extend their work on angles from Year 4, estimating, measuring, comparing and drawing a variety of angles using degrees. They use given dimensions to help them draw shapes accurately, and use techniques learnt in the context of missing number problems to help them work out missing angles.

Geometry: position and direction

Building on work with coordinate grids from Year 4, children work out the position of shapes following reflection or translation, in the first quadrant.

Statistics

In Year 4, children were introduced to line graphs; now they use information from line graphs to solve problems. They practise completing and reading tables, including timetables

Year 5 Long Term Planning

Number and place value

- Children should identify the place value in large whole numbers.
- They should continue to use number in context, including measurement. Children extend and apply their understanding of the number system to the decimal numbers and fractions they have met so far.
- They should recognise and describe linear number sequences, including those involving fractions and decimals, and find the term-to-term rule.

Multiplication and division

- Children should practise and extend their use of the formal written methods of short multiplication and division (see National Curriculum Appendix 1). They apply all the multiplication tables and related division facts, commit them to memory and use them confidently to make larger calculations.
- They should use and understand the terms factor, multiple and prime, square and cube numbers.
- Children should interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding
- Children use multiplication and division as inverses to support the introduction of ratio in Year 6, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as kilometres and metres. Distributivity can be expressed as a(b +c) = ab + ac in preparation for using algebra.

Measurement

- Children should use their knowledge of place value and multiplication and division to convert between standard units.
- Children should calculate the perimeter of rectangles and related composite shapes, including using the relations of perimeter or area to find unknown lengths. They calculate the area from scale drawings using given measurements.
- Children should use all four operations in problems involving time and money, including conversions.

Geometry: properties of shapes

- Children should become accurate in drawing lines with a ruler to the nearest millimetre, and measuring with a protractor. They use conventional markings for parallel lines and right angles.
- Children should use the term diagonal and make conjectures about the angles formed by diagonals and sides, and other properties of quadrilaterals, for example using dynamic geometry ICT tools.
- Children should use angle sum facts and other properties to make deductions about missing angles and relate these to missing number problems.

Statistics

- Children should connect their work on coordinates and scales to their interpretation of time graphs.
- They should begin to decide which representations of data are most appropriate and why.

Geometry: position and direction

- Children recognise/use reflection and translation in a variety of diagrams, including continuing to use a 2D grid and coordinates in the first quadrant. Reflection should be in lines parallel to the axes.

Addition and subtraction

- Children should practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency.
- They should practise mental calculations with increasingly large numbers to aid fluency.

Fractions (including decimals and percentages)

- Children should be taught throughout that percentages, decimals and fractions are different ways of expressing proportions. They extend their knowledge of fractions to thousandths and connect to decimals and measures.
- Children should connect equivalent fractions >1 that simplify to integers with division and fractions >1 to division with remainders, using the number line and other models, and hence move from these to improper and mixed fractions.
- Children should connect multiplication by a fraction to using fractions as operators (fractions of), and to division, building on work from previous years. This relates to scaling by simple fractions.
- Children should practise adding and subtracting fractions to become fluent through a variety of increasingly complex problems. They should extend their understanding of adding and subtracting fractions to calculations that exceed 1 as a mixed number.
- Children should read and write proper fractions and mixed numbers accurately and practise counting forwards and backwards in simple fractions.
- Children should continue to develop their understanding of fractions as numbers, measures and operators by finding fractions of numbers and quantities, writing remainders as fractions.
- Children extend counting from Year 4, using decimals and fractions including bridging zero, for example on a number line.
- Children should say, read and write decimal fractions and related tenths, hundredths and thousandths accurately and are confident in checking the reasonableness of their answers to problems.
- They should mentally add and subtract tenths, and one-digit whole numbers and tenths.
- They should practise adding and subtracting decimals including whole numbers and decimals, decimals with different numbers of decimal places, and complements of 1. Children should go beyond the measurement and money models of decimals.
- Children should make connections between percentages, fractions and decimals and relate this to finding 'fractions of'. They recognise that percentages are proportions of quantities as well as operators on quantities.

Key Maths Concepts in Year 5

Introducing negative numbers in context

Children will have encountered negative numbers during Year 4, but in Year 5 they extend their understanding, meeting negative numbers in a range of different contexts.

The idea of negative numbers may seem counterintuitive in some ways – it's clear what we mean by 3 in the context of sweets, jumpers or sheep, but what about –3? Fortunately, there are several everyday contexts which will give children a sense of how useful negative numbers can be. Probably the most familiar context for negative numbers in daily life is temperature. Children will see negative numbers used on a thermometer scale for values below 0°, and they will have heard weather forecasters predicting an overnight drop in temperature, for example to –2°.

Children may also be familiar with negative numbers in terms of distances above and below sea level, such as a particular location might be –8 metres (8 metres below sea level). Or they may have used a lift in a large building where the ground floor is marked as 0 on the lift buttons, in which case basement levels may be called –1 and –2.

When introducing negative numbers, it's a good idea to use a vertical number line rather than a horizontal line, because this will help children to use accurate language to describe number relationships above and below zero – for example, they will naturally describe numbers as *falling*, *dropping* or *rising*, and will speak in terms of one number being below or above another. It can be helpful to display the vertical number line like a scale on a giant thermometer.

Refer to numbers less than zero as negative numbers, but allow children to say minus six, minus thirteen, for example.

Comparing percentages with fractions and decimals

Children will need to understand that a percentage is really a fraction with a denominator of 100, so 25% is equivalent to $^{25}/_{100}$. Children will begin to make connections between percentages and decimals when they look at patterns such as this:

15% = 0.15

43% = 0.43

75% = 0.75

The digits are the same, but the decimal point is in a different place. 15% is the same as $^{15}/_{100}$, so drawing on their knowledge of place value, children should begin to understand why the decimal equivalent of 15% is written 0.15.

Percentages below 10% can cause problems because, for example, 5% is not written 0.5 but 0.05 (0.5 being equivalent to 1/2 or 50%). However, place value should also help children avoid giving the wrong decimal equivalent for smaller percentages and fractions.

Overview of Progression in Year 6

Number and place value

Children work with numbers up to 10,000,000, using knowledge of place value to work out the value of digits. They continue working with negative numbers in different contexts, and work out intervals across zero.

Addition, subtraction, multiplication and division Children continue to practise using efficient written and mental methods for all four operations, working with larger numbers and increasingly complex calculations, and confidently using number facts from the multiplication and division tables. They learn about the correct order of operations, understanding that (for example) to work out (7 + 8) ÷ 3 they need to tackle the operation in brackets first.

Fractions (including decimals and percentages)

Children begin to add and subtract fractions with different denominators. They multiply pairs of simple proper fractions together, and divide proper fractions by whole numbers.

Children begin to multiply and divide numbers with two decimal places by one-digit and two- digit whole numbers. They are introduced to this in practical contexts such as measures and money (for example, multiplying 1.80 metres by 2, or dividing £1.80 by 3).

Children extend their work on percentage and decimal equivalents of fractions, begun in Year 5. They work out simple percentages of whole numbers, and encounter equivalences between fractions, decimals and percentages in different contexts.

Ratio and proportion

In Year 6, children are introduced to the concepts of ratio and proportion and use these to compare quantities and sizes; for example, understanding that mixing sugar and flour in a ratio of 1:2 means using 1 part of sugar for every 2 parts of flour, and that the proportion of sugar in the mixture is 1 out of 3 parts, which is $^1/_3$.

Algebra

Children begin to form an understanding of algebra by encountering the use of symbols and letters to represent unknown elements, for example using letters to represent missing numbers in missing number problems. They also describe and generate number sequences and patterns. They begin to use simple formulae expressed in words, such as 'the perimeter of a rectangle is two times the length plus two times the width.

Measurement

Children extend their Year 5 work on calculating area and estimating volume and capacity to calculate the area of parallelograms and triangles, and work out the volume of cubes and cuboids using standard units. They convert measurements from miles to kilometres.

Geometry: properties of shapes

This year, children make nets to build simple 3D shapes, and work out unknown angles in triangles, quadrilaterals and regular polygons. They draw and name the different parts of a circle (radius, diameter and circumference).

Geometry: position and direction

Extending their work with coordinate grids, children learn to describe positions on all four quadrants of the grid, including using negative numbers. They translate simple shapes on the coordinate plan, reflecting them in the axes.

Statistics

Children continue working with line graphs and also learn how to use pie charts, linking this with their work on angles, percentages and fractions. Children learn how to work out the mean of a set of data and understand when it might be appropriate to calculate the mean, and why.

Year 6 Long Term Planning

Number and place value

- Children should use the whole number system - saying, reading and writing numbers accurately.

Fractions (including decimals and percentages)

- Children should practise, use and understand the addition and subtraction of fractions with different denominators by identifying equivalent fractions with the same denominator. They should start with fractions where the denominator of one fraction is a multiple of the other and progress to varied and increasingly complex problems.
- Children should use a variety of images to support their understanding of multiplication with fractions. They should use their understanding of the relationship between unit fractions and division to work backwards by multiplying a quantity that represents a unit fraction to find the whole quantity. They practise with simple fractions and decimal fraction equivalents to aid fluency, including listing equivalent fractions to identify fractions with common denominators.
- Children can explore and make conjectures about converting a simple fraction to a decimal fraction. For simple fractions with recurring decimal equivalents, children should learn about rounding the decimal to three decimal places, or other appropriate approximations depending on the context.
- Children also develop their skills of rounding and estimating as a means of predicting and checking the order of magnitude of their answers to decimal calculations.

Algebra

- Children should be introduced to the use of symbols and letters to represent variables and unknowns in mathematical situations that they already understand, such as:
  - missing numbers, lengths, coordinates and angles
  - formulae in mathematics and science
  - arithmetical rules (e.g. a + b = b + a)
  - generalisations of number patterns
  - number puzzles

Geometry: properties of shapes

- Children should draw shapes and nets accurately, using measuring tools and conventional markings and labels for lines and angles.
- Children should describe the properties of shapes and explain how unknown angles and lengths can be derived from known measurements. These relationships might be expressed algebraically.

Geometry: position and direction

- Children should draw and label a pair of axes in all four quadrants with equal scaling.
- Children draw and label rectangles, parallelograms and rhombuses, specified by coordinates in the four quadrants, predicting missing coordinates using the properties of shapes.

Addition, subtraction, multiplication and division

- Children should practise addition, subtraction, multiplication and division for larger numbers, using the efficient written methods of columnar addition and subtraction, short and long multiplication, and short and long division (see Appendix 1).
- They should undertake mental calculations with increasingly large numbers and more complex calculations.
- Children should continue to use all the multiplication tables to calculate mathematical statements in order to maintain their fluency.
- Children should round answers to a specified degree of accuracy.
- Children explore the order of operations using brackets.
- Common factors can be related to finding equivalent fractions.

Ratio and proportion

- Pupils recognise proportionality in contexts when the relations between quantities are in the same ratio.
- Pupils link percentages or 360° to calculating angles of pie charts.
- Children should consolidate their understanding of ratio when comparing quantities, sizes and scale drawings by solving a variety of problems. They may use the notation a: b to record their work.
- Children should solve problems involving unequal quantities. These problems are the foundation for later formal approaches to ratio and proportion.

Measurement

- Using the number line, children should use, add and subtract positive and negative integers for measures such as temperature.
- They should know approximate conversions and be able to tell if an answer is sensible.
- They should relate the area of rectangles to parallelograms and triangles, and be able to calculate their areas, understanding and using the formula to do this.
- Children could be introduced to other compound units for speed, such as miles per hour, and apply their knowledge in science or other subjects as appropriate.

Statistics

- Children should connect their work on angles, fractions and percentages to the interpretation of pie charts.
- Children should both encounter and draw graphs relating two variables, arising from their own enquiry and in other subjects.
- They should connect conversion from kilometres to miles in measure to its graphical representation.
- Children should know when it is appropriate to find the mean of a data set.

Key Maths Concepts in Year 6

Ratio and Proportion: solving problems involving unequal sharing

Children will already know that if they want to work out how to share, for example, 20 sweets equally between two people, they can use straightforward division: they can calculate 20 ÷ 2 = 10. However, what if they need to find out how to share 20 sweets between two people in a ratio of 1:3; in other words, where Person A receives three sweets for every one sweet received by Person B?

Children will need to understand that the ratio 1:3 implies that there are 4 'shares' to be parcelled out between the two people (1 + 3 = 4). If 20 sweets = 4 shares, then each share is worth 5 sweets (20 ÷ 4 = 5), so Person A gets one share, consisting of 5 sweets in total, and lucky Person B gets three shares, consisting of 15 (3 × 5 = 15) sweets in total.

When working with ratios and proportions, children will need to understand the distinction between ratio and proportion. A ratio compares part of the whole with another part of the whole; for instance, shortbread might be made using flour, butter and sugar in a ratio of 4:3:2, with four parts of flour and three parts of sugar for every two parts of butter. However a proportion is used to describe a part of the whole in relation to the whole itself; so in this fictional shortbread, the proportion of butter is 3 out of 9 parts, or one third.

Working out the size of the sectors in pie charts

Children will need to understand that in order to create a pie chart, they first need to work out the fraction of the total that each sector represents. They can then convert this fraction to an angle, and draw sectors with the correctly sized angles.

So, for example, imagine the following data set needs to be represented by a pie chart:

- Number of children travelling to school by car: 15
- Number of children travelling to school by bike: 10
- Number of children walking to school: 5

Children would need first to work out the total number of children in the group (30). They can then work out the fraction of the total which makes up each category – so 'car' accounts for 15 out of the 30 children, or $^1/_2$ of the total; 'bike' accounts for 10 out of 30, or $^1/_3$; and 'walk' accounts for 5 out of 30, or $^1/_6$ of the total.

Children will know that there are 360° in a full turn, and this means they can work out the angle needed for each segment by multiplying the fraction by 360°. (In this example, since the numerator of each fraction is 1, you can just divide 360 by the denominator of each fraction.) This gives the following angles for each segment of the pie:

- car 180°
- bike 120°
- walk 60°

Children can then use these angles to draw the sectors on the pie chart