Year 5

Progression in mathematics

The learner

At the start of Year 5, children have developed their understanding of numbers to include negative whole numbers, decimals and fractions. They have a growing understanding of mathematical ideas such as equivalence, estimation, proportion, scaling and angle. They are confident at calculating mentally and use place value to manipulate and partition numbers. They have started to use calculators as a tool for solving problems or looking for patterns. They apply their knowledge and skills to a wider range of challenges. They are willing to discuss a variety of approaches and to choose the one that is most appropriate to the challenge.

During Year 5, children continue to consolidate their knowledge of number facts through frequent and regular practice. They continue to develop mental methods of calculation and always look at calculations to decide if they can do them in their heads. They calculate mentally with decimals with up to two places. They refine their written methods of calculation for all four operations to make them more efficient.

Children use their understanding of properties of polygons to sort and classify them. They have a broad range of vocabulary to describe position, movement and direction, which they extend to include parallel and perpendicular lines and the coordinate system. They identify acute and obtuse angles and measure angles in degrees, for example, when they draw and explore shapes. They read partly numbered scales accurately. They use 24-hour clock notation, timetables and a calendar to calculate time intervals.

Daily mathematics teaching continues to develop children's understanding, use and application of mathematics. They plan and pursue lines of enquiry and propose general statements involving numbers or shapes. They answer a set of related questions, collecting, sorting and organising relevant information, using ICT to help them. The home–school link is sustained through homework and information that children are given about their next steps in learning.

Children are encouraged to make connections between mathematics and other subjects. They recognise how their literacy skills contribute to their mathematical development. In their mathematics lessons, they strengthen their speaking and listening skills and develop the key aspects of learning identified in *Excellence and Enjoyment: learning and teaching in the primary years*.

Using and applying mathematics

Children solve one- and two-step problems involving whole numbers and decimals and any of the four operations. They solve simple problems involving fractions. They decide what calculations to do and choose the method of calculation that they think is most appropriate for the calculations involved. They use a calculator to find fractions of quantities and measures. Sometimes this involves a decimal answer that they have to interpret, for example: 'A man has £1250. He decides to save one quarter of this with one bank and one eighth with another bank. How much has he left to spend?'

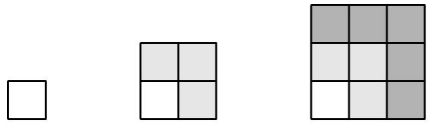
When they solve problems, children discuss the approaches that they plan to use to engage with the problem. They then select the information and resources that they need. For example, they discuss the measurements and materials that they need to build a box to contain four tennis balls. They identify nets of the boxes that they might make and compare alternatives. They recognise when a particular example or approach is not working and select another strategy.

When they solve mathematical puzzles, children work systematically. They use some of the information that they are given to see what possibilities this allows. Alternatively, they use simple cases or particular examples and build these up in the light of their observations. For example, children solve this problem: 'Half of the cubes in a box are red and half are blue. When three red cubes are replaced with three blue cubes, only one third of the cubes in the box are red. How many cubes are in the box?' They look at a simpler case where changing just one cube from red to blue changes the proportion of red cubes from one half to one third of the total. They build up to changing two cubes and then three cubes and draw out the patterns as increasing numbers of cubes are exchanged.

Children plan and pursue a line of enquiry. They suggest further questions that extend the ideas involved. They recognise how problems can be represented by number sentences or by diagrams, appreciating that this allows them to work on a problem away from the 'clutter' of the context. When they have found a solution, they check and confirm it back in context. For example, children recognise that a problem about paying £370 for several table lamps at £40 each and chairs at £70 each can be simplified to finding two numbers from the 4 and 7 times-tables that sum to 37.

Children record their steps and results to share with others. For example, they choose four different digits, such as 7, 4, 3 and 2, to form numbers and generate products. They experiment with 247 × 3, 37 × 24, 43 × 7 × 2, and so on, to identify how to make the largest even product or the product closest to 500. They record and adjust their products in the light of their findings. They then explore the effect of using other digits, including a zero, cases where two digits are the same and examples that include decimals.

Children continue to explore relationships between numbers, for example, between odd numbers and square numbers. They predict the sum of consecutive odd numbers and test and confirm that the sum of the first 12 odd numbers is 12 squared, using diagrams to support their reasoning.



Counting and understanding number

Children count from any given number in step sizes such as 19 or 0.2. They count beyond zero when counting back, or start from a negative number to count on. They relate counting in steps of, say, 0.3 to counting in threes. They relate the numbers in the sequence to their position on a number line, recognising when they cross whole-number boundaries.

Children know the value of the digits in numbers such as 30.45 and 30.9 and understand why 30.9 is the larger of these two examples. They partition decimals and round them up or down. For example, they round 12.66666 in their calculator display to the nearest whole number, 13, and to 12.7 to one decimal place. They know that 17.499999 is interpreted as £17.50 in the context of money. They use decimals in the context of measures and convert between related units of measurement.

Children form families of equivalent fractions such as $^{2}/_{3}$, $^{4}/_{6}$, $^{3}/_{9}$, …, and simplify fractions by cancelling. They relate fractions to their decimal representation. They know, for example, that 0.25 is one quarter and 0.4 is four tenths or 40 hundredths. They work out the decimal form of fractions whose denominator is a factor of 10 or 100, such as $^{2}/_{5}$ or $^{3}/_{20}$, by finding the equivalent number of tenths or hundredths, and they confirm their answers using a calculator. They change an improper fraction such as $^{10}/_{3}$ to the equivalent mixed number $3^{1}/_{2}$, and vice versa, and position these numbers on a number line. They express a smaller whole number as a fraction of a larger number. For

example, they explain that 15 as a fraction of 60 is 15 out of 60 or $^{15}/_{60}$ or $^{1}/_{4}$; they relate this to a context such as 15 seconds being $^{1}/_{4}$ of a minute and 15 minutes $^{1}/_{4}$ of an hour.

Children understand percentage as the number of parts in every 100. They express tenths and hundredths as percentages and recognise, for example, that finding 25% of a quantity is the same as finding one quarter, or that 80% of a quantity is equivalent to eight tenths or 80 hundredths. They find simple percentages of amounts, calculating, for example, 10% of 5 kg. They use 10% to work out 5% and 20% by halving or doubling.

Children use a fraction to describe the proportion of particular items in a given quantity. For example, they describe 6 red counters in a pack of 18 counters, saying: 'One third of the counters are red', and using the language: 'One counter in every three is red'. They begin to understand ratio as describing the relationship between two separate quantities, knowing for example that in a box of four blue hats and twelve green hats the ratio of blue hats to green hats is 1 : 3, or that there are three green hats to or for every blue hat. They recognise that multiplying two quantities by the same factor or scaling up keeps the ratio between the quantities the same. For example, if two boxes of four blue hats and twelve green hats are tipped into a bigger box, the ratio of blue hats to green hats in the box of 32 hats is still 1 : 3. They apply ideas of ratio and proportion to solve problems such as scaling a recipe up or down to feed more or fewer people.

Knowing and using number facts

Children apply to decimals their knowledge of addition and subtraction facts involving one- and two-digit whole numbers. They know that 7 + 8 is 15 and therefore that 0.7 + 0.8 is 1.5 and 0.07 + 0.08 is 0.15. They work out half of 7.4 by halving 74 and dividing by 10; they double 0.75 by doubling 75 and dividing by 100, taking care that the decimal point is in the right place in the answer 1.50 or 1.5.

Children continue to secure their speed of recall of multiplication tables to 10 × 10. They use their knowledge to recall, for example, 8 squared or the seventh multiple of 8. They derive families of calculations such as 8 × 3, 80 × 3, 800 × 3, 80 × 30, 80 × 300, … They derive division facts such as 56 ÷ 8 and apply this fact to calculations such as 560 ÷ 8 and 560 ÷ 80.

Children identify the factors of a two-digit number such as 56 by listing its factor pairs: 1 and 56, 2 and 28, 4 and 14, 8 and 7. They establish that 70 and 8, and 7 and 80, are factor pairs of 560. They use lists of factors to find common factors of two numbers such as 36 and 54. They find common multiples of two numbers such as 8 and 12, identifying 24, 48 and 72 as numbers in a sequence of common multiples.

Calculating

Children continue to check a calculation to see if they can carry out it out mentally. They bridge through the landmarks of multiples of 1, 10, 100 and 1000 when they add and subtract mentally and make jottings. They calculate mentally with two-digit decimals; for example, they relate 9.5 – 3.7 to the whole-number calculation 95 – 37 = 58, giving the answer 5.8. They work out, say, 19.7 + 3.4 by adding 0.3 to 19.7 to make 20, then adding 3.1 to 20 to give a total of 23.1. They find the difference between 7012 and 3984 by stepping from 3984 to 4000 (16) and from 4000 to 7012 (3012), and adding the steps to get the answer 3028. They use an empty number line and notes to record and explain their solutions if necessary.

Children multiply and divide whole numbers and decimals by 10, 100 and 1000, describing the effects. They recognise, for example, that 3400 is 100 times larger than 34 and that 0.4 is 10 times smaller than 4. They round whole numbers to the nearest 10, 100 or 1000 and decimals to the nearest whole number, and use this to find approximate answers to calculations.

Children draw on their knowledge of number facts and place value to refine their use of expanded methods. They use efficient written methods to add and subtract whole numbers and decimals with one or two places. They begin to record the calculations more succinctly, embedding the processes of partitioning and exchange in the presentation.

1576 + 858

$$\begin{array}{rrrrrr} 1500 & + & 70 & + & 6 & \\ +\ 800 & + & 50 & + & 8 & \\ \hline 2300 & + & 120 & + & 14 & = 2434 \end{array}$$

2362 – 548

$$\begin{array}{rrrrrr} 2300 & + & 50 & + & 12 & \\ -\ 500 & + & 40 & + & 8 & \\ \hline 1800 & + & 10 & + & 4 & = 1814 \end{array}$$

1576 + 858

$$\begin{array}{r} 1576 \\ +\ 858 \\ \hline 2434 \\ {\scriptstyle 1\,1\,1} \end{array}$$

2362 – 548

$$\begin{array}{r} {\scriptstyle 1}\not{2}\,{\scriptstyle 1}3{\scriptstyle 5}\not{6}\,{\scriptstyle 1}2 \\ -\ 5\ 4\ 8 \\ \hline 1\ 8\ 1\ 4 \end{array}$$

23.7 + 48.55

$$\begin{array}{r} 23.70 \\ +\ 48.55 \\ \hline 72.25 \\ {\scriptstyle 1\,1} \end{array}$$

72.5 – 45.7

$$\begin{array}{r} {\scriptstyle 6}\not{7}\,{\scriptstyle 11}\not{2}.{\scriptstyle 1}5 \\ -\ 4\ 5.\ 7 \\ \hline 2\ 6.\ 8 \end{array}$$

Children use partitioning to multiply and divide whole numbers by a one-digit number, using jottings to help them. For example, they find 73 × 5 by adding 70 × 5 to 3 × 5, and they recognise that 136 ÷ 4 can be found by adding 120 ÷ 4 to 16 ÷ 4. Children link these methods to the written methods that they use. They begin to express a remainder as a whole number, fraction or decimal; for example, they give the answer to 23 ÷ 4 as 5 remainder 3, $5\frac{3}{4}$ or 5.75. They understand when the context of a division problem requires rounding, for example, that when 50 eggs are placed in boxes that each hold six eggs, this will require nine boxes, eight of which will be full.

Children refine and use efficient written methods to multiply whole numbers and decimals, and to divide two- and three-digit whole numbers by a one-digit number. They approximate first, check their answers. They discuss when to record their method and how the method helps them to keep track of the steps to an answer that they can use to check later. They begin to recognise the efficiency of different methods

47 × 36

(estimate: 50 × 40 = 2000)

×	40	7	
30	1200	210	1410
6	240	42	282
			1692

237 × 4

(estimate: 250 × 4 = 1000)

$$\begin{array}{r} 237 \\ \times\ 4 \\ \hline 28 \\ 120 \\ 800 \\ \hline 948 \end{array}$$

4.7 × 8

(estimate: 5 × 8 = 40)

$$\begin{array}{r} 4.7 \\ \times\ 8 \\ \hline 37.6 \\ {\scriptstyle 5} \end{array}$$

346 ÷ 8

(estimate: 400 ÷ 8 = 50)

$$\begin{array}{r} 8\overline{)346} \\ -320 \quad (8 \times 40) \\ \hline 26 \\ -24 \quad (8 \times 3) \\ \hline 2 \end{array}$$

Answer: 43 R 2

257 ÷ 7

(estimate: 280 ÷ 7 = 40)

$$\begin{array}{r} 36\ \text{R}\ 5 \\ 7\overline{)25{\scriptstyle 4}7} \end{array}$$

Answer: 36 R 5

Children use division and multiplication to find fractions of quantities. They find three fifths of £3.50 by dividing £3.50 by 5 to get one fifth, £0.70, then multiplying this by 3 to get the answer £2.10; and seven tenths of 2 litres by dividing by 10 to get one tenth, 0.2 litres, then multiplying this by 7.

Children develop their skills in using a calculator to solve problems, including those that involve decimals and fractions. They interpret the display correctly in contexts of money and measures. They identify missing numbers in more complex calculations, such as 39 × (△ – 79) = 429 or (2.4 + □) ÷ 3 = 21.9, and describe their methods. They explore relationships between numbers, for example, to find out what factors 124 and 412 have in common, or to compare the answers to the calculations such as 4000 ÷ 32, 2000 ÷ 16 and 1000 ÷ 8; they use the patterns that they observe to predict answers to other calculations. They use examples to test statements such as 'Numbers that end in 52 have a factor of 4', and make up other statements to test. They solve puzzles such as making 100 using only the digits 2, 3 and 7 and the operations – and ×.

Understanding shape

Children's visualisation and construction of shapes become increasingly accurate. They identify and make nets of cubes and other 3-D solids, and use the nets to create the shapes. They recognise parallel and perpendicular lines in grids, and identify and explore the properties of shapes with parallel sides such as a rectangle, trapezium and parallelogram. They use a set-square and ruler to construct shapes with perpendicular or parallel sides.

Children use coordinates in the first quadrant to read and plot points which form the vertices of shapes. For example, they plot the points (1, 3) and (5, 1) and choose a third point to form a triangle and see if they can make an isosceles triangle. They determine the position of shapes after a translation or a reflection. They complete patterns with two perpendicular lines of symmetry.

Children use their knowledge of right angles to identify acute and obtuse angles and to estimate the size of angles in degrees. They use a protractor to measure and draw acute and obtuse angles with increasing accuracy. They investigate angle properties of the polygons that they can draw on different grids. They know that all the angles and all the sides in a regular polygon are equal. They explore shapes that have line symmetry to see if they always have pairs of equal angles. They know that adjacent angles on a straight line sum to 180° and they use this fact to calculate the size of angles that make up a straight line.

Measuring

Children choose, use and record standard metric units to estimate and measure length, mass and capacity to a suitable degree of accuracy. They convert larger units to smaller related units, such as 0.7 litres to 70 centilitres or 5.5 cm to 55 mm. They measure and draw lines to the nearest millimetre. They solve practical problems and word problems involving measurement, such as deciding how large to make a display of the work of the whole class. They use their estimation and measuring skills in science, geography and PE, and when they are designing and making projects in art or design and technology.

Children measure the sides of shapes and use their measurements or given information to calculate the perimeters. They know that for regular polygons the perimeter is the length of one side multiplied by the number of sides. They understand that the unit for area is a square unit and use square centimetres to find an area by counting squares. They design, for example, rectangular frames from a strip of card 30 cm long, recording the lengths of the sides and the area of each frame. They use squared paper to establish that for a rectangle of, say, 9 cm by 6 cm, the area is 54 cm² and can be found by multiplying 9 by 6. They use this approach and other resources to establish and use the formula for calculating the area of a rectangle.

Children read scales accurately and interpret a reading that lies between two unnumbered divisions, for example, when they read time on an analogue clock, the capacity of liquid in a jug, or frequencies on a bar chart. They understand and use 24-hour clock notation and use timetables and calendars to solve problems involving time. For example, they plan a journey that involves stops and

transfers. They use the ITPs 'Measuring cylinder', 'Measuring scales' and 'Time' for further practice, and to pose and solve problems.

Handling data

Children describe the likelihood of particular events. For example, they describe the likelihood of frost in England in July as very unlikely but highly likely in January; they explain that there is an even chance of rolling an odd number on an ordinary dice, but no chance of rolling a zero. They pose questions and collect data that they can use to answer them. For example, they hypothesise about an aspect of children's lives in Victorian times, the angle of a slope before different objects will slide down it, or the time it takes to carry out different tasks such as reading a page of text or standing on one foot. They identify further questions to ask and follow these up with further data and analysis.

Children represent data on bar charts, using different intervals for different bar charts. They understand that lines joining points on a line graph – for example, to show changes over time in the depth of water in a water butt – have meaning, since they represent how the changes might have occurred. They appreciate that points used to show the frequency of particular events – for example, the frequency of rolling each of the numbers on a dice – cannot be joined as the lines would have no meaning.

Children collect, store and retrieve data electronically. They interpret the data that they collect and apply their ICT skills to the analysis. They know which table, chart or graph to use to enhance visual representation and precision. They know that the most frequently occurring event is the mode and they find it from frequency tables and bar charts.

Embedding key aspects of learning

In Year 5, children's thinking, communication and social skills continue to develop through their broader understanding, use and application of mathematics. For example, they use reasoning to propose general statements and to identify examples that do or do not meet a statement. They also use reasoning when the find and confirm solutions to problems. They develop their information processing skills when they collect, organise and present data and when they propose how to extend a line of enquiry. They draw on their evaluation skills as they assess which approach to solving a problem or pursuing an enquiry is preferable, and why.

Children's vocabulary is extended as they learn new words to describe factors, chance, likelihood and percentages. Their communication skills are strengthened through their increasing access to written methods of calculation and ways of presenting data in charts, graphs and tables. Their social skills are developed through discussion as they explain their hypotheses, reasoning and decisions.

Children become better at initiating and sustaining their own mathematical activity. They use, for example, their knowledge of shapes and measures to investigate and to be increasingly creative. This independence is enhanced by sharing their thinking and listening to the ideas of others during collaborative activity. Children's increasing use of ICT offers them a tool that they can use to access more and increasingly diverse information and to present their work.

During Year 5 children's understanding of how they learn continues to grow. They use this self-awareness to identify their own targets in mathematics. They evaluate their success in meeting these targets.