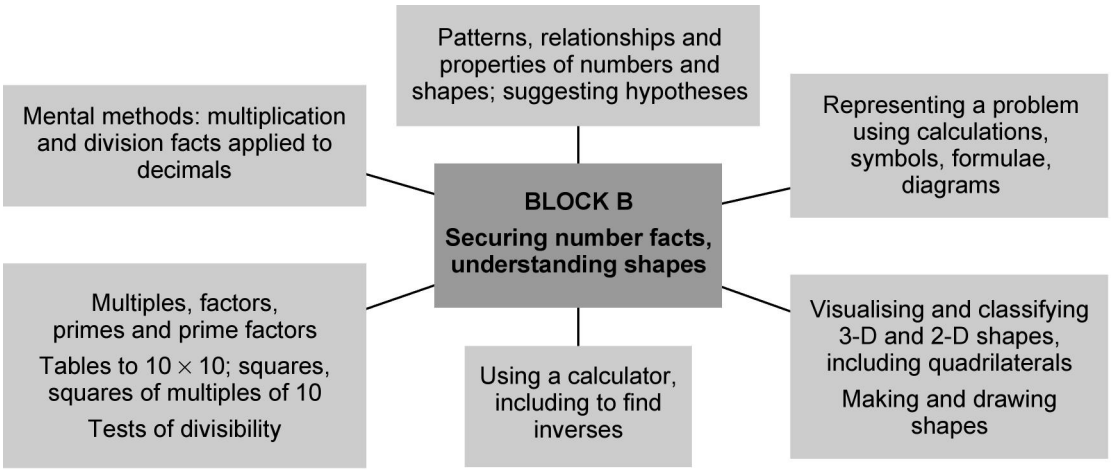
Year 6: Block B — Three 3-week units

Securing number facts, understanding shapes



Objectives End-of-year expectations (key objectives) are highlighted	Units 1	 2	 3
• Tabulate systematically the information in a problem or puzzle; identify and record the steps or calculations needed to solve it, using symbols where appropriate; interpret solutions in the original context and check their accuracy		✓	✓
• Represent and interpret sequences, patterns and relationships involving numbers and shapes; suggest and test hypotheses; construct and use simple expressions and formulae in words then symbols (e.g. the cost of c pens at 15 pence each is $15c$ pence)	✓	✓	✓
• Use knowledge of multiplication facts to derive quickly squares of numbers to 12 × 12 and the corresponding squares of multiples of 10	✓	✓	✓
• Use knowledge of place value and multiplication facts to 10 × 10 to derive related multiplication and division facts involving decimals (e.g. 0.8 × 7, 4.8 ÷ 6)	✓	✓	✓
• Recognise that prime numbers have only two factors and identify prime numbers less than 100; find the prime factors of two-digit numbers	✓	✓	✓
• Use approximations, inverse operations and tests of divisibility to estimate and check results	✓	✓	✓
• Use a calculator to solve problems involving multi-step calculations		✓	✓
• Describe, identify and visualise parallel and perpendicular edges or faces; use these properties to classify 2-D shapes and 3-D solids	✓	✓	✓
• Make and draw shapes with increasing accuracy and apply knowledge of their properties	✓	✓	✓

Speaking and listening objectives for the block

Objectives	Units		
	1	2	3
• Use a range of oral techniques to present persuasive argument	✓		
• Use a variety of ways to criticise constructively and respond to criticism		✓	
• Use a range of oral techniques to present persuasive arguments and engaging narratives			✓

Opportunities to apply mathematics in science

Activities		Units		
		1	2	3
6e	Forces in Action: Weigh objects in air and suspended in water. Calculate the differences between readings. Discuss patterns in data generated	✓		
6e	Forces in action: When investigating paper spinners, take measurements of area. Present results in a graph, identify patterns and anomalies		✓	
6h	Enquiry in environmental and technological contexts: Identify patterns in data on dandelion growth in different habitats.			✓

Key aspects of learning: focus for the block

Enquiry	Problem solving	**Reasoning**	**Creative thinking**
Information processing	Evaluation	Self-awareness	Managing feeling
Social skills	**Communication**	Motivation	Empathy

Vocabulary

problem, solution, calculate, calculation, equation, method, explain, reasoning, reason, predict, rule, formula, relationship, sequence, pattern, classify, property, criterion/criteria, generalise, construct

integer, decimal, fraction, square number, multiple, factor, factorise, divisor, divisible, divisibility, prime, prime factor, consecutive, operation, inverse, product, quotient, round, estimate, approximate

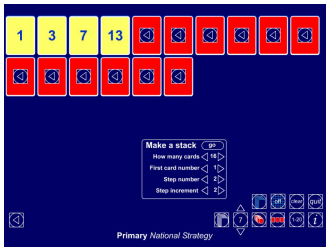
parallel, perpendicular, regular, irregular, face, edge, vertex/vertices, polyhedron, dodecahedron, octahedron, tetrahedron, polygon, quadrilateral, rhombus, kite, parallelogram, trapezium, triangle, isosceles, equilateral, scalene, radius, diameter, circumference, intersecting, intersection, plane

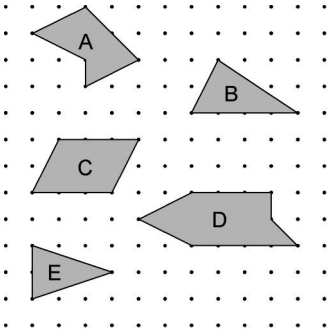
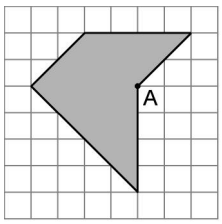
Building on previous learning

Check that children can already:

- propose a general statement involving numbers or shapes
- organise information in a table
- use knowledge of place value and addition and subtraction of two-digit numbers to derive sums, differences, doubles and halves of decimals, e.g. 6.5 ± 2.7, halve 5.6, double 0.34
- identify pairs of factors of two-digit whole numbers and find common multiples
- recognise parallel and perpendicular lines
- identify, visualise and describe properties of rectangles, regular polygons and 3-D solids

Unit 6B1 3 weeks

Objectives *Children's learning outcomes in italic*	Assessment for learning
• Represent and interpret sequences, patterns and relationships involving numbers and shapes; suggest and test hypotheses; construct and use simple expressions and formulae in words then symbols (e.g. the cost of c pens at 15 pence each is $15c$ pence) *I can describe and explain sequences, patterns and relationships* *I can suggest hypotheses and test them* *I can write and use simple expressions in words and formulae*	Describe the relationship between terms in this sequence: 2, 3, 8, 63, … Make the ITP '20 cards' generate this sequence of numbers: 1, 3, 7, 13, …  Explain why a square number always has an odd number of factors. The first two numbers in this sequence are 2.1 and 2.2. The sequence then follows the rule: 'to get the next number, add the two previous numbers'. What are the missing numbers? 2.1 2.2 4.3 6.5 ☐ ☐
• Use knowledge of multiplication facts to derive quickly squares of numbers to 12 × 12 and the corresponding squares of multiples of 10 *I can say the squares of numbers to 12 × 12 and work out the squares of multiples of 10*	Tell me how to work out the area of a piece of cardboard with dimensions 30 cm by 30 cm. Find two square numbers that total 45.
• Use knowledge of place value and multiplication facts to 10 × 10 to derive related multiplication and division facts involving decimals (e.g. 0.8 × 7, 4.8 ÷ 6) *I can use tables facts to work out other facts with decimals*	Start from a two-digit number with at least six factors, e.g. 72. How many different multiplication and division facts can you make using what you know about 72? What facts involving decimals can you derive? What if you started with 7.2? What about 0.72? The answer to a calculation is 0.56. What could the calculation be?
• Recognise that prime numbers have only two factors and identify prime numbers less than 100; find the prime factors of two-digit numbers *I can work out which numbers less than 100 are prime*	Can you tell me another prime number? What do these two numbers have in common? Millie and Ryan play a number game. Is it under 20? No Is it under 25? Yes Is it odd? Yes Is it a prime number? Yes What is the number?
• Use approximations, inverse operations and tests of divisibility to estimate and check results *I can estimate and check the calculations that I do*	Roughly, what will the answer to this calculation be? How do you know that this calculation is probably right? Could you check it a different way? Should the answer be odd or even? How do you know?

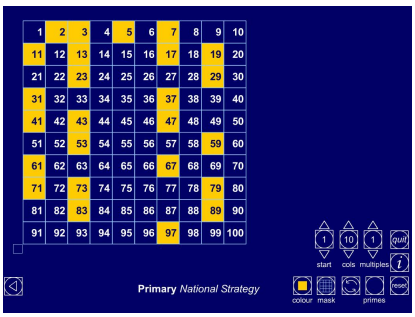
Objectives *Children's learning outcomes in italic*	Assessment for learning
• Describe, identify and visualise parallel and perpendicular edges or faces; use these properties to classify 2-D shapes and 3-D solids *I can classify 2-D shapes with perpendicular or parallel sides*	Look at this cube. How many edges are parallel to this one? How many edges are perpendicular to this one? How would you check if two lines are parallel? Perpendicular? Tell me some facts about parallelograms. Which of these shapes has two pairs of parallel sides? 
• Make and draw shapes with increasing accuracy and apply knowledge of their properties *I can make and draw shapes accurately*	Draw two straight lines from point A to divide the shaded shape into a square and two triangles.  Use your ruler and set-square to draw a 5 cm by 7 cm rectangle. Investigate the minimum number of flaps that you would need to put on the edges of a net of the cube in order to secure each edge of the cube.
• Use a range of oral techniques to present persuasive argument *I can persuade others that my solution makes sense or my hypothesis is correct*	Convince me that in a number grid starting at 1 with nine columns, there will never be a prime number in the sixth column. John says that every multiple of 4 ends in 2, 4, 6 or 8. Persuade me that John is wrong.

Learning overview

Children respond quickly to multiplication and division calculations involving decimals. They work out calculations such as 5.6 ÷ □ = 0.7 or 3 × 0.6, drawing on their knowledge of **number facts** and understanding of **place value**. They are able to **approximate**, use **inverses** and apply **tests of divisibility** to check their results.

Children know the square numbers up to 12 × 12 and derive the corresponding squares of multiples of 10, for example 80 × 80 = 6400. Children investigate the **factors** of different numbers and establish that numbers with an odd number of factors are square numbers (for example, the factors of 9 are 1, 3 and 9).

They recognise that numbers with only two factors are **prime numbers** and can apply their knowledge of multiples and tests of divisibility to identify the prime numbers less than 100. They explain that 73 children can only be organised as 1 group of 73 or 73 groups of 1, whereas 44 children could be organised as 1 group of 44, 2 groups of 22, 4 groups of 11, 11 groups of 4, 22 groups of 2 or 44 groups of 1. They explore the pattern of primes on a 100-square, explaining why there will never be a prime number in the tenth column and the fourth column.



Children recognise and use **sequences, patterns and relationships** involving numbers and shapes to solve problems such as:

How can you use factors to calculate 35 × 14?

Investigate multiples of 25. What do you notice about the last two digits?

How could you test a number to see whether it is divisible by 8?

Investigate the differences between terms of the sequence of square numbers 1, 4, 9, 16, … Describe the pattern and use it to continue the sequence.

Investigate the statement: 'Every square number is the sum of two triangular numbers'.

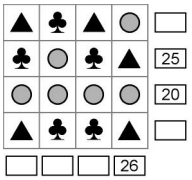
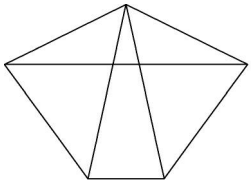
Children use their knowledge of multiples to solve problems such as: *My age is a multiple of 8. In a year's time, my age will be a multiple of 7. How old am I*? They work **systematically** to find **all possible solutions**, tabulating the information they need to solve the problem.

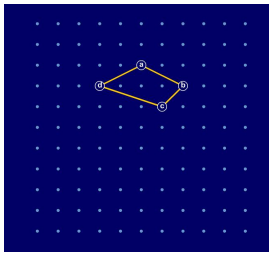
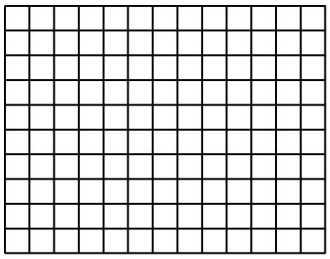
Children identify **parallel and perpendicular sides** in 2-D shapes. They explore which quadrilaterals have pairs of parallel and/or perpendicular sides. They investigate how many pairs of parallel sides there are in regular polygons, **generalising** and explaining their findings and expressing them in a formula, at first in words then using **symbols**. They classify 2-D shapes using assorted criteria. They use their knowledge of shape properties to solve problems, for example:

How many different shapes can be made by placing two identical equilateral triangles edge to edge? What about 3, 4, 5, … identical equilateral triangles?

Children **make** and **draw** shapes and apply their knowledge of the properties; for example, they use art straws to create 'skeleton' shapes. They draw shapes with increasing accuracy, for example, using a set-square and ruler to draw a right-angled triangle with its two shorter sides 7.2 cm and 9.6 cm long. They find the perimeter of the triangle by measuring accurately.

Unit 6B2 3 weeks

Objectives *Children's learning outcomes in italic*	Assessment for learning
• Represent and interpret sequences, patterns and relationships involving numbers and shapes; suggest and test hypotheses; construct and use simple expressions and formulae in words then symbols (e.g. the cost of c pens at 15 pence each is $15c$ pence) *I can describe and explain sequences, patterns and relationships* *I can suggest hypotheses and test them* *I can write and use simple expressions in words and formulae*	☐ and ○ each stand for a different number. ☐ = 34 ☐ + ☐ = ○ + ○ + ☐ What is the value of ○? Now make up another problem like this. How could you use symbols to help you to solve this problem? Each shape stands for a number. The numbers shown are the totals of the line of four numbers in the row or column. Find the remaining totals. 
• Tabulate systematically the information in a problem or puzzle; identify and record the steps or calculations needed to solve it, using symbols where appropriate; interpret solutions in the original context and check their accuracy *I can use a table to help me solve a problem* *I can identify and record what I need to do to solve the problem, checking my answer makes sense and is accurate*	How could you organise the information to help you? How many triangles can you see in this diagram?  How can you make sure that you have counted them all?
• Use knowledge of multiplication facts to derive quickly squares of numbers to 12 × 12 and the corresponding squares of multiples of 10 *I can say the squares of numbers to 12 × 12 and work out the squares of multiples of 10*	Estimate the area of a field 38 m wide by 42 m long. How could you use 12 × 12 = 144 to work out 12 × 13? What number when multiplied by itself has the answer 400? 17 multiplied by itself gives a three-digit answer: 17 × 17 = 289. What is the smallest two-digit number that can be multiplied by itself to give a four-digit answer?
• Use knowledge of place value and multiplication facts to 10 × 10 to derive related multiplication and division facts involving decimals (e.g. 0.8 × 7, 4.8 ÷ 6) *I can use tables facts to work out related facts with decimals*	You know that 72 ÷ 8 = 9. What other division and multiplication facts can you derive from this? Multiply 9 by 0.7. What number multiplied by 6 equals 4.2?
• Recognise that prime numbers have only two factors and identify prime numbers less than 100; find the prime factors of two-digit numbers *I can work out which numbers less than 100 are prime*	How many distinct prime factors has 16? What about 17? Can you give me a number with prime factors 3 and 5? What about 2 and 3? How could you use prime factors to help you to multiply by 18? Which numbers between 20 and 30 have the greatest number of factors? Which have the least? Which have an odd/even number of factors?
• Use approximations, inverse operations and tests of divisibility to estimate and check results *I can estimate and check the result of a calculation*	How do you know that 234 is divisible by 3? Should the answer be a multiple of 4? How could you check? I think that the answer to 3768 × 3 is wrong. How can I tell? What would be the best approximation for 9.8 × 31.8?

Objectives *Children's learning outcomes in italic*	Assessment for learning
• Use a calculator to solve problems involving multi-step calculations *I can use a calculator to solve problems with more than one step*	Which three prime numbers multiply to make 231? What is the missing number in these calculations? 21.8 × ☐ = 294.3 (14.7 + ☐) × 4.8 = 164.64
• Describe, identify and visualise parallel and perpendicular edges or faces; use these properties to classify 2-D shapes and 3-D solids *I can use the properties of parallel and perpendicular to describe and classify 2-D shapes and 3-D solids*	What is the same about a rhombus and a kite? What is different? Name a shape that has one pair of parallel sides, but no pairs of perpendicular sides. What do you notice about the opposite sides of this parallelogram? Is it true for all parallelograms? What about this trapezium? By moving just one point, can you change this shape into a kite? A rhombus? A non-isosceles trapezium?  Which quadrilaterals have diagonals that intersect at right angles?
• Make and draw shapes with increasing accuracy and apply knowledge of their properties *I can make and draw shapes accurately*	Give me instructions to get me to draw a rhombus using my ruler and a protractor. On the grid below, use a ruler to draw a pentagon that has three right angles. 
• Use a variety of ways to criticise constructively and respond to criticism *I can respond to the suggestions of others, explaining how they have or haven't changed my opinion*	Does your rule for the relationship between edges, faces and vertices work for cylinders and cones? Are you certain that multiplying 6 by a number makes 6 larger? Have you tried multiplying 6 by 0.5?

Learning overview

Children use decimal notation in a variety of contexts, such as 3.5 ÷ 7 or ☐ ÷ 5 = 0.4, explaining methods and checking that answers are correct. They apply knowledge of multiplication facts to **derive related facts**; for example, they state the three other known facts when given 23.4 × 2.5 = 58.5, or work out that since 8 × 7 = 56 then 0.8 × 0.7 = 0.56.

Children multiply and divide decimals to solve word problems such as: *How many cups holding 0.2 litres can be filled from three 1.5 litre bottles of lemonade?* They approximate first to check that their answers are sensible: 'I estimated that the answer must lie between 21 and 24 so it cannot possibly be 225.' They **communicate** their **reasoning** and rectify the error. They use symbols to write a formula for the number of glasses g in y bottles, if one bottle holds 5 glasses.

Children solve problems involving patterns and relationships using their calculators. They use rounding to find an approximate answer as a check. They record the calculations involved using **symbols** for unknown numbers where appropriate. They look at an answer in its original context and check that it is reasonable. For example, they use a calculator to find the missing numbers and digits in calculations such as 568.1 ÷ □ = 24.7, or 14□ × □6 = 10 868, and explain their reasoning.

Children find the **squares of multiples of 10** and answer questions such as:

What is 40 squared?

What number when multiplied by itself gives 900?

They find **prime factors** of two-digit numbers; for example, they find that the prime factors of 28 are 7 × 2 × 2. They collaborate to find the number between 0 and 50 with the greatest number of prime factors. They solve problems such as:

Find two prime numbers with a total of 30.

Which prime numbers lie between 20 and 30?

Is 96 a prime number? How do you know?

Explain why 87 is not a prime number.

Children **explore** patterns, sequences and relationships and explain their method and reasoning, using diagrams where helpful. For example:

What are the missing numbers in this sequence? 10, 25, □, □, 70, □

Write a formula for the nth term of the sequence 3, 6, 9, 12, 15, …

A line of counters is set out in a pattern: 5 white, 4 blue, 5 white, 4 blue, …

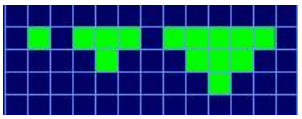
What colour is the 65th counter?

Make a pattern with blue and yellow beads so that the 57th bead is yellow.

Children **hypothesise** and **investigate systematically**. They explore the patterns made by multiples of 2, 3, 4, 5, … on a 100-square. They predict the numbers whose multiples will form vertical or diagonal lines, or checkerboard patterns. They change the layout to a nine-column grid, and hypothesise about the patterns that the multiples will make. They **predict** a number whose multiples will be in vertical lines, or what multiples will form diagonal lines. They continue and extend the investigation, asking 'What if…?' questions and making **general statements**.

Children investigate the line symmetry of polygons. They find assorted shapes with 2 lines of symmetry. They **measure** the angle between the lines of symmetry of shapes with 2, 3, 4, 5, … lines of symmetry. They describe what they have found out, commenting on patterns and relationships. They investigate the properties of quadrilaterals, measuring the angles or using paper-folding to establish which angles in a quadrilateral are equal. They investigate the diagonals of quadrilaterals to discover which of them are perpendicular and which intersect at their mid-points.

Unit 6B3 3 weeks

Objectives *Children's learning outcomes in italic*	Assessment for learning
• Tabulate systematically the information in a problem or puzzle; identify and record the steps or calculations needed to solve it, using symbols where appropriate; interpret solutions in the original context and check their accuracy *I can use a table to help me solve a problem* *I can identify and record what I need to do to solve the problem, checking that my answer makes sense and is accurate*	Imagine you have 25 beads. You have to make a three-digit number on an abacus. You must use all 25 beads for each number you make. How many different three-digit numbers can you make? How can you be sure that you have counted them all? How will you organise the information in this problem? Two boys and two girls can play tennis. Yasir said: 'I will only play if Holly plays.' Holly said: 'I won't play if Ben is playing.' Ben said: 'I won't play if Luke or Laura plays.' Luke said: 'I will only play if Zoe plays.' Zoe said: 'I don't mind who I play with.' Which two boys and which two girls play tennis?
• Represent and interpret sequences, patterns and relationships involving numbers and shapes; suggest and test hypotheses; construct and use simple expressions and formulae in words then symbols (e.g. the cost of c pens at 15 pence each is $15c$ pence) *I can describe and explain sequences, patterns and relationships* *I can suggest hypotheses and test them* *I can write and use simple expressions in words and formulae*	Draw the next two terms in this sequence:  Describe this sequence to a friend using words. Describe it using numbers. How many small squares would there be in the 10th picture? I want to know the 100th term in the sequence. Will I have to work out the first 99 terms to be able to do it? Is there a quicker way? How? How would you change an amount of money from pounds sterling to euros? Record it for me using symbols.
• Use knowledge of multiplication facts to derive quickly squares of numbers to 12 × 12 and the corresponding squares of multiples of 10 *I can say the squares of numbers to 12 × 12 and work out the squares of multiples of 10*	How many squares of multiples of 10 lie between 1000 and 2000? How many lie between 1000 and 10 000?
• Use knowledge of place value and multiplication facts to 10 × 10 to derive related multiplication and division facts involving decimals (e.g. 0.8 × 7, 4.8 ÷ 6) *I can use my tables to work out decimal facts like 0.4 × 8 and 5.6 ÷ 7*	Which of these are incorrect? 56 × 0.7 = 8 56 ÷ 0.7 = 80 0.7 × 0.8 = 6.6 Explain how you know using words or diagrams.
• Recognise that prime numbers have only two factors and identify prime numbers less than 100; find the prime factors of two-digit numbers *I can tell you all the prime numbers up to 100 and find the prime factors of other numbers*	Investigate which numbers to 30 have only one distinct prime factor (prime numbers, squares of prime numbers, cubes of prime numbers). Predict what numbers to 60 will have only one distinct prime factor when you test them.

Objectives *Children's learning outcomes in italic*	Assessment for learning
• Use a calculator to solve problems involving multi-step calculations *I can use a calculator to solve problems with more than one step*	Which part of your problem will you solve mentally? Which part will you solve using a calculator? My calculator shows:  My question was about pounds. Complete this: 0.35 means … pence. My question was about litres. Complete this: 0.35 means … millilitres. My question was about metres. Complete this: 0.35 means … centimetres.
• Use approximations, inverse operations and tests of divisibility to estimate and check results *I can estimate and check the result of a calculation*	Is this calculation correct? How do you know? What inverse operation could you use to check this result? I multiplied two odd numbers and my answer was 186. Explain why I cannot be correct. Should the answer be a multiple of 6? How could you check? This sequence of numbers goes up by 40 each time. 40 80 120 160 200 … This sequence continues. Will the number 2140 be in the sequence? Explain how you know.
• Describe, identify and visualise parallel and perpendicular edges or faces; use these properties to classify 2-D shapes and 3-D solids *I can identify 3-D shapes with perpendicular or parallel edges or faces*	Imagine a triangular prism. How many faces does it have? Are any of the faces parallel to each other? How many pairs of parallel edges has a square-based pyramid? How many perpendicular edges? Look at these 3-D shapes (e.g. a cuboid, tetrahedron, square-based pyramid and octahedron). Show me a face that is parallel to this one. Which face is perpendicular to this one? What can you tell me about the faces of a cuboid? Why are so many packing boxes made in the shape of a cuboid? Which of these shapes is incorrectly placed on this Carroll diagram? Change the criteria so the shapes are correctly sorted according to their properties.
• Make and draw shapes with increasing accuracy and apply knowledge of their properties *I can make and draw shapes accurately*	Use your ruler and protractor. Draw the net of a regular tetrahedron with edges of 6 cm. Use compasses to draw a circle. Use a ruler and protractor to draw a regular pentagon with its vertices on the circumference of the circle. Tell me an example of a circular object that would have a radius of about 5 cm. What about 50 cm? 500 cm?
• Use a range of oral techniques to present persuasive arguments and engaging narratives *I can listen to the ideas of others, making sure that I respond to their ideas when I make my next statement*	In your group, consider the sum of five numbers in a straight line on the 100-square. What do you notice? Think about this problem and how to solve it. Take turns to contribute one idea for the group to discuss.

Learning overview

Children use **number facts** and **place value** to solve word problems involving whole numbers and decimals. They solve problems such as: *A box contains 250 matches and weighs 55 grams. The empty box weighs 12 grams. Calculate the weight of one match.* They interpret the decimal answer in the context of the problem.

They identify stages in **solving multi-step problems**, what calculations to do and the most efficient way to do them. They **record their methods** clearly, showing each stage. They suggest word problems involving numbers, money or measures to match given calculations, such as 4.2 ÷ 0.7, making sure that the answer will make sense in the context of the problem. They **tabulate results systematically** so that they know that they have found all possible solutions to a problem. For example, they work systematically through three-digit numbers beginning 99, 98, 97, 96, … then 89, 88, 87, 86, …, and so on when they solve this problem:

> *Imagine you have 25 beads. You have to make a three-digit number on an abacus. You must use all 25 beads for each number you make. How many different three-digit numbers can you make?*

They record all their solutions by writing them in order.

Children investigate **relationships** and **patterns** in numbers. They write a formula for converting one currency to another, researching the accurate exchange rate and using symbols to express the relationship between the two currencies. They find the digit sum of multiples of 3 and use results to establish a rule for divisibility by 3. They explore multiples of other numbers in a similar way and establish general rules for recognising where a number is a multiple of 2, 3, 4, 5, 6, 8 or 9.

Children **approximate** and **test for divisibility** to check results. For example, they give reasons why the calculation 2065 ÷ 3 = 714 cannot be correct, or they find the missing digits in the calculation 3□5 ÷ 9 = □5. They use **tests of divisibility** to find the **prime factors** of two-digit whole numbers, writing 60, for example, as 2 × 2 × 3 × 5.

They solve problems and puzzles, testing answers using tests of divisibility and **approximation**. For example, they investigate the general statement: *When you add three consecutive numbers, the sum is a multiple of 3*. They predict what will happen when they add four consecutive numbers, and then five. They **pose questions** of their own, such as: *Is the product of two odd numbers always odd?* They test their hypotheses for accuracy.

Children use inverse operations to **solve problems** such as: *I think of a number, subtract 15 and then multiply the answer by 4. I get the answer of 130. What number did I start with?*

Children extend their explorations of **properties of shapes**. They identify and **visualise** shapes. They recognise parallel and perpendicular faces of 3-D shapes practically through, for example, placing one face on a horizontal surface and observing whether any other faces are horizontal (or vertical). They describe the shape generated by cutting through a tetrahedron or a triangular right prism in a plane parallel to a base. They classify 3-D shapes using criteria such as 'has at least one pair of parallel faces'. They investigate the number of edges, faces and vertices in polyhedra, record these in a table and explore the **relationship**: the number of vertices plus the number of faces equals the number of edges.

Children **draw 2-D shapes and make 3-D shapes with increasing accuracy**. For example, they program an on-screen turtle to draw regular polygons or specific quadrilaterals. They use compasses to construct circles with a given radius or diameter, suggesting ways to investigate the relationship between the diameters of a set of concentric circles and their radii. They create a set of nesting boxes from card.