Stage 6	Unit 1: Pattern Sniffing	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000 ➢ recognise and use square numbers and cube numbers, and the notation for squared (²) and cubed (³) ➢ multiply and divide numbers mentally drawing upon known facts ➢ identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers ➢ establish whether a number up to 100 is prime and recall prime numbers up to 19	➢ generate and describe linear number sequences ➢ identify common factors, common multiples and prime numbers	➢ **generate terms of a sequence from a term-to-term rule** ➢ **recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions** ➢ **use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple** ➢ **use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5**

Key learning steps	Key Vocabulary
1. I can generate a linear sequence using a rule 2. I can describe a linear sequence using a term-to-term rule 3. I can find missing terms in a sequence 4. I can solve problems involving sequences 5. I can identify factors and multiples of numbers 6. I can identify the common factors of 2 or more numbers 7. I can identify the common multiples of 2 or more numbers 8. I can identify whether any number (of reasonable size) is a prime number	linear sequence term position factor multiple prime

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
"A linear sequence An increasing linear sequence A decreasing linear sequence A common factor of 24 and 40 A common multiple of 5 and 8	"...The 10th term of the sequence 3, 7, 11, 15, … is 39 ...12 is a common factor of 24 and 60 ...2 is a prime number ...1 is not a prime number	1, 4, 7, 10, … 7, 10, 13, 16, … -7, -4, -1, 2, … 17, 14, 11, 8, …. 4, 8, 24, 12 1, 2, 3, 5 7, 9, 13, 17	The 5th term of a sequence is double the 10th term of a sequence A number has an even number of factors A number has an even number of multiples

A prime number A prime number greater than 50	...A prime number has two factors		Pick a number, multiply by 6, add 1. The answer is a prime number. Prime numbers are odd Prime numbers can be a multiple of 4 Cube numbers are square numbers

Misconceptions	**Guidance**
Pupils think all sequences are increasing Pupils think, for example, the 5th term will be double the 10th term Pupils think all sequences are linear Pupils forget that 1 and the number itself are two factors of a number Pupils forget that the number itself is a multiple of the number Pupils think all prime numbers are odd Pupils think 1 is a prime number Pupils think 2 is not a prime number	Use counters, matchsticks etc. to build sequences practically and then develop the skills of generalisation .... Get children to consider how many factors and multiples there are of a number - the idea that factors are finite but multiples are infinite is important. You should still be finding common factors and multiples by listing - however, you can extend thinking by asking children about whether knowing that 2 and 3 are both factors of a number gives you any extra info (i.e. that 6 will be too) It is worth discussing how you know if you've got all the factors - you can get more able children to discover that you only have to test the numbers up to the square root of the number.
Activities	**Show me what you know**
https://www.ncetm.org.uk/resources/42893 "'Abundant Numbers', an activity from Nrich requires children to explore factors of numbers. 'Factors and multiples' is another Nrich game, perfect for practicing skills. http://nrich.maths.org/1011 http://nrich.maths.org/5468 Identify common factors, common multiples and prime numbers NRICH: Mystery Matrix ** NRICH: Factor Lines ** NRICH: Factor-multiple Chains ** NRICH: The Moons of Vuvv * NRICH: Round and Round the Circle ** NRICH: Counting Cogs **"	Click here to access files in Google drive

Stage 6	Unit 2: Investigating Number Systems	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit ➢ read Roman numerals to 1000 (M) and recognise years written in Roman numerals ➢ read, write and interpret negative numbers in context ➢ solve number problems and practical problems that involve all of the above ➢ round any number up to 1 000 000 to the nearest 10, 100, 1000, 10 000 and 100 000 ➢ round decimals with two decimal places to the nearest whole number and to one decimal place ➢ read, write, order and compare numbers with up to three decimal places	➢ read, write, order and compare numbers up to 10 000 000 and determine the value of each digit ➢ use negative numbers in context, and calculate intervals across zero ➢ solve number and practical problems that involve all of the above ➢ round any whole number to a required degree of accuracy ➢ identify the value of each digit in numbers given to three decimal place	➢ **understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)** ➢ **round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures)** ➢ **order positive and negative integers, decimals and fractions**

Key learning steps	Key Vocabulary	
1. I can read, write, order and compare numbers up to 10,000,000. 2. I can talk about the place value of each digit up to 10,000,000. 3. I can use negative numbers in context. 4. I can calculate intervals across zero. 5. I can round any number to a required degree of accuracy.	Hundred Thousand Ten thousand Million Tenths Hundredths Thousandths Place Value Order	Compare Negative Round Rounding Nearest Decimals Decimal place

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... a number that is ten greater than 16,548,891	...that 0.048 > 0.0084	4.152 and 41.52	-73 is less than -1

- a thousand greater? - ten thousand greater? - ten million greater? ... two numbers with a difference of 3? ... two negative numbers with a difference of 3? ... two numbers, one negative and one positive, with a difference of 3? ...a length that rounds 4.3m to one decimal place ... 84,684,152.391 rounded to - 1 dp - the nearest integer - the nearest 1000 etc.	... that 85,635,147 is less than one hundred million ... that there are infinite pairs of negative numbers with a difference of 5	-730, -73, -37, -7.3 -16, -24, -3, -12 one, thousand, million, billion	0 is a positive number -3.5 rounds to -4 to the nearest integer
Misconceptions		**Guidance**	
Pupils may forget about the existence of ten thousands and hundred thousands prior to a million. They may also then think that the next place from 1 million is a billion. Children may count in the wrong direction when adding negative numbers or finding the difference between them - at this stage they only need to work within a number line context so use this to revisit how we can 'count on' from a negative number or to find the difference between any two integers. When rounding, some children look at the wrong column to decide whether to leave the stem as it is or to round up - they may also begin a chain of rounding from the end of the number, instead of simply looking at the next number after the required degree of accuracy.		Ensure children are secure with place value to 1 million and possibly beyond - pay particular attention to the columns used more rarely e.g. ten thousands or hundred thousands. Link rounding to estimation to help children get a sense of the size of number they are expecting - this will encourage them to use 0s as placeholders also. Try using a visual technique of 'chopping' the number at the required point for rounding and 'circling - looking at' the next number to decide whether you need to round up or not. Avoid the language of rounding down if possible as this is misleading. Link decimals to money to provide a rapid way into 2 decimal places particularly - when working with decimals also use the place value apparatus that would have been used for whole numbers earlier e.g. place value counters to help children see decimals as just another form of unitisation in our system. e.g. if they know that 4 and 3 make seven then they also know that 4 tenths	

	and 3 tenths make 7 tenths. Ensure children fully understand negative numbers and can place them securely on a number line or equivalent before calculating intervals between negative numbers or other integers. At this level, use number lines to show the calculation of intervals as this is an area of great confusion later - avoid learning 'rules' about, for example, what happens when you have two negatives as this takes attention away from the key concept emphaised by the number line representation.
Activities	**Show me what you know**
STANDARDS UNIT: N8 Using Directed Numbers in Context	Click here to access files in Google drive

Stage 5	Unit 3: Solving Calculation Problems	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ add and subtract numbers mentally with increasingly large numbers ➢ add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction) ➢ multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers ➢ divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context ➢ use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy	➢ perform mental calculations, including with mixed operations and large numbers ➢ multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication ➢ divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context ➢ use their knowledge of the order of operations to carry out calculations involving the four operations ➢ solve problems involving addition, subtraction, multiplication and division ➢ use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy ➢ use simple formulae ➢ "recognise when it is possible to use formula for area and volume of shapes (Measurement)"	➢ **apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers** ➢ **use conventional notation for priority of operations, including brackets** ➢ **use the symbols =, ≠, <, >, ≤, ≥** ➢ **estimate answers; check calculations using approximation and estimation, including answers obtained using technology** ➢ **substitute numerical values into formulae and expressions** ➢ **understand and use standard mathematical formulae** ➢ **understand and use the concepts and vocabulary of expressions, equations, formulae and terms** ➢ **use and interpret algebraic notation, including: ab in place of a × b, 3y in place of y + y + y and 3 × y, a^2 in place of a × a, a^3 in place of a × a × a, a/b in place of a ÷ b, brackets**
Key learning steps		**Key Vocabulary**

1. I can perform mental calculations including mixed operations 2. I can multiply a four digit number by a two digit number using long multiplication 3. I can divide a four digit number by a two digit number using long division 4. I can divide a four digit number by a two digit number using compact division 5. I can interpret remainders of a division as whole number remainders, fractions or by rounding 6. I can carry out calculations involving all four operations (in the correct order) 7. I can solve problems involving any or all of the four operations and use estimation to check answers 8. I can use simple formulae	"ones tens hundreds thousands mental mentally add sum of total subtract take away minus less than more than multiply multiple divide round rounding product	calculate digit column addition column subtraction estimate inverse operation check remainders lots of groups of nearest addition subtraction multiplication division fractions formula formulae area volume

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... two numbers that are easy to multiply ... two numbers that are hard to multiply ... two numbers that are easy to divide ... two numbers that are hard to divide ... a four digit number and two digit number that can be multiplied without using long multiplication ... a division with a remainder	... that if I divide 132 sweets between 5 people, this gives 26 r2 or 26 2/5 each. ... that 3 + 5 x 2 can be done in two orders and give different answers	63, 7, 441, 371 125/15, 390/4, 1245/9, 216/6 4563x14, 3212x20, 4158x27, 6389x50	Long multiplication is needed to multiply four digit numbers by two digit numbers Long division is needed to divide a four digit number by a two digit number A calculation involving division will have a remainder Division is the inverse of multiplication Addition makes a number larger Subtraction makes a number smaller

... a division without a remainder			
Misconceptions		**Guidance**	
When doing long multiplication, children sometimes forget to multiply all the parts together - they struggle to record each separate multiplication within one line, particularly where there are lots of numbers carried across following exchanges. Children often want to write out an expanded multiplication (which is longer!) but don't realise that this isn't proper long multiplication, where the steps need to be compacted. Children forget to put in a place holder 0 when multiplying by a tens digit. Children have difficulty interpreting remainders resulting from a division as fractions, eg if the remainder is 3 from a calculation involving the divisor 5, children will write the remainder as 1/3 rather than 3/5		Ensure children are secure with column addition and subtraction before teaching long multiplication and division as these methods depend on the ability to use these skills. Consider teaching an expanded method first as a precursor to long multiplication to see how the different parts are put together in long multiplication. Initially try to minimise the need to exchange and carry numbers across. When teaching division, make use of the place value counters to model the process of grouping by place value before extrapolating to a written method. As always, ensure children carry out the apparatus and written approaches simultaneously during the learning process so that they realise these are the same methods. Ensure children are secure with fractions before interpreting remainders as fractions	
Activities		**Show me what you know**	
NRICH: Cinema Problem •		Click here to access files in Google drive	

Stage 6	Unit 4: Exploring Shape	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles ➢ use the properties of rectangles to deduce related facts and find missing lengths and angles ➢ distinguish between regular and irregular polygons based on reasoning about equal sides and angles.	➢ illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius ➢ … and find unknown angles in any triangles, quadrilaterals, and regular polygons ➢ recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles ➢ compare and classify geometric shapes based on their properties and sizes	➢ **identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres** ➢ **use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries** ➢ **use the standard conventions for labelling and referring to the sides and angles of triangles** ➢ **apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles** ➢ **derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus; and triangles and other plane figures using appropriate language**

Key learning steps	Key Vocabulary	
1. I can identify the radius, diameter and circumference on a circle 2. I can describe the relationship between radius and diameter 3. I can calculate missing angles within triangles 4. I can calculate missing angles within quadrilaterals 5. I can calculate missing angles within regular polygons 6. I can calculate missing angles on a straight line and around a point 7. I can calculate missing angles that are vertically opposite each other 8. I can classify shapes using any given criteria	radius diameter circumference circle degrees relationship calculate (versus estimate and	quadrilaterals straight line around a point polygons regular, irregular angles vertically opposite, classify

		measure) triangles	criteria Venn, Carroll
Show me... , And another ...	**Convince me**	**What's the same? What's different? (Odd one out)**	**Always, sometimes, never**
... a radius ... a diameter ... a circumference ... the radius if the diameter is 7cm ... a triangle with: i) one acute angle ii) two acute angles iii) one obtuse angle iv) two obtuse angles ... a sketch of a parallelogram with its angles labelled ... the value of this angle if this one is .... the value of the other two angles in this isosceles triangle if this topic one is 40 degrees ... a quadrilateral with a missing angle that must be worth 70 degrees	...that a rhombus must be a parallelogram but a parallelogram is not necessarily a rhombus ... why a trapezium can't have three acute angles ... that the angles in a kite/quadrilateral must add up to 360 degrees ... that the missing angle is 70 degrees	angles in a triangle, angles round a point, angles on a straight line, angles in a quadrilateral trapezium, parallelogram, kite, square radius, circumference, diameter, chord	An isosceles triangle has one angle of 30o. Is this enough information to know the other two angles? A trapezium is also a parallelogram
Misconceptions		**Guidance**	
Children get confused over the special circle language of radius, diameter and circumference. Children do not realise that circumference is just a particular word for perimeter within the context of a circle. Children forget the sum of the angles in a triangle or in a quadrilateral.		Use a diagrammatic approach to the language of circles - explore the relationships so that children discover that the radius is half the diameter. Make links to words in other parts of life that are similar e.g. radius bone in arm, circumnavigate etc. Establish clearly the difference between calculating missing angles using	

When finding angles on straight lines, children look at the whole line and not just at the point where their angle is involved. Children apply vertically opposite angle rules when there are three lines crossing (which can be done if viewed in pairs) but frequently they make errors with this. Children forget to use properties of shapes in angle questions e.g. symmetry will imply two angles of the same value When classifying shapes, children are imprecise with language and so do not adequately sort the shapes - they need to be really exact with their meaning and use the mathematical terms, not everyday ones.	properties of shapes and estimating them from the diagram or measuring them with equipment. Ensure children realise that sometimes these questions are multi-step - you have to find one angle to lead you to the one you really want. Use the properties of shapes in these situations to tie the learning together e.g. opposite angles are equal in parallelograms. Bring in problems where the rules combine to challenge children further. Get children to classify ALL the shapes they know! This can be a very revealing activity! If you are sorting using a Venn or a Caroll diagram, make sure they are labelled correctly covering all possibilities.
Activities	**Show me what you know**
STANDARDS UNIT: SS1 Classifying Shapes NRICH: Where Are They? * NRICH: Quadrilaterals *** NRICH: Round a Hexagon * NRICH: Right Angles* • BOWLAND assessments: Three of a Kind BOWLAND assessments: Rods and Triangles	Click here to access files in Google drive

Stage 6	Unit 5: Generalising Arithmetic	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ add and subtract numbers mentally with increasingly large numbers ➢ add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction) ➢ multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers ➢ divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context ➢ multiply and divide whole numbers and those involving decimals by 10, 100 and 1000 ➢ solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why	➢ perform mental calculations, including with mixed operations and large numbers ➢ multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication ➢ divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context ➢ multiply one-digit numbers with up to two decimal places by whole numbers ➢ use written division methods in cases where the answer has up to two decimal places ➢ solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why ➢ solve problems involving addition, subtraction, multiplication and division	➢ **"apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers** ➢ **use conventional notation for priority of operations, including brackets** ➢ **recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculation"** ➢ **recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions** ➢ **use and interpret algebraic notation, including: ab in place of a × b, 3y in place of y + y + y and 3 × y, a^2 in place of a × a, a^3 in place of a × a × a, a/b in place of a ÷ b, brackets** ➢ **simplify and manipulate algebraic expressions by collecting like terms and multiplying a single term over a bracket** ➢ **understand and use the concepts and vocabulary of expressions, equations, formulae and terms**
Key learning steps		**Key Vocabulary**

1. I can perform mental calculations including mixed operations 2. I can multiply a four digit number by a two digit number using a written method of long multiplication 3. I can divide a four digit number by a two digit number using a written method of long division 4. I can interpret remainders as whole number remainders, fractions or by rounding 5. I can multiply one digit numbers with two decimal places by whole numbers 6. I can use written division methods in cases where the answer has up to two decimal places 7. I can solve multi step addition and subtraction problems choosing the correct operation and using the most appropriate methods 8. I can solve problems involving addition, subtraction, multiplication and division	ones tens hundreds thousands tenths hundredths mental mentally add sum of total subtract take away minus less than more than multiply multiple divide divisible factor round rounding	product calculate digit column addition column subtraction carry borrow inverse operation check place value partition remainders fractions rounding multi step lots of groups of nearest decimal decimal places

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... the operations you would carry out to solve this problem "Printing charges for a book are 3p per page and 75p for the cover. I paid £4.35 to get this book printed. How many pages are there in the book?" ... how you can multiply 4305 by 37	... that you get the same answer using a grid method as you do using a column method for multiplication ... 6.24×8 does not equal (6x8)+(0.2×8)+(0.04×8)=48 + 0.16 + 0.032 = 48.192 ... 7314×11=80454 and this 7.314 x 11	...long division and compact division ... 4565 ÷ 15 and 456.5 ÷ 1.5 and 45.65 ÷ 0.15	You can multiply by the tens or the units first using column multiplication - it doesn't matter You can convert an improper fraction into a mixed number by doing the division it shows e.g. 27/4 means do 27 ÷ 4.

using - a grid method - a column method ...how you can divide 4305 by 5 - using place value counters - using a written method	= 80.454 ... 1756 ÷ 5 will have a remainder of 1 ... that a remainder of 5 can mean different things in different questions		

Misconceptions	Guidance
Children sometimes fail to multiply all parts of a number e.g. they lose track of what they have already multiplied. This is easier to do in column method than in the grid where there will be a space if a calculation has been missed. Children will often be found adding and carrying incorrectly when using long multiplication Similarly, they may carry their remainders incorrectly when completing short or long division - this is usually because there is too much information to hold in their head with the nearest multiple and the remainder then not accounted for. Children will sometimes approach multi operational problems with the correct operations but carry them out in the wrong order. They may also sometimes choose the incorrect operation directly. Children may sometimes solve problems by choosing the least efficient operation e.g. using repeated addition instead of multiplication When solving multi-step problems, some children complete only the first step of a problem and use it as the answer without going on to the next step Children may ignore or forget the remainders - alternatively, they may present the remainders as the answer Often children misinterpret the remainders as fractions e.g. remainder 3 = 1/3	Ensure children are secure with column addition and subtraction before teaching long multiplication and division as they are dependent on these skills. Make use of place value counters to assist with the process of compact or long division - children can group the counters in the dividend according to the divisor and, where any counters are 'left over', exchange these for 10 of the next value of counter. See the videos at the NCETM website for more details of this. Ensure children are secure with fractions before interpreting remainders as fractions Use place value and multiply decimals by 10 or 100 to make calculations simpler then divide answer by 10 or 100 Draw attention to language used within addition, subtraction, multiplication and division problems Make children aware that some problems involve multiple steps which could mean 2 or more different operations. Use the bar model to represent the problem visually before deciding the operations to carry out and the order of these.
Activities	**Show me what you know**
	Click here to access files in Google drive

Stage 6	Unit 6: Reasoning with Measures	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres ➢ calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm²) and square metres(m²) and estimate the area of irregular shapes ➢ "estimate volume [for example, using ➢ 1 cm³ blocks to build cuboids (including cubes)] and capacity [for example, using water]"	➢ recognise that shapes with the same areas can have different perimeters and vice versa ➢ calculate the area of parallelograms and triangles ➢ recognise when it is possible to use formulae for area of shapes ➢ calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm³) and cubic metres (m³), and extending to other units [for example, mm³ and km³] ➢ recognise when it is possible to use formulae for volume of shapes	➢ **calculate perimeters of 2D shapes** ➢ **know the formulae: circumference of a circle = 2πr = πd,** ➢ **know and apply formulae to calculate area of triangles, parallelograms, trapezia** ➢ **know the formulae: area of a circle = πr²** ➢ **know and apply formulae to calculate volume of cuboids**

Key learning steps	Key Vocabulary
1. I can find rectangles with the same perimeter but different areas and vice versa. I can investigate the max area for a given perimeter or min perimeter for a given area. 2. I can find the area of a composite shape by dissecting it into rectangular pieces. I can use this idea to explain the grid method of multiplication in terms of areas. 3. I can use formulas to solve problems involving the perimeter and area of rectilinear shapes, including inverse problems. 4. I can explain the formulas for (i) area of a parallelogram by relating it via cut and paste to the area of a rectangle (ii) area of a triangle as half of a parallelogram 5. I can calculate the area of a parallelogram by using base x perpendicular height and of a general triangle as 1/2 base x perpendicular height. I understand that two triangles with the same base and same perpendicular height have the same area. 6. I can identify composite shapes where area formulas can be applied to different parts and combined, and solve related problems including areas of geoboard shapes 7. I can explain why the volume of cuboid is l x w x h by referring to rectangular layers of unit cubes. I can calculate simple cases using this formula. 8. I can solve problems in estimating, calculating and comparing volumes of cubes and cuboids, including inverse problems using mm3, cm3, m3 and km3 as appropriate.	base; dissect; formula; geoboard; grid; height; inverse; investigate; km3; layers; m3; maximum; minimum; mm3; multiply; parallelogram; perpendicular; rectangular; rectilinear

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
How to find the area of a (specified) shape on a geoboard. How to find the area of a (specified) triangular shape on a geoboard.	That the formula for the area of a parallelogram gives the same answer as counting squares.	Buying carpet, buying lawn seed, buying skirting board.	If one box fits inside another, the inner box has a smaller volume than the outer box. A box with volume 8cm3 will fit completely inside a box of 9cm3.

Misconceptions	Guidance
Confusion of perimeter and area; not realising that dissecting and rearranging preserves area; lack of previous experience with area concept (evident in not being able to explain formula, or over-reliance on formula); confusion of parallelogram with trapezium; not realising the importance of perpendicular height for parallelograms and triangles; inability to identify perp height; wildly multiplying any lengths given; lack of volume concept as number of unit cubes needed to fill a solid; difficulty in seeing equivalence of area of base and no. of cubes in bottom layer; lack of experience or basic knowledge to support estimates of measures	The first lesson should be investigative. Focus on developing good recording skills and praise/foster systematic approaches that support checking of all cases. Link area to grid method via (eg) 23cm x 14 cm rectangle on cm squared paper. Dissect into 20x10 + 20x4 + 3x10 + 3x4 rectangles and compare to grid method. Grid thinking can also support fraction work and algebra later on. Area of parallelogram should start as a challenge eg on geoboard. Work to formula via pupils cutting and rearranging pieces. Earlier work on right-triangles as half of rectangle now extends to general triangle. Emphasise height of rectangle is perpendicular height of parallelogram /triangle. Previous work on volume now extends to developing the formula. Emphasise counting in layers, where vol of 1 layer in cm3 = area of base in cm2 (helpful for prisms later). A variety of problems is essential to develop resilience and thinking skills.

Activities	Show me what you know
STANDARDS UNIT: SS2 Understanding Perimeter and Area	Click here to access files in Google drive

Stage 6	Unit 7: Discovering Equivalence	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number [for example, 2/5 + 4/5 = 6/5 = 1 1/5 ➢ compare and order fractions whose denominators are all multiples of the same number ➢ identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths ➢ count up and down in hundredths; recognise that hundredths arise when dividing an object by one hundred and dividing tenths by ten ➢ read and write decimal numbers as fractions [for example, 0.71 = 71/100] ➢ recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents ➢ recognise the per cent symbol (%) and understand that per cent relates to 'number of parts per hundred' ➢ write percentages as a fraction with denominator 100, and as a decimal ➢ solve problems which require knowing percentage and decimal equivalents of 1/2, 1/4, 1/5, 2/5, 4/5 and those fractions with a denominator of a multiple of 10 or 25.	➢ compare and order fractions, including fractions > 1 ➢ use common factors to simplify fractions; use common multiples to express fractions in the same denomination ➢ solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison ➢ associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, 3/8] ➢ recall and use equivalences between simple fractions, decimals and percentages, including in different contexts	➢ **define percentage as 'number of parts per hundred'** ➢ **interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively** ➢ **express one quantity as a percentage of another** ➢ **compare two quantities using percentages** ➢ **solve problems involving percentage change, including percentage increase/decrease** ➢ **interpret fractions and percentages as operators** ➢ **order positive and negative integers, decimals and fractions**
Key learning steps		**Key Vocabulary**

1. I can find common factors of two numbers and use these to simplify fractions 2. I can find common multiples of two numbers and use these to find common denominators 3. I can compare and order fractions by finding a common denominator 4. I can compare and order improper fractions by finding common denominators and converting appropriately 5. I can calculate percentages of amounts by finding 10% and then adjusting (e.g. halving that to find 5%). I can use this to solve problems. 6. I can solve percentage comparison problems 7. I can find decimals that are equivalent to fractions by dividing the numerator by the denominator (e.g. 3/8 = 3 divided by 8 = 0.375) 8. I can recall and use equivalent fractions, decimals and percentages to solve problems	fraction improper fraction decimal percentage compare order convert denominator numerator factor multiple common equivalent simplify calculate divide comparison

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... a fraction that cannot be simplified ... three ways that you could simplify 18/30 ... four possible common denominators for 3/5 and 7/20 ... the equivalent decimal for 1/4, 7/20, 1/8, 4/25	"... how to simplify a fraction ... how to order a set of fractions such as 2/3, 1/4, 5/6, 1/2 ... what is wrong with 2/3 = 1/1.5 ... that 8/5 > 3/2	"30%, 3/10, 0.3, 0.03, 3/100, 3% 1/5, 5%,1/20, 20% 20% of 25 and 25% of 20 14/21, 8/12, 20/30	"... you can have more than 100% ... to cancel a fraction, you halve the numerator and denominator until you can't do it any more ... you can always simplify a fraction ... to find x% of a number, just divide it by x ... you can do long division when the dividend is less than the divisor

Misconceptions	Guidance
Children may confuse the definitions of factors and multiples and hence muddle the processes of simplifying and finding fractions with a common denominator. This work will be greatly hindered by children not knowing their times tables securely as this may lead to errors as well as unnoticed opportunities to simplify.	This unit is all about securing children's understanding of and flexibility with representations of fractions (decimals and percentages). In the forthcoming Unit 10, children will need to conduct arithmetic with fractions but for now they are simply representing, manipulating and ordering them. Therefore, spend time ensuring that all possible representations are fully understood at this point and that, even when we use improper fractions or those with more unusual denominators, children have strong skills in representing these visually (e.g. using a number line, proportion of a shape, proportion of a set of objects,

When finding equivalent fractions, children may forget to adjust the numerator as well as the denominator, or they may multiply it by a different value, thus losing the value of the fraction. Some children will still try to make comparisons of fractions and order fractions by inspection of the numerators and/or denominators rather than seeking equivalent fractions with matching denominators to facilitate the comparison. When finding percentages of amounts, children sometimes revert to thinking that (because one can find 10% by dividing by 10) one can find, for example, 20% by dividing by 20. There is often an interchange of fifths and twentieths i.e. children may think that 1/5 is 5% instinctively. When finding 10%, children may make errors in their division by 10, for example, by thinking that dividing by ten means removing the zero rather than moving all the digits down one place. When finding decimal equivalents to more complex problems, the issues and misconceptions of division may arise. Commonly children often struggle to conceive of how we might divide a smaller number by a larger and thus may put the dividend and the divisor in the wrong places within the formal written method.	proportion of a bar) as well as in decimal and percentage form. Some of these fraction/decimal/% equivalents simply need to be learned to be recalled - make sure you explore the concepts first but then insist on rapid recall. You will need to include regular rehearsal of times tables and corresponding division facts in order to maintain the recall of knowledge that supports the processes of simplifying and finding equivalent fractions with a common denominator. When children struggle with a representation, go back to first principles to unpick the issue and build it back up - make sure you don't rely on a single representation to work with fractions here - you need to use a range to build a confident learner. It is better to spend time ensuring children can recognise and draw representations in all formats than move straight to the number work. At all costs, refrain from instructing children to mechanically multiply (or divide) the top and bottom numbers by the same amount as this type of algorithmic approach will not generate the conceptual understanding you will need in Unit 10 and beyond. When working with decimals and percentages, spend time making sure children are able to multiply and divide by 10, 100, 1000 by moving digits using the unitisation argument (this will be critical at secondary school later as they apply this logic to algebra, surds and much more!). It is key that children have efficient methods for division to enable them to divide the numerator by the denominator so revisit this if necessary beforehand.
Activities	**Show me what you know**
	Click here to access files in Google drive

Stage 6	Unit 8: Investigating Statistics	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ solve comparison, sum and difference problems using information presented in a line graph ➢ complete, read and interpret information in tables, including timetables	➢ interpret and construct pie charts and line graphs and use these to solve problems ➢ calculate and interpret the mean as an average	➢ **interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data and know their appropriate use** ➢ **interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (median, mean, mode and modal class) and spread (range)**

Key learning steps	Key Vocabulary	
1. I can construct a simple pie chart for a data set using simple proportions of a whole. 2. I can construct a standard pie chart for any data set by scaling up to 360 degrees. 3. I can explain what a pie chart tells me about the distribution of data and compare two pie charts in this way; I understand that the pie charts may represent very different amounts of data. 4. I can construct a line graph for a data set, including drawing and selecting appropriate axes and scales. 5. I can analyse a line graph to describe the overall trend of the data and to make predictions as appropriate. 6. I can calculate the mean of a set of a data; I can say how this is different to finding the mode or the median. 7. I can give a set of data with a given mean 8. I can explain what the mean tells me in the context of the original data set and compare two data sets using means.	"pie chart proportion distribution scaled up/scaled down compare	line graph axes scale prediction trend mean average

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... that if the mean height of a class is 150cm. What does this tell you about the tallest and shortest pupil?	...pie charts are easier to draw when the frequencies add up to a factor of 360	bar chart, line graph, frequency diagram, pictogram, pie chart average, mean	... You can read the frequency from a pie chart ... You can read the proportion from a pie chart

... five numbers that have a mean of 6 and a range of 8.	... that pie charts can be misleading	1, 3, 3, 5 and 1, 2, 4 ,5 as data sets	... You can read the frequency from a bar graph .... If the section is the same size on two pie charts then the section represents the same frequency ... In order to interpret and compare two pie charts, you have to measure the angles on the pie charts.

Misconceptions	**Guidance**
"Children sometimes struggle to use the fractional, proportional reasoning necessary for both constructing and interpreting pie charts. They need to link slices of the chart to fractions e.g. 1/6, 1/5. Children do not realise that you cannot tell the size of the data set from a pie chart, only the distribution. Therefore, they believe that two pie charts are directly comparable, even when one represents many more pieces of data than the other. Children sometimes select a scale for a line graph that compresses the graph so much that no discernible trend can be seen or one that does not fit all the points on. Children make calculation errors with the mean and do not check to see if their answer is sensible and lies within the range of the data.	To teach pie charts, begin with examples using simple fractions. e.g. quarters, thirds, fifths, sixths, etc. Then move to a situation where you scale up (or down) your frequencies so that the total is 360 (degrees). E.g. if the frequencies sum to 72, you need to scale up by a factor of 5 to reach a total of 360 degrees. Focusing on the proportional reasoning approach here will be more memorable and connected to other mathematics than trying to learn a formula. Students struggle to construct angles correctly when using a protractor, often reading from the wrong side of the protractor (ie not starting from 0) or failing to align it correctly with the centre of the circle. Having pre-printed circles with their centres marked can speed this process up considerably. Similarly, when analysing pie charts, make sure children can measure angles correctly (encouraging them to re-orient the paper if necessary) before calculating what fraction or proportion of the whole they have and applying that to the total frequency. When constructing line graphs, pay particular attention to the selection of the scale for the axes. Don't forget, the scale doesn't have to start at 0 - but if this is chosen then it should be marked clearly. It can be good to extend children by drawing two line graphs on the same axes and then comparing them and their trends. The mean is the last of the famous three averages to be met and is often

	thought of as the hardest by children - sell the attributes of the mean to children as factoring in ALL of the pieces of the data. It is worth investigating what happens if you have a large outlier - ie what is the impact on the mean (and compare this to the mode or the median). Also make time to go backwards and to find, for example, three numbers with a mean of 5 and a range of 3. Make sure children understand what having a non-integer answer means in situations where the data is discrete. Encourage them to check whether their answer is sensible i.e. falls within the range of the data.
Activities	**Show me what you know**
	Click here to access files in Google drive

Stage 6	Unit 9:Solving Number Problems	
Stage 5 support overview	**Stage 6 core learning overview**	**Stage 7 extension overview**
➢ multiply and divide whole numbers and those involving decimals by 10, 100 and 1000 ➢ multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers ➢ divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context ➢ solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes ➢ solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign ➢ solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates ➢ solve problems involving number up to three decimal places	➢ multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places ➢ perform mental calculations, including with mixed operations and large numbers ➢ multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication ➢ divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context ➢ multiply one-digit numbers with up to two decimal places by whole numbers ➢ use written division methods in cases where the answer has up to two decimal places ➢ solve problems involving addition, subtraction, multiplication and division ➢ use their knowledge of the order of operations to carry out calculations involving the four operations ➢ solve problems which require answers to be rounded to specified degrees of accuracy ➢ express missing number problems algebraically ➢ find pairs of numbers that satisfy an equation with two unknowns ➢ enumerate possibilities of combinations of two variables	➢ **solve linear equations in one unknown algebraically** ➢ **use the symbols =, ≠, <, >, ≤, ≥**
Key learning steps		**Key Vocabulary**

1. I can multiply and divide whole numbers and decimals by 10, 100 and 1000 (where the answer can be 3dp or fewer) 2. I can calculate in the correct order. 3. I can use efficient written methods to solve addition, subtraction, multiplication and division problems 4. I can round my answer to a problem as appropriate for the context. 5. I can express remainders as whole numbers, fractions and rounded numbers 6. I can express missing number problems using numbers and symbols. 7. I can find pairs of numbers that satisfy an equation 8. I can solve an algebraic problem by listing possible numbers that satisfy it.	multiply divide place value decimal places rounding remainder problem	solve context missing number order of operations value equation expression algebra

Show me... , And another ...	Convince me	What's the same? What's different? (Odd one out)	Always, sometimes, never
... how you would solve this problem: Milly is saving £2.75 a week to buy a pair of jeans. The jeans cost £37. For how many weeks does she need to save? ... how you would solve this problem: In Sports 4 U, there are 18 larges boxes each containing 136 footballs. How many footballs are there altogether?	... that there are an infinite number of solutions to x + y = 12. ... why 6×100 and 60×10 give the same answer ... what 0.6 would mean on a calculator display if the units were pounds, metres, hours, cars	x+y = 10; x + y = 7, 2x + 2y = 20, 3 + x = 10	There are an infinite number of possible values for: x + y = 11 x + 5 = 20 2x + y = 10

Misconceptions	Guidance
See stage 4 and 5 re issues with mult and dividing by powers of 10. When rounding some children round from the end of the number in a 'chain reaction' rather than looking at the next digit to decide whether to keep the stem the same or round the last digit up. When interpreting remainders, children sometimes see these as literal numbers and cannot say what they mean in the context of the problem e.g. money or time. They may struggle to give the remainder as a fraction. Children find the order of operations rules non-intuitive sometimes because	See Stage 4 and 5 for guidance on teaching mult and div by powers of 10 conceptually to avoid incorrect use of the 'short cut'. This unit is about solving problems so ensure that there is considerable exposure to applying the calculation methods here. (the greyed out parts above are only to show you the theory that this application depends upon in case you need to go back to it). Try to use a range of contexts including measures, money, time and the full range of numbers.

they are used to reading from left to right. They do not therefore always carry out multiplication and division before addition and subtraction when a calculation is presented e.g. 2 + 3 x 6 = 20 but many children will say 12 because they have added first. With algebra, children often don't see it is EXACTLY the same as number but with some numbers unknown. They may get confused with how to read terms such as 3a as a multiplication. For example, if a = 3 they would say that 3a is 33 rather than 3 lots of 3.	When working with order of operations, you may need to explore what happens when people calculate in different orders to get children to see WHY we need a convention about the order. These rules apply to number and algebra settings so are worth spending time on - look out for children reading from left to right! Spend time developing the concept of the variable number e.g. in x + y = 10, there are lots of numbers that x and y could be. However, once you pick one for x, you have essentially narrowed down y to just one possibility. If this is hard for children, try using ? symbols or empty boxes first as missing number problems before moving to letters so that they see that this is just a more 'grown up' way of doing the same thing. Make sure they still calculate in the correct order e.g. 3 + 5 x ? = 48
Activities	**Show me what you know**
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