

Year 7 Detailed Programme of Study

Autumn 1: Making generalisations about the number system 1

<p style="text-align: center;">Unit 1</p> <p style="text-align: center;">Numbers and Numerals</p> <p style="text-align: center;">(1 week)</p>	<p>In this unit students experience a range of number and numeral systems to develop their understanding of the base 10 place value system from primary years.</p> <p>First, students explore time to see that numeral systems can be used to group number in ways other than base 10 (while time still uses base 10 within groups). This provides students with a context in which to explore decomposition and regrouping of number.</p> <p>Students then meet the Indian number system. They convert between this and standard short form naming convention to strengthen recognition and naming of large numbers, increasing an understanding of why we cluster digits in groups of three.</p> <p>Finally, the Mayan number system is introduced as an informal way of meeting base 20 (and base 5) number composition. By seeing the pattern of 'place value rows' in the Mayan numeral system students can become more aware of the pattern that exists in base 10.</p>	<ul style="list-style-type: none"> • Understand the value of different place value columns in base 10 number systems • Understand the multiplicative relationships between different columns in base 10 number systems • Recognise and name nine- and ten-digit numbers in base 10 • Understand a range of notation for quantities of time and time of day • Develop a sense of flexible number composition by solving problems involving time of day and quantities of time • Have an awareness of different numerical systems and their representation
<p style="text-align: center;">Unit 2</p> <p style="text-align: center;">Axioms and Arrays</p> <p style="text-align: center;">(2 weeks)</p>	<p>In this two-week unit, students develop their understanding of different models for multiplication and division. Students also explore the axioms of number and which operations they can be applied to.</p> <p>The unit begins by looking at structures which lead to multiplication and the different models that can be associated with these structures. The array model is developed to explore the commutativity of multiplication before looking at this axiom with other models. The array model is again used to introduce the associativity and distributivity axioms. Students' understanding of</p>	<ul style="list-style-type: none"> • Use arrays and area models to develop understanding of commutativity of multiplication • Use arrays and area models to develop understanding of associativity and distributivity • Make use of and generalise the commutative, associative and distributive properties • Use commutativity, associativity and distributivity to solve calculations efficiently • Compare and contrast scaling, area, repeated addition and grouping/sharing models for multiplication and division • Develop number sense and efficient calculation strategies

	<p>these axioms is developed by showing how they can be utilised to calculate efficiently.</p> <p>Further use of these axioms takes place where students are asked the question: “What is the minimum number of multiplication tables they need to memorise?” It is shown that by utilising the axioms of number, and doubling and halving strategies, students can quickly generate other multiplication tables without the need for memorisation.</p>	<ul style="list-style-type: none"> • Make links between efficient calculation strategies and the axioms
<p>Unit 3</p> <p>Factors and Multiples</p> <p>(2 weeks)</p>	<p>In this unit students are given the opportunity to explore the ‘structure’ of the natural numbers. Students will be introduced to factors, multiples and important sets of numbers such as prime numbers, square numbers and cube numbers. Once the fundamental concepts have been introduced students are given the opportunity to develop their understanding, conjecture, problem solve and generalise in a series of structured tasks.</p> <p>Throughout the unit, students consider the structure of number by considering some interesting and important properties e.g. a six-column number grid is used to show that any prime number greater than 3 can be written as $6n+1$ or $6n-1$. Students are exposed to a variety of representations and these are used to promote dialogue and develop understanding.</p>	<ul style="list-style-type: none"> • Understand the terms factor and multiple • Recognise and define prime, square and cube numbers • Use the definitions of factors and multiples to find common factors and common multiples • Express an integer as a product of its factors • Interpret and create representations of integers that reveal their structure • Conjecture and make generalised statements e.g.: <ul style="list-style-type: none"> - Square numbers cannot be prime - The common multiples of 5 and 4 are always multiples of 20 - Prime numbers greater than 3 are one more or one less than a multiple of 6 • Solve problems involving factors and multiples in unfamiliar contexts
<p>Unit 4</p> <p>Order of Operations</p> <p>(1 week)</p>	<p>In this unit students will develop an explicit understanding of the order of operations based on the equal priority of addition with subtraction and multiplication with division. They will understand the higher priority of multiplication with division in written calculations and understand the use of brackets and vincula to manipulate this priority order.</p> <p>Throughout the unit, students will work with calculations represented via function machines, worded descriptions, area calculations of rectilinear shapes, and formal written calculations. Careful attention must be paid to identifying and representing</p>	<ul style="list-style-type: none"> • Understand the equal priority of addition with subtraction and multiplication with division in written calculations • Understand that operations of equal priority can be evaluated in any order • Understand that written calculations follow rules of ‘syntax’ determining the order of operations • Understand the higher priority of multiplication with division over addition with subtraction in written calculations. • Interpret the order of operations from written calculations, function machines and worded descriptions

	<p>equivalent calculations across these formats simultaneously to experience how the order of operations is embedded syntactically within each.</p> <p>Students will also practise representing variables with letters within expressions accurately using the order of operations.</p>	<ul style="list-style-type: none">• Form written calculations, function machines and worded descriptions correctly embedding the order of operations• Form and identify equivalent calculations based on distributivity, commutativity and the order of operations• Form and interpret expressions involving variables correctly embedding the order of operations
--	---	--

Autumn 2: Making generalisations about the number system 2

<p style="text-align: center;">Unit 5</p> <p style="text-align: center;">Positive and Negative Numbers</p> <p style="text-align: center;">(3 week)</p>	<p>This unit provides opportunities to interpret negative quantities in practical situations allowing students experiences to shift their thinking from the idea that “measures” must be positive. Students will have experienced negative numbers in context from primary education and know that the number line extends beyond zero.</p> <p>Understanding is developed by placing number on a number line and using the number line as a representation for addition and subtraction of negative numbers as well as a scaling model for multiplying and dividing. Carefully structured tasks allow students to extend existing understanding of calculations with integer values to include negative numbers. By extending the axioms of positive numbers to negative numbers we will conclude that $(-1) \times (-1) = 1$ and $a - (-b) = a + b$.</p> <p>Teachers should be aware of language, using phrases such as 'subtract negative three' rather than 'minus, minus three'. Laminated sheets with a selection of number lines (labelled and unlabelled) could prove a useful resource especially for demonstrating multiplication and division with negative numbers.</p>	<ul style="list-style-type: none"> • Interpret negative numbers in a variety of contexts • Compare and order positive and negative numbers • Use positive and negative numbers to express change and difference • Understand the meaning of absolute value • Calculate using all four operations with positive and negative values • Form and manipulate expressions involving negative numbers • Use number lines to model calculations with negative numbers • Explore scaling with negative multipliers
<p style="text-align: center;">Unit 6</p> <p style="text-align: center;">Expressions, equations and inequalities</p> <p style="text-align: center;">(3 weeks)</p>	<p>In this unit, students use algebraic notation to express the multiples of integers and see collecting like terms as a development of the distributive property.</p> <p>Students first use a range of representations and contexts including Cuisenaire rods, bar models, number pyramids to manipulate expressions into their simplest form as well as representing equality statements. Seen alongside ‘tracking calculations’, students will develop flexibility in expressing</p>	<ul style="list-style-type: none"> • Develop understanding of algebraic notation including: $a \times b = ab, y + y + y = 3y, a \times a = a^2, \frac{a}{b} = a \div b$ • Collect like terms to simplify expressions and understand that this is a result of the distributive property e.g. $3a + 2a = (3 + 2)a = 5a$ • Substitute numerical values into expressions and evaluate • Use the distributive property to identify equivalent expressions involving a single bracket and the expanded form e.g. $3(a + b) = 3a + 3b$ • Develop understanding of the equality and inequality signs

relationships algebraically as well as being comfortable substituting constant values for variables.

Once familiarity with this notation system has been developed, students will explore representations of equality, and understand the preservation of equality in written equations. This will then lead to exploration of inequalities utilising bar models and algebraic coding of perimeter as a problem-solving context.

Finally, students will explore tracking calculations for counting strategies in growing dot patterns as another context for generalisation, introducing the foundation for later study of sequences.

- Use two equations to form another related equation or inequality e.g. if $a = b$ and $b = c$ then $a = c$, $a + 1 > b$, $2a + b = 3c$ etc.
- Use different contexts, including sequences, to construct expressions, equations and inequalities
- Represent algebraic expressions using a variety of models including arrays and bar models

Spring 1: 2-D Geometry

<p>Unit 7</p> <p>Angles</p> <p>(2 weeks)</p>	<p>This unit covers estimating, measuring, drawing and calculating angles. Students describe, classify and identify types of angles using clear vocabulary, and measure and draw angles accurately. Students revise facts involving angles around a point, angles at a point on a straight line and vertically opposite angles from experiences in primary school. Students will begin to generalise these angle facts.</p> <p>Students explore and clarify definitions of parallel lines and perpendicular lines, and use rules around corresponding, alternate and co-interior angles. This will be built upon and applied in the following unit when exploring properties of quadrilaterals.</p> <p>Students begin to formulate equations to show relationships between angles using the angle facts that are introduced in this unit. This is first done numerically before introducing unknown angles. Through this, students begin to solve equations with one unknown.</p>	<ul style="list-style-type: none"> • Draw and measure acute and obtuse angles reliable to the nearest degree • Estimate the size of a given angle • Know and use angle facts: angles at a point, angles at a point on a straight line, vertically opposite angles. • Generalisations and reasoning – e.g. going beyond two angles • Define parallel and perpendicular lines • Use angle facts around corresponding, alternate and co-interior angles to find missing angles • Find unknown angles. Form algebraic expressions. Solve for unknowns on one side.
<p>Unit 8</p> <p>Classifying 2-D shapes</p> <p>(2 weeks)</p>	<p>This unit involves analysing the geometric properties of polygons before focusing more closely on triangles and quadrilaterals. Students begin by classifying polygons by their properties including number of sides, number of line and rotational symmetries, types of internal angles, number of equal sides, and number of parallel sides. Students are encouraged to conjecture and prove which properties are the result of other properties. For example, if a polygon has as many line symmetries as sides then it must be regular.</p> <p>Students move on to look at triangles and quadrilaterals more closely. Some properties are proved, some are identified inductively (by generalising phenomenon based on a number</p>	<ul style="list-style-type: none"> • Classifying polygons by symmetry, regularity, intersection of diagonals, number of parallel sides • Classify triangles and quadrilaterals according to properties (angles, regularity, symmetry) • Know and use the angle sum of triangles and quadrilaterals • Generalise results for properties of special types of triangles and quadrilaterals • Form and solve equations from contexts arising from properties of triangles and quadrilaterals

	<p>of concrete examples) and some deductively (using previous results). Special types of triangles and quadrilaterals are defined and the properties of each are explored. Generalisations are expressed algebraically, and students set up and solve equations involving special types of triangle and quadrilaterals.</p>	
<p>Unit 9</p> <p>Constructing triangles and quadrilaterals</p> <p>(2 week)</p>	<p>This unit involves students drawing and constructing triangles and quadrilaterals. In addition, there will be time allocated for a further analysis of their geometrical properties. Students will draw and measure angles within this context allowing them to practise the skills learned in the previous unit.</p> <p>As a way of setting the scene for construction, the unit begins by introducing the anatomy of a circle. The minimum conditions for constructing triangles are explored and thereby informally introducing congruence. Students will construct/draw triangles using initial information and conversely will deduce properties of triangles from completed constructions.</p> <p>Students will then construct/draw quadrilaterals, providing an opportunity to further develop an understanding of their properties.</p>	<ul style="list-style-type: none"> • Construct triangles and quadrilaterals for given conditions using ruler, protractor and compasses • Explore constructions through use of dynamic geometry software • Explore and define the minimum conditions for constructing triangles • Become familiar with the different cases of minimum conditions for the construction of triangles • Recognise when two triangles are congruent using the criteria of minimum conditions

<p>Unit 10</p> <p>Coordinates</p> <p>(2 week)</p>	<p>In this unit students develop their understanding of the cartesian coordinate grid and solve problems in all four quadrants. Students will be familiar with coordinates from work at primary school and in other subjects. The tasks in this unit will give students opportunities to apply their understanding from previous units including negative numbers and geometric properties of triangles and quadrilaterals.</p> <p>The unit begins by revisiting their understanding of working with a number line in one dimension to working in two dimensions. Students solve problems involving midpoints and develop strategies for solving related problems. Students will begin to label horizontal and vertical lines by recognising the constant x or y coordinates along them.</p>	<ul style="list-style-type: none"> • Reading and writing coordinates of points in all four quadrants. Including non-integer coordinates • Solving geometric problems involving missing coordinates • Finding the mid-point of a line segment or two points • Using the midpoint and a point on the line to find the coordinates of another point on the line • Recognise and plot horizontal and vertical lines on a coordinate axis
<p>Unit 11</p> <p>Area of 2-D shapes</p> <p>(2 week)</p>	<p>In this unit, the concept of area as a measurable quantity is introduced. This begins by revisiting arrays introduced in previous units for multiplication. Starting with rectilinear shapes, this is built upon to explore the area of other shapes including, triangles and special quadrilaterals. Reasoning about calculating the area of shapes is built up by decomposing shapes and connecting to existing knowledge.</p> <p>The generalised expressions for finding the area of shapes are used to introduce rearranging formulae. Solving equations and substituting for an unknown is also practised in this unit. Students also engage with generalised statements about the relationship between area and perimeter.</p>	<ul style="list-style-type: none"> • Develop understanding of counting strategies in arrays to using similar strategies to calculate the area of shapes • Finding the area of rectilinear shapes • Finding the area of other 2-D shapes including triangles, and special quadrilaterals • Generalise formulae for finding the area of 2-D shapes using the language of height, base, width, length etc. • Rearrange formulae to make a different subject • Reason about generalised statements of the relationship between area and perimeter
<p>Unit 12</p> <p>Transforming 2-D figures</p> <p>(2 weeks)</p>	<p>In this unit, students are expected to consider how different transformations acting on an object produce different images. Reflection, rotation, translation and enlargement are first applied to an object on a grid before moving onto a coordinate axis. Reflection and rotation are introduced through previous experience of line and rotational symmetry.</p> <p>There is a focus on language and consideration of the amount of information required to perform each transformation. The</p>	<ul style="list-style-type: none"> • Reflection of an object in a mirror line • Identify horizontal and vertical mirror lines and their equations • Rotation of an object using the centre of rotation • Translating shapes by a given number of units (positive or negative) in the x and y directions • Combining transformations and which combinations can be expressed as a single transformation • Simple enlargements with positive scale factors

	<p>transformations are sorted into those which result in a congruent image (rotation, reflection and translation) and those which give a similar image (enlargements). The ratios within are considered and between the similar shapes produced when an object is enlarged by a given scale factor. This is the foundation for exploring similarity and trigonometry later. Combinations of transformations are explored, including which combinations can or cannot be described as a single transformation.</p>	<ul style="list-style-type: none">• Exploring the ratios of sides lengths within and between shapes produced by an object being enlarged by a given scale factor• Recognise which transformations produce congruent shapes• Explore the ratios within and between similar shapes when an object is enlarged by a given scale factor
--	---	---

Summer 1: Fractions

<p style="text-align: center;">Unit 13</p> <p style="text-align: center;">Prime factor decomposition</p> <p style="text-align: center;">(2 weeks)</p>	<p>In this unit, students revisit the composition of numbers developed in unit 3. Student use the “lots of” representation to find the prime factor decomposition of a positive integer. The uniqueness of the prime number decomposition, for which indices notation is used, is explored. This is used to show properties of particular numbers e.g. if a number is a square or cube number and therefore identify square and cube roots. Prime factorisation is used to determine the highest common factor and lowest common multiple of two or more numbers. Different methods for finding these are introduced and students are required to reason why different methods work.</p> <p>Students manipulate the prime factor decomposition to find how many factors a number has and also to problem solve. During this unit, indices are used to denote powers greater than 2 for the first time.</p>	<ul style="list-style-type: none"> • Factors and multiples, square numbers, cube numbers, prime number, triangular • Write a number as a product of primes • Find the highest common factor and lowest common multiple using the prime factorisation • Determine LCM by prime factorisation • Find squares, square roots, cubes and cube roots using prime factorisation • Use indices to record repeated multiplication • Calculate with the use of a calculator, including squares, cubes, square roots and cube roots
<p style="text-align: center;">Unit 14</p> <p style="text-align: center;">Conceptualising and comparing fractions</p> <p style="text-align: center;">(2 week)</p>	<p>This unit builds on knowledge of fractions from KS2. Students explore multiple interpretations of fractions and establish useful language and representations to use alongside these. Fractions are considered simultaneously as a number, as a way of expressing division, as a continuous part-whole model and as a discrete part of a larger set. The representations are built to consider the concepts of equivalent fractions, working with improper and mixed fractions. Students are required to find equivalent fractions including simplifying by finding common factors in the numerator and denominator.</p> <p>Students also convert between different abstract representations of fractions including decimal fractions and mixed numbers. Teachers should use fraction notation for division alongside the division sign in order to consolidate</p>	<ul style="list-style-type: none"> • Explore multiple representations of fractions • Represent fractions using area diagrams, bar models and number lines • Recognise and name equivalent fractions • Convert fractions to decimals • Convert terminating decimals to fractions in their simplest form • Convert between mixed numbers and improper fractions • Compare and order numbers (including like and unlike fractions) • Convert simple fractions and decimals to percentages • Express one quantity as a fraction of another

	<p>understanding that fractions can be viewed as divisions. When considering the equivalence of fractions and decimals in this unit, the notion of a percentage is dealt with briefly; this is revisited and developed. Using different representations, students compare two or more fractions in a set and order them by their size.</p>	
<p>Unit 15</p> <p>Manipulating and calculating with fractions</p> <p>(2 weeks)</p>	<p>In this unit students extend their understanding of applying the four operations to non-integer values. This includes non-integers represented as fractions, decimal fractions and mixed numbers. Students find fractions of amounts by considering the multiplication of an amount by a fraction. The different conceptual meanings of $\frac{a}{b} \times c$ are explored as well as the equivalence of $\frac{a}{b} \times c$, $a \times \frac{c}{b}$ and $\frac{a \times c}{b}$.</p> <p>Students build on this understanding and look at finding the whole given a fractional part before progressing onto the processes of fraction multiplication and division. After establishing methods and understanding for multiplying and dividing fractions, students move on to adding and subtracting fractions including those represented as decimal fractions.</p> <p>Bar models, line models and rectangular representations are used heavily throughout to represent the fractional amounts. Teachers should encourage students to use these to help them solve and demonstrate understanding of the problems even where not stated explicitly.</p>	<ul style="list-style-type: none"> • Find a fraction of a set of objects or quantity • Find the whole given a fractional part • Multiply and divide fractions by a whole number or fraction • Solve word problems involving multiplication of a fraction by a whole number or fraction using models and equations to represent the problem • Add and subtract fractions with like denominators • Add and subtract fractions with unlike denominators • Add and subtract fractions mixed numbers and improper fractions • Convert between improper fractions and mixed numbers • Calculate with decimals

Summer 2: Ratio and proportion

<p>Unit 16</p> <p>Ratio</p> <p>(2 weeks)</p>	<p>This unit explores ratio notation, language, representations and contexts. The ratio notation of $a : b$ is unpicked using bar models and this is used to show that in this notation it is possible to see the following fractional relationships: $\frac{a}{a+b}, \frac{b}{a+b}, \frac{a}{b}, \frac{b}{a}, \frac{a+b}{a}, \frac{a+b}{b}$.</p> <p>Students work on a series of problems that require them to use all of these relationships. Bar models, double number lines and line graphs are used throughout this unit to help develop and expand students' conceptual understanding of ratio.</p>	<ul style="list-style-type: none"> • Understand the concept of ratio and use ratio language and notation • Connect ratio with understanding of fractions • Compare two or more quantities in a ratio • Recognise and construct equivalent ratios • Express ratios involving rational numbers in their simplest form • Construct tables of values and use graphs as a representation for a given ratio • Compare ratios by finding a common total value • Solve ratio and proportion problems in a variety of contexts
<p>Unit 17</p> <p>Percentage</p> <p>(3 weeks)</p>	<p>In this unit, students work with percentages as another representation of ratios and fractions. The different ways of interpreting fractions are again referenced in this unit building on work from the previous unit in connecting ratios to fractions and decimals. In order to manipulate calculations involving percentages, students need to be able to use their knowledge of arithmetic with decimals and fractions. Therefore, it is important that students are also able to interpret percentages first as a number between 0 and 1 before moving onto work with percentages greater than 100.</p> <p>The unit progresses to the use of percentages to compare quantities and find a given percentage of a quantity. Students then increase and decrease quantities by a given percentage and find the original quantity given a percentage of the quantity. Bar models provide an excellent representation of percentage change and equivalence between amounts, hence should be used throughout the unit to deepen understanding.</p>	<ul style="list-style-type: none"> • Understand percentages as a ratio of two quantities where one quantity is standardised to 100 • Understand percentages as a fractional operator with a denominator of 100 • Understand and interpret percentages over 100 • Interpret a percentage as a fraction and decimal • Express a quantity as a percentage of another • Compare two quantities using percentages • Find a percentage of an amount with and without a calculator • Increase and decrease a quantity by a given percentage • Find a quantity given a percentage of it

