Year 7 SOW

Structure

- The entire course consists of **FIVE STEPS** with each step covering appropriate aspects of number, algebra, probability, statistics, measures and geometry.
- It is expected that the great majority of learners (i.e. pupils who meet the expected standard at KS2 – reported as AS) will start on Step 2 and progress to Step 4 in the three years of Key Stage 3.
- High attainers will start on Step 3 and progress to Step 5 and lower attaining learners will start on Step 1 and progress to Step 3.
- Each chapter begins with either a diagnostic activity to reveal any misconceptions which can be dealt with before the new work is started,
- Or a meaningful **TASK** or problem-solving activity that will drive the learning from the known to the unknown.
- At the end of each chapter there is an assessment to check that the topic has been fully mastered.

Text Books

- There will be five online digital books in the series. One for each step. A year's course will cover one online book.
- The online textbook covers the lessons taught within school.
- The online textbooks are specifically designed to encourage students to study on their own and to enable students to relive the latest lesson at home at their own pace.
- This may sound as if the intention is that the teacher teaches the textbook.
- This is not the case.
- The teacher studies the textbook including the given hints and then adapts this to fit in with their own knowledge of their students.
- The pupils then use the textbook to relive the lesson at home.
- This enables parents/carers to be much more involved in their children's school work
- This is an element of mastery learning that does not appear to have been fully understood in the UK – namely that all pupils are capable of learning but that they learn at different speeds.
- There is also a great emphasis on the use of pupils use of notebooks. More about will follow.

Assessment

- There will be regular assessments throughout the year as shown in Table 1 and Table 2.
- Pupils will be expected to prepare for these assessments at home by working through parallel versions of the assessments.
- The “mastery” achievement mark is then set at 80%.
- Pupils who do not reach this level should then be given individual support in a form of catch up, preferably in the form of a diagnostic interview (details to follow) before retaking the assessment.
- It is very important that all students succeed in every assessment.

Trackers

- All pupils will be given tracker documents to record their own progress as shown in Table 3 (to follow shortly not shown).

First semester (Weeks 1 – 20 approximately)

Content area	General description	Step 1	Step 2	Step 3
Statistics	Unit 1 Descriptive statistics*	Statistics 1	Statistics 1	Statistics 1
Geometry	Unit 2 Shape and angles	Geometry 1a	Geometry 2a	Geometry 3a
Number	Unit 3 Calculations	Number 1a	Number 2a	Number 3a
Assessment A	Units 1 - 3	Assessment 1A	Assessment 2A	Assessment 3A
Algebra	Unit 4 Sequences	Algebra 1a	Algebra 2a	Algebra 3a
Statistics	Unit 5 Summary statistics	Statistics 7B	Statistics 7B	Statistics 7B
Geometry	Unit 6 Transformations	Geometry 1b	Geometry 2b	Geometry 3b
Assessment B	Units 4 - 6	Assessment 1B	Assessment 2B	Assessment 3B
Assessment C	Units 1 - 6	Assessment 1C	Assessment 2C	Assessment 3C

Table 1

*All Year 7 pupils will cover the same Statistics units (Statistics 7A and 7B).

Second semester (Weeks 21 – 38 approximately)

Content area	General description	Step 1	Step 2	Step 3
Number	Unit 7 Fractions, decimals, percentages	Number 1b	Number 2b	Number 3b
Algebra	Unit 8 Functions and equations	Algebra 1b	Algebra 2b	Algebra 3b
Assessment D	Units 7 - 8	Assessment 1D	Assessment 2D	Assessment 3D
Assessment E	Units 1 - 8	Assessment 1E	Assessment 2E	Assessment 3E
Probability	Unit 9 Probability	Probability 1	Probability 2	Probability 3
Geometry	Unit 10 Measures	Geometry 1c	Geometry 2c	Geometry 3c
Number	Unit 11 Ratio and proportion	Number 1c	Number 2c	Number 3c
Assessment F	Units 9 - 11	Assessment 1F	Assessment 2F	Assessment 2F
Assessment G	Units 1 - 11	Assessment 1G	Assessment 2G	Assessment 3G

Table 2

KS3 Key Objectives- Number

At all Steps pupils are able to

- understand and use place value for decimals, measures and integers of any size
- order positive and negative integers, decimals and fractions; use the number line as a model for ordering of the real numbers; use the symbols =, ≠, <, >, ≤, ≥
- use the concepts and vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, square, cube, square root and cube root
- appreciate the infinite nature of the sets of integers, real and rational numbers
- use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals
- recognise and use relationships between any operations including inverse operations

At Step 1 pupils are able to

- round any whole number
- use negative numbers in practical contexts such as temperature and calculate intervals across zero [N5]
- count forwards or backwards in steps of any whole number with one significant figure, e.g. 9, 20, 3000 [N1]
- add and subtract whole numbers with more than four digits, using formal written methods where appropriate [C2]
- use their understanding of place value to multiply and divide whole numbers and decimals with up to two decimal places by 10 or 100 (e.g. 1532 ÷ 100 = , ÷ 100 = 6.3) [C6]
- multiply and divide whole numbers mentally drawing upon multiplication facts up to 12 × 12 and place value (e.g. 60 × 70) and begin to use these facts to work with larger numbers [C6]
- multiply numbers with up to two digits by a two digit number using the formal long multiplication method and becoming more confident with multiplication with larger numbers; multiply and divide numbers with up to four digits by a single digit number using the formal short division method and become more confident with division using larger numbers including the long division method. [C7]
- round decimals with two decimal places to the nearest whole number and to one decimal place
- solve problems involving number up to three decimal places
- add and subtract decimal numbers that have the same number of decimal places (e.g. 157.31 – 29.16) [F10]
- multiply a one digit decimal number by a single digit number (e.g. 0.6 × 8) [F9]
- express one quantity as a fraction of another in simple cases.
- 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

- 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,
- add and subtract fractions with the same denominator and denominators that are multiples of the same number
- multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
- read and write decimal numbers as fractions
- recognise and use fractional 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', and write percentages as a fraction with denominator 100, and as a decimal
- solve problems which require knowing fraction, percentage and decimal equivalents of halves, quarters, fifths and those fractions with a denominator of a multiple of 10 or 25.
- use common factors to simplify fractions; use common multiples to express fractions in the same denomination
- Use the time to cover calculations (FEMA) and FDP

At Step 2 pupils are able to

- identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places
- 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 which require answers to be rounded to specified degrees of accuracy
- compare and order fractions, including fractions > 1
- add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- multiply simple pairs of proper fractions, writing the answer in its simplest form [for example,
- divide proper fractions by whole numbers [for example,
- associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example,
- recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.
- recognise the relationship between fractions, decimals and percentages and can express them as equivalent quantities (e.g. one piece of cake that has been cut into 5 equal slices can be expressed as a fifth or 0.2 or 20% of the whole cake).
- can calculate using fractions, decimals or percentages both as numbers and operators
- Use ratio notation, including reduction to simplest form
- Relate the language of ratios and the associated calculations to the arithmetic of fractions
- Divide a given quantity into two parts in a given part:part ratio; express the division of a quantity into two parts as a ratio

At Step 3 pupils are able to

- round numbers and measures to different degrees of accuracy, for example to the nearest whole number or to one decimal place
- use the four operations, including formal written methods, applied to integers and decimals, all both positive and negative
- Understanding numbers in contextual calculations
- round numbers and measures to an appropriate degree of accuracy, for example to the nearest whole number or to one decimal place
- use approximation, through rounding to the nearest whole number or to one decimal place, to estimate answers
- define percentage as 'number of parts per hundred', and know their decimal and fraction equivalents
- multiply proper and improper fractions, and mixed numbers
- work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and 7/2 or 0.375 and 3/8)
- Understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction
- Solve problems involving direct proportion
- Use compound units such as unit pricing to solve problems

At Step 4 pupils are able to

- state the multiplicative relationship between the numbers represented by any two digits in any number
- use prime factorisation
- use integer powers
- round numbers and measures to an appropriate degree of accuracy, for example to the nearest whole number or to one or two decimal places
- use approximation, through rounding to the nearest whole number or to one significant figure, to estimate answers
- relate percentages to decimals and fractions by showing their relative positions on a number line
- multiply and divide a whole number by a fraction, whether positive and negative
- interpret fractions and percentages as operators
- work interchangeably with terminating decimals their corresponding fractions and percentages (such as 3.5, 7/2, and 350% or 0.375, 3/8, and 37.5%)
- interpret percentages and percentage changes as a fraction or a decimal, interpret these multiplicatively, express one quantity as a percentage of another, compare two quantities using percentages, and work with percentages greater than 100%
- Solve ratio problems where the part relationship is known rather than the total
- Solve problems involving direct proportion, including graphical and algebraic representations

At Step 5 pupils are able to

- State in the form $A \times 10^n$ (n any positive or negative integer) the multiplicative relationship between the numbers represented by any two digits in any number

- round numbers and measures to different degrees of accuracy, for example, to a number of decimal places or significant figures
- use the four operations applied to real numbers, whether positive or negative
- use prime factorisation, including using product notation and the unique factorisation property
- use integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
- distinguish between exact representations of roots and their decimal approximations
- interpret and compare numbers in standard form $A \times 10^n$ $1 \leq A < 10$, where n is a positive or negative integer or zero
- round numbers and measures to an appropriate degree of accuracy, for example, to a number of decimal places or significant figures
- calculate possible resulting errors expressed using inequality notation $a < x \leq b$
- relate percentages to decimals and fractions, moving efficiently between the different forms in any context
- use A = 1/n of B implies B = nA, and A = n% of B implies B = (100A)/n
- work interchangeably with terminating decimals their corresponding fractions and percentages, and know the fraction and percentage equivalents of some common recurring decimals (such as 3.5, 7/2, and 350% or 0.375, 3/8, and 37.5%, or 0.33333...., ⅓ and 33⅓%)
- understand why an “n% increase” is not the inverse operation of an “n% decrease”
- Solve problems involving inverse proportion, including graphical and algebraic representations
- Use compound units such as speed and density to solve problems

Key Objectives- Algebra

Overview

We will introduce algebra through generalising in everyday situations. Pupils will then gradually move from generalising in words to generalising with symbols. This is to enable our pupils to understand why algebra is useful and realise that algebra enables us to express general numerical relations in symbolic terms. In much of this work we will be treating letters as variables and this should be emphasised. Encouraging our pupils to find multiple symbolic representations of the same idea will then lead quite naturally into manipulating symbols to show that these different ideas are actually the same. 'Think of a number' activities should also be explained by algebraic methods.
Functions are used to describe the relationship between quantities that change simultaneously. Pupils should be encouraged to focus on the patterns of change in both quantities. This can be expressed in words, numbers, algebraic expressions, diagrams, tables and graphs. Activities such as "Both Ways" will give pupils the chance to hypothesise, test their hypothesis and then use algebra to prove their hypothesis. '
It is also important that all of the pupils understand the difference between 'variables' and 'unknowns' especially when asked to solve equations and inequalities.

All steps

- understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors.

At Step 1 pupils are able to

- make and use word formulas by modelling real world situations or procedures.
- substitute positive whole numbers into word formulas to find the value of the subject.
- use and interpret algebraic notation including: ab in place of a x b, $3y$ in place of 3 x y
- substitute numerical values into simple algebraic formulas that model real world situations or procedures.
- simplify expressions by collecting like terms.
- continue simple sequences and can explain how to find the next term.
- find missing numbers in a number sequence
- generate terms of a sequence from a term-to-term rule including practical examples such as matchstick patterns
- begin to investigate linear sequences when the n^{th} term is given

At Step 2 pupils are able to

- use simple function machines to deal with inputs and outputs, recognising basic inverse functions.
- use interpret algebraic notation, including: ab, $3y$ in place of $y + y + y$, a^2 in place of a x a, a^3 in place of a x a x a, a^2b in place of a x a x b, $\frac{x}{y}$ instead of $x \div y$, coefficients written as fractions rather than decimals
- model situations or procedures by translating them into simple algebraic formulas.

- understand and solve problems involving exchange rate
- understand and solve problems involving unit costs
- set up and solve one-step equations with integer coefficients.
- generate terms of a sequence from a term-to-term or a position to term rule
- begin to generalise their results in words

At Step 3 pupils are able to

- create and solve two-step equations that model real world situations or procedures.
- simplify and manipulate expressions to maintain equivalence by multiplying a single term over a bracket and taking out common factors
- Rearrange simple formulae to change the subject
- find the position to term formula for given linear sequences and for linear sequences that arise from modelling real world situations.
- investigate and recognise special sequences such as triangular numbers, square numbers and Fibonacci numbers.
- use the rules of indices for positive whole number powers.
- model and interpret real life situations or procedures graphically.
- plot graphs of linear functions

At Step 4 pupils are able to

- create and solve equations using brackets and where the unknown appears on both sides of the equation.
- simplify and manipulate algebraic expressions to maintain equivalence by expanding products of two or more binomials
- use the rules of indices for positive whole number powers.
- generate terms a quadratic sequence from a position to a term rule.
- calculate and interpret gradients and intercepts of graphs of linear equations in the standard form $y = mx + c$ numerically, graphically and algebraically
- recognise and generate lines that are parallel to a given line and pass through a given point.
- plot quadratic and cubic graphs and use then to estimate values of y for given values of x and vice versa.
- solve quadratic equations graphically.
- recognise and can sketch simple quadratic and cubic graphs.
- form and solve simple linear inequalities in one variable and represent the solution set on a number line.

At Step 5 pupils are able to

- use more complex formula; they substitute positive and negative numbers into formulas that involve powers and roots.
- Rearrange complex formulae to change the subject, including cases where the new subject appears twice or includes powers and roots
- use trial and improvement methods to solve equations that do not have an analytical solution that is accessible to pupils
- find the rule for simple quadratic sequences (i.e. coefficient of n^2 is one)
- recognise geometric sequences and find the term to term rule

- find the exact solution of two simultaneous equations in two unknowns by eliminating a variable, and interpret the equations as lines and their common solution as the point of intersection.
- find the exact solution of two simultaneous equations in two unknowns by substitution.

At Step 5+ pupils are able to

- recognise geometric sequences and find the position to term rule
- Factorise simple quadratic expressions where the coefficient of x^2 is one.

KS3 Key Objectives- Geometry

- use the standard conventions for labelling the sides and angles of triangle ABC
- draw and measure line segments and angles in geometric figures, including interpreting scale drawings
- describe, sketch and draw: points, lines, parallel lines, perpendicular lines, right angles. use conventional terms and notations, such as using 'dashes' to indicate equal lengths and (multiple) arrows to indicate parallel lines
- derive and illustrate properties of circles

At Step 1 pupils are able to

- read, write and convert time between analogue (including clock faces using Roman numerals) and digital 12 and 24– hour clocks, using a.m. and p.m. where necessary [M4]
- calculate the duration of an event using appropriate units of time (e.g. A film starts at 6:45p.m. and finishes at 8:05p.m. How long did it last?) [M4]
- convert between 'adjacent' metric units of measure for length, capacity and mass (e.g. 1.2 kg = 1200 g; how many 200 ml cups can be filled from a 2 litre bottle?; write 605 cm in metres) [M5]
- find the perimeter of compound shapes when all side lengths are known or can be easily determined (e.g. a simple shape made from two identical rectangles joined together to make an L-shape with given dimensions of the rectangle) [M7]
- calculate and compare the area of squares and rectangles including using standard units, square centimetres (cm^2) and square metres (m^2) and estimate the area of irregular shapes by counting squares [M7]
- compare and classify 3–D and 2–D shapes based on their properties (e.g. for 2–D shapes: parallel sides, length of sides, type and size of angles [G4], reflective symmetry [G2], regular / irregular polygons [G2]; for 3–D shapes: faces, vertices and edges) [G2]
- recognise and describe simple 3–D shapes, including using nets and other 2–D representations [G3]
- complete simple shapes using given lengths, such as 7.5cm, (accurate to +/-2 mm) and acute angles that are multiples of 5° (accurate to +/– 2°) [G3] know and use the facts that angles at a point sum to 360°, angles at a point on a straight line sum to 180° and angles in a triangle sum to 180° (e.g. calculate the base angles of an isosceles triangle where the other angle is 110°) and identify other multiples of 90° [G4]
- identify, describe; and represent the position of a shape following a reflection or translation, using the appropriate language and know that the shape has not been changed. [P2]

- describe positions on a 2–D co-ordinate grid using axes with equal scales in the first quadrant (in the context of number or geometry) and use co-ordinates to complete a given rectangle; become more confident in plotting points in all four quadrants [P3]

At Step 2 pupils are able to

- use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places [M5]
- convert between miles and kilometres [M6]
- recognise that shapes with the same areas can have different perimeters and vice versa [M7]
- recognise when it is possible to use formulae for area and volume of shapes [M7]
- calculate the area of parallelograms and triangles [M7]
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units (for example, mm^3 and km^3) [M8]
- solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places [M9]
- compare and classify geometric shapes based on their properties and sizes [G2a]
- draw 2-D shapes using given dimensions and angles [G3a]
- describe and build simple 3-D shapes, including making nets [G3b]
- find unknown angles in any triangles, quadrilaterals, and regular polygons [G4a]
- derive and apply formulae to undertake calculations and solve problems involving perimeter and area of rectangles
- recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles [G4b]
- apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
- illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius [G5]
- draw and translate simple shapes on the co-ordinate plane, and reflect them in the axes [P2]
- describe positions on the full co-ordinate grid (all four quadrants) [P3]

At Step 3 pupils are able to

- draw and measure line segments and angles in geometric figures; calculate lengths represented by line segments in scale drawings given scale factors as ratios in the form 1 : n, and understand that the lengths are approximate
- derive and apply formulae to undertake calculations and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes)
- classify quadrilaterals by their geometric properties, and provide convincing arguments to support classification decisions

- construct similar shapes by enlargement, with and without coordinate grids
- use the properties of faces, surfaces, edges and vertices of cubes and cuboids to solve problems in 3-D
- derive and use the sum of angles in a triangle
- undertake calculations and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes
- Draw, sketch and describe regular polygons, and other polygons that are reflectively and rotationally symmetric;
- derive and illustrate properties [for example, equal lengths and angles] of triangles, quadrilaterals, and other plane figures using appropriate language and technologies
- apply translations, rotations and reflections to given figures, and identify examples of translations, rotations and reflections (for example, be able to pick out from a group of shapes those that are translations, rotations or reflections of a given shape)

At Step 4 pupils are able to

- understand implications of the accuracy of the measurements for the accuracy of the calculated lengths
- use Pythagoras' Theorem to solve problems involving right-angled triangles
- use conventional terms and notations, such as complementary to describe angles with a sum of 90˚ and supplementary to describe angles with a sum of 180˚
- derive and use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); recognise and use the perpendicular distance from a point to a line as the shortest distance to the line
- understand and use the relationship between parallel lines and alternate and corresponding angles. Use vertically opposite angles and other angle relationships to solve angle problems.
- use the sum of angles in a triangle to deduce the angle sum in any polygon, and to derive properties of regular polygons
- use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms and cylinders to solve problems in 3-D
- derive and apply formulae to undertake calculations and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)

At Step 5 pupils are able to

- use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles
- know that translations, rotations and reflections map shapes onto congruent shapes; understand that the relation 'is congruent to' implies that there exists a translation, rotation or reflection that takes one shape to another
- identify properties of, and describe the results of, translations, rotations and reflections applied to given figures; know that any reasoning using these

transformations could be replaced by reasoning using congruence criteria, and be familiar with some examples

- identify and construct congruent triangles, with and without coordinate grids
- use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres to solve problems in 3-D

At Step 5+ pupils are able to

- use construction methods to: investigate what happens (for example to the angle bisectors, or perpendicular bisectors of sides, of triangles) in changing situations; explore derived shapes, such as circumcircles and inscribed circles of triangles, and other polygons (where possible)
- know and use the criteria for congruence of triangles
- apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem, and use known results to obtain simple proofs

KS3 Key Objectives- Statistics

- Statistics is the science of data. The overriding question should always be, “What does the data tell you?”
- Wherever possible use real data. The context always matters.
- There should be an equal balance between interpreting and analysing at each step. Pupils should be encouraged to develop a feel for statistics rather than mere procedural knowledge.
- Pupils should be able to describe, interpret and compare distributions of a single variable appropriate to their step.
- Pupils should also be able to describe mathematical relations between two variables as appropriate to their step.
- Pupils should be given the opportunity to use a data collection sheet and/or a questionnaire at each step.
- plot and interpret scatter diagrams for bivariate data at the appropriate level describe simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts.

At Step 1 pupils are able to:

- complete, read and interpret information presented in tables, pictograms and bar charts (e.g. find the difference between two bars showing temperatures, where one is 20°C and the other is 13°C, on a scale labelled in multiples of 5) [S1]
- interpret line graphs (e.g. begin to find the difference between two temperatures on a line graph, where one is 20°C and the other is 13°C, on a scale labelled in multiples of 5) and simple pie charts (e.g. a pie chart cut into eight pieces for favourite fruit using whole numbers for each section) [S1]
- plot and interpret scatter diagrams - describe mathematical relations between the two variables in simple words.
- calculate the mean as an average for simple sets of discrete data (e.g. find the mean mass of three parcels weighing 5 kg, 3 kg and 10 kg) [S3]
- summarise data using the mean, mode as “representative or typical” values and the range as a measure of spread.

At Step 2 pupils are able to:

- interpret and construct pie charts and line graphs and use them to solve problems [S1]
- calculate the mean and interpret the mean as an average [S3]
- calculate the range and interpret the range as a measure of spread
- describe, interpret and compare two simple datasets of a single variable through: appropriate graphical representations, and by considering the mean or median or mode and range of the datasets.

- plot and interpret scatter diagrams - describe mathematical relations between the two variables in less obvious cases.

At Step 3 pupils are able to:

- describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, ungrouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range)
- construct and interpret frequency tables, bar charts, pie charts, and stem and leaf diagrams for simple categorical data, and vertical line (or bar) charts for small sets of ungrouped numerical data and numerical data grouped into a small number of groups
- recognise graphical misrepresentation through incorrect scales, labels etc.
- plot and interpret scatter diagrams recognise and use the language of correlation.

At Step 4 pupils are able to

- describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete grouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range)
- construct and interpret frequency tables, bar charts, pie charts, and pictograms for larger sets of categorical data, and vertical line (or bar) charts for larger sets of ungrouped and grouped numerical data
- define the population in a study and understand the difference between population and sample.
- identify an outlier in simple cases and appreciate there may be errors in data from values (outliers) that do not 'fit'.
- infer the properties of populations or distributions from a sample
- understand what is meant by simple random sampling and bias in sampling
- plot and interpret scatter diagrams - draw a line of best fit by eye and use it to make predictions. Discuss implications of outliers.
- interpolate and extrapolate from data and be aware of the limitations of these techniques

At Step 5 pupils are able to

- describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete or continuous grouped, data; and appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)
- construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data
- plot and interpret scatter diagrams - interpret correlation within the context of the variables and appreciate the distinction between correlation and causation
- Draw and interpret cumulative frequency diagrams and boxplots.

Key Objectives – Probability

At all stages:

- Emphasise the difference between being absolutely sure and probably sure about something happening.
- Make sure everyone understands that probability is the study of the chances of something happening.
- Understand and test the idea of fairness.
- Emphasise that we study probability so that we can make predictions over the long term rather than the predictions about individual events. Link this to the law of large numbers.
- Use experimental probabilities
- Emphasise 'gut reaction', experimental probability and theoretical probability.

At Step 1 pupils are able to

- explain what is meant by a probability scale and position key words on that scale
- list all possible outcomes for two events such as choosing from a menu
- investigate simple games

At Step 2 Pupils are able to

- mark events and/or probabilities on a probability scale of 0 to 1
- find and justify probabilities by considering equally likely outcomes for single events
- list all possible outcomes for three events such as from a menu
- investigate more complicated game

At Step 3 pupils are able to

- record and describe the frequency of outcomes of simple probability experiments; try to explain their findings using their own ideas about randomness and possible outcomes; make and explain their own judgments about the fairness of situations; understand that the probability of an impossible event is 0, and of a certain event is 1, and begin to use the 0-1 probability scale.
- use systematic listing strategies to list all possible outcomes for four events such as tossing four coins.
- record outcomes of probability experiments in tables
- use a two circle Venn diagram to calculate related probabilities.
- enumerate sets systematically making use of tables and grids
- investigate games

At Step 4 pupils are able to

- record and describe the frequency of outcomes of simple probability experiments; in the light of experience begin to refine their own ideas about causal connections between aspects of experiments that involve randomness and equally and unequally

likely outcomes and the properties of data distributions; make better informed judgments about the fairness of situations; begin to allocate probabilities to particular outcomes by considering all possible outcomes

- understand why, when there are only two possible outcomes, the probabilities of the two possible outcomes sum to 1
- use a two circle Venn diagram to enumerate sets, and use this to calculate related probabilities.
- use simple set notation to describe simple sets of numbers and objects.
- generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities.

At Step 5 pupils are able to

- record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale; begin to notice the same patterns in different situations
- understand that the probabilities of all possible outcomes sum to 1
- enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams
- use tree diagrams to calculate the probability of two independent events
- understand selection with or without replacement
- use Venn diagrams to calculate conditional probability
- draw a frequency tree based on given information and use this to find probability and expected outcome

Key objectives by step

Step 1

Number

At Step 1 pupils are able to

- round any whole number
- use negative numbers in practical contexts such as temperature and calculate intervals across zero [N5]
- count forwards or backwards in steps of any whole number with one significant figure, e.g. 9, 20, 3000 [N1]
- add and subtract whole numbers with more than four digits, using formal written methods where appropriate [C2]
- use their understanding of place value to multiply and divide whole numbers and decimals with up to two decimal places by 10 or 100 (e.g. 1532 ÷ 100 = , ÷ 100 = 6.3) [C6]
- multiply and divide whole numbers mentally drawing upon multiplication facts up to 12 × 12 and place value (e.g. 60 × 70) and begin to use these facts to work with larger numbers [C6]
- multiply numbers with up to two digits by a two digit number using the formal long multiplication method and becoming more confident with multiplication with larger numbers; multiply and divide numbers with up to four digits by a single digit number using the formal short division method and become more confident with division using larger numbers including the long division method. [C7]
- round decimals with two decimal places to the nearest whole number and to one decimal place
- solve problems involving number up to three decimal places
- add and subtract decimal numbers that have the same number of decimal places (e.g. 157.31 – 29.16) [F10]
- multiply a one digit decimal number by a single digit number (e.g. 0.6 × 8) [F9]
- express one quantity as a fraction of another in simple cases.
- 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
- 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,
- add and subtract fractions with the same denominator and denominators that are multiples of the same number
- multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
- read and write decimal numbers as fractions
- recognise and use fractional 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', and write percentages as a fraction with denominator 100, and as a decimal
- solve problems which require knowing fraction, percentage and decimal equivalents of halves, quarters, fifths and those fractions with a denominator of a multiple of 10 or 25.
- use common factors to simplify fractions; use common multiples to express fractions in the same denomination
- Use the time to cover calculations (FEMA) and FDP

Algebra

At Step 1 pupils are able to

- make and use word formulas by modelling real world situations or procedures.
- substitute positive whole numbers into word formulas to find the value of the subject.
- use and interpret algebraic notation including: ab in place of a x b, $3y$ in place of 3 x y
- substitute numerical values into simple algebraic formulas that model real world situations or procedures.
- simplify expressions by collecting like terms.
- continue simple sequences and can explain how to find the next term.
- find missing numbers in a number sequence
- generate terms of a sequence from a term-to-term rule including practical examples such as matchstick patterns
- begin to investigate linear sequences when the n^{th} term is given

Geometry

At Step 1 pupils are able to

- read, write and convert time between analogue (including clock faces using Roman numerals) and digital 12 and 24– hour clocks, using a.m. and p.m. where necessary [M4]
- calculate the duration of an event using appropriate units of time (e.g. A film starts at 6:45p.m. and finishes at 8:05p.m. How long did it last?) [M4]
- convert between 'adjacent' metric units of measure for length, capacity and mass (e.g. 1.2 kg = 1200 g; how many 200 ml cups can be filled from a 2 litre bottle?; write 605 cm in metres) [M5]
- find the perimeter of compound shapes when all side lengths are known or can be easily determined (e.g. a simple shape made from two identical rectangles joined together to make an L-shape with given dimensions of the rectangle) [M7]
- calculate and compare the area of squares and rectangles including using standard units, square centimetres (cm^2) and square metres (m^2) and estimate the area of irregular shapes by counting squares [M7]
- compare and classify 3–D and 2–D shapes based on their properties (e.g. for 2–D shapes: parallel sides, length of sides, type and size of angles [G4], reflective

symmetry [G2], regular / irregular polygons [G2]; for 3–D shapes: faces, vertices and edges) [G2]

- recognise and describe simple 3–D shapes, including using nets and other 2–D representations [G3]
- complete simple shapes using given lengths, such as 7.5cm, (accurate to +/-2 mm) and acute angles that are multiples of 5° (accurate to +/– 2°) [G3] know and use the facts that angles at a point sum to 360°, angles at a point on a straight line sum to 180° and angles in a triangle sum to 180° (e.g. calculate the base angles of an isosceles triangle where the other angle is 110°) and identify other multiples of 90° [G4]
- identify, describe; and represent the position of a shape following a reflection or translation, using the appropriate language and know that the shape has not been changed. [P2]
- describe positions on a 2–D co-ordinate grid using axes with equal scales in the first quadrant (in the context of number or geometry) and use co-ordinates to complete a given rectangle; become more confident in plotting points in all four quadrants [P3]

Statistics

At Step 1 pupils are able to:

- complete, read and interpret information presented in tables, pictograms and bar charts (e.g. find the difference between two bars showing temperatures, where one is 20°C and the other is 13°C, on a scale labelled in multiples of 5) [S1]
- interpret line graphs (e.g. begin to find the difference between two temperatures on a line graph, where one is 20°C and the other is 13°C, on a scale labelled in multiples of 5) and simple pie charts (e.g. a pie chart cut into eight pieces for favourite fruit using whole numbers for each section) [S1]
- plot and interpret scatter diagrams - describe mathematical relations between the two variables in simple words.
- calculate the mean as an average for simple sets of discrete data (e.g. find the mean mass of three parcels weighing 5 kg, 3 kg and 10 kg) [S3]
- summarise data using the mean, mode as “representative or typical” values and the range as a measure of spread.

Probability

At Step 1 pupils are able to

- explain what is meant by a probability scale and position key words on that scale
- list all possible outcomes for two events such as choosing from a menu
- investigate simple games

Step 2

Number

At Step 2 pupils are able to

- identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places
- 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 which require answers to be rounded to specified degrees of accuracy
- compare and order fractions, including fractions > 1
- add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- multiply simple pairs of proper fractions, writing the answer in its simplest form [for example,
- divide proper fractions by whole numbers [for example,
- associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example,
- recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.
- recognise the relationship between fractions, decimals and percentages and can express them as equivalent quantities (e.g. one piece of cake that has been cut into 5 equal slices can be expressed as a fifth or 0.2 or 20% of the whole cake).
- can calculate using fractions, decimals or percentages both as numbers and operators
- Use ratio notation, including reduction to simplest form
- Relate the language of ratios and the associated calculations to the arithmetic of fractions
- Divide a given quantity into two parts in a given part:part ratio; express the division of a quantity into two parts as a ratio

Algebra

At Step 2 pupils are able to

- use simple function machines to deal with inputs and outputs, recognising basic inverse functions.
- use interpret algebraic notation, including: ab, $3y$ in place of $y + y + y$, a^2 in place of a x a, a^3 in place of a x a x a, a^2b in place of a x a x b, $\frac{x}{y}$ instead of $x \div y$, coefficients written as fractions rather than decimals
- model situations or procedures by translating them into simple algebraic formulas.
- understand and solve problems involving exchange rate
- understand and solve problems involving unit costs
- set up and solve one-step equations with integer coefficients.
- generate terms of a sequence from a term-to-term or a position to term rule
- begin to generalise their results in words

Geometry

At Step 2 pupils are able to

- use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places [M5]
- convert between miles and kilometres [M6]
- recognise that shapes with the same areas can have different perimeters and vice versa [M7]
- recognise when it is possible to use formulae for area and volume of shapes [M7]
- calculate the area of parallelograms and triangles [M7]
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units (for example, mm^3 and km^3) [M8]
- solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places [M9]
- compare and classify geometric shapes based on their properties and sizes [G2a]
- draw 2-D shapes using given dimensions and angles [G3a]
- describe and build simple 3-D shapes, including making nets [G3b]
- find unknown angles in any triangles, quadrilaterals, and regular polygons [G4a]
- derive and apply formulae to undertake calculations and solve problems involving perimeter and area of rectangles
- recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles [G4b]
- apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
- illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius [G5]
- draw and translate simple shapes on the co-ordinate plane, and reflect them in the axes [P2]
- describe positions on the full co-ordinate grid (all four quadrants) [P3]

Statistics

At Step 2 pupils are able to:

- interpret and construct pie charts and line graphs and use them to solve problems [S1]
- calculate the mean and interpret the mean as an average [S3]
- calculate the range and interpret the range as a measure of spread
- describe, interpret and compare two simple datasets of a single variable through: appropriate graphical representations, and by considering the mean or median or mode and range of the datasets.
- plot and interpret scatter diagrams - describe mathematical relations between the two variables in less obvious cases.

Probability

At Step 2 Pupils are able to

- mark events and/or probabilities on a probability scale of 0 to 1
- find and justify probabilities by considering equally likely outcomes for single events
- list all possible outcomes for three events such as from a menu
- investigate more complicated game

Step 3

Number

At Step 3 pupils are able to

- round numbers and measures to different degrees of accuracy, for example to the nearest whole number or to one decimal place
- use the four operations, including formal written methods, applied to integers and decimals, all both positive and negative
- Understanding numbers in contextual calculations
- round numbers and measures to an appropriate degree of accuracy, for example to the nearest whole number or to one decimal place
- use approximation, through rounding to the nearest whole number or to one decimal place, to estimate answers
- define percentage as 'number of parts per hundred', and know their decimal and fraction equivalents
- multiply proper and improper fractions, and mixed numbers
- work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and 7/2 or 0.375 and 3/8)
- Understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction
- Solve problems involving direct proportion
- Use compound units such as unit pricing to solve problems

Algebra

At Step 3 pupils are able to

- create and solve two-step equations that model real world situations or procedures.
- simplify and manipulate expressions to maintain equivalence by multiplying a single term over a bracket and taking out common factors
- Rearrange simple formulae to change the subject
- find the position to term formula for given linear sequences and for linear sequences that arise from modelling real world situations.
- investigate and recognise special sequences such as triangular numbers, square numbers and Fibonacci numbers.
- use the rules of indices for positive whole number powers.
- model and interpret real life situations or procedures graphically.
- plot graphs of linear functions

Geometry

At Step 3 pupils are able to

- draw and measure line segments and angles in geometric figures; calculate lengths represented by line segments in scale drawings given scale factors as ratios in the form 1 : n, and understand that the lengths are approximate
- derive and apply formulae to undertake calculations and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes)
- classify quadrilaterals by their geometric properties, and provide convincing arguments to support classification decisions
- construct similar shapes by enlargement, with and without coordinate grids
- use the properties of faces, surfaces, edges and vertices of cubes and cuboids to solve problems in 3-D
- derive and use the sum of angles in a triangle
- undertake calculations and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes
- Draw, sketch and describe regular polygons, and other polygons that are reflectively and rotationally symmetric;
- derive and illustrate properties [for example, equal lengths and angles] of triangles, quadrilaterals, and other plane figures using appropriate language and technologies
- apply translations, rotations and reflections to given figures, and identify examples of translations, rotations and reflections (for example, be able to pick out from a group of shapes those that are translations, rotations or reflections of a given shape)

Statistics

At Step 3 pupils are able to:

- describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, ungrouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range)
- construct and interpret frequency tables, bar charts, pie charts, and stem and leaf diagrams for simple categorical data, and vertical line (or bar) charts for small sets of ungrouped numerical data and numerical data grouped into a small number of groups
- recognise graphical misrepresentation through incorrect scales, labels etc.
- plot and interpret scatter diagrams recognize and use the language of correlation

At Step 3 pupils are able to

- record and describe the frequency of outcomes of simple probability experiments; try to explain their findings using their own ideas about randomness and possible outcomes; make and explain their own judgments about the fairness of situations; understand that the probability of an impossible event is 0, and of a certain event is 1, and begin to use the 0-1 probability scale.

- use systematic listing strategies to list all possible outcomes for four events such as tossing four coins.
- record outcomes of probability experiments in tables
- use a two circle Venn diagram to calculate related probabilities.
- enumerate sets systematically making use of tables and grids
- investigate games