OCL Maths Curriculum: Statement of Intent

Purpose of study

The OCL Maths Curriculum is designed using a mastery approach and is based on the science of learning. This means that pupils are given a "thorough understanding of mathematical concepts, rather than a set of techniques or routines to get to the right answer" (EEF). We want our students to be curious learners who can apply their knowledge and skills to the real world. We enable them with the powerful knowledge that allows them to acquire fluency in crucial mathematical procedures and means they can master and retain key concepts which in turn will result in all students fulfilling their academic potential in maths. We want our students to understand the history of our subject as one which has developed over millennia of collective human endeavour, and which is embedded in every facet of our civilisation. Our curriculum provides students with the foundation for understanding the world and an appreciation of the beauty and power of mathematics so therefore students know where maths can take them in real life.

We value character, competence, and community in our curriculum:

- **Character:** Our Maths lessons ensure that all students develop confidence in Maths and identify as "good at Maths". Through talk tasks to check for understanding, the participation of all students in articulating mathematical ideas is a key feature of our teaching. Students are taught to interact with each other with patience, honesty, and independence through opportunities for structured self-reflection throughout the lesson: in self and peer assessment, exit tickets, and mastery matrices.
- **Competence**: Developing pupils' competence in Maths is at the heart of our curriculum. We build strong foundations by taking every opportunity to develop our students' numeracy skills: in lessons, and in structured interventions. In our curriculum, we draw on research from cognitive science to accelerate our students learning. We connect new knowledge to existing knowledge, to expand students' schemas, and develop their skills in the core concepts of Maths.
- **Community:** Through an engaging, relevant Maths curriculum, students are exposed to the story and history of mathematical ideas. In this way students develop respect for others and an appreciation of diversity and inclusivity and learn how to challenge and question. Students also have the opportunity to develop their passion, their identity, and their sense of belonging, through success in Maths, and through trips and after-school clubs, in different forms across the trust.

Core concepts (strands)

The Oasis Maths curriculum is carefully planned so that core mathematical skills, knowledge and understanding are developed over time. Mathematical knowledge is understood and built on cumulatively, and in the context of applying this knowledge to develop skills. These core mathematical skills build on the "big ideas" of the OCL Primary curriculum and exceed the objectives of the Maths national curriculum for KS3/4. They are laid out below:

Number. Pupils are taught to understand and use place value for decimals, measures, and integers of any size. Students learn to develop mathematical fluency mathematical representation, language, and notation and conceptual understanding by:

- ordering positive and negative integers, decimals, and fractions; use the number line as a model for ordering of real numbers.
- vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation property.
- using the four operations, including formal written methods, applied to integers, decimals, proper and improper fractions, and mixed numbers, all both positive and negative.
- using conventional notation for the priority of operations, including brackets, powers, roots, and reciprocals.
- recognising and using relationships between operations including inverse operations.
- using integer powers and associated real roots (square, cube and higher) and distinguish between exact representations of roots and their decimal approximations.
- interpreting and comparing numbers in standard form.
- developing their estimation skills by rounding numbers and measures to an appropriate degree of accuracy and apply and interpret limits of accuracy when rounding or truncating, {including upper and lower bounds}.
- In addition to consolidating subject content from key stage 3, students are taught at KS4 to apply systematic listing strategies, {including use of the product rule for counting}, {estimate powers and roots of any given positive number}, calculate with roots, and with integer {and fractional} indices, apply and interpret limits of accuracy when rounding or truncating, {including upper and lower bounds}. Higher pathway students calculate exactly with fractions, {surds} and multiples of pi: {including simplifying surd expressions and rationalising denominators} {changing recurring decimals into their corresponding fractions and vice versa}.

Algebra. Students are taught to use and interpret algebraic notation. Students develop mathematical fluency, mathematical representation, language and notation, conceptual understanding, problem-solving and reasoning skills by:

- substituting numerical values into formulae and expressions, including scientific formulae.
- developing their mathematical language vocabulary of expressions, equations, inequalities, terms, and factors.
- simplifying and manipulating algebraic expressions to maintain equivalence by collecting like terms, multiplying a single term over a bracket, taking out common factors, expanding products of two or more binomials.
- using standard mathematical formulae; rearranging formulae to change the subject, modelling situations or procedures by translating them into algebraic expressions or formulae and by using graphs.
- using algebraic methods to solve linear equations in one variable (including all forms that require rearrangement) and work with coordinates in all four quadrants.
- recognising, sketching, and producing graphs of linear and quadratic functions of one variable with appropriate scaling, using equations in x and y and the Cartesian plane.
- interpreting mathematical relationships both algebraically and graphically.
- calculating and interpreting gradients and intercepts of graphs, generating terms of a sequence, recognising arithmetic sequences and find the nth term, recognise geometric sequences, and appreciate other sequences that arise.
- In addition to consolidating subject content from key stage 3, students are taught to recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions, simplify and manipulate algebraic expressions (including those involving surds {and algebraic fractions}) by factorising quadratic expressions, including the difference of two squares.
- showing algebraic expressions are equivalent and use algebra to support and construct arguments {and proofs}.
- finding the equation of the line through two given points, or through one point with a given gradient {including equations of perpendicular lines} identify and interpret roots, intercepts and turning points of quadratic functions graphically; deduce roots algebraically {and turning points by completing the square}.
- solving quadratic equations {with higher solving by quadratic formula and completing the square}, find approximate solutions using a graph, solving two simultaneous equations in two variables algebraically.
- finding approximate solutions to equations numerically using iteration – higher only.
- Interpreting simple expressions as functions with inputs and outputs {interpret the reverse process as the 'inverse function'; interpret the succession of two functions as a composite function'} - higher only

- Sketch transformation of the graph of a given function – higher only
- Recognise and use the equation of circle with the centre at the origin; find the equation of a tangent to a circle at a given point} - higher only
- Calculate or estimate gradients of graphs and areas under the graphs (including quadratic and other non-linear graphs} - higher only

Geometry and measures. Students are taught to derive and apply formulae to calculate and solve problems involving properties, perimeters, and areas of 2D shapes and volume and surface area of 3D shapes. Students develop mathematical fluency, mathematical representation, language and notation, conceptual understanding, problem-solving and reasoning skills by:

- drawing and measuring line segments and angles in geometric figures, including interpreting scale drawings, and deriving and using the standard ruler and compass constructions and recognising and using the perpendicular distance from a point to a line as the shortest distance to the line
- deriving and illustrate properties of triangles, quadrilaterals, circles, and other plane figures using appropriate language and technologies.
- identifying properties of, and describe the results of, translations, rotations and reflections applied to given figures and constructing congruent triangles, and construct similar shapes by enlargement, with and without coordinate grids.
- applying the properties of angles at a point, angles at a point on a straight line, vertically opposite angles and understanding and use the relationship between parallel lines and alternate and corresponding angles.
- deriving and using the sum of angles in a triangle and use it to deduce the angle sum in any polygon, and to derive properties of regular polygons.
- interpreting and using bearings and applying 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.
- using Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles.
- In addition to consolidating subject content from key stage 3, pupils are taught to interpret and use fractional {and negative} scale factors for enlargements.
- describe the changes and invariance achieved by combinations of transformations.
- Calculating arc lengths, angles, and areas of sectors of circles and identifying and applying circle definitions and properties and apply and prove the standard circle theorems and use them to prove related results.
- construct and interpret plans and elevations of 3D shapes and apply the concepts of congruence and similarity, including the relationships between lengths, {areas and volumes} in similar figures.
- know and apply the sine rule, and cosine rule, to find unknown lengths and angles and calculate the area, sides, or angles of any triangle.
- describe translations as 2D vectors and apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; {use vectors to construct geometric arguments and proofs}.

Statistics and probability. Students are taught 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 scale. Students are also taught how to process, represent, and analyse both univariate and bivariate data. Students develop mathematical fluency, mathematical representation, language and notation, conceptual understanding, problem-solving and reasoning skills by:

- understanding that the probabilities of all possible outcomes sum to 1
- enumerating sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams and generating theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities.
- describing, interpreting, and comparing observed distributions of a single variable through appropriate graphical representation involving discrete, continuous, and grouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)
- constructing and interpreting 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 and describing simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts and illustrate using scatter graphs.
- In addition to consolidating subject content from key stage 3, pupils are taught to apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one and using a probability model to predict the outcomes of future experiments.
- understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size and calculate the probability of independent and dependent combined events, including using tree diagrams and other representations.
- calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams.
- infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling
- interpret and construct tables and line graphs for time series data and construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use}

Ratio and proportion. Students are taught to change freely between standard units for example, time, length, area, volume, and mass and develop understanding of rates, conversion, and scale. Students develop mathematical fluency, mathematical representation, language and notation, conceptual understanding, problem-solving and reasoning skills by:

- using ratio notation, including reduction to simplest form, dividing a given quantity into two parts and expressing the division of a quantity into two parts as a ratio
- understanding that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction.
- relating the language of ratios and the associated calculations to the arithmetic of fractions and to linear functions
- solving problems involving percentage change, including percentage increase, decrease and original value problems and simple interest in financial mathematics.
- solving problems involving direct and inverse proportion, including graphical and algebraic representations, and using compound units such as speed, unit pricing and density to solve problems.
- In addition to consolidating subject content from key stage 3, students are taught to compare lengths, areas and volumes using ratio notation and/or scale factors; make links to similarity (including trigonometric ratios)
- convert between related compound units in numerical and algebraic contexts, construct and interpret equations that describe direct and inverse proportion.
- interpret the gradient of a straight-line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion.
- interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of instantaneous and average rate of change (gradients of tangents and chords) in numerical, algebraic, and graphical contexts}
- set up, solve, and interpret the answers in growth and decay problems, including compound interest {and work with general iterative processes}.

Cross Strand development

The core concepts not only develop over time within their own strands, for example within 'number', the unit on standard form is dependent on an understanding of place value taught in an earlier year, but they are also pre-requisites for one another. The strands do not operate in a mutually exclusive nature, they are woven together throughout the whole curriculum plan, hence the need for careful sequencing of content. This means knowledge can accumulate over time and the curriculum can make connections and build on existing schema. Some examples below demonstrate this.

- Trigonometry (using SOHCAHTOA) primarily falls within geometry, however the prerequisite knowledge is rearranging and solving equations (algebra), substitution (algebra), scale factors and proportion (ratio), angle facts (geometry) and multiplying and dividing decimals (number).
- Algebraic fractions fall within the strand of algebra, however, have prerequisites of not only solving quadratic and linear equations and rearranging (algebra), but also manipulation of fractions (number), use of powers and roots (number) and are often found within shape problems (geometry).
- Growth and decay problems fall within the strand of ratio, however, have pre-requisite knowledge of percentage increase (number), percentage multipliers (number), and substitution (algebra).
- Histograms are a KS4 higher topic that seemingly sits strictly in the statistics and data strand however has prerequisite knowledge of area (geometry), multiplying decimals (number), fractions (number) and proportion (ratio).

Endpoints

Through our carefully sequenced and ambitious curriculum we intend that our students will be able to develop their **mathematical fluency**, **mathematical reasoning,** and **problem-solving skills** in the following areas:

Number
-consolidating their numerical and mathematical capability and extending their understanding of the number system to include powers and roots
- selecting and using appropriate calculation strategies to solve increasingly complex problems and use application and interpretation of limits of accuracy.

Algebra
-use algebra to generalise the structure of arithmetic, including to formulate mathematical relationships
- extend their mathematical fluency from previous years and extend their understanding of algebraic simplification and manipulation to include quadratic expressions, {and expressions involving surds and algebraic fractions}
-develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems

Geometry and measures
-use language and properties precisely to analyse 2-D and 3-D shapes
-reasoning deductively in geometry including using geometrical constructions
-begin to model situations mathematically and express the results using a range of formal mathematical representations

Statistics and probability
-use language and properties precisely to analyse probability and statistics
-exploring what can and cannot be inferred in statistical and probabilistic settings and express their arguments formally.
-assessing the validity of an argument and the accuracy of a given way of presenting information.

Ratio and proportion
-Extending and formalising their knowledge of ratio and proportion and formulating proportional relations
-Identify the connection between ratio and different forms, such as equations and fractions, and develop fluency in converting between them
-develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics