Maths Curriculum Sequencing Rationale

1a.	**What are the key topics taught in Year 7?** We put a big emphasis on Number in Year 7 teaching Proportion, Calculations with Directed Numbers, Fractions and Percentages. We also teach students to start developing their Algebraic thinking as well as their ability to reason in geometry and with numbers.
1b.	**Why is this?** We know that, in maths, gaps in pupils' knowledge cause serious difficulties in pupils' ability to progress into the next stage of learning. As a result, we purposely sequence our Year 7 curriculum to revisit KS2 topics checking students understanding before building on it and stretching our learners further. We follow a small steps approach, this means all content from our curriculum is broken down and explored in depth. By doing this we ensure that pupils don't just learn a procedure but they understand the underlying concepts.
2a.	**What order is this taught in and why?** The theme for the units taught in Year 7 Autumn 1 is Algebraic Thinking. This might seem unusual to start with algebra, but there are reasons for this. Algebra is not a theme focused on much by primary schools. By starting with algebra, we give all pupils a fresh start, they are starting their secondary maths journey on a level footing. We allow them to use calculators so any gaps in basic numeracy and arithmetic won't be a barrier for pupils. This helps improve their confidence with maths, which can be the biggest barrier faced by pupils. This also allows us to link algebraic techniques explicitly with arithmetic structures covered in the primary school. Our year 7 scheme ensures that pupils continuously have opportunities to use numbers in different formats such as fractions and decimals. The theme of year 7 Autumn 2 is Place Value and Proportion, here pupils are explicitly taught to work with fractions and decimals and convert between them. However throughout Year 7 students are constantly using these number formats through the interleaving nature of our curriculum. This includes the four operations with fractions and decimals, calculating perimeters with fractional and decimal lengths and substitution with fractions and decimals
3a.	**How do we build on these topics and rationale in Year 8?** In year 8 we evolve the thinking that we started to develop in Year 7 and really start to explore the world of algebra in depth. We teach topics such as expanding brackets, factorising, forming and solving equations and start to use algebra skills in coordinate axes. We apply the number work that was taught in Year 7 to more scenario's and really put an emphasis on problem solving using those mathematical skills. Within geometry we take the students knowledge of shape and space further by looking at more complex ideas such as angles in polygons, area and circumference of circles and reflecting shapes in diagonal lines. Throughout Year 8 we focus on retention of knowledge and skills that the students have previously learnt and add further knowledge by introducing new topics and increasing the complexity of the maths.
3b.	**What order is this taught in and why?** In the first half term of Year 8 we teach proportional reasoning. This takes the number skills that the students learn in year 7 and knits them together. It combines working with multiplication, division and fraction work and embeds them further, whilst still introducing the students to worldly concepts such as scale diagrams, currency conversions and circumference of circles. We then continue the links to the wider world and teach ways of representing data through tables, scatter graphs and venn diagrams. We then spend an entire half term looking at Algebraic techniques. We realise that Algebra is a topic, that students often find daunting and challenging. But by giving a lot of time to Algebra and exploring it in depth, we give the students time for mastery of the topics and to build their confidence. It also allows us to highlight key connections between the number work previously covered and the algebra work they are doing. In the next half term we take the same mastery approach towards number looking more at the equivalence of fractions, decimals and percentages and using those skills to introduce percentage multipliers and their application in terms of housing markets, sales and more real life examples. We teach the students standard form and continuously make links to science through distances in outer space and size of atoms. The final term is firstly spent working with geometry where we initially revisit the Year 7 angle rules and knowledge. We quickly expand upon that knowledge by looking at angles between parallel lines and angles in polygon, whilst also looking at how to find area of more complex shapes such as trapezia and circles. The students finish the year by delving into the world of statistical and data analysis by being taught different ways of representing data and completing an investigation project. The main aims of the Year 8 curriculum is to build algebraic knowledge, increase fluency with number and gain an understanding of the real life applications of the areas of maths they are studying.

4a. **How do we build on these topics and rationale in Year 9?**

After building strong numerical and algebraic foundations in Year 7 and 8, in year 9, there is a much bigger focus on introducing students to new topics within maths especially geometry. The difficulty of the topics is increased but because of their strong foundations students are able to understand and apply the new concepts well. Examples of topics covered include Forming and Solving Equations, Pythagoras' Theorem and Straight Line Graphs.

The aim is for all students to leave KS3 with a wide breadth of mathematical knowledge, whilst always ensuring conceptual understanding and retention. Our whole philosophy is built around student confidence in mathematics so we aim to make sure students feel confident in maths moving in to KS4.

4b. **What order is this taught in and why?**

We start Year 9 like Year 7, with Algebra. After building basic algebraic skills in Year 8 in this unit we look more at the application of the skills through investigating y=mx+c and forming and solving equations. We aim to show how algebra can be introduced and applied to many problems in order to solve them. The half term is completed by spending time developing the students ability to reason mathematically with a whole 2 weeks dedicated to testing conjectures. We realise that for students to be able to problem solve effectively in day to day life this is a skill that will really benefit them.

Half terms 2 and 4 are focussed around building students geometry skills. With each branch of mathematics we like to give students time to explore in depth, after prioritising number, proportion and algebra in Year 7 and 8 we see it important to give the same time to geometry in Year 9. Students will be taught about 3D shapes and their properties, they use knowledge from Year 7 and 8 to find volume and surface area. We teach students to construct shapes and bisectors and they use constructions to get a visual understanding of congruency . They look at transforming shapes through translations, rotations and enlargements and how this affects congruency. As part of the geometry exploration we explore Pythagoras Theorem and give students opportunity to discover the theorem by investigation. The aim of the time spent on geometry is for the students to get a better visual understanding of the shapes around them and their properties.

We do not forget the importance of number and interleave it into every topic we cover. In half term 3, knowing the importance that number skills has in making good mathematicans, we dedicate more time to working with percentage skills and fractions as well as revisiting standard form. It is crucial that our students leave Open Academy with understanding of personal finances and so we spend 8 lessons looking at financial maths such as bank statements and compound interest. We aim to prepare our students to be able to make calculations with their finances in future.

The next half term is spent looking at proportion topics using students knowledge of exchange rates and ratio to draw conversion graphs, understand scale factors and calculate with speed distance time.

At the end of Year 9, we give time for our teachers to choose topics to teach their students. From the teachers knowledge of their students and using our rigorous assessment and tracking policy they are able to identify student next steps and address them before the students move on to KS4. The students should therefore enter the next phase of learning with a solid base of knowledge and good confidence to build upon.

5a. **Select one concept/theme you teach in your subject across more than one key stage**

How is this taught in each year?

At KS3 Algebra progresses following this guidance;

Algebra

Pupils should are taught to:

- use and interpret algebraic notation, including:
    - ab in place of a × b
    - 3y in place of y + y + y and 3 × y
    - a^2 in place of a × a, a^3 in place of a × a × a; a^2b in place of a × a × b
    - in place of a ÷ b
    - coefficients written as fractions rather than as decimals
    - brackets
- substitute numerical values into formulae and expressions, including scientific formulae
- understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors
- simplify and manipulate algebraic expressions to maintain equivalence by:

- collecting like terms
- multiplying a single term over a bracket
- taking out common factors
- expanding products of 2 or more binomials

- understand and use standard mathematical formulae; rearrange formulae to change the subject
- model situations or procedures by translating them into algebraic expressions or formulae and by using graphs
- use algebraic methods to solve linear equations in 1 variable (including all forms that require rearrangement)
- work with coordinates in all 4 quadrants
- recognise, sketch and produce graphs of linear and quadratic functions of 1 variable with appropriate scaling, using equations in x and y and the Cartesian plane
- interpret mathematical relationships both algebraically and graphically
- reduce a given linear equation in 2 variables to the standard form y = mx + c; calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically
- use linear and quadratic graphs to estimate values of y for given values of x and vice versa and to find approximate solutions of simultaneous linear equations
- find approximate solutions to contextual problems from given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs
- generate terms of a sequence from either a term-to-term or a position-to-term rule
- recognise arithmetic sequences and find the nth term
- recognise geometric sequences and appreciate other sequences that arise

This followed in KS4 looking at algebra in more depth and becoming fluent in i

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- simplify and manipulate algebraic expressions (including those involving surds {and algebraic fractions}) by:
- factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of 2 squares; {factorising quadratic expressions of the form $ax^2 + bx + c$}
    - simplifying expressions involving sums, products and powers, including the laws of indices
- know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments {and proofs}
- where appropriate, interpret simple expressions as functions with inputs and outputs; {interpret the reverse process as the 'inverse function'; interpret the succession of 2 functions as a 'composite function'}
- use the form y = mx + c to identify parallel {and perpendicular} lines; find the equation of the line through 2 given points, or through 1 point with a given gradient
- identify and interpret roots, intercepts and turning points of quadratic functions graphically; deduce roots algebraically {and turning points by completing the square}
- recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function y = with $x \neq 0$, {the exponential function $y = k^x$ for positive values of k, and the trigonometric functions (with arguments in degrees) y = sin x, y = cos x and y = tan x for angles of any size}
- {sketch translations and reflections of the graph of a given function}

	• plot and interpret graphs (including reciprocal graphs {and exponential graphs}) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration • {calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as distance-time graphs, velocity-time graphs and graphs in financial contexts} • {recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point} • solve quadratic equations {including those that require rearrangement} algebraically by factorising, {by completing the square and by using the quadratic formula}; find approximate solutions using a graph • solve 2 simultaneous equations in 2 variables (linear/linear {or linear/quadratic}) algebraically; find approximate solutions using a graph • {find approximate solutions to equations numerically using iteration} • translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or 2 simultaneous equations), solve the equation(s) and interpret the solution • solve linear inequalities in 1 {or 2} variable {s}, {and quadratic inequalities in 1 variable}; represent the solution set on a number line, {using set notation and on a graph} • recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a positive rational number {or a surd}) {and other sequences} • deduce expressions to calculate the nth term of linear {and quadratic} sequence.
5b.	**How does this become progressively more challenging?** GCSE in the later units combine various elements of maths together with a particular emphasis on algebra and geometry. This aspect of the curriculum shows a clear progression from skills and procedure to multiple applications. Pupils are assessed after every unit to monitor progress and to also highlight misconceptions. These assessments are designed so that throughout the year they incorporate questions based on content from previous topics. Every Do-Now activity is retrieval based, this means pupils can demonstrate progression after the content has been taught. These retrieval activities also ensure that every pupil is fluent and confident in the facts and methods that are most frequently needed to make progress and be successful in further study
6.	**What exam boards do you use in KS4 and KS5 and why? How does this link to your KS3 curriculum?** At KS4, we continue to help pupils make connections between prior knowledge and new concepts. We do this by sequencing our curriculum to make these links explicit for pupils. Historically our pupils have struggled to recall the knowledge they need for future learning. As a result, we have a focus on retrieval practice. Every lesson, pupils complete a retrieval 'do-now' activity making them think hard to recall the knowledge they need. Our curriculum also identifies the prior knowledge needed for each new unit of work. This allows teachers to determine if pupils have a solid foundation, without any gaps in knowledge, before they introduce new ideas.
7.	**What career opportunities does the study of your subject bring?** Career opportunities are unlimited for mathematics majors. They may pursue graduate education, career paths in business, science or technical fields or disciplines such as social services, education, and government. Some of the occupations that mathematics majors enter include: ▪ accountant ▪ actuary ▪ computer programmer ▪ doctor ▪ engineer ▪ investment manage ▪ theoretical mathematician ▪ mathematician ▪ numerical analyst ▪ statistician ▪ teacher ▪ market researcher ▪ systems analyst ▪ banking ▪ government ▪ space/aircraft industry ▪ lawyer

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