Curriculum Progression Pathway

MATHS

MATHEMATICS:

Why is the study of MATHEMATICS important?

MATHEMATICS has two disciplines: Pure and Applied – Pure Mathematics is the abstract science of number, quantity and space as abstract concepts and Applied Mathematics is where the knowledge learned is applied to other disciplines such as statistics, physics and engineering.

Initially your mathematics study focuses on building firm foundations, including your fluency and understanding in readiness for your future GCSE and even A level mathematics study. Our curriculum is carefully designed to ensure that all students get a firm grounding in the basic rules of number. This is differentiated by depth, as opposed to students racing onto the next topic. This approach develops more confident mathematicians as students move through the curriculum and helps them to retain their new learning for longer. Your study of mathematics at Outwood will make you think about the beauty of how numbers connect and how processes relate to each other. Mathematics encourages you to discover those connections for yourself, to make you a detective of mathematics and to explore how to solve problems. This enables you to become an analytical thinker, someone who sees that the answer is only the beginning. It will help you to learn how to make conjectures (a conclusion based on evidence, patterns and thought, but not yet confirmed with proof) to reason and to prove. It will enable you to be more logical in your approach to complex issues and be more analytical.

You will discover how the basic four rules can be applied to fractions, decimals, standard form and algebra and how multiplicative reasoning can be applied to many areas of maths, such as percentages, ratio, proportion and enlargement to name but a few. You will get to investigate the beauty of mathematics connected to shape, and the usefulness it brings in analysing data and solving mechanical problems.
Your study of Mathematics will encourage you to think deeply and help you to problem solve more effectively – a great life skill that all universities and employers will appreciate. Across your study you will explore number, algebra, shape and space and statistics. Lessons will provide a wide range of opportunities for constructing your own learning and discovering your own rules, through the use of concrete materials such as counters, through pictorial representations to demonstrate mathematical concepts and to apply these to solve problems, both abstract and from real-life.

Maths lessons will be full of discussion, questioning, proving and explaining. You are going to love it! Mathematics will expand your mind!
Big Questions such as: How tiny is the earth in comparison with the universe? How can solutions to difficult engineering problems be found using graphs and calculus? How do people predict what is going to happen in the economy? and other such seemingly bewildering questions will be answered … you just need to learn the basics, be an inquisitive learner, and the rest will follow.

What skills will the study of Mathematics teach you?

You are a citizen in this world and you need to know the basic skills of number and how to apply them to a range of problems – known as 'being numerate'. It will teach you:

- Not to be afraid of "being lost" and having to struggle to find one's way through the problem – RESILIENCE!
- To use calculation to solve basic problems
- To make and use generalisations—often quite quickly. One of the basic abilities, easily detectable even at the level of primary school: after solving a single example from a series, a child immediately knows how to solve all examples of the same kind.
- To have rapid and sound memorisation of mathematical material.
- To be able to concentrate on mathematics for long periods without apparent signs of tiredness.
- To be able to offer and use multiple representations of the same mathematical object. (For example, switching easily between representations of the same function by tables, charts, graphs, and analytic expressions.)
- An instinctive tendency to approach a problem in different ways: even if a problem has been already solved, you are keen to find an alternative solution.
- To utilise analogies and make connections.
- Skills to link two (or more) elementary procedures to construct a solution to a multi-step problem.
- To recognise what it means to "know for certain".
- To detect unstated assumptions in a problem, and either to explicate and utilise them, or to reject the problem as ill-defined.
- To be efficient, a distinctive tendency for "economy of thought," striving to find the most economical ways to solve problems, for clarity and simplicity in a solution.
- To be aware of the presence and importance of an underlying structure.
- To use rapid abbreviation, compression or a curtailment of reasoning in problem solving e.g. algebra.
- How to grasp encapsulation and de-encapsulation of mathematical objects and procedures.

How does your study of MATHEMATICS support your study in other subjects?

Study of any subject in our curriculum takes full advantage of links with other subject areas- we term these as interdisciplinary links and we make the most of them because we know that deep learning requires the transference of knowledge and skills from one topic of learning to another. Once you can transfer your learning across topics and subject areas then you are really mastering what you know and how to apply your understanding and skills.

Mathematics touches on many other subjects such as geography and science, any subject that analyses data, looks at trends, uses formulae. Computer Science is a subject that uses the algorithmic approach that many topics in mathematics also use. The ability to follow a process accurately is applicable to many other subjects too. The Social Sciences, particularly at Post 16 and at undergraduate level have a strong need for the use of data, for understanding of exponential growth and decay, for manipulation of formulae – and this is one reason why the Core Maths AS Level was introduced recently.

Across the other subjects, teachers will make reference to your learning in Maths and this will help you to develop your understanding. There may be opportunities to explore the links between science, engineering and mathematics departments in STEM activities.
Outside of Mathematics lessons there are a range of initiatives that can help you deepen your understanding of mathematics such Numeracy Ninjas, Timetable Rock Stars, UKMT Maths Challenge led by Leeds University, Maths Masters – for our elite mathematicians, and online learning programmes such as the wonderful Sparx.

How are you assessed in MATHEMATICS?

Throughout the 5 year MATHEMATICS course you are assessed using the following assessment objectives which ensure that you can cumulatively build your subject understanding in preparation for future GCSE and A Level study. There are regular assessment points each year that we term Praising Stars©. For younger years we base our assessment on our subject mapping of the age related expectations across the curriculum, assessing students' performance at their current stage of study against expectation. At GCSE we make informed predictions informed by our holistic assessment of their progress against the key assessment objectives and their aspirational GCSE targets. These are also the basis for any appropriate support and intervention.

<u>Key Assessment Objectives</u>

AO1: Use and apply standard techniques

Students should be able to:

- accurately recall facts, terminology and definitions
- use and interpret notation correctly
- accurately carry out routine procedures or set tasks requiring multi-step solutions

AO2: Reason, interpret and communicate mathematically

Students should be able to:

- make deductions, inferences and draw conclusions from mathematical information
- construct chains of reasoning to achieve a given result
- interpret and communicate information accurately
- present arguments and proofs

• assess the validity of an argument and critically evaluate a given way of presenting information

AO3: Solve problems within mathematics and in other contexts

Students should be able to:

• translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes
• make and use connections between different parts of mathematics
• interpret results in the context of the given problem
• evaluate methods used and results obtained
• evaluate solutions to identify how they may have been affected by assumptions made

GCSE specifications in mathematics should enable students to:

1. develop **fluent** knowledge, skills and understanding of mathematical methods and concepts
2. acquire, select and apply mathematical techniques to **solve problems**
3. **reason mathematically**, make deductions and inferences and draw conclusions
4. comprehend, interpret and **communicate mathematical information** in a variety of forms appropriate to the information and context.

How can Mathematics support your future?

We offer the study of GCSE Mathematics and we strongly encourage your continued study in this fantastic subject if you have demonstrated a passion for it, a flair and an ability.

However, whether you have chosen to study Mathematics into A level or not you will have gained a lot from its study over the 5 years from years 7-11. We know that the depth of understanding we encourage and support you to achieve will set you up well to be not only numerate, but a really logical and analytical thinker, who is resilient and ready to solve problems.

Mathematics is offered at prestigious universities either as a single honours or a joint honours subject studied alongside other disciplines e.g. Statistics, Computer Science, Science, Philosophy, Engineering.

A high level of qualification in mathematics is a prerequisite for honours degrees in many engineering and physics related subjects.

It is also cited that an A level in maths demonstrates the very high level of analytical thinking that many universities are looking for in their applicants. The very fact that you have been able to study mathematical thinking post 16 will help your future applications, be they for colleges, universities, apprenticeships or employment.

A strong GCSE in Maths opens doors for your future career – employers look favourably on this and it would put you in a very strong position when looking for jobs or placements Post 16 and in colleges.

Careers that the study of MATHEMATICS supports include:

- Actuarial analyst
- Actuary
- Chartered accountant
- Chartered certified accountant
- Data analyst
- Data scientist
- Investment analyst
- Research scientist (maths)
- Secondary school teacher
- Software engineer
- Statistician
- Civil Service fast streamer
- Financial manager
- Financial trader
- Insurance underwriter
- Meteorologist
- Operational researcher
- Quantity surveyor
- Software tester

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Autumn 1	**Transition Block** Exploring Mathematics whilst reinforcing the basics and identifying any Covid catch-up needs. Activities will include: Statistics Additive Reasoning Multiplicative Reasoning Geometry Fractions	**Block 2** **Number** 1. Primes and indices 2. Prime Factorisation to find LCM, HCF, squares, cubes 3. Basic laws of indices 4. Basic introduction to Surds and four operations 5. Standard Form	**Block 8** **Proportional Reasoning** 1. Ratio – equivalence and simplifying 2. Ratio – problem solving 3. Proportional Reasoning 2 4. Maps and scales 5. Ratio and Rate incl. speed, distance, time and pressure 6. Constructing pie and interpreting pie charts 7. Rounding, significant figures and estimation
Autumn 2	**Block 1** **Applications of Algebra** 1. Negative Numbers (four operations) 2. Squares, Cubes and Roots 3. Order of operations 4. Simplify algebraic expressions 5. Substitution 6. Sequences (term-to- term, not nth term) **Block 2** **Number** 1. Primes and indices	**Block 4** **Algebraic Expressions** 1. Formulate and evaluate expressions 2. Linear equations 3. Linear sequences: nth term 4. Cartesian coordinates and an introduction to functions 5. Expressions and equations from real-world situations	**Block 9** **3-D Geometry** 1. Circumference and area of a circle 2. Arcs and sectors of circles 3. 3-D shapes & their nets; plans and elevations 4. Volume and surface area of prisms, composite solids, pyramids, cones and spheres (with formula and without for pyramids and cones.) and mass, density and volume 5. Pythagoras – 2-D and 3-D Pythagoras

Spring 1	**Block 2** **Number** 2. Prime Factorisation to find LCM, HCF, squares, cubes 3. Basic laws of indices 4. Basic introduction to Surds and four operations 5. Standard Form **Block 3** **Percentages and Statistics** 1. Divide fractions	**Block 5** **2-D Geometry** 1. Draw accurate triangles and quadrilaterals 2. Find unknown angles (including parallel lines) 3. Conversion between length units and between area units 4. Area of trapeziums 5. Areas and perimeters of composite figures 6. Problem solving with area & perimeter **Block 6** **Proportion & Percentages** 1. Fractions, Decimals and Percentages of amounts	**Block 10** **Algebraic Expressions** 1. Arithmetic & geometric sequences 2. Expansion incl. double brackets 3. Factorisation including double brackets and solving simple quadratic equations 4. Quadratic graphs, drawing and sketching, roots etc 5. Algebraic manipulation (rearranging and advance rearranging)

Spring 2	**Block 3** **Percentages and Statistics** 2. Proportional Reasoning 1 3. Convert Fractions, Decimals and Percentages 4. Ordering Fractions, Decimals & Percentages and Equivalence 5. Percentage of an amount 6. Find the whole, given the part and the percentage 7. Interpret and compare statistical representations. 8. Averages and the range incl. frequency tables **Block 4** **Algebraic Expressions** 1. Formulate and evaluate expressions	**Block 6** **Proportion & Percentages** 2. Percentage Increase and Decrease 3. Repeated change and percentage/fraction problems 4. Reverse Percentages 5. Amounts as percentages 6. Frequency trees	**Block 11** **Graphs & Proportion** 1. Linear graphs 2. Direct and inverse proportion 3. Relationships and Proportionality 4. Variation and variation with powers (direct and inverse proportion with algebra)
Summer 1	**Block 4** **Algebraic Expressions** 2. Linear equations 3. Linear sequences: nth term 4. Cartesian coordinates and an introduction to functions 5. Expressions and equations from real-world situations	**Block 7** **Probability & Statistics** 1. Probability 2. Averages from grouped data 3. Compare two data sets including stem-and-leaf diagrams 4. Scatter graphs, basic correlation and drawing lines of best fit	**Block 12** **2-D Geometry** 1. Bearings 2. Further construction and loci 3. Congruence and similarity 4. Triangles and quadrilaterals (angles on diagonals) 5. Angles in polygons

Summer 2	**Block 5** **2-D Geometry** 1. Draw accurate triangles and quadrilaterals 2. Find unknown angles (including parallel lines) 3. Conversion between length units and between area units 4. Area of trapeziums 5. Areas and perimeters of composite figures 6. Problem solving with area & perimeter	**Block 8** **Proportional Reasoning** 1. Ratio – equivalence and simplifying 2. Ratio – problem solving 3. Proportional Reasoning 2 4. Maps and scales 5. Ratio and Rate incl. speed, distance, time and pressure 6. Constructing pie and interpreting pie charts 7. Rounding, significant figures and estimation	**Block 13** **Geometry** 1. Similar shapes 2. Exploring trigonometric ratios with 30-60-90 and 45-45-90 triangles of varying dimensions 3. Trigonometry and Pythagoras in right angled triangles, 3-D trigonometry and Pythagoras (Real life applications - Bearings)

In Years 10 and 11, Students will cover Block 14 to 23 as detailed below. Due to our Covid recovery plans and the need to cover lost learning and re-visit prior learning there will be some flexibility with the timings of when these units are delivered.		
Block 10 **Algebraic Expressions** 1. Arithmetic & geometric sequences 2. Expansion incl. double brackets 3. Factorisation including double brackets and solving simple quadratic equations 4. Quadratic graphs, drawing and sketching, roots etc 5. Algebraic manipulation (rearranging and advance rearranging)	**Block 11** **Graphs & Proportion** 1. Linear graphs 2. Direct and inverse proportion 3. Relationships and Proportionality 4. Variation and variation with powers (direct and inverse proportion with algebra)	**Block 12** **2-D Geometry** 1. Bearings 2. Further construction and loci 3. Congruence and similarity 4. Triangles and quadrilaterals (angles on diagonals) 5. Angles in polygons

Block 13 **Geometry** 1. Similar shapes 2. Exploring trigonometric ratios with 30-60-90 and 45-45-90 triangles of varying dimensions 3. Trigonometry and Pythagoras in right angled triangles, 3-D trigonometry and Pythagoras (Real life applications - Bearings)	**Block 14** **Equations and Inequalities** 1. Construct and solve equations and inequalities algebraically 2. Graphical solutions to simultaneous linear **equations and inequalities** 3. Linear simultaneous equations 4. Quadratic and non-linear graphs and links with quadratic equations	**Block 15** **Applications of Algebra** 1. Expand/factorise binomials and **triple brackets** 2. **Algebraic fractions** 3. Quadratic equations; roots of functions, solving by factorising, **complete the square, quadratic formula, quadratic inequalities** 4. **Quadratic Simultaneous equations** 5. Cubic/reciprocal graphs, exponential graphs, **trig graphs, transformations of graphs** 6. Graphical solutions of equations
Block 16 **Statistics** 1. Represent and describe distributions and **histograms, cumulative frequency and box plots** 2. Identify misleading graphs 3. Time series 4. Correlation, using lines of best fit and interpolation/ extrapolation	**Block 17** **Sampling and Probability** 1. **Populations and samples; capture/recapture** 2. Theoretical and experimental probability 3. **Listing and the product rule for counting** 4. Set notation & Venn diagrams 5. Combined events, including tree diagrams and **conditional probability**	**Block 18** **Geometry** 1. Transformations (translation, rotation, reflection) and combined transformations 2. Use known angle and shape facts to obtain simple proofs 3. Enlargement and **negative** scale factors of enlargement. 4. Combine transformations

Block 19 **Number** 1. Calculations with and rules of indices and fractional indices 2. Indices and Surds 3. Calculations with standard form 4. Repeated change and percentage/fraction problems 5. Standard non-linear sequences and **recurrence relations and iteration**	**Block 20** **Reasoning** 1. **Algebraic arguments – algebraic proof and recurring decimal proof** 2. Using angle and shape facts to derive results and **circle theorems** 3. Coordinates (including midpoints, coordinate problems) 4. Equations of parallel and **equations of perpendicular lines** 5. Vectors and **vector proofs**	**Block 21** **Geometry and Number** 1. Further surface area and volume (including exact answers) and **similar areas and volumes** 2. Solve problems involving compound units 3. **Trigonometry in all triangles** 4. Limits of accuracy and upper and lower bounds
Block 22 **Algebra and Geometry** 1. Arcs and sectors of circles 2. **Proof in algebra and geometry and equation of a circle and the tangent to a circle** 3. Rates of change and **gradients of chords and tangents** 4. **Area under a graph and interpreting in context**	**Block 23** **Functions** 1. **Functions – will be taught at every appropriate opportunity (e.g. algebraic notation, rearranging formulae, linear graphs, mappings etc) and then brought together as a topic here**	