The Mathematics Department - The Purpose of Maths at HCHS

"Every student will leave Hanley Castle High School a problem solver"

They will have the mathematical curiosity and skills to equip them for life as well as a resilient and pragmatic approach to dealing with challenges, whatever their starting point.

Mathematics is a creative and highly interconnected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. We believe that everyone can make progress in mathematics and relentlessly promote the message that effort and belief lead to success. Students at Hanley Castle High School follow an ambitious mathematics curriculum that provides an equality of experience with the opportunity for all to flourish. We set 'BIG IDEAS' benchmarks that provide students with a clear sense of progression in their acquisition of knowledge and development of mathematical reasoning. Along this journey of discovery, students encounter a number of essential experiences and common teaching approaches that help them to appreciate the beauty and power of mathematics and develop a sense of enjoyment and curiosity about the subject.

Lesson Format: Lessons are centred around a Key Learning Point (KLP) with each key learning point being a footstep through our mathematics curriculum. Teachers will model new concepts using intuitive, concrete, or pictorial representations before moving to abstract ideas. In lessons students can expect to work on:

- **Fluency** - the maths facts and procedures that students need at their fingertips because these are the foundations of the subject;
- **Reasoning** - using and communicating their understanding of maths concepts
- **Problem Solving** - a gathering of their topic specific and interrelated knowhow applied to finding solutions to routine and non-routine problems.

Unit Format: KLPs are grouped into units. These units are stepping-stones through our maths curriculum. Within each unit of work teachers will consider the starting points and prerequisite knowledge of the students. Only once this is secure then new material will be covered. Within each unit students can expect time for:

- **Prerequisites** – teachers checking what students understand from prior learning.
- **Practice** - retrieving prior and interrelated knowledge.
- **Progress** - working on and developing their understanding of new concepts.
- **Problem solve** – be taught how to solve problems in context
- **Pause** - reflecting and working on their next steps based on assessed work.
- **Practice** - deliberate practice on areas they need to master.

Pathways: The units are grouped into pathways (these are displayed on the maths department wall) and provide a clear route through our curriculum. The majority of students will start on the stage 7 pathway with students who have lower levels of prior knowledge starting on the Entry to Key Stage 3 pathway. Along each pathway students can expect teacher to draw their attention to:

- **The Biggest Ideas – will be mastered by the end of each stage -** The most important (for mathematical progress) ideas in each year are highlighted below. These are the ones that we revisit regularly to ensure students fully understand them and can carry them out automatically.
- **Essential Experiences and common approaches -** to highlight maths concepts/problems.

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Entry to Key Stage 3

BIG IDEAS

1	Multiply and divide numbers with up to three decimal places by 10, 100, and 1000
2	Round to the nearest whole number, 10, 100, 1000 and to one decimal place
3	Add and subtract numbers of any size
4	Recall multiplication facts up to 12 × 12
5	Use known and derived facts to multiply and divide mentally
6	Multiply a three-digit number by a two-digit number
7	Divide numbers up to four-digits by a single-digit number
8	Know common equivalences between fractions, decimals and percentages
9	Identify and find equivalent fractions
10	Find percentages of quantities using mental methods
11	Measure and draw lengths and angles
12	Calculate the area of rectangles and triangles
13	Use coordinates in all four quadrants

Essential experiences

- A fraction wall is used when finding equivalent fractions, and when adding fractions
- Students use the sieve of Eratosthenes to identify the first 25 prime numbers
- Students are encouraged to say 'negative numbers', rather than 'minus numbers'
- Napier's bones is shown as an alternative method for multiplying by a two-digit number
- The 'Chinese tables' approach is used to show how few times-table facts there are to learn, and to challenge any negative mentality
- Fibonacci's disappearing squares is used to demonstrate the importance of accurate drawing
- Unravelling dice is used when working with nets
- Short division is never called 'bus stop' (and neither is long division)
- Up or down (demonstrating the importance of the number line) is used when learning about rounding
- Dotty activities is used when looking at properties of shapes
- Pick's theorem is used to make a connection between adjacent units and working with formulae
- Fascinating food makes use of real-life worded formulae
- The bar model is used when working with ratio
- Pumpkin pie is used as an example of a worded ratio problem
- The history of calculating with fractions is shared from Egyptian fractions and the Rhind Papyrus, to the invention of the horizontal fraction bar by the Moroccan mathematician Abu Bakr al-Hassar
- Ziggurat (addition pyramids) are used when developing basic rules of algebra
- Dissection deductions are used to derive formulae for area of a triangle and parallelogram
- Real examples are used to help students develop a feel for units of volume and area
- Students use Moving House when learning about translation
- Match of the matches is used as a problem involving the representation of data
- Birdwatch is used as a problem involving interpreting the mean
- Students are taught to use a 360 degree protractor, which helps when learning about angle facts

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Year 7

BIG IDEAS

1	Use positive integer powers and associated real roots
2	Apply the four operations with negative numbers
3	Convert between terminating decimals and fractions
4	Write a quantity as a fraction or percentage of another
5	Use multiplicative reasoning to interpret percentage change
6	Understand how to multiply with fractions and mixed numbers
7	Check calculations using inverse operations
8	Select and use checking strategies in a range of contexts
9	Simplify and manipulate expressions by collecting like terms
10	Simplify and manipulate expressions by multiplying a single term over a bracket
11	Substitute numbers into formulae
12	Solve linear equations in one unknown
13	Calculate surface area of cubes and cuboids

Essential experiences

- The story of Srinivasa Ramanujan and the number 1729 is shared when learning about cube numbers
- The patterns of Pascal's triangle are used (prime numbers, multiples, powers of 2, triangle numbers)
- The determination against the odds shown by Sophie Germain is shared (Sophie Germain primes)
- Double number lines are used to help develop understanding of calculating with negative numbers
- Students are strongly encouraged to say 'negative numbers', rather than 'minus numbers'
- During the introduction to significant figures, the wealth of Jeff Bezos, and age in seconds, is explored
- Students discover that the equals sign was invented by a Welsh mathematician, Robert Recorde
- Archimedean solids are used when exploring simpler polyhedra and Euler's formulae
- A link between adjacent units using Goldberg Polyhedra is made when substituting into formulae
- A clouding the picture approach is used to introduce substituting into expressions
- The bar model is used when working with ratio
- Students explore growing patterns when working with linear sequences
- Students are taught a brief history of length (and mass, and capacity)
- Students learn some features of UK tax returns as part of their work on percentages
- When dividing with fractions, the 'division without dividing' example is posed
- The origins of algebra are shared in the Al Khwarizmi's algebra activity
- Students are shown the Curry Triangle paradox
- Heron's alternative formulae for the area of a triangle is explored
- Students learn that a Scottish engineer, William Playfair, invented both the bar chart and the pie chart
- Students discover that Florence Nightingale was really a statistician!

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Year 8

BIG IDEAS

1	Apply the order of operations including brackets and powers
2	Convert numbers into standard form and vice versa
3	Apply the multiplication, division and power laws of indices
4	Find a relevant multiplier when solving problems involving proportion
5	Solve problems involving percentage change
6	Factorise an expression by taking out common factors
7	Change the subject of a formula when two steps are required
8	Find and use the nth term for a linear sequence
9	Solve linear equations with unknowns on both sides
10	Understand and use lines parallel to the axes, y = x and y = -x
11	Plot and interpret graphs of linear functions
12	Apply the formulae for circumference and area of a circle
13	Calculate theoretical probabilities for single events

Essential experiences

- Students learn about the role of prime numbers in public key cryptography
- The scale of the universe is used when learning about standard form
- The story of the invention of coordinates is used: Rene Descartes and the fly
- Students learn that John Napier, inventor of the 'bones', also invented the decimal point
- Students complete the Mayan multiplication jigsaw
- An investigation is used to establish angles in polygons
- The possibly apocryphal tale of the Earl of Sandwich is used when introducing probability
- All teachers have a pack of cards available to help illustrate theoretical probability
- Scientific formulae, as used in physics, are made use of when substituting and changing the subject
- When learning about the laws of indices students learn about the zenzizenzizenzic
- Examples from Fun with Flags are used when moving between ratios and fractions
- Decimation is used as an example of the nth term
- When learning about bearings, students find out about the numbers on runways at airports
- Dynamic geometry software is used to help visualise graphs of functions
- Students discover pi through an investigation, and search for their birthday in pi
- A selection of boxes are used as examples of prisms
- Students are reminded of the origins of the word 'algebra' in the work of Al-Khwarizmi
- The horse race activity is used when learning about possibility space diagrams
- Students discover that the inventor of the Venn diagram was a Scottish mathematician
- When estimating averages from a grouped frequency table, family size is used

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Year 9

BIG IDEAS

1	Calculate with roots and integer indices
2	Manipulate algebraic expressions by expanding the product of two binomials
3	Manipulate algebraic expressions by factorising a quadratic expression of the form $x^2 + bx + c$
4	Understand and use the gradient of a straight line to solve problems
5	Solve two linear simultaneous equations algebraically and graphically
6	Plot and interpret graphs of quadratic functions
7	Change freely between compound units
8	Use ruler and compass methods to construct perpendicular bisectors and angle bisectors
9	Solve problems involving similar shapes
10	Calculate exactly with multiples of π
11	Apply Pythagoras' Theorem in two dimensions
12	Use geometrical reasoning to construct simple proofs
13	Use tree diagrams to list outcomes

Essential experiences

- Narcissistic numbers are used when learning about powers (153, 370, 371, 407, 1634, 8208, 9474, 54748, …)
- Kaprekar numbers are used when learning about powers
- Human constructions are employed when learning about ruler and compass constructions
- Students explore scenarios involving the tethered goat
- When learning about plans and elevations students visualise through the use of multilink cubes
- Napoleon's theorem / rose windows are used as examples of complex ruler and compass construction
- The grid method is used to give a structure to understanding how to expand and factorise
- The story of Archimedes is used when learning about density
- Students use interesting real life examples of compound units and convert between silly and sensible
- Students learn about the story of Fibonacci
- Students explore growing patterns when working with linear sequences
- Ideas from Plutarch's boxes are used as an introduction to volume and surface area. A connection is made with a cylinder of height 6 cm and cross-sectional diameter of 6 cm.
- The story of Pythagoras is shared with students
- 'One old Greek' and 'Daniel Gumb's cave' are used when exploring proof and Pythagoras' theorem.
- Shrink-wrapped Stilton is used as an example of how to find surface area of a complex solid
- Students observe the patterns on a graph that can be created using Pythagorean triples
- Examples are chosen from the graphing stories website
- Students carry out the drawing pin experiment when learning about relative frequency
- The first ever stem-and-leaf diagram (volcano heights), created by John Tukey in the 1960s, is shared