

# Curriculum Mathematics



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### **Mathematics progression and content map**

## a. What is our Go Further curriculum?

*At PHSG we cover the relevant specifications for a breadth of challenging pathways. Our Go Further Curriculum ensures that our students have not only the pathways and qualifications that they will need to Go Further in their later lives but are each the very best Mathematician that they can be.*

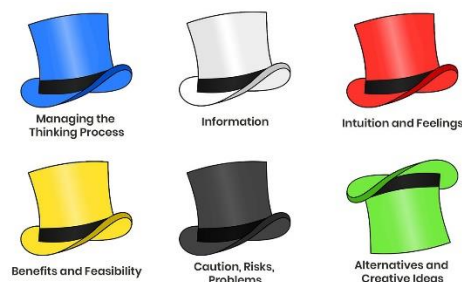


*Our students acquire the aptitudes of outstanding Mathematicians by thinking and learning about Mathematics in three explicitly linked strands:*

**Facts and Formulae:** Students will acquire knowledge and embed key Mathematical facts and formulae into long term memory. Students will have freedom of thought in their working memory, a developed vocabulary for reasoning and lower assessment anxieties because of accumulating expertise over time.

**Fluency:** Students will be secure with the application of learned skills and execute learnt methods with precision, accuracy, and efficiency. Thinking maps are used to organise and compare processes and new techniques are learned.

**Flexibility:** Students will use both their acquired knowledge and skills to adapt to new problems, thinking about strategy, creative solutions and critically evaluating their conclusions. Thinking hats are used to consciously select, use and evaluate Mathematical skills to confidently approach new and blended problems.



Our curriculum content ensures that all students are able to achieve on a higher tier GCSE pathway by the end of year 11. We study the 5 key areas of **Number, Geometry, Algebra, Data & Statistics and Ratio and Proportion** with an interleaved and spiralled curriculum design from years 7-11.

Students in year 11 focus on consolidation, revision for long term memory and problem-solving technique as the content of the GCSE course is covered early in their academic year. *All students cover the higher tier Edexcel GCSE content.*

Mathematics is based on **6 big ideas**.

Number	Ratio and Proportion	Algebra
Geometry	Data Analysis	Probability

Our curriculum is an ambitious seven-year programme, gradually leading to the mastery of these 6 big ideas.

At Key Stage 5 all students can choose a pathway that suits their needs to Go Further with their Mathematical Studies in Further Education or the workplace. Students can choose from

- Core Mathematical studies; blending Pure Mathematics with Statistics and Modern Finance *All students cover the level 3 AQA content.*
- A level Mathematics; A Pure Mathematics rich course combining Mechanics, Statistics and Mathematical Comprehension Skills. *All students cover the OCR MEI B content.*
- A level Further Mathematics; adding both breadth and depth to A level Mathematics with greater depth on Statistics (major) and Modelling with Algorithms (minor). *All students cover the OCR MEI B content.*

## *How does this fit in with the PHSG curriculum?*

Plymouth High School for Girls aims to be an outstanding Grammar School for the 21st century remaining true to the philosophy of the school's motto 'For Life Not School We Learn'.

A school which:

- Promotes a culture of high **aspiration** enabling personal and academic success
- Prepares students to **think confidently and independently**
- Provides an **outstanding education** for all, the key to this being high quality teaching
- Provides **enjoyment, excitement and challenge** for all, stimulating an enthusiasm for lifelong learning
- Prepares students to become **active citizens**, equipped to succeed in a world of rapid change

## *b) Thinking, Teaching and Learning in Lessons*

All Mathematics lessons incorporate the three strands of the curriculum of facts and formulae, fluency and flexibility in proportions which are relevant to the learned content.

Every lesson has both a low stakes retrieval quiz and salient slide summary to create long term memories. Facts and formulae are directly linked to the Knowledge Bank linked to the learning for the current learning cycle and low stakes long term memory assessments (extended quiz) take place 3 times a year to measure the impact of the memory techniques that are employed.

Students are actively involved in every part of the lesson through whole class questioning, think pair share discussion times, use of thinking maps to organise thoughts, thinking hats to approach and solve new problems and connect different areas of Mathematics. Students are given explicit instructions about the purpose and criteria for each small task and are aware when a task should be completed independently.

Lessons are thoughtfully planned to incorporate all of the crucial elements above which are encapsulated through our RESPECT lesson ingredients; we have high expectations for our learners in each moment and for their overall outcomes.

<b>R</b>	<b>Retrieval</b>
<b>E</b>	<b>Expectations (learning)</b>
<b>S</b>	<b>Salient</b>
<b>P</b>	<b>Pace</b>
<b>E</b>	<b>Expectations (behaviour)</b>
<b>C</b>	<b>Challenge</b>
<b>T</b>	<b>Thinking Strategies</b>

Teachers use targeted question, regular checks for understanding and instant 'live' feedback to monitor and ensure the progress of all learners in the classroom during every lesson.
















The Go Further Curriculum takes into account the unique start point of our very able year 7's and separates learning objectives into **Building Blocks**, **Expected** and **Go Further** Outcomes.

**Building blocks** are assumed prior learning and are signposted and resourced all the way through our curriculum; empowering students to bridge any identified gaps for themselves and making them explicit aware of the cumulative nature of the subject.

**Go Further** outcomes are linked to each expected learning outcome and all students are exposed to and expected to use thinking tools to collaboratively and later independently work through higher level problems associated with the Mathematical concepts they have mastered. Students regularly use reverse processes, proof and reasoning and multi-step processes to show their thinking and strategies and meet these challenging objectives.

### What is 'Going Further' in Mathematics

We work with students over their entire Maths journey at Plymouth High School for Girls to develop the aptitudes of truly outstanding Mathematicians; rather than simply being able to follow steps and replicate methods. Here are the aptitudes that we develop by following our unique curriculum and approach to learning and expect of our students when they are thinking and working with **FLEXIBILITY**:

<b>I CAN REVERSE PROCESSES</b> 	<b>I HAVE A 'MATHS MEMORY'</b> 	<b>I CAN USE A SEQUENCE OF REASONS TO EXPLAIN</b> 	<b>I CAN SEGMENT MY WORKING INTO CLEAR SECTIONS</b> 
<b>I CAN GO FROM EXAMPLES AND NUMBERS TO GENERALISING</b> 	<b>I CAN HAVE ANOTHER GO AND TRY AGAIN</b> 	<b>I UNDERSTAND CONCEPTS AS WELL AS FOLLOWING STEPS</b> 	<b>I HAVE A GROWTH MINDSET</b> 
<b>I HAVE A GOOD SPATIAL AWARENESS</b> 	<b>I SHOW MY WORKINGS IN CLEAR SHORT STEPS</b> 	<b>I CAN GIVE REASONS FOR REACHING MY ANSWERS</b> 	<b>I CAN MAKE AN ESTIMATE TO CHECK HOW REASONABLE MY ANSWER IS</b> 
<b>I CAN SEE HOW DIFFERENT CONCEPTS ARE CONNECTED</b> 	<b>I CAN CHOOSE THE RIGHT METHODS TO APPLY TO A NEW PROBLEM</b> 	<b>I CAN WRITE USING MATHS SYMBOLS AND NOTATION</b> $\pi \Sigma \beta$	<b>I CAN ORGANISE MY THOUGHTS AND WORK THROUGH THEM IN A SYSTEMATIC WAY</b> 

### *c) Go Further Assessments*

Thinking and learning is clearly sectioned into 6 half termly cycles. Students are aware of the content that is to be assessed at the end of each cycle; as it begins. The National Curriculum and GCSE Higher Tier Edexcel specification is interleaved between years 7-11 to ensure challenge and connected ideas are revisited; each time in greater depth and drawing on previous concepts.

Each assessment is broken into the three strands of the Go Further Curriculum as such

- Section A: Knowledge recall of facts and formulae as a measure of long term memory
- Section B: Basic and uncomplicated application of skills learned in this cycle as a measure of fluency
- Section C: Flexible thinking to solve problems which are new and / or required a blend of skills.

We expect all students to achieve 40% or higher in our assessment as an indication that they are keeping up with the challenges of our curriculum and securing long term memory.

A level and Further Mathematics A level students complete both topic-based assessments and blended 'midterm' assessments during each of the 6 cycles. In this way students develop an awareness of which individual parts of the course are secure or need revising as well as having the opportunity to test long term memory, problem solving skills and simulate exam experience and time pressures through our mixed midterms.

Core Mathematical studies assessments combine investigative projects with real life case study of financial matters as well as more traditional practice of Mathematical techniques. Assessments not only reflect the expectations of the external exams but also include real life analytical approaches to scenarios involving money or large data sets; sometimes incorporating software that is used in industry.

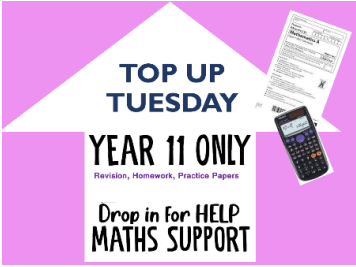
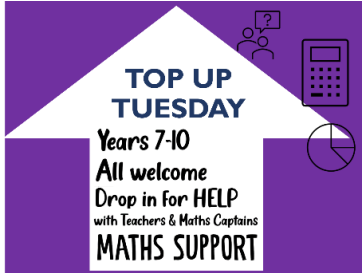


## d) Independent Study

We believe in supporting our students to Go Further with education and their careers by simultaneously developing effective independent learning habits as a crucial aspect of the Mathematics curriculum. A core responsibility of a PHSG Mathematician is that of using mark schemes and correct answers to edit and amend workings and ideas. Access to answers; solutions and mark schemes are a critical resource in our curriculum as our students develop the habits to self-check and self-correct.

Students are fully equipped with not only the information but bespoke and perfectly matched resources to empower them to become motivated independent learners.

Weekly support is available for all students at any time in their learning cycles; including a year 11 only exam focus room during our 'Top Up Tuesday' drop-in Maths support surgeries. Here, students can request support with content from lesson, homework or revision with the aid of teachers or student Maths Captains!


Drop-In Support Sessions:	 <p>TOP UP TUESDAY YEAR 11 ONLY Revision, Homework, Practice Papers Drop in for HELP MATHS SUPPORT</p>	 <p>TOP UP TUESDAY Years 7-10 All welcome Drop in for HELP with Teachers &amp; Maths Captains MATHS SUPPORT</p>
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Students in years 7-11 and on A level pathways all have a unique student account to an online independent learning platform which can be accessed from home or school. The online learning platforms feature linked videos, show students assignments that are set by their teachers and offer a range of matching questions at varying difficulty levels. ***We endorse independence and believe that all students have the tools to achieve 100% completion in their set tasks each week, this is an expectation.***

Our curriculum is consciously interleaved through set online tasks. Students use a range of interfaces to commits facts and formulae to memory, to rehearse fluency and to flexibly apply their skills to strategically linked problems.

Online learning gives students the opportunity to instantly receive their score, re-attempt any outstanding problem areas, find directly matched help with each type of question and communicate directly with their own class teacher. We use 'QUIZLET' in year 7 - 10 as a tool to self quiz for retrieval of facts and formulae, with set flash cards to match each half term of learning and the knowledge bank we expect students to commit to long term memory.

Our curriculum content and expectations are mirrored in the way that we structure the tasks for our students so that in their own time they will revisit topics for memory building as well as being able to find help when they are finding new topics challenging. We believe that training students to work through the curriculum with both repetition and easy to access help resources makes the curriculum accessible and achievable for all and embeds learning habits for life as they repeat this model each week.

Our Partner Online Learning Platforms:	Year 7 - 11	Sparx Maths
 For the new 2017 AS/A levels in Maths and Further Maths	Year 7 - 10	Quizlet



## ***e) Student Voice***

Our curriculum design gives students opportunities for student lead revision ahead of formal and external assessments ensuring that students take an active role in shaping their assessment preparation journey.

Formal and informal assessment for learning strategies in every lesson ensure that all students understanding is assessed as new content is explored and teachers react appropriately so that targeted support and extension is provided for those who have indicated that this is their need.

Formal student voice via teams surveys is collected from all year groups to ensure that both understanding and opinions on our systems and policies for thinking, learning and assessment can be voiced.

Microsoft teams is used professionally and frequently to allow for ad hoc student voice and dialogue from student and groups of students to teachers, contributing to a curriculum which is understood, accessible and where success is achievable for all; even remotely.

## ***f) Feedback***

Feedback opportunities are built into every lesson following whole class checks for understanding and reviewing independent work in books in the lesson time.

Additional feedback is given to students:

- At least once per half term following formal assessment
- At least once per half term after a class work book review (*we incorporate habits of mind and set a First Important Priority*)
- Instant feedback via online homework self marking platforms - for year 7-11 any misconceptions then lead to a shadow model example to support them
- In lessons or for other set revision task in addition to the above

***First Important Priority: (An actionable target highlighted to each student suggesting an improvement to their work).***

## ***g) Opportunities to Go Further***

Whilst the central direction of our curriculum lends itself to higher tier GCSE and a range of 3 KS5 courses; it features an explicit range of additional and strengthening strands.

Our most able students add depth of understanding and develop acute problem solving skills through accessing our 'UKMT Maths Challenge' or 'Further Friday' (Level 2 Further Maths) societies. Participating groups of students follow mini calendared schemes of learning and weekly workshops as well as having access to the curriculum and resources online and lead teachers to support them with their additional studies.

We find and build opportunities for celebration of our subject through global events such as pi day and build links with local professionals such as the University of Plymouth to add breadth to our curriculum with off site experiences.

Our curriculum offer across all years is strengthened and made truly inclusive through both weekly intervention and support clubs (drop in style and targeted small group tuition). Additional time and support

is on hand for students that need further time and consolidation to keep up with the pace of our challenging and deep Mathematical curriculum. Many students enjoy the change of pace and style that support sessions offer as a complement to their lessons and independent learning.

<p>Our Go Further Opportunities:</p>	 <p>Extend your Maths knowledge and thinking further than GCSE.....</p> <p><b>Lab 11</b></p> <p><b>FURTHER FRIDAYS</b></p> <p>EVERY FRIDAY 1.55 to 2.25pm</p> <p>Year 11 only</p>	 <p>Extend your Maths knowledge and thinking further than the curriculum</p> <p><b>UKMT Maths Challenge</b></p> <p>All welcome</p> <p>Senior Challenge 11th November Intermediate Challenge 2nd February Junior Challenge 23rd April</p>
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## *h) Assessment Preparation*

With long term memory building a key part of the Mathematics curriculum as an integrated part of learning from year 7 upwards, our students build on their knowledge with protected time periods of revision and exam strategy focus in both year 11 and 13. Our students benefit greatly from the timings of our teaching which offers months of external examination preparation time and opportunities to consolidate through spaced learning and revision which includes opportunity for student voice requests.



### Mathematics progression and content map

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
<b>KEY STAGE 3</b>						
Year 7	Ratio sharing Best buys Negative numbers Laws of indices Rounding Standard form	Algebra essentials Expanding brackets Factorising expressions Substitution Venn diagrams HCFs and LCMs	Solving equations Converting units 3D shapes 2D representations of 3D shapes Speed, distance, time	Area and perimeter Straight line graphs; recognising and plotting 3D coordinates Midpoints Symmetry Reflection Rotation Translation	FDP conversions Fractions arithmetic Percentages calculations Reverse percentages Currency Conversion  <b>END OF YEAR EXAMS</b>	Averages calculations Averages from tables Frequency Polygons Pie Charts Scatter Diagrams
Year 8	Negative and fractional indices Calculations with standard form Simplifying surds Bearings Angles on parallel lines Angles in polygons	Solving complex linear equations Rearranging formulae Inequalities Expanding double brackets Factorising and solving quadratics	Multipliers Repeated % change Linear sequences $y=mx+c$ and gradient Area and volume unit conversion Speed from distance time graphs	Area of a circle Circumference of a circle Volume of prisms Pythagoras' theorem Distance between 2 points Graphs of quadratic and cubic functions  <b>END OF YEAR EXAMS</b>	Surface area of prisms Enlargements Congruency and similarity Experimental probability and expectation	Time series and moving averages Averages from grouped data Sampling Capture Recapture
Year 9	Direct and inverse proportion problems Trial and improvement Iterations	Compound measures Speed time graphs Impact of rounding Simultaneous Equations	Difference of 2 squares Factorising complex quadratics Completing the square form	Sample Spaces AND OR rules Tree diagrams Conditional probability IQRs and boxplots	Ruler and compass constructions Loci Tests for congruency	Enlargements with negative and fractional scale factors and combined transformations

	Exponential growth and decay Reciprocal graphs	Solving equations from graphs	Sketching quadratic functions Solving quadratics from graphs The quadratic formula Solving complex inequalities	Comparing data sets Cumulative Frequency	Right angled trigonometry Reverse percentages (calc techniques)  <b>END OF YEAR EXAMS</b>	Arc Lengths Sector Areas Circle Theorems
<b>KEY STAGE 4</b>						
Year 10	Limits of calculations Surds arithmetic Rationalising the denominator Direct and inverse proportion Combining ratios Recurring decimals	Expanding 3 brackets Algebraic fractions Graphical linear inequalities and region shading Functions	Sequences; quadratic, Fibonacci and geometric Equation of a circle Quadratic simultaneous equations Coordinate geometry skills Parallel and Perpendicular lines	Histograms Dimensional Analysis Similarity with area and volume 3D Pythagoras Exact trig values 3D trigonometry	Sine and cosine rules Area of a non-right triangles Venn Diagrams with probability Complex rearranging and SUVAT Algebraic proof	Vector arithmetic, geometry and proof Trig function graphs Solving trig equations Transforming curves  <b>END OF YEAR EXAMS</b>
Year 11	Complex solids Quadratics in context Quadratic inequalities Ratio problem solving	Revision, consolidation, and examination preparation  <b>END OF YEAR EXAMS</b>	Revision, consolidation, and examination preparation	Revision, consolidation, and examination preparation	Revision, consolidation, and examination preparation	<b>GCSE EXAMS</b>
<b>A level Mathematics and A level Further Mathematics</b>						

Year 12	<p>Topic(s):  <b>Pure</b> - Indices and surd, trigonometry, quadratics, simultaneous equations and inequalities, polynomials.  <b>Stats</b> - The data cycle, summary statistics,  <b>Mechanics</b>-Kinematics and vectors</p>	<p>Topic(s):  <b>Pure</b> - binomial expansion  <b>Stats</b> - The data cycle, representing data, permutations and combinations  <b>Mechanics</b>-Kinematics, vectors and forces and Newton's Laws</p>	<p>Topic(s):  <b>Pure</b> - calculus: differentiation  <b>Stats</b> - Probability, Binomial Distribution, Hypothesis testing</p>	<p>Topic(s):  <b>Pure</b> - integration, coordinate geometry  <b>Mechanics</b> - Variable acceleration</p>	<p>Topic(s):  <b>Pure</b> -Graph transformations, sequences and series</p> <p><b>YEAR 12 EXAMS</b></p>	<p>Topic(s):  <b>Pure</b> - logarithms, exponentials, further differentiation and integration</p>
Year 12 Further Maths	<p>Topic(s):  <b>Pure</b> - <b>Statistics</b> -, discrete random variables</p>	<p>Topic(s):  <b>Pure</b> - <b>Statistics</b> - Poisson Distribution, Uniform and Geometric Distributions</p>	<p>Topic(s):  <b>Pure</b> - <b>Statistics</b> - Bivariate Data analysis, PMCC, LSR, Rank correlation</p>	<p>Topic(s):  <b>Pure</b> - <b>Statistics</b> - Chi squared distribution and goodness of fit</p>	<p>Topic(s):  <b>Pure</b> - <b>Statistics</b> - Conditional Probability, Bayes theorem, Normal Distribution</p> <p><b>YEAR 12 EXAMS</b></p>	<p>Topic(s)  <b>Pure</b> - <b>Statistics</b> - Continuous random variables</p>
Year 13	<p>Topic(s):  <b>Pure</b> - partial fractions and further binomial expansion, numerical methods</p>	<p>Topic(s):  <b>Pure</b> -Further differentiation, functions  <b>Stats</b> - probability distributions  <b>Mechanics</b> - kinematics and projectiles</p>	<p>Topic(s):  <b>Pure</b> - Further integration, trigonometry  <b>Stats</b> - hypothesis testing</p> <p><b>MOCK EXAMS</b></p>	<p>Topic(s):  <b>Pure</b> - differential equations, trigonometric functions  <b>Mechanics</b>- forces and motion, friction  <b>Pure</b> - Parametric equations  <b>Mechanics</b> - moments</p>	<p>Revision, consolidation, and examination preparation</p>	<b>A LEVEL EXAMS</b>
Year 13 Further Maths	<p>Topic(s):  <b>Pure</b> -vectors, matrices, series and induction</p>	<p>Topic(s):  <b>Pure</b> -further calculus, polar coordinates, Maclaurin series</p>	<p>Topic(s):  <b>Pure</b> -Hyperbolic functions, first order differential equations</p>	<p>Topic(s):  <b>Pure</b> - complex numbers, second order differential equations</p>	<p>Topic(s):  <b>Pure</b> -REVISE  <b>Decision</b>- simplex method</p>	<b>A LEVEL EXAMS</b>

	<b>Statistics</b> - Expectation algebra, confidence intervals, hypothesis testing	<b>Statistics-</b> simulation	<b>Decision-</b> algorithms and modelling with graphs and networks  <b>MOCK EXAMS</b>	<b>Decision-</b> network algorithms, linear programming	Revision, consolidation, and examination preparation	
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