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Mathematics Curriculum

Intent

Curriculum Vision

Mathematics is a universal language - a language universally spoken and understood across different cultures. It has the power to prevent chaos and catastrophe, help us find patterns and structures, and model how complex systems might change over time or under different conditions.

Throughout their course of sixth form study, students use mathematical knowledge to make logical and reasoned decisions in solving problems both within pure mathematics and in a variety of applied contexts, as well as develop the ability to communicate the mathematical rationale for their decisions in a sophisticated manner. Students study more advanced material relating to algebraic reasoning, polynomials, co-ordinate geometry and trigonometry; this builds on previous knowledge and introduces new areas of pure mathematics. Students are introduced to calculus, learning how to differentiate and integrate a range of functions, including from first principles; this in turn enables students to be able to find the gradient and area under non-linear functions, which are techniques important in the context of optimisation and other wide-reaching applications involving rates of change. Students apply their knowledge to mathematically model problems involving position after extending their understanding of vectors to provide a powerful abstract framework for both two- and three-dimensional contexts.

Students further develop their problem-solving skills in applied contexts. Students develop abstraction skills that can be used in the complex mathematical modelling such as the non-linear relationships that might be being used to explain and model the exponential growth of a pandemic or the quadratic relationship seen in the movement of a satellite when launched. In mechanics, students model forces and motion to solve problems in contexts like predicting the behaviour of projectiles or objects on slopes. In statistics, students are introduced to hypothesis testing, a fundamental technique used for research in all academic disciplines. Students also deepen their understanding of advanced statistical inference techniques which are vital in equipping students to better understand and critically evaluate the increasingly complex data on which our society depends.

The advanced skills, concepts and methods which form our curriculum aid students' progression to a variety of areas of further study and are particularly important for those wanting to specialise in areas

of science, engineering, and social sciences. Mathematical capability is empowering and will provide students with skills that allow them to excel in any chosen career, and to develop an understanding that will equip them with the tools needed to solve the world's biggest and most difficult problems.

Concepts and Skills

The overarching concepts for Mathematics are:
o Abstract representation of problems (especially with respect to modelling motion and forces)
o Formal logical and analytical reasoning and construction of proofs and solutions to complex problems

The overarching skills for Mathematics (A-level pathway) are:
o The rigorous and systematic application of abstract analytical methods
o Calculating and interpreting advanced statistics
o Logical reasoning and the communication of complex methods and mathematical representations

Disciplinary Literacy

Disciplinary approach

In Mathematics we support the development of disciplinary vocabulary and the students' ability to read, write and communicate at an academic level so that they master the nuances of the curriculum.

Students develop their ability to understand and use mathematical language and syntax appropriate to the context of the particular nature of problems they encounter. They are expected to comprehend and critique mathematical arguments.

Interdisciplinary approach

To understand the depth of mathematics it is vital to explore the organic connection to other disciplines.

Students are supported to comprehend the use of mathematical arguments in a range of applied contexts and have opportunities to develop their ability to communicate conclusions appropriately when mathematical reasoning (especially when studying statistics) is used in other fields of study.

The systematic work done on hypothesis testing and levels of significance in statistics is very useful to students also trying to understand research methods in the natural and social sciences subjects and is particularly complementary to material studied in the Key Stage 5 Psychology curriculum.

The study of exponential and logarithms in Mathematics, and as a result the ability to be engaged with non-linear mathematical modelling of variable, is important to students studying Science in Key Stage 5, particularly Physics. Work on the mathematical modelling of forces and motion is explicitly linked between Physics and Mathematics in Key stage 5, with students studying mechanics in both subjects.

Intellectual autonomy

In order to develop intellectual autonomy and confidence, we foster the willingness and ability of students in Mathematics to comprehend challenging texts, assimilate key concepts and synthesise them with prior learning. Students are equipped to think critically and apply strategies independently so that they can form their own cohesive conclusions and be able to express that in written work.

This is facilitated by high expectations for pupils over the two years of study to take increasing responsibility for their own learning and for evaluation of their own mathematical development.

Students are encouraged to engage in additional independent reading to deepen their mathematical understanding. Recommended texts include: *Mathematics: A Very Short Introduction* by Timothy Gowers; *Why Study Mathematics?* by Vicky Neale; and *How to Study for a Mathematics Degree* by Lara Alcock.

Independent Study

In Mathematics students undertake both directed and self-directed independent learning activities that support the strengthening of long-term memory and retrieval. Independent study helps our students achieve mastery in Mathematics and prepares them to work at an undergraduate level.

Directed independent learning tasks set in Mathematics can include background reading to build knowledge and deeper connections to the existing frame of learning, or responding to interlocking questions on a given topic across more than one text source. Self-directed independent study in Mathematics involves retrieval practice which is a crucial component of mastery. As students encounter challenges and learn to wrestle with demanding concepts and texts, they develop not only their knowledge and understanding but also resilience through perseverance.

Instead of revision being perceived as something that is crammed into a few weeks, independent study supports spaced practice throughout the curriculum. By repeatedly returning to content covered, students' knowledge has time to 'rest and be refreshed.'

We recognise that not all students process material at the same rate. Students who need extra support to achieve mastery are supported by targeted intervention in Mathematics where a staged or 'scaffolded' process is used to enable students to move from being dependent learners to autonomous ones.

Implementation

Overview Statement

The curriculum in Mathematics is sequenced coherently so that knowledge, concepts and skills are rigorously developed over time. This supports all students, including the most disadvantaged, and those with high levels of need, especially SEND. Planning is informed by Rosenshine's Principles of Instruction and Cognitive Theory which support students in building secure schemas both within Mathematics and between ideas studied in Mathematics and other subjects.

Vocabulary is developed in Mathematics using the principles outlined in the Frayer Model and students are equipped to be able to read, write and speak like a skilled user of mathematics. This is done by the careful modelling of the use of mathematical language and symbolic conventions, and by the high expectations for the rigours and correct use of these by students in their written work.

Through the use of independent study resources in Mathematics, students are expected to master key skills required to be intellectually autonomous.

Regular retrieval-based activities, including key skills checks completed in most lessons, strengthen long-term memory and aid fluency, as do our cumulative unit tests and end-of-year assessments.

Independent study is supported by technology and students are expected to practise key mathematical skills in part through work set via an online platform that serves to complement and consolidate work done in lessons. This use of an online platform also provides an efficient way for students to have targeted feedback and support on more routine and procedural work, which means that guided learning time is focused on more complex mathematical problem solving.

Learning character is developed through a culture of high expectations for resilient and independent learners who are also encouraged to collaborate effectively and have awareness. This is in part developed outside of lesson in weekly twilight clinics during which some students also engage with extension work that may be as part preparation for mathematical entrance examinations or just simply for the intrinsic enjoyment of such work.

Impact

The Key Stage 5 curriculum builds upon students' initial understanding, extending their knowledge in the areas of reasoning and problem-solving.

Through developing their knowledge of new advanced mathematical methods, they are able to engage with more sophisticated mathematical modelling and problem solving.

Students also develop an understanding of the interdisciplinary nature of their studies, and this is supported though explicit cross-curricular links in Physics, Biology, Chemistry, Applied Science, Psychology and Sociology.

Students use their knowledge of cognitive theory to recognise and use the most impactful methods of revision and retrieval practice. There is a high expectation for students to engage with high levels of independent practice, especially of routine key skills with which they can develop fluency, independently.

Academic progress in Mathematics is recognised through A-level qualifications in Mathematics and, for some, Further Mathematics, which act as benchmarks of mastery; these provide students with the national currency needed for access to higher education and apprenticeship courses, and prepare them for a career in any workplace.