Mathematics

Curriculum Principles

By the end of their education, a student of mathematics at Dixons Kings will:

- know and be able to apply the fundamental skills of the subject to become confident and keen mathematicians. Students will develop fluency in procedures, be able to reason mathematically and demonstrate resilience when solving problems.
- understand how the skills developed in mathematics are important for their future learning, employment and in everyday life.

To truly appreciate the subject and create deep schema, topics within mathematics have been intelligently sequenced with the following rationale:

- The overall aim is to provide all students with the knowledge and skills they need to achieve excellence in mathematics, ultimately providing them with the tools to increase their cultural capital and lead happy and successful lives beyond the academy.
- A spiral curriculum has been adopted in which topic areas are revisited and extended on a yearly basis. Algebra, Number, Statistics, Ratio and Proportion, Probability and Statistics appear several points in the curriculum, each time ensuring that prior learning is retrieved before more difficult concepts are delivered to students. Year 9 provides an opportunity for students to consolidate foundational concepts in order to access more complex ideas and procedures in Key Stage 4. This sequence of learning promotes a deeper understanding of the mathematical concepts being taught, both in line with the National Curriculum and in the wider mathematical domain. This spiral curriculum supports the idea that each year should not be viewed in isolation; students are on a mathematical journey to ensure they are fully prepared for their GCSEs and wider world.
- The Year 7 mathematics curriculum begins by exploring sequences and algebra, teaching students to reason and communicate mathematically while developing new calculator skills (not used is KS2). The curriculum continues by consolidating and extending their prior learning from Key Stage 2, i.e. (number skills: including place value and applying the four operations within multiple contexts such as calculating with averages, converting metric units, area and perimeter). The Year 8 curriculum begins by introducing ratio before extending the fraction and percentages topics from Year 7 to include fractional increase and decrease, simple and compound interest, compound depreciation and repeated percentage change. High prior attaining students will always be stretched and challenged by completing extension topics identified on the long-term plans e.g., in Year 7, a recap of the four operations extends to including standard form for high prior attaining students.
- The Year 9 mathematics curriculum is the first year of a two-year Key Stage 4 curriculum mapped from the Edexcel scheme of work. This first year of the focuses on teaching the Grade 4-5 topics from the Higher tier and Grade 1-2 topics from the Foundation tier to ensure students are secure with the skills required to access the more challenging topics in Year 10. For Higher students, it is important to teach rounding and estimation at the start of Cycle 1 because these skills are required repeatedly in subsequent units of learning such as area and volume. The sequencing of all the topics on the Higher tier scheme of work has been imperative in designing this scheme of work e.g. forming and solving equations is taught before finding missing angles on in polygons using algebra, factorising quadratics is taught before working with algebraic fractions and surds are taught before Pythagoras' theorem and trigonometry. Similarly, for the Foundation Tier, sequencing has been carefully considered e.g., prime numbers are taught before prime factorisation and finding the HCF and LCM from Venn diagrams and solving equations is taught before solving inequalities to maximise students' chances of success with grasping new concepts.
- The Year 10 mathematics curriculum builds upon the skills and content introduced in Year 9 and focuses on teaching the Grade 6-8 topics at the Higher tier and Grade 3-4 topics at the Foundation tier. Careful sequencing continues into Year 10 with simultaneous equations being taught at the start of the year; students have historically found this skill difficult to master so it is important to teach them this at a point where they are confident with substitution and also leave enough time for them to regularly revisit this during Year 10 and Year 11.
- In the final year of the GCSE mathematics course in Year 11, teaching is focused on the Grade 7-9 topics at the Higher tier and Grade 4-5 topics at the Foundation tier as Year 9 and Year 10 have ensured students are secure with the skills required to access the more challenging topics. For the Higher Tier, it is essential to teach factorising quadratics at the start of Cycle 1 because this skill is required for various topics to follow e.g., simplifying algebraic fractions, solving quadratic simultaneous equations, completing the square and algebraic proof. The topic order for the Foundation tier has also been carefully designed e.g., solving equations is taught before solving inequalities, solving simultaneous equations, sequences, angles, area and perimeter. Solving equations is a key skill that can be revisited through several topics, so this is essential that this is taught during cycle 1. Fractions is also a fundamental topic that must be taught during cycle 1 as this skill will be applied through topics which follow e.g., probability trees with fractions and ratios

- The mathematics department works closely with Science, PE and Geography departments to improve cross-curricular delivery of specific content. Key topics have been identified where students could be confused between different teaching methods across subjects, such as graphs and compound measures. Content is sensibly sequenced to allow students to encounter new knowledge and methods in Mathematics prior to using these skills in other subjects. This way, teachers are able to use their curriculum time effectively to build on existing knowledge in their domain. Examples of this include teaching standard form, rearranging equations and the equation of straight-line graphs in Year 8 so that when they encounter similar content in Year 9 Science, they are already familiar with the basics. Similarly, a large amount of the Statistics strand is taught in Year 9 to both Higher and Foundation students so that they can confidently engage with the Year 10 Geography curriculum which has a large statistical and numerical skills focus.

The mathematics curriculum at Kings has been influenced by:

Consistency in teaching and sequencing within topics is supported by the department's vision to work collaboratively and actively engage with up-to-date research in education to improve our pedagogy so that no child is left behind in mathematics. Approaches are shared and discussed before agreeing on best practice which is used so that students do not become confused when taught by different teachers.

Evidence from cognitive science:

- Cognitive Load Theory - Working Memory, Cognitive Overload
- Ebbinghaus' Forgetting Curve
- Interleaving, Spaced Practice, Retrieval Practice, Dual Coding
- Rosenshine's Principles of Instruction (Modelling, Guided Practice, AfL Checks)
- Education Endowment Foundation research – e.g., Homework, Misconceptions

Influenced by Mastery Approaches:

- Mark McCourt's work on mastery in his 2019 book 'Teaching for Mastery'
- White Rose Maths Hub which is a scheme of work designed to support a mastery approach to teaching and learning in mathematics. When students are introduced to a new concept in mathematics, they should have an opportunity to build competency with each topic by taking an approach which involves concrete objects and manipulatives to help them explain and understand what they are doing. Students will also be given the opportunity to use pictorial representations to reason and solve problems e.g., bar modelling, box method for sharing ratios.
- Edexcel (GCSE 9-1) two-year scheme of work which is completed during Year 9 and Year 10. This two-year scheme of work is designed to take an innovative mastery approach to teaching and learning in mathematics and focuses on nurturing confidence, building fluency, and embedding problem-solving and reasoning. By the end of Year 10 students should be confident problem solvers which should support them to access the most challenging topics during Year 11 and prepare them for their final summer examinations.

Other resources:

- D. Rohrer (2015) in Journal of Educational Psychology 107 'Interleaved practice improved mathematics learning'
- Craig Barton's books: 'How I Wish I'd Taught Maths' and 'Reflect, Expect, Check, Explain'
- National Curriculum for Key Stages 3 and 4

- The idea that the memory of new information is lost without spaced learning and retrieval practice is addressed in several ways. Across each year, students will consistently revisit topics (spaced learning) through regular retention 'Do Now's and fortnightly mini-assessments that students complete which include a review section. Homework tasks are spaced effectively, each week contains tasks which review prior content.
- Topics will be interleaved through Years 7 to 11 to allow students the opportunity to gain a deeper understanding e.g. when teaching the angles unit this will be interleaved with forming and solving equations and percentages will be interleaved with converting units and area application problems. As exam questions often require the use of multiple mathematical concepts, exam question plenaries (Yr8-11) are used regularly to provide an opportunity to apply several skills which may not have been explicitly taught that day

- Every mathematics lesson follows an 'I Do, We Do, You Do' sequence where the teacher explicitly models and explains a concept, providing the opportunity to address errors and misconceptions e.g., when rounding to significant figures the examples are carefully planned to contain leading zeros as this is a common misconception that students make when rounding to significant figures. In both key stages, students will always complete a set of example questions as part of an assessment for learning (AfL) activity on mini-whiteboards which will then determine their starting points on the collaboratively planned differentiated activities.

Our mathematics curriculum ensures that social disadvantage is addressed through:

- A spiral curriculum which ensures content is revisited and gaps (for any reason) can be closed.
- We prioritise high-quality teaching to all students. Teachers will deliver new content by identifying links with existing knowledge before explicit instruction via modelling and guided practice. Curriculum content is differentiated to the needs of the students, including centrally planned resources, practice tasks will be chosen and scaffolded as informed by AfL checks on mini-whiteboards.
    - All mathematics lessons are differentiated to ensure students are stretched and challenged in every lesson. In Key Stage 3, there are six activities which are appropriately scaffolded to support the weakest pupils and sufficiently challenge the most able. In Key Stage 4, all Higher and Foundation lessons contain two levels of differentiation activities. For the Higher Tier, the first level of differentiated activities is aimed at Grades 5-7 and the second level of differentiated activities are aimed at Grades 7-9. Similarly, for Foundation, the first level of differentiated activities are aimed at Grades 1-3 and then second level of differentiated activities at Grade 3-5 which all foundation students will be aiming to complete every lesson. Foundation lessons also contain scaffolded resources to support the lower ability students. SEN students will also have their mathematics book marked more frequently to ensure timely and effective feedback is given to support students' progress.
- All teachers plan suitable interventions, considering SEN and disadvantaged pupils at all stages
    - As well as ongoing formative assessments, after summative assessments teachers analyse the progress of all their students. Weekly interventions take place for students who are not making good progress to ensure that gaps are closed and followed up as quickly as possible.
- Numeracy intervention is provided for appropriate students
    - Students who are below expected progress in mathematics will receive two additional small group numeracy lessons and complete a structured intervention programme (using the Rising Stars assessment and White Rose Maths) to ensure students close their individual learning gaps during Year 7 and Year 8. The intervention teacher works closely with the Mathematics department to accurately identify from the baseline assessment which learning objectives need to be revisited. The sequencing of these sessions is designed to retrieve content previously taught in Mathematics lessons. Weekly meetings are used to ensure the content and delivery of these sessions is of a high quality, from a subject knowledge and pedagogical perspective. Methods and processes are aligned to those in the Mathematics department to ensure continuity of learning. All intervention sessions are quality-assured by specialist teachers and follow the same structure as Mathematics lessons.

Becoming a confident mathematician is essential to unlocking the potential of our most disadvantaged pupils and ensure they can be successful in their journey beyond the academy, whether that be in higher education, apprenticeships or the workplace. Students who have mastered the fundamental skills in mathematics will benefit from the utility of this knowledge in future learning and employment. These include money management, reading timetables, discovering and understanding patterns in data. The mathematics curriculum will develop students to become analytical thinkers, confident in problem solving and have a thirst for mathematical reasoning which are great skills for future success.

- Oracy skills have been proven to be instrumental to a child's future success. Regrettably, students from disadvantaged backgrounds, a significantly high percentage of the cohort we serve, do not always receive the same opportunities to develop this skill. The mathematics curriculum aims to challenge this through the exploration of functional questions. Using techniques such as Lemov's Reading Reconsidered ensures full understanding of the context of a question, including any expected 'real life' knowledge, before tacking the mathematics behind it.
- In Year 11, tutor-time mathematics (3 days per week) is informed by question-level-analysis data from the most recent assessments to identify the topics which need to be addressed in these sessions. All Year 11 students will complete an Edexcel exam paper every fortnight during lesson, so students are exposed to regular exam questions, this also supports interleaving and retention strategies.
- In Year 11, disadvantaged students are also given the opportunity to attend 'Aiming for grade 5' or 'Aiming for grade 9' masterclasses held at the academy and across the Dixons MAT.

We fully believe mathematics can contribute to the personal development of students at Dixons Kings through:

- Students will be encouraged to develop socially in mathematics lessons through strategies such as 'track the speaker', 'no opt out' and 'right is right'. Promoting a culture in which students are confident to contribute to class and peer discussions whilst being unafraid of making mistakes is of upmost importance in Maths classrooms. Maintaining high expectations for these interactions supports students to develop listening and speaking skills and celebrating mistakes encourages resilience. Self-awareness is developed through self-assessment every lesson, which enables students to have an accurate understanding of their strengths and weaknesses; directed independent reflection time following formative and summative assessments provide further opportunities to develop this skill in order to identify next steps to improve.
- Problem-solving is a regular feature of all mathematics lessons, a skill which is transferable to all subject disciplines and in the wider world. Participation in 'The Maths Challenge' events and 'The Dixons Cup' enable students to develop teamwork and communication skills. These events also provide an opportunity to interact and learn from adults and students beyond their friendship group and academy environment.
- The curriculum allows teachers to develop an understanding of ethics and morality in many ways through exploring the real-life applications of mathematics. The positive and negative consequences of making decisions is explored through topics such as comparing interest rates in the percentages unit. The study of statistics provides countless opportunities to explore themes of morality. For example, the manipulation of data and averages to serve a particular purpose in the media and the effects of the use of poor or misleading graphs and diagrams. It is important that students understand different types of data, sampling and how data presented can be affected by bias.
- Encouraging students to think about how mathematics impacts the way the world is important to their development. Teachers regularly encourage students to apply their knowledge to contextual problems to help them understand how mathematics fits into not only everyday life but 'big issues' such as poverty, the gender pay gap and gambling through questions on comparing wages and probability.

Our belief is that homework is used for deliberate practice of what has been taught in lessons. We also use retrieval practice and spaced revision to support all students with committing knowledge to long term memory.

- Students receive weekly online mathematics homework on Sparx (Y7-10) or Hegarty Maths (Y11) which is a combination of tasks that students have learnt recently during lessons and retention tasks. The retention tasks have been planned to retrieve knowledge taught at appropriate intervals.
- After most of the content has been taught in Year 11, students are provided with a weekly GCSE exam paper for homework to ensure regular exposure and practice of exam-style questions to improve retention. Whilst Hegarty Maths provides opportunities to review topics, online quizzes are used to supplement fact recall and test understanding of more complex procedures.

Opportunities to build an understanding of social, moral and ethical issues are developed alongside links to the wider world, including careers:

- The mathematics curriculum provides students with opportunities to consider the world of work and how mathematics leads to successful careers. Each topic or strand in mathematics has a purpose attached for all students to see and, where relevant, staff refer to how the skill in question relates to specific careers. For example, when teaching constructions, links can be made to any form of design work or navigational careers. Weekly enrichment is run for year 7 students, where they explore mathematics further through puzzles and real-life problems.
- Students have the opportunity to discover exciting career options available to them through the study of mathematics at the yearly Careers Fair. Other opportunities include the BAE Systems Schools Roadshow which is designed to inspire students to choose a career in STEM subjects. This Roadshow provides students with an interactive experience to understand how STEM underpins everything that we do.
- Students are able to participate in trips and workshops provided by the Advanced Mathematics Support Programme, previously including; Women in Mathematics event at Nottingham University which encouraged girls to continue studying Maths in further education and disadvantaged students have had the opportunity to attend a Further Maths Workshop with the University of Bradford with the aim of encouraging them to study mathematics at A-Level and beyond.

Further Information can be found in:

- Long term plans
- Schemes of work
- Knowledge Organisers