Curriculum Intent

Science

At Dixons Croxteth we develop students to lead successful and happy lives and make a positive contribution to their community. Our curriculum in each year is designed to provide experiences, opportunities, knowledge, and skills that enrich and challenge our students. We understand that the curriculum is key to determining the life chances and choices for our students and therefore we will not compromise on providing the very best. We achieve this in science through the below:

By the end of Year 11 students at Dixons Croxteth studying Science will be exposed to the following:

- Students will be building on the knowledge they have obtained in KS2 when they begin KS3 at Dixons Croxteth.
- In Biology at KS2, students developed an understanding of animals and plants as well as their life processes. At KS3, students will learn about the structure, function, and behaviour of living organisms in greater detail, building up from the microscopic cellular level to the macro-scale interactions in an ecosystem. This provides pupils with a greater understanding of the fundamentals of Biology for KS4 where they will use this knowledge in several topics such as photosynthesis and homeostasis.
- In Chemistry at KS2, students developed their understanding of abstract concepts such as solubility, conductivity and changes of state. At KS3, students will start with a rigorous grouping in the fundamentals of secondary level chemistry. Such as, states of matter, the periodic table, chemical reactions and behaviour of materials. Having gained this knowledge, students are fully equipped to tackle the more challenging KS4 content, such as chemical bonding and quantitative chemistry.
- In Physics at KS2, students developed an understanding of forces, electricity, sound, light, and space. At KS3 we focus on concrete concepts and experiences as well as the beginnings of more complex and challenging ideas such as energy, pressure, and density. These provide the baseline for which students can develop the mathematical skills within these complex ideas as they move into KS4.
- Students will be building on the knowledge they have obtained in KS2 and KS3 as they begin their journey through GCSE content in Year 11 at Dixons Croxteth.

Students will learn the content of the following AQA GCSE Combined Science topics in Year 9, 10 and 11:

- Biology: Cell Biology, Organisation, Infection and Response, Bioenergetics, Homeostasis and Response, Inheritance, Variation and Evolution; Ecology.
- Chemistry: Atomic Structure and the Periodic Table; Bonding, Structure and Properties, Quantitative Chemistry, Chemical Changes, Energy Changes, The Rate and Extend of Chemical Changes, Organic Chemistry, Chemical Analysis, Chemistry of the Atmosphere, Using Resources.
- Physics: Energy, Electricity, Particle Model of Matter, Atomic Structure, Forces, Waves, Magnetism and Electromagnetism.

By the end of Year 11 students at Dixons Croxteth studying Science will be taught the following skills:

- Throughout their time at Dixons Croxteth students will develop a comprehensive set of skills that will serve as the foundation for their scientific journey across all disciplines. They will grasp the evolution of scientific methods and theories, recognising how knowledge develops over time. These students will adeptly utilise various models, including representational, spatial, descriptive, computational, and mathematical, to address complex problems, make predictions, and craft scientific explanations. Furthermore, they will gain an understanding of both the potential and limitations of science, critically examining the many ethical implications that may arise.
- •Students will be able to explain the practical and technological applications of science, evaluating their personal, social, economic, and environmental implications. They will make informed decisions based on the careful assessment of evidence and arguments. These students will skilfully assess risks, both in the realm of practical science and within the broader societal context, including the perception of risk related to data and its consequences. They will appreciate the significance of peer review and effective communication, as well as the role of scientific theories in the development of hypotheses.
- They will acquire the competence to plan experiments, devise procedures, and select appropriate techniques, instruments, apparatus, and materials. They will execute experiments with precision, emphasising correct apparatus, ensure accurate measurements, and maintain high levels of health and safety. These students will be adept at recognising when to apply sampling techniques to ensure the representativeness of collected samples and the ethical considerations when carrying out this procedure.
- Students will make and record observations and measurements, while also evaluating methods and suggesting potential improvements and further investigations. They will present observations and data using various methods and translate data from one form to another. Mathematical and statistical analysis, as well as the representation of result distributions and estimations of uncertainty will also be an area of focus. These students will adeptly interpret data in various formats, identifying patterns and trends, making inferences, and drawing conclusions.

- They will present reasoned explanations, connecting data to hypotheses while maintaining objectivity and evaluating data for accuracy, precision, repeatability, and reproducibility, all while identifying potential sources of error. Effective communication skills are the hallmark of science students who must convey the scientific rationale for their investigations, methods, findings, and make reasoned conclusions through various mediums, including paper-based and computer based.
- These students will employ scientific vocabulary, terminology, and definitions, recognising the significance of scientific quantities and understanding how they are determined. They will consistently use SI units and IUPAC chemical nomenclature, convert units, and apply an appropriate number of significant figures in calculations.
- In order to truly appreciate the subject and create deep schema, Science has been sequenced with the following rationale:
- At Dixons Croxteth, our teaching approach is grounded in a spiral curriculum, ensuring that students continuously revisit and expand upon their knowledge and skills as they advance through both KS3 and KS4. We place a strong emphasis on providing all students with the chance to reconnect with the science concepts they were initially introduced to during KS3 through our "Do Now, Review Now" initiative. This deliberate choice guarantees that every student embarking on the GCSE course starts from a shared foundation, fostering a consistent and comprehensive learning experience.
- To ensure all students are at the same starting point at Dixons Croxteth all students begin Y7 with the topic 'Science Skills' where these skills are taught explicitly. These skills have been carefully mapped across all topics throughout KS3 and KS4 so that students are given many opportunities to apply and develop these concepts.
- The KS3 Curriculum is meticulously structured both horizontally and vertically to optimise learning. This approach serves a dual purpose: it ensures that knowledge and skills are revisited regularly, allowing students to employ them swiftly without taxing their working memory. This, in turn, equips them to tackle more intricate problems and delve deeper into their responses. For example:

- Students are first introduced to Plant and Animal cells in Cells and Life Processes in Cycle 1 Year 7. Here pupils learn the various parts of a cell, its organelles, and their functions. They view these under a microscope before describing some of the processes that occur in these cells. In Cycle 2, we look at specific adaptions of cells involved in Reproduction in plants and animals. Later in Cycle 3, students look at Ecology and discuss how these different cells and tissues form living organisms that interact with one another.
- In Year 8, this building continues still. Students have an understanding of the different cells and tissues of the body form various systems that interact with each other. We look in more detail regarding plants and photosynthesis and look at how we as humans manipulate these to our betterment. We then delve further into the various organelles of the cells and how these features allow us to explain the wealth of biodiversity around us.
- Students also return to ideas in areas outside of Biology, for example, using the particle model of matter in Chemistry to aid the understanding of diffusion or using the concept of conservation of mass to help them balance the photosynthesis and respiration equations whilst using methods we develop in Physics to help us calculate size of objects viewed through microscopes.
- In KS4, our approach begins with a focus on Atomic Structure and the Periodic Table. This foundational concept serves as a vital cornerstone for students, equipping them with essential knowledge to navigate a wide range of scientific disciplines. As we delve into the intricacies of atomic structure, we introduce students to new terminology, which they will encounter and apply in subsequent Physics topics. Moreover, as we explore the History of the Atom and the Development of the Periodic Table, students gain valuable insights into the scientific method, highlighting that today's knowledge is the result of the collective contributions of numerous scientists who preceded us. This perspective forms the basis for students' understanding of how science operates in the real world. Next, we delve into the practical applications of chemistry, initially delving into quantitative chemistry. Following this, we discuss the energy changes in various reactions and the most effective methods for representing this data for calculation purposes. Subsequently, we examine how these principles are applied in the physical world around us and their utilisation in various industries.
- After exploring the fundamental concept that atoms serve as the building blocks of everything in Chemistry, students will then move into the field of Biology to delve into the fundamental components of plants and animals. In this phase, they expand upon the foundational knowledge they acquired during KS3, focusing on key terminology and the functions of cell organelles. This phase culminates in students undertaking their initial Core Practical, which involves Observing Cells Using a Microscope. This practical exercise builds upon the skills they first acquired in Year 7, forming the basis for their understanding of subsequent Core Practicals in Biology, Chemistry, and Physics. Subsequently, students shift their focus towards examining the interactions between bacteria, viruses, and fungi with humans, exploring both their detrimental and beneficial effects, and understanding how our bodies respond to these interactions to maintain long-term homeostasis. The course then progresses to an exploration of how these traits are inherited through generations, not only in humans but also in all the organisms that preceded us. Finally, the course concludes by investigating the role that humans play in shaping the environment and the measures we can take to ensure the preservation of high levels of biodiversity for future generations.
- To ensure a holistic understanding of science, we commence our journey into Physics by exploring the Particle Model of Matter and Atomic Structure. This choice is deliberate, as this segment of the physics curriculum revisits concepts introduced in KS3 and also shares a unit with Chemistry, which was covered earlier in the academic year. Consequently, the fundamental understanding linking chemistry and physics is reinforced, and we also emphasise the connection between biology and chemistry, as they form the basis of life sciences. Building on this foundation, we delve into the interactions between atoms and how we can harness their inherent energy. This knowledge serves as a bridge between the microscopic world of chemistry and the broader realm of physics.

Subsequently, we explore various forms of energy and introduce equations that provide numerical values for real-world applications, further strengthening the connection between the two disciplines. Our journey continues with a focus on electricity and the tangible impact of fundamental particles such as electrons, which can be harnessed for practical purposes, including applications in biological systems. This underscores the interconnectedness of physics, chemistry, and biology. Ultimately, we culminate the year by investigating how electricity generates waves and serves as a valuable resource in our modern world, with applications spanning biology, chemistry, and numerous other scientific fields. This integrated approach equips students with a well-rounded understanding of the interplay between these essential scientific domains.

The Science curriculum at Croxteth has been influenced by:

- AQA GCSE Combined Science
- Teaching Secondary Science by Adam Boxer
- Cracking Key Concepts in Science by Adam Boxer, Heena Dave and Gethyn Jones
- Hermann Ebbinghaus's research on the 'Forgetting Curve'
- Research into the area of cognitive science
- By drawing upon the extensive knowledge generously shared by educators within the wider profession through their contributions in blogs, books, articles, and seminars. Their valuable pedagogical insights have played a pivotal role in this curriculum's development.

Our Science curriculum ensures that social disadvantage is addressed through:

- The Education Endowment Foundation published a major report in 2017 examining the disadvantaged attainment gap in science. The strongest factor affecting pupils' science scores is their literacy levels. In our department, we actively promote literacy in every lesson by explicitly teaching new vocabulary and reading and discussing challenging texts. We also support our students to answer questions in full sentences by verbally modelling sentence starters, giving adequate thinking time and allowing children to 'turn and talk' with a partner to improve oracy. We plan frequent extended writing tasks and support children with verbal rehearsal activities, sentence starters and keywords.
- In addition to frequent formative assessment within class after each assessment cycle teachers analyse their class booklets to identify gaps in students' knowledge. During these data and planning days detailed intervention/prevention plans are produced which aim to target and address these gaps in knowledge. This often takes the form of targeted cold calling during the Do Now, additional scaffolding within the lesson and small group intervention where possible.
- All students are taught the same rigorous curriculum. Although students at secondary level are taught in groups, we have the same high expectations of all students – we do not narrow or dilute the curriculum. All students are taught from the same work booklets so that everyone is given access to the same powerful and catalytic knowledge. Teachers understand the need to supplement the work booklets with additional practice/scaffolds or extension material, as required for individual students
- When timetabling we believe that our science curriculum should be delivered to our most vulnerable learners by our most qualified, most accountable, and most experienced teaching staff if it is to be equitable and maximise their opportunity to make progress.
- 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.
- Opportunities to build an understanding of social, moral, and ethical issues are developed alongside links to the wider world, including careers, through:
- Explicit teaching and practice of effective teamwork and communication skills when working in groups for scientific investigations. Groups are selected by the teacher to ensure that students learn to effectively collaborate with others from diverse backgrounds or from outside of their friendship circle.
- Science naturally provides many opportunities for balanced discussions of moral and ethical issues. For example, we explore the moral complexities of organ transplant, the controversial use of genetic engineering and the disputed use of stem cells for disease treatment. Students are given time to discuss these issues both in pairs and as a class to allow students to develop spiritually.
- When teaching topics such as the theory of evolution and the Big Bang theory, this provides a chance to develop students' cultural awareness as we can discuss viewpoints of these theories from different religions and cultures. We also discuss historical sexism in scientific developments – for example, the famous case of Rosalind Franklin's discovery of the structure of DNA.
- Science lessons also provide a wealth of opportunities to explore personal development relating to physical and mental health. For example, students study the effects of smoking, drugs, and alcohol from both a scientific and social perspective. When teaching about the digestive system, students are taught about the importance of a balanced diet and how to interpret nutritional information.

- We want students to become respectful and responsible members of society who contribute positively to the world around them. For example, students are taught in detail about global warming, pollution, and energy resources so that they understand the importance of recycling, reducing waste and cutting down their carbon footprint.

A true love of Science is developed by teaching beyond the domain of the GCSE specification. Examples of such content:

Embedded within the curriculum are opportunities for students to delve into the history and philosophy of science, fostering engagement and the cultivation of cultural capital. This is exemplified through the exploration of diverse subjects, such as Semmelweis' groundbreaking work on Germ Theory and the nomenclature of new chemical elements.

At Dixons Croxteth, we firmly believe that Science possesses the capacity to enrich students' cultural capital. By immersing them in contemporary scientific developments worldwide, we impart the understanding that science is in a perpetual state of evolution. Moreover, an examination of the historical trajectory of scientific concepts reveals their evolution across not just years, but decades and even centuries.

These foundational principles seek to instil the broader curriculum with 'Hinterland,' transcending the confines of the national curriculum and nurturing a more ambitious educational landscape. For instance, the exploration of disease transmission involves a narrative reiteration of Joseph Lister's contributions, bridging the realms of Science and History, and explaining how his theories underpin the modern field of epidemiology. In so doing, we not only augment the curriculum's depth and breadth, but also embark on a captivating historical voyage that underscores the non-absolute nature of science, highlighting our journey of learning by 'standing on the shoulders of giants'.

Although students' practical skills are no longer assessed through coursework, we believe it is essential that all students can plan and carry out practicals using laboratory equipment safely and accurately so that they are fully prepared for future study and employment. At KS3, we want students to be exposed to a wide variety of engaging practicals, such as investigations into the effectiveness of different brands of indigestion tablets. In KS4 there is a greater focus on the GCSE required practicals – but we are not restricted to this list of experiments.

Further Information can be found in:

- Long-Term Plans
- Knowledge Organisers
- Science Curriculum Handbook

Curriculum Overview

All children are entitled to a curriculum and to the powerful knowledge which will open doors and maximise their life chances. Below is a high-level overview of the critical knowledge children will learn in this particular subject, at each key stage from Year 7 to Year 11, in order to equip students with the cultural capital they need to succeed in life. The curriculum is planned vertically and horizontally giving thought to the optimum knowledge sequence for building secure schema.

	Knowledge, skills and understanding to be gained at each stage*		
	Cycle 1	**Cycle 2**	**Cycle 3**
YEAR 7	Science Skills Cells and Life Processes Forces and Space Particles and Solutions	Energy Reproduction Atoms and Elements	Acids and Alkalis Ecology Waves
YEAR 8	The Body Metal Reactions Forces and Motion Plants and Photosynthesis	Chemical Reactions Electricity and Magnetism Variation and Inheritance	Pressure, Moments and Density Earth, Materials and Atmosphere GCSE Skills
YEAR 9	C1 Atomic Structure and the Periodic Table B1 Cell Biology P3 Particle Model of Matter	C2 Bonding, Structure and Properties B2 Organisation	P4 Atomic Structure B3 Infection and Response C8 Chemical Analysis
YEAR 10	C1 Atomic Structure and the Periodic Table C2 Bonding, Structure and Properties C3 Quantitative Chemistry C4 Chemical Changes C5 Energy Changes	B1 Cell Biology B2 Organisation B3 Infection and Response B4 Bioenergetics P1 Energy	P2 Electricity P3 Particle Model of Matter P4 Atomic Structure B5 Homeostasis and Response
YEAR 11	Paper 1 Physics Paper 2 Chemistry	Paper 2 Biology Paper 2 Physics	Paper 2 Physics

*A powerful, knowledge-rich curriculum teaches both declarative knowledge (facts; knowing that something is the case; what we think about) and non-declarative or procedural knowledge (skills and processes; knowing how to do something; what we think with). There are no skills without bodies of knowledge to underpin them.

In some subjects, a further distinction can be made between substantive knowledge (the domain specific knowledge accrued e.g. knowledge of the past) and disciplinary knowledge (how the knowledge is accrued e.g. historical reasoning).