Science

Curriculum principles

By the end of their education, a student of science at Dixons Brooklands will:

- Know fundamental scientific principles from biology, chemistry and physics that will provide a foundation for understanding and navigating the world. Student knowledge is structured around the big ideas in science which range from the particulate nature of matter, to the cellular basis of living organisms, to space.
- Understand the processes of scientific inquiry that leads to the creation and development of concepts and theories. Students will understand how science can be used to explain observations and make predictions about natural phenomena.

The vision of the science department at Dixons Brooklands Academy is to empower students to explore scientific concepts and to achieve academic excellence, whilst instilling a sense of excitement and curiosity about natural phenomena.

In order to achieve a true understanding of Science, topics have been intelligently sequenced based on the following rationale:

- Scientific knowledge is broadly hierarchical in nature – students must have a secure understanding of each key block of knowledge before progressing onto the next stage. At KS2 pupils are taught to plan different types of scientific enquiries, take measurements, record data and present findings. We build upon this during KS3, therefore, topics have been meticulously planned and ordered to ensure that students are building on and developing their previous learning. The scientific skills developed during KS3 allows pupils to be able to access the required practical activities during their GCSE lessons.

Examples of the sequencing across the scientific disciplines include that:

- In KS2 in biology pupils learn about living things and their habitats and animals including humans and plants. At KS3 students learn about the structure, function and behaviour of living organisms, building up from the microscopic cellular level to the macro-scale interactions in an ecosystem. These topics are revisited and extended at KS4, with the expectation that students learn to apply this knowledge and make links with other topics.
- In KS2 in chemistry pupils learn about properties and changes in materials, states of matter and rocks. At KS3 students start with a rigorous grounding in the fundamentals of chemistry: states of matter, elements, compound and mixtures, the periodic table, chemical reactions and the behaviour of materials. Having mastered the foundation knowledge, students are fulling equipped with the necessary knowledge and skills to tackle the more challenging KS4 content, such as chemical bonding and quantitative chemistry.
- In KS2 in physics pupils start to explore electricity, forces, light and space. At KS3 students are introduced to the fundamentals of forces, energy, waves and electricity, focusing on concrete concepts and experiences. They continue to study these topics, as well as introducing more challenging concepts such as energy, pressure and density. In KS4 the focus shifts to a more quantitative appreciation of the subject matter and develops mathematical skills.
- 'Working scientifically' skills are taught explicitly as an introductory topic at the start of Y7. 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. For example, each topic deliberately includes several opportunities to revisit graph and table interpretation skills, so that students are able to fully master these concepts. Pupils also explore the development of scientific models such as how the model of the atom has changed and our understanding of evolution and inheritance.

The science curriculum will address social disadvantage by addressing gaps in students' knowledge and skills:

- Our curriculum is designed around the most vulnerable learners. We are careful not to assume any prior general knowledge or cultural capital and always teach new knowledge explicitly. During learning episodes, using messy marking, and through the delivery of Nothing New Just Review teachers are able to identify gaps in foundation knowledge. We build on prior knowledge, revisit topics regularly, embed opportunities for regular purposeful formative and summative assessment and explicitly teach vocabulary and literacy because we recognise the most vulnerable often have poorer literacy skills.
- 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 every lesson through reading, annotating and discussing challenging texts. We also support children to answer questions in full sentences by verbally modelling sentence starters.
- Disadvantaged students and those from identified underrepresented groups receive priority for extra intervention sessions. For example, students have the opportunity to receive additional guidance and tutoring in small groups to close specific gaps in their understanding during weekly 'Morning Mastery' sessions. Teachers also prioritise these students when creating and implementing their Intervention & Prevention plans. At GCSE level, students are provided with suitable revision resources (e.g. revision guides and stationary) to give all students a fair opportunity to be successful.

- Pupils are set from Year 7 and are taught the same rigorous curriculum. However, we have the same high expectations of all students – we do not narrow or dilute the curriculum. All students are taught from the same student work booklets so that everyone is given access to the same powerful knowledge. That being said, teachers understand the need to use addaptive teaching in lessons by supplementing the work booklets with additional practice/scaffolds or extension material, as required for individual students.
- Students with special educational needs or disabilities are given extra support through the use of flexible grouping. Students are taught in small groups so that individual needs can be catered for. Students who are new to English receive support with vocabulary and literacy.

We fully believe science can contribute to the personal development of students at DBK:

- The social development of our students is nurtured through the 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 different 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 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 stem cells, 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 citizens who contribute positively to society. 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.

At KS3 and KS4, our belief is that homework should be interleaved-revision of powerful knowledge that has been modelled and taught in lessons. This knowledge is recalled and applied through a range of low-stakes quizzing and practice.

In science homework is carried out using knowledge organisers to do read, cover, write and check. Pupils also have access to Educake where addition weekly homework is set.

A true love of science involves learning about science. We teach beyond the specification requirements, but do ensure students are well prepared to be successful in GCSE examinations:

- By the end of secondary education, a student in science should be well-rounded, possessing a deep understanding of scientific principles, strong analytical and practical skills, and a readiness to engage with future scientific challenges. This holistic preparation ensures that students are not only knowledgeable but also capable of contributing meaningfully to scientific discourse and innovation, whether they pursue further education or enter the workforce.
- Opportunities to explore the history and philosophy of science are embedded into the curriculum. This mainly taking the form of reading rich texts about an array of topics, such as: the history of the atom and the periodic table, Semmelweis' work on Germ Theory and how new chemical elements get their names. Whilst not examined, they are included for engagement and to build cultural capital.
- Although students' practical skills are no longer examined through coursework, we believe it is absolutely essential that all students can plan and carry out practical activities using laboratory equipment safely and accurately so that they are fully prepared for future study and employment. In KS3, we want students to be exposed to a wide variety of engaging practical work, such as investigations into the effectiveness of different brands of indigestion tablets and hand sanitiser. In KS4 there is a greater focus on the GCSE Required Practical Activities – but we are not restricted to this list of experiments.
- Students that wish to develop their science knowledge beyond the curriculum can select STEM Club as an extra curricula activity. As part of this club, students are given opportunities to represent the academy at competitions and to gain a CREST award. There is also an ever-growing collection of science based non-fiction books in the HUB which are very popular with our students.

DIXONS BROOKLANDS ACADEMY

Science Curriculum Overview

Year 7	Cycle 1	Cycle 2	Cycle 3
Substantive knowledge introduced	**Particles and Solutions** -Defining solid, liquids and gases and their properties in terms of particles -Change in state linked to cooling curves -Solutions as mixtures -Temperature and effect on solubility -Separation techniques for different types of mixtures	**Atoms, elements and the periodic table** -Periodic table structure and symbols -Metals and non-metals -Elements, compounds and mixtures -Groups of the periodic table -Name and chemical formulae of substances -Chemical reactions vs. physical changes -Writing chemical equations	**Acids and Alkalis** -Defining acids and alkalis -The role of indicators and different indicators -Neutralisation and salt production -Uses of neutralisation
Substantive knowledge revisited & embedded	-Classifying materials as solid, liquid and gas **KS2** Y9 C2 -Materials change state when heated or cooled **KS2** Y9 C2 -Some materials dissolve to form solutions **KS2** Y9 C2 -Separating mixtures **KS2** Y9 C1 -Dissolving and changes of state are reversible **KS2** Y9 C2	-Separation of mixtures **Y7 C1** Y9 C1 -Particle diagrams of matter **Y7 C1** Y9 C2 -Metals are conductors **KS2** Y9 C1 Y10 C2 -Uses of metals and non-metals **KS2** Y9 C1 -Physical changes are reversible **KS2** Y9 C2 -Chemical changes result in the formation of new substances **KS2** Y10 C2	-Separation techniques **Y7 C1** Y9 C1 -Chemical reactions **Y7 C2** Y9 C2 Y10 C1 -Writing chemical equations **Y7 C2** Y9 C2 Y10 C1
Substantive knowledge introduced	**Cells and Life Processes** -Characteristics of living and non-living -Cell as the basic 3D unit of life -Specialised cells -Unicellular & multicellular organisms -Organisation of multicellular organisms -Movement in and out of cells -Cellular processes of respiration & photosynthesis	**Reproduction** -Puberty -Human reproductive systems -Sexual reproduction in humans -Development of the foetus -Sexual reproduction in plants. -Plant life cycles including germination	**Ecology** -Ecosystems -Animal and plant adaptations -Food chains and webs -Interdependence -Population changes and factors affecting these -Predator prey relationships -Pyramids of number -Classification
Substantive knowledge revisited & embedded	-Characteristics of living and non-living **KS2** Y11 C2 -Main parts and organs of body systems **KS2** Y9 C2	-Changes as humans develop **KS2** Y10 C2 -Plant germination and growth **KS2** Y10 C1 -Roles of plant organs **KS2** Y9 C2 -Animal and plant life cycles **KS2** Y11 C2 -Specialised animal cells **Y7 C1** Y9 C1	-Plant life cycles including germination **Y7 C2** Y9 C2 -Constructing food chains **KS2** Y11 C2 -Classification systems **KS2** Y11 C2
Substantive knowledge introduced	**Forces and Space** -Defining forces -Different types of force -The effect of friction as a force -Force diagrams and resultant forces -Balanced and unbalanced forces -Interaction pairs of forces	**Energy** -Energy stores and transfer pathways -Law of conservation of energy -Efficiency -Advantages and disadvantages of energy resources -Heat energy transfer	**Earth, materials and atmosphere** -Igneous, metamorphic and sedimentary rocks -The rock cycle -Ceramics, polymers, composites and their properties -Combustion; complete and incomplete -Greenhouse effect and its effects -Acid rain and its effects -The Earth's atmosphere -The Carbon cycle

Substantive knowledge revisited & embedded	-Some forces need contact, others act at a distance (magnetism and gravity) **KS2** **Y11 C2** -Effect of forces on motion **KS2** **Y10 C3**	-Photosynthesis involves an energy transfer **Y7 C1** **Y10 C2** -Common conductors and insulators **KS2** **Y10 C2**	-Common chemical reactions **Y10 C2** -Balancing equations **Y7 C2** **Y9 C1** -Writing symbol equations **Y7 C2** **Y9 C1** -Conservation of mass **Y7 C2** **Y9 C3** -Energy stores **Y7 C2** **Y9 C1** -Heating as an energy transfer pathway **Y7 C2** **Y9 C1** -Characteristics of acids **Y7 C3** **Y10 C2** -Identifying elements, compounds in the mixture of air **Y7 C2** **Y9 C1**
Disciplinary knowledge introduced, revisited & embedded	**Science Skills** -Carrying out investigations to test hypotheses -Identifying and using a wide range of scientific equipment safely and evaluating risks -Identifying independent, dependent & control variables -Taking accurate measurements and observations using a range of instruments -Recording measurements/observations effectively in tables and creating results tables -Recording data in bar charts and line graphs and creating bar charts and line graphs to display data -Drawing lines of best fit on line graphs -Identifying trends in data and predicting further patterns based on trends seen -Calculating the mean from a range of results and performing simple calculations -Identifying anomalous results and sources of error in an experiment -Evaluation of an investigation identifying improvements that could be made -Using their scientific knowledge to explain the results seen -Calculating the mean from a range of results and performing simple calculations		