DIXONS NEWALL GREEN ACADEMY

Subject: Science

Curriculum Principles

By Year 11, a student of science at Dixons Newall Green 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 evolution of the atmosphere to the structure of the Universe.
- 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.

Our uniting 'sentence' is "The science department empowered students to achieve mastery in science and explore the wider world, by promoting curiosity and inspiring them to think beyond the known"

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 – pupils must have a secure understanding of each key block of knowledge before progressing onto the next stage. Therefore, in order to support this, topics have been meticulously planned and ordered to ensure that students are always building on and deepening their previous learning.
- In Biology, KS3 students learn about the structure, function and behaviour of living organisms; from the microscopic cellular level to the macro-scale interactions in an ecosystem. These topics are all revisited and extended at KS4, with the expectation that students learn to apply this knowledge and make developed links between topics.
- In Chemistry, students start with a rigorous grounding in the fundamentals of chemistry at KS3: states of matter, elements, compounds and mixtures, the periodic table, chemical reactions and the behaviour of different 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 Physics, students are introduced at KS3 to the fundamentals of forces, energy, waves and electricity, focusing mainly on a qualitative understanding of these topics. At KS4 the focus shifts to a more quantitative appreciation of the subject matter, which allows students to apply skills that have already been introduced in their Mathematics lessons.
- 'Working Scientifically' skills are taught explicitly as an introductory topic at the start of year 7. These skills have then been carefully mapped across all topics throughout KS3 and KS4 so that pupils are given many opportunities to apply and develop these concepts. For example, each cycle deliberately includes several opportunities to revisit graph and table interpretation skills, so that students can fully master these concepts. Experimental work is also a key feature in lessons with students learning the basic skills in KS3 enabling them to master the required practicals in KS4.

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

- By being designed around the most disadvantaged learner in our community. We are careful not to assume any prior general knowledge or cultural capital – instead we aim to democratise knowledge through explicit teaching, so that all students can lay claim to a rich intellectual inheritance.
- By teaching all students the same rigorous curriculum. We have the same high expectations of all students – we do not narrow or dilute the curriculum for students who arrived at the school with previous lower levels of attainment. All students are taught from the same student work booklets so that everyone is given access to the same powerful and catalytic knowledge. That being said, teachers understand the need to supplement the work booklets with additional practice/scaffolds or extension material, as required for individual students.
- By providing extra support to students with special educational needs through the use of double staffing, and also ensuring these students are prioritised when teachers create and implement their intervention prevention plans.
- 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 using expert language by verbally modelling the use of subject specific vocabulary. We plan frequent extended writing tasks and support children with verbal rehearsal activities, sentence starters and keywords.

We fully believe science can contribute to the personal development of students at Dixons Newall Green:

- The social development of our pupils is nurtured through the explicit teaching and practice of effective teamwork and communication skills when working in small groups for scientific investigations. Student groups are always selected by the teacher to ensure that students learn to effectively collaborate with others who may be 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 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 pupils to develop spiritually. This allows pupils to form and articulate informed opinions, whilst also carefully and respectfully listening to others viewpoints.
- 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.
- 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.

Opportunities are built in to make links to the world of work to enhance the careers, advice and guidance that students are exposed to:

- Problem solving activities are built into the curriculum that allow students to apply scientific knowledge to certain career based scenarios. For example, when learning about health and disease, students have to write an explanation to a patient from the point of view of a doctor explaining why they are prescribing painkillers rather than antibiotics.
- Each topic at KS3 and KS4 provides the teacher moments to allow pupils to explore a profession linked to that particular unit of work. For example, when year 7 pupils study the Cell and Life Processes topic, they learn about careers in histology. Pupils will learn about the skills required and the responsibilities of the job.
- We regularly invite professionals from various scientific fields to deliver talks and share their career journeys with our students. These sessions are designed to help students understand the wide range of career opportunities that a background in science can offer. During these visits, students often take part in informal 'meet and greet' sessions, where they have the chance to interact with the guest speakers, ask questions, and gain valuable insights into potential career paths and how to pursue them.

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

- Although students' practical skills are no longer examined through coursework, we believe it is absolutely 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 pupils to be exposed to a wider variety of engaging practicals, such as investigations into the effectiveness of different brands of indigestion tablets, finding the best metal for making frying pans and working out the calorie content of crisps through combustion. At KS4 there is a greater focus on the GCSE Required Practicals – but we are not restricted to this list of experiments.
- Students who wish to develop their scientific knowledge beyond the curriculum can select 'Science in the Media; for their co-curricular elective. As part of this club students look at and evaluate how science is represented across different media platforms such as on the TV, in podcasts and in print. There is also an opportunity to take part in the Science Dixons Cup and earn points for the school.

Curriculum Overview

All children are entitled to a curriculum and to the powerful knowledge that 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 Key Stage 3 and 4, 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 Revision, introduction and expansion	**Knowledge Introduced**	**Science skills** Development of scientific theories; planning an investigation and displaying and analysing results; bouncing balls investigation (these skills are embedded in all future topics from year 7 – 11). **Ecology**	**Energy** Energy stores and transfer pathways; law of conservation of energy; efficiency; advantages and disadvantages of renewable and non-renewable energy resources and heat energy transfer	**Reproduction** Puberty; reproductive systems; pregnancy; parts of a flower and plant reproduction. **Acids and alkalis** pH scale; indicators; neutralisation reactions; indigestion tablet investigation and making salts practical. **Earth, Materials and Atmosphere**

		Knowledge, skills and understanding to be gained at each stage*		
		Cycle 1	**Cycle 2**	**Cycle 3**
		Competition in ecosystems; adaptations of plants and animals; food chains and webs; pyramids of numbers and classification. **Forces and space** Force diagrams; resultant forces; balanced and unbalanced forces; air resistance investigation; the solar system; day/night and seasons.	Investigation. **Cells and Life processes** Plant and animal cells; using a microscope to view cells; specialised cells; unicellular organisms; introduction to respiration, photosynthesis and diffusion. **Atoms & Elements** Atoms; elements, compounds and mixtures; the periodic table; chemical formulae; properties of metals and non-metals and introduction to chemical reactions. **Particles and solutions** Solids, liquids and gases; changes of state; dissolving; solubility; separating mixtures; rock salt investigation.	Burning fuels theory and investigation; Earth's changing atmosphere; global warming; acid rain and water cycle; rocks
	CEAIG	Careers in aeronautical engineering (forces and space topic)	Careers in histology (cells topic)	Careers in midwifery (reproduction topic)
	Knowledge & Skills Revisited	Science skills builds on how science works skills previously taught through investigations. Ecology builds on previous knowledge from the Animals (including Humans) topics.	Life processes, forces causes an energy transfer, science skills applied to investigations.	Life processes and specialised cells, chemical reactions linked to atmosphere, science skills applied to investigations.
YEAR 8 **Development and expansion**	**Knowledge Introduced**	**The Body** Skeletal system; muscular system; food groups; digestive system; respiratory system; circulatory system; the heart and exercise **Metals** Properties of metals; reactions of metals and reactivity series; extraction of metals from ores and recycling metals **Forces and motion** Weight, mass and gravity; Hooke's Law theory and investigation; speed calculations and distance-time graphs	**Plants and photosynthesis** Photosynthesis; structure of leaves; plant roots and minerals; fertilisers; bioaccumulation and testing leaves for starch **Chemical reactions** Chemical equations; rates of reaction theory and investigations; conservation of mass and exo/endothermic reactions **Electricity and magnetism** Circuit components and diagrams; series and parallel circuit theory and investigation; current, voltage and resistance; magnets; magnetic fields and electromagnets	**Inheritance and variation** DNA and genetics; environmental and inherited variation; natural selection and extinction **Waves** Behaviour of light waves; reflection, refraction and dispersion investigations; colours of light; seeing and the eye. Behaviour of sound waves; amplitude and frequency; oscilloscope traces; hearing and the ear. **Pressure, Density & Moments** Pressure in solids, liquids and gases; density of regular and irregular objects; moments
	CEAIG	Careers in medicine / nursing (the body topic)	Careers in chemical engineering (chemical reactions topic)	Careers in ophthalmology (waves topic)
	Knowledge & Skills Revisited	Cells and life processes, metal and non- metal properties, year 7 forces knowledge is further developed, science skills applied to investigations.	Specialised cell knowledge is developed, alongside , photosynthesis, ecology, year 7 simple chemical reactions knowledge is further developed, science skills applied to investigations.	Cell structure, and specialised cells, chemical reactions, from year 7, science skills applied to investigations.
YEAR 9 **Consolidation**	**Knowledge Introduced**	**AQA GCSE Combined Science Trilogy B1 - Cell biology** Structure of eukaryotic and prokaryotic cells; cell division; advantages and disadvantages of stem cells; microscopy and cell transport (diffusion; active transport and osmosis).	**AQA GCSE Combined Science Trilogy** **B2 - Organisation** Organ systems in plants and animals **C2 - Bonding and structure**	**AQA GCSE Combined Science Trilogy** **B3 - Infection and response** Pathogens; spread and prevention of infection; immune response and treatment of infectious diseases. **P4 - Atomic structure** Model of an atom; radioactive decay and nuclear radiation

		Knowledge, skills and understanding to be gained at each stage*		
		Cycle 1	Cycle 2	Cycle 3
		C1 - Atomic structure and periodic table Development and current model of the atom; group 1; 7 and 0 elements; properties of metals and non-metals	Ionic; covalent and metallic bonding; solids; liquids and gases and properties of substances **P3 - Particle model of matter** States of matter; changes of state; density; internal energy; energy transfers and gas pressure	
	CEAIG	Careers in microbiology (cell biology topic)	Careers in plant science and horticulture (organisation topic)	Careers in pharmacology (infection and response topic)
	Knowledge & Skills Revisited	Builds on year 7 and 8 knowledge of cells and life processes, periodic table, elements, compounds, mixtures, chemical equations and separation techniques. Science skills continue to be embedded.	Builds on year 7 and 8 knowledge of body systems and life processes, properties of matter and states of matter. Science skills continue to be embedded.	Builds on year 7 and 8 knowledge of infectious disease and Y9 atomic structure (C1). Science skills continue to be embedded.

*A powerful, knowledge-rich curriculum teaches both **substantive 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).
Please refer to the DAT Curriculum Principles, published on our website, for further information about how we have designed our curriculum.

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