Science

Curriculum Intent

By the end of their secondary education, a student of Science at Dixons McMillan will have developed in 5 key areas:

- **Social development** is encouraged when testing the data of others to ensure reproducibility, and when working within peer groups to discuss scientific principles and produce data from experiments.
- **Moral development** of students is promoted when discussing controversial topics within science, such as the use of stem cells, renewable fuels and debates surrounding our obligation to protect the environment and how to avoid global warming.
- **Spiritual development** is highlighted when providing students with the opportunity to reflect upon their obligation as educated scientists, so that they can use this knowledge to better the lives of others.
- **Cultural development** of students is developed to enlighten them regarding different cultural beliefs surrounding issues such as contraception and blood and organ donation.
- **Personal development** is the focus of our teaching about the importance of a healthy diet and the benefits of a healthy lifestyle. We will encourage students to research and use data to justify these findings.

In order to truly appreciate the subject and create deep schema, topics within Science have been intelligently sequenced with the following rationale:

- Scientific knowledge: students will need to understand key terminology and will develop understanding through the careful sequencing of topics across the domains of Science. Knowledge recall will be a vital part of the Science journey to deepen previous knowledge and develop with application.
- Biology: at KS3 students need to develop understanding with the fundamentals in areas such as cell structure, cell function, behaviour of organisms, changes in organisms and development of organisms. These topics are extended at GCSE, with the expectation that students learn to apply this knowledge and make links with other topics to further understanding in areas such as transport systems in organisms, interactions within ecosystems and the menstrual cycle.
- Chemistry: at KS3 students are embedded with the fundamentals of chemistry in areas such as states of matter, the periodic table, chemical reactions, chemical equations and health and disease. Continuing with this learning journey students' progress to more challenging GCSE content such as chemical bonding, quantitative chemistry, electrolysis and rates of reaction.
- Physics: at KS3 students are introduced to the fundamentals of forces, electricity, sound, light and space – focusing on concrete concepts and experiences. At GCSE, students continue to study these topics, as well as introducing more challenging concepts such as energy, pressure and density. However the focus shifts to a more quantitative appreciation of the subject matter and develops mathematical skills.
- Experimental work is a key feature of lessons so that students can build confidence working practically and can start to appreciate the nature of scientific enquiry. At the start of Y7, 'working scientifically' skills are taught explicitly to embed key concepts and understanding. These skills are carefully mapped across all topics throughout so that students are given many opportunities to apply and develop these skills. Cross curricular links are made with Maths in several key topics to revisit graph and table interpretation skills.

The Science curriculum at Dixons McMillan has been influenced by:

- The desire to produce independent and inquisitive scientists, who can contribute to their chosen field and positively impact upon their communities through scientific discovery.
- An aim to embed this love and passion for discovery through explicit teaching of pivotal scientific advancements, such as the work of; Marie Curie (radiation), Fritz Haber (haber process), James Joules (energy), Mendel (genetics).

Our Science curriculum ensures that social disadvantage is addressed through:

- All students are taught the same rigorous curriculum. Although students are taught in set groups, we have the same high expectations of all students – we do not narrow or dilute the curriculum, though we differentiate booklets to allow students to access the information. All students are taught from 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.
- 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 key scientific terminology. We also support children to answer questions in full sentences by verbally modelling sentence starters, giving adequate thinking time and allowing children to work with a purposeful partner.

- 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 'Prep' and 'intervention' sessions. These groups are reallocated twice a cycle based on question level analysis from cycle assessments and teacher judgement based on classwork. 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) to give all students a fair opportunity to be successful.

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.

- Knowledge retrieval plays a large role at the start of every Science lesson. Students will always complete a Do Now on mini whiteboards at the beginning of a lesson. The questions are retrieval of a previous topic and misconceptions are addressed.
- This will be consistent across KS3 and KS4 allowing for a settled start but more importantly, engaging all in the class in accessing that day's learning (Sherrington: 2019)
- The Science curriculum has been sequenced to allow for focused revision and interleaving of knowledge retrieval from previous learning especially in the run-up to an assessment or marked piece of work. Whilst retrieval arrival activities will allow for greater access of new learning and content, building upon what is already known, homework and revision and recap lessons will ensure that that knowledge is revisited throughout a student's history career (Lemov: 2021)

Opportunities to build an understanding of social, moral and ethical issues are developed alongside links to the wider world, including careers. We fully believe Science can contribute to the personal development of students at Dixons McMillan through:

- 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 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 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.

Further information can be found in:

- AQA GCSE (9-1) Science Trilogy exam specification
- Science Curriculum Overview (KS3 & GCSE)
- Science Long Term Plans (Y7-11)

References:

- Lemov, Doug et al (2016) 'Control the Game' in Reading Reconsidered: A Practical Guide to Rigorous Literacy. Jossey-Bass: Hoboken, New Jersey. pp. 225-39
- Lemov, Doug (2021) 'Double Planning' in Teach Like A Champion 3.0. Jossey-Bass: Hoboken, New Jersey. pp. 58-62

Curriculum overview - Science 2023-24

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 Y7 through to Y11 in order to equip scholars 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 schema.

	Knowledge, skills and understanding to be gained at each stage		
	Cycle 1	**Cycle 2**	**Cycle 3**
Year 7	**Science skills** *Variables, planning investigations, displaying and evaluating results.* **Cells and life processes** *Introduction to plant and animal cells, using microscopes, and key life processes, e.g. respiration and photosynthesis.* **Forces and space** *Force diagrams, resultant forces, balanced forces, and the solar system.*	**Particles and solutions** *Solids, liquids and gases, solubility, changes of state, and separating mixtures investigations.* **Energy** *Energy stores and transfers, the law of the conservation of energy, different energy sources and evaluating energy costs.* **Reproduction** *Puberty, reproductive systems, pregnancy, and reproduction in plants.*	**Elements, compounds and mixtures** *Atoms, elements and compounds, the periodic table, metals and non-metals, mixtures, and chemical formulae.* **Acids and alkalis** *pH scale, indicators, neutralisation and indigestion remedies practical.* **Ecology** *Competition, food chains and food webs, adaptations of organisms, and classification.* **Waves** *Sound waves, light waves, reflection, refraction and colour.*
CEAIG	**Science skills** Lab technician – maintenance of lab tools and equipment, capture and sort data and ensure efficiency and accuracy. **Cells and life processes** Biologist - study living things, like animals and plants. **Forces and space** Planetary scientist - They conduct research to understand the origins, evolution, and geologic processes on other planets in the solar system.	**Particles and solutions** Pathologist - a medical detective, and their job is to figure out the root cause of real-life medical puzzles. **Energy** Energy engineer - aim to increase energy efficiency and environmental friendliness in buildings and manufacturing processes. **Reproduction** Midwife - deliver, or assist in the delivery of babies, provide antenatal and postnatal care and advise parents on baby care.	**Elements, compounds and mixtures** Pharmacist - provide expert advice on the use and supply of medicines and medical appliances. **Acids and alkalis** Biochemist - investigate the chemical processes that take place inside all living things, from viruses and bacteria to people. **Ecology** Environmental consultant - Advice on sustainability, including waste management, recycling, flood risk and the effects of climate change. **Waves** Optometrist - test vision, identify eye health problems, prescribe glasses and fit contact lenses.

Year 8	**The body** *Food groups and digestion, the respiratory system, circulatory system and skeletal system.* **Metals** *Properties of metals, reactions of metals, and the reactivity series.* **Forces & motion** *Weight, mass and gravity, Hooke's law theory and investigation, speed calculations, distance-time graphs.*	**Health and disease** *The immune system, pathogens, vaccinations, smoking, drugs and alcohol, and fitness investigation.* **Chemical reactions** *Factors affecting the rate of reactions, rates practical, word and symbol equations, and endo/exothermic reactions.* **Electricity and magnetism** *Circuit components, series/parallel circuits, voltage and current, magnets, magnetic fields and electromagnets.* **Pressure, density and moments** *Density, measuring density practical, pressure, moments, calculating moments, and calculating moments practical.*	**Plants** *Structure and function of leaves, photosynthesis, testing leaves for starch, roots and minerals, and bioaccumulation.* **Environmental chemistry** *Fossil fuels, the atmosphere, greenhouse effect and global warming, and acid rain.* **Waves** *Sound waves, light waves, reflection, refraction and colour.* **Inheritance and variation** *Variation, DNA, adaptation, natural selection and selective breeding, cloning, and classification.*
CEAIG	**The body** Sports scientist - use knowledge of how the body works to help people improve their health or sporting ability. **Metals** Civil engineer - design and manage construction projects, from bridges and buildings to transport links and sports stadiums **Forces & motion** Airline pilot - fly passengers and cargo to destinations around the world.	**Health and disease** Physiotherapist - work with patients to improve their range of movement, and promote health and wellbeing. **Chemical reactions** Chemical technician - conduct experiments, record data, and help to implement new processes and procedures in the laboratory. **Electricity and magnetism** Electrician - install and maintain the wiring and equipment that carries electricity, and they also fix electrical machines. **Pressure, density and moments** Marine Engineer - Design, build, test and repair boats, ships, underwater craft, offshore platforms and drilling equipment.	**Plants** Biotechnologist - use plants, animals, microbes, biochemistry and genetics to develop new products and improve existing ones. **Environmental chemistry** Volcanologist - geoscientists study formation of volcanoes and activity to help predict future eruptions. **Waves** Optometrist - test vision, identify eye health problems, prescribe glasses and fit contact lenses. **Inheritance and variation** Audiologist - Work with children and adults who suffer from hearing loss, tinnitus, or have problems with balance.

Year 9	**B1 - Cell Biology** *Structure of eukaryotic and prokaryotic cells, cell division, advantages and disadvantages of stem cells, microscopy and cell transport.* **C1 - Atomic structure** Development and current model of the atom, groups 1, 7 and 0, properties of metals and non-metals. **P3 - Particle model of matter** States of matter, changes of state, density, internal energy, energy transfers, and gas pressure.	**B2 - Organization** *Organ systems in plants and animals, enzymes and digestion, lifestyle factors affecting health, and blood.* **C2 - Structure and bonding** *Ionic, covalent and metallic bonding. Solids, liquids and gases, nanoparticles, and polymers.* **P4 - Atomic structure** *Model of an atom, radioactive decay, and nuclear radiation.*	**B3 - Infection and response** *Pathogens, the spread of disease, the immune response, vaccination and treatment, and drug discovery.* **C9 - Chemistry of the atmosphere** *Composition and evolution of the Earth's atmosphere, greenhouse gases and pollutants, and acid rain.*
CEAIG	**B1 - Cell Biology** Microbiologist - study microscopic organisms like bacteria, algae, or fungi in order to solve practical problems. **C1 - Atomic structure** Industrial engineer - people who figure out how to do things better. **P3 - Particle model of matter** Research Scientist - plan and carry out experiments and investigations to broaden scientific knowledge.	**B2 – Organization** Dentists - diagnose and treat teeth and mouth problems, and work to prevent dental disease and promote oral health **C2 - Structure and bonding** Materials Engineer - research the structure and properties of different materials, and use the information to develop new products or improve old ones. **P4 - Atomic structure** Radiographer - Medical imaging professionals operate X-ray and imaging equipment to diagnose, monitor and treat patients.	**B3 - Infection and response** GP - General practitioners (GPs) are doctors who provide medical services to people in their local community. **C9 - Chemistry of the atmosphere** Geoscientist - study the Earth's history and are often hired to hunt down gems, oils and other hidden resources.
Year 10	**B4 - Bioenergetics** *Respiration and photosynthesis* **P4 - Atomic structure** *Model of an atom, radioactive decay, and nuclear radiation.* **C4 - Chemical changes** *Reactivity of metals and acids, pH and neutralization, and electrolysis.* **C5 - Energy changes** *Endothermic and exothermic reactions, bond energy, and temperature changes.*	**B5 - Homeostasis** *Regulation of internal conditions, nervous and endocrine systems, hormones, and fertility.* **C3 - Quantitative chemistry** *Chemical measurement, conservation of mass, chemical calculations and concentration.* **P2 - Electricity** *Circuit components, current, potential difference, resistance, I-V graphs, mains electricity, and the national grid.*	**B6 - Inheritance and variation** *Reproduction, meiosis, genetics, selective breeding, genetic engineering, and classification.* **C6 - Rates of reaction** *Rate of reaction, collision theory, catalysts, reversible reactions and dynamic equilibrium.* **P5 - Forces** *Scalars and vectors, types of forces, resultant forces, work done, Hooke's law, Newton's laws, speed, acceleration, motion graphs, stopping distances, and momentum.*

CEAIG	**B4 - Bioenergetics** Botanist - look at all aspects of plant life – from growth, metabolism, diseases, chemical properties, evolution, plant DNA, and more **P4 - Atomic structure** Radiographer - Medical imaging professionals operate X-ray and imaging equipment to diagnose, monitor and treat patients. **C4 - Chemical changes** Civil engineer - design and manage construction projects, from bridges and buildings to transport links and sports stadiums **C5 - Energy changes** Heating and ventilation engineers - install and service heating and air conditioning in large buildings like factories, schools and hospitals	**B5 - Homeostasis** Anaesthetists - doctors who give anaesthetics to patients before, during and after surgery. **C3 - Quantitative chemistry** Chemical engineer - can find new ways to be eco-friendly or how to convert raw materials into other useful forms. **P2 - Electricity** Electrical engineering - the study, design and application of equipment, devices and systems which use electricity, electronics, and electromagnetism.	**B6 - Inheritance and variation** Geneticist - unravel the mysteries of DNA and heredity like scientific sleuths. **C6 - Rates of reaction** Quantity surveyors- oversee construction projects, managing risks and controlling costs. **P5 - Forces** Physicist - study matter and try to work out why it behaves like it does.
Year 11	**P5 - Forces** *Scalars and vectors, types of forces, resultant forces, work done, Hooke's law, Newton's laws, speed, acceleration, motion graphs, stopping distances, and momentum.* **C7 - Organic chemistry** *Crude oil, hydrocarbons, fractional distillation and cracking.* **C8 - Chemical analysis** *Purity, formulations, chromatography, and gas tests.* **P6 - Waves** *Types of waves, properties of waves, reflection of waves, uses of waves, electromagnetic waves and black body radiation.*	**B7 - Ecology** *Adaptation, interdependence, competition, biodiversity, and human effects.* **C10 - Using resources** *Potable water, life cycle assessments, and recycling.* **P7 - Magnetism** *Permanent and induced magnetism, magnetic fields, and the motor effect.* **P8 - Space physics** *The solar system, the life cycle of a star, orbital motion, satellites, and red-shift.*	

CEAIG

C7 - Organic chemistry Petroleum engineer - are involved with the production of crude oil and natural gas, which we use as fuels. **C8 - Chemical analysis** Gas service technician - install, service and repair gas appliances and heating systems. **P6 - Waves** Seismologist - study shock waves created by earthquakes and volcanic activity. They also work in oil, gas and minerals exploration.	**B7 – Ecology** Conservationist - managing natural habitats, introducing new ways to protect environments and advising farmers on land-based issues such as erosion control. **C10 - Using resources** Hydrologist - study of the movement, distribution, and management of water on Earth and other planets. **P7 – Magnetism** Radio Frequency engineer - help make sure that information gets from one place to another. **P8 - Space physics** Astrophysicist – test theories about space.	

* Skills and understanding are seen as forms of knowledge and we do not believe that there are any real generic skills that can be taught outside of specific knowledge domains. Please refer to the DAT Curriculum Principles.

Links

https://careerswithstem.com.au/the-a-z-stem-careers-list/

https://carnegiestemgirls.org/stem-resources/careers/

https://www.careerpilot.org.uk/job-sectors/stem/job-profiles

https://www.sciencebuddies.org/science-engineering-careers?p=1