

Subject Curriculum Intent: Science

Definition of Subject

I felt my being was as much a part of this universe as any star, as any comet
– Dr. Mae Jemison¹

As astronaut Dr Mae Jemison alludes we, as humans, are as much a product of science as any other phenomena. Our origin of matter is shared with both celestial bodies and microscopic life forms yet the diversity of life, matter and experience present in our universe is boundless.

Our experience of existence is defined by a myriad of laws, principles and processes which, when considered cumulatively, provide a ‘rulebook’ to explain our experiences. Science began as the fundamental study of ‘the rules’ which explain what has and is happening around us. However, as society moves forward, there is a demand for scientists to use their subject mastery to create ‘new rules’ and engineer opportunities for a new future.

Every person is entitled to a scientific education that allows them to engage fully with the world around them and assess the opportunities that come from scientific advancement. In the first instance of studying science, students are introduced to fundamental concepts, the essential rules and processes of the natural world, which are developed throughout their education. The sophistication of science education grows with scientific understanding, in later years of study students will be taught to analyse laws, question principles and rewrite processes in order to understand how science can work for societal good.

Nature of Subject

The study of secondary science is centred on three disciplines; Biology the study of organisms & their interdependence, Chemistry the study of matter, and Physics the study of fundamental interactions. From within these three disciplines, the ‘big ideas’ in science are distilled. By completing a secondary education in science, pupils will know of; the behaviour of particles and matter, the reason and nature by which objects interact with each other when in contact and from afar, how our planet is structured and the place it holds in the universe, the evolution of living organisms from one common ancestor and how these organisms depend on interactions to survive.

To be an accomplished scientist, students will master a range of skills in order to analyse patterns, manipulate data to draw conclusions to support explanations and ascertain knowledge that forms the basis of new theory. Students will be able to follow complex processes, understanding the links between subjects and how these interactions can influence change. Students will be taught to think critically and evaluate the effects of scientific discoveries and inventions in terms of environmental, ethical and societal impact. Lastly, students will be able to communicate their scientific knowledge through multiple channels: diagrammatically, written and spoken.

¹ Mae C. Jemison: First African American Woman in Space, Kristin Thiel, Cavendish Square Publishing, 2018

The core concepts within science will equip students with the knowledge they will need to give explanation to their experience. Through understanding these concepts, students will be able to appreciate the integrity of science in everyday life and the opportunities afforded by scientific progress. The core threshold concepts are studied within the three disciplines.

- The threshold concepts presented in biology are: Cells are alive; Bodies are systems; Organisms are interdependent; Ecosystems recycle resources; Characteristics are inherited; Species show variation
- The threshold concepts presented to in chemistry are: Structure determines properties; Reactions rearrange matter; Earth systems interact
- The threshold concepts presented to in physics are: Forces predict motion; Fields produce forces; Energy is conserved; Electricity transfers energy; Radiation transfers energy

These concepts are underpinned by the ideology of the scientific method; that hypothesis leads to investigation and the data collected serves as proof for scientific theory. Scientific theory then allows us to create representative models to aid understanding, under the caveat that new data may refine these models over time.

Within the teaching of science, Ark Blake teachers will ensure that subject content is accessible and appropriately challenging for all. Lessons will be taught by subject experts who prioritise strong teacher explanations and rigorous practice of core skills. Teachers will be aware of common subject misconceptions and assess appropriately throughout lessons to check student understanding. Excellence will be demonstrated to students through the use of modelling and suitable scaffolds in both written and practical work. Practical work will feature often as teachers use the best demonstrations and practical opportunities to enhance subject knowledge and encourage the technical skill and dexterity required of scientists. Teachers themselves will work collaboratively to develop subject knowledge and suitable teaching practices which will support all Ark Blake students to achieve.

Purpose of Subject

The purpose of studying science is to give all students the opportunity to engage critically with the world around them. Whether or not students decide to pursue a scientific career they are entitled to a level of scientific understanding essential in navigating the modern world. Rosalind Franklin² once stated, 'science and everyday life cannot and should not be separated.' The nature of science means it is integral to human life impacting on technology, medicine, politics, sport, nutrition, transport, architecture, our behaviour, our health and our environment. Studying science empowers students to go forward in life, with sound knowledge and critical thinking, allowing them to make well informed decisions, and understand the choices of others.

² Women in Science, Rachel Iqnotofsky, Wren& Rook, 2017

The study of science can lead to greatness, yet the story of science is one ever evolving. As a subject we no longer teach solely what the rulebook says, but also how we have used it to break down barriers and create newness in our world. Students will learn of scientists who embody the BLAKE academy values, for example: Wangari Maathai who founded the Green Belt movement for environmental conservation and won a Nobel peace prize for her achievements; to the Wright Brothers who defied gravity in their first flying machines with little funding or recognition; or Jane Cooke Wright whose innovation pioneered the field of chemotherapy as a cancer treatment, saving lives throughout the world.

To be a scientist one must be an intrepid explorer, a truth seeker, a persistent believer. To be an Ark Blake scientist one will take opportunities to seize greatness in daring to ask; 'what if...?'

Design of Subject

Learning at KS3 is driven by prior knowledge and understanding of the KS1&2 curriculum. The acknowledgement of prior knowledge is crucial to ensure that every student can succeed. The science curriculum at KS3 follows a mastery approach aspiring for all students to progress in every lesson. The KS3 curriculum embeds key foundational knowledge, allowing students to thrive when faced with high-level content at KS4. The development of knowledge over time will include exposure to scientific laws and discoveries and will challenge students to tackle sophisticated ideas surrounding scientific processes and impacts. In KS5, a firm background of all three science disciplines will ground students as they explore the intricacies of their subject at a burgeoning expert level.

The skills which are explicitly taught at the beginning of KS3 will advance students' fundamental KS2 maths and science enquiry understanding. Through explicit teaching, skills are introduced in KS3, and embedded throughout rigorous practice. The refinement of scientific skills as a mode of communication in KS3 means students will demonstrate exemplary 'scientific literacy' that will allow them to flourish in a KS4 curriculum. Throughout KS4, students will apply their skills analytically to deduce patterns, seek information and evaluate models. This will equip students to succeed in the highly rigorous KS5 science curriculums as they further their subject exploration.

The key threshold concepts established in KS3 are enriched in KS4 where the development of models further lace together the overarching elements of science. Whilst science is a subject composed of three disciplines, these are heavily intertwined by the threshold concepts which support knowledge throughout. When students develop their understanding of respiration and photosynthesis in biology, a knowledge of chemical reactions is a prerequisite. Without understanding the nature of electric current, we cannot explain electrolysis or the properties of graphite conductors. The interdependence of threshold concepts is closely mapped in order to support the development of internal schema. At a KS5 level, students become scientists as they start to investigate the nature of the threshold concepts themselves.

The purpose of homework in science will be to revisit subject knowledge so that students are consistently developing their long-term schema and practising the use of subject-specific vocabulary to aid confident communication. Homework will encourage students to establish a mind-set of growth and allow space for self-reflection. Throughout the year there will also be the opportunity for students

to explore a personal connection with science through projects and the development of science capital.

Extension of Subject

Students at Ark Blake will have the opportunity to enrich their experience of science through many extra-curricular activities. Over the course of their Blake education, students will have access to clubs such as coding, gardening, and STEM which will highlight the application of science in multiple forums. Students will also be able to work towards achievements such as the CREST award, science ambassador training and subject Olympiads. Students will be offered the opportunity to challenge personal boundaries through events such as 'Soapbox science' and school science fairs.

Students at Ark Blake will be encouraged to develop a love of science and study their subject further whether at university level or through vocational training. The science education provided will equip students to study university subjects such as Biology, Chemistry, Physics, Engineering, Natural Science, Biochemistry and Materials Science. During their years at Ark Blake, students will be exposed to the range of career opportunities from research scientists to geologists, climate activists, food or drug developers, physiotherapists, doctors, nurses, architects, engineers, computer scientists, ecologists, geneticists, neuro-scientists, electricians, laboratory technicians or science communicators. It is hoped that for all Ark Blake students an appreciation of science will allow them to engage with questions of science, whatever their future holds.