Curriculum Intent - Science

Curriculum Priorities

In a diverse community where science might be not always be seen as relevant or as a viable career choice, and a world where women are under-represented in STEM, a high-quality science education provides the foundations for understanding the world and increasing opportunities in these areas. Through the disciplines of biology, chemistry and physics, science has changed our lives and is vital to the world's future survival and prosperity, and all pupils should be taught essential aspects of the knowledge, the scientific method, processes and uses of science. By building up a body of key foundational knowledge and concepts, pupils should develop a sense of sense of awe in the beauty of our universe and curiosity about natural phenomena and be encouraged to recognise the power of rational explanation. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

Knowledge

In KS3 and KS4 content is organised under 10 big idea headings:
Forces, Electromagnetism, Energy, Waves, Matter, Reactions, Earth, Organisms, Ecosystems and
Genes.

Each idea is made up of smaller topics: the building blocks for the big ideas.

By the end of **Key Stage 4** we want pupils to have an:

- Understanding of core cell concepts, from organelles to photosynthesis and respiration
- Appreciation of how multicellular organisms function, including structure and function of systems, health, and reproduction.
- Understanding how organisms interact with each other and the environment.
- Understanding of how all matter is made up of tiny particles, their properties, and interactions.
- Knowledge of the changes in energy and chemistry when particles react, and factors that affect these changes.
- Understanding that all resources are finite and come from the Earth and it's atmosphere, and the importance of extraction, processing and conservation of these resources.
- Understanding of how all interactions in the Universe are reliant on forces and that these force interactions are inextricable from the corresponding energy and momentum conservation within systems.
- Understanding that all particles carry an abstract quantity labelled as energy that can be stored in different stores, which can be transferred between stores or between systems but is always conserved.

- Understanding that energy can be transferred through media in the form of waves, with no net transfer of matter.
- Understanding that electricity and magnetism are fundamentally and invariably linked.
- Understanding that science uses models to approximate theories, and that these can change, with an appreciation that theories must be testable.
- Understanding of how to structure scientific investigations.
- Conduct practical science safely and accurately.
- Visualise physical and chemical processes.
- Form reasoned and logical conclusions backed up with evidence.
- The ability to use a range of mathematical tools to calculate, manipulate, predict, and represent physical systems and processes.
- Having a good grasp of numerical, analytical and literacy skills to communicate scientific idea effectively.

For those who study this subject at **Key Stage 5** we want students to have:

KS5 Biology:

- Development of practical skills in biology
- Foundations in biology
- Exchange and transport
- Biodiversity, evolution and disease
- Communication, homeostasis and energy
- Genetics, evolution and ecosystems

KS5 Chemistry:

- Development of practical skills in chemistry
- Foundations in chemistry
- Periodic table and energy
- Core organic chemistry
- Physical chemistry and transition elements
- Organic chemistry and analysis

KS5 Physics:

- Development of practical skills in physics
- Foundations of physics
- Forces and motion
- Electrons, waves and photons
- Newtonian world and astrophysics
- Particles and medical physics

KS5 Applied Human Biology:

- Principles of applied human biology
- Microbiology
- Human biology and health
- Physiology or Biomedical science (optional units)

Skills

The skills we aim to develop are:


Literacy & Numeracy


Communication


Problem Solving


Metacognition


Leadership


Collaboration


Physical, Practical & Technical


Digital Literacy

For example:

<u>Literacy & Numeracy</u>
Developing their use of scientific vocabulary and nomenclature.
Recognising the importance of scientific quantities and understanding how they are determined.
Using SI units and IUPAC chemical nomenclature unless inappropriate.
Using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano).
Interconverting units.
Using an appropriate number of significant figures in calculations.
Use of tier 3 science specific language throughout the curriculum.

<u>Communication</u>
Presenting observations and other data using appropriate methods.
Presenting reasoned explanations, including relating data to hypotheses.
Communicating the scientific rationale for investigations, including the methods used, the Findings and reasoned conclusions, using paper-based and electronic reports and presentations.

<u>Problem Solving</u>
Use a variety models (spatial, mathematical etc) to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.
Appreciate the power and limitations of science and consider any ethical issues which may arise.
Explain every day and technological applications of science, evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.

<u>Metacognition</u>
Developing an understanding of the use of retrieval and interleaving within the science curriculum.
Explicit teaching about revision techniques.

<u>Leadership</u>
Understand how scientific theories develop over time.
Evaluating methods and suggesting possible improvements and further investigation.

Collaboration
Recognise the importance of peer review and of communicating results to a range of audiences.

Practical and Technical
Evaluate risks in both practical sciences and the wider societal context, including perception of risk in relation to data and consequences.
Use scientific theories and explanations to develop hypotheses.
Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
Applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments.
Carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.
Recognising when to apply a knowledge of sampling techniques to ensure any samples collected are representative.
Making and recording observations and measurements using a range of apparatus and methods.

Digital Literacy
Use of technology to support independence, Seneca and GCSE pod.
Using onenote to teach and supplement learning.

Qualities

The qualities we aim to develop are:

For example:

- **Kindness, Respect and Tolerance** are all developed in practical lessons, discussions and debates throughout KS3 and KS4 science.
- **Resilience** is developed throughout the curriculum as pupils are supported to embrace difficulty, and use it to improve
- **Creativity** is encouraged when making physical models of (often abstract) phenomena (e.g., model cells, models of atoms, space, wind turbines)
- **Integrity** is developed at pupils are encouraged to take responsibility for their own learning and development with the use of check lists and homeworks which support learning.

- **Positivity** is developed as pupils are asked to embrace difficult concepts, and learn to embrace challenge, and be constantly positive when facing adversity.
- **Empathy** is fostered when discussing challenging subjects (e.g., cloning, IVF, genetics, impact of using resources)
- **Aspiration** is embedded when discussing famous scientists, careers, university links & visits.

Curriculum Principles

Sequencing, Learning and Assessment

Our curriculum has been structured to consider the cognitive science of how we learn. Key knowledge is covered sequentially and deliberately revisited and built upon. Spaced practice and retrieval are a feature of the curriculum structure.

This is further reinforced by:

- Learning Challenge: a purely formative assessment to help evaluate, and then reshape learning and address misconceptions at the end of each unit.
- Learning Consolidation: a summative assessment, taken at a planned interval from the end of the unit, to help evaluate retention of learning in the long-term memory.

Cultural Capital

Cultural capital is developed throughout the curriculum with deliberate opportunities for all pupils (but especially disadvantaged pupils) to experience aspects of the taught curriculum through trips, events and activities and broaden their horizons.

For example:

- In Y10, groups of pupils are taken to Brackenhurst agricultural college in Southwell to experience careers and courses in subject areas that they might not have previously been exposed to or considered.
- International Women in Engineering week encourages participation in engineering-based activities to remove barriers to these career areas.
- British Science Week – every year a week of themed activities and events are developed and run by pupils from across the school.
- Ignite, in partnership with the Royal Society of Chemistry, work with local scientists and artists to deliver projects with the aim of pupils developing a product and presenting scientific information to other pupils.
- We visit local universities' science and engineering departments for Christmas lectures and Days in the Life of a Pupil.
- Yearly Y11 and Y13 trips to Science Live!!! To experience talks from inspirational famous scientists.

- We encourage and assist pupils in Y12 applying for the Nuffield Research placements during the summer holidays (aimed primarily at disadvantaged pupils and those with no family history of university)

Equality

We want our curriculum to reflect what it means to be a young, British woman today; for our pupils to know about the struggle and sacrifice that has led to the freedom and opportunity they have. We want them to know about their heritage and culture, and that of others in our community, enabling them to celebrate it and contribute to the progress of democracy as global citizens. We therefore regularly review and consult on the equality of our curriculum.

For example:

- Science and STEM themed events are organised for Women in Engineering Day, International Women's Day, and International Women in Engineering week, celebrating the role that women have played.
- In lessons, valuable contributions from a diverse range of female and male scientists are shared and discussed, demonstrating that everyone can achieve and that the glass ceiling can be shattered.

Careers and Employability

To support our pupils growing understanding of how our subject might support them with employment, we plan in explicit links between their subject area and possible career pathways. Examples of the careers and sectors we highlight are:

- We have strong links with outreach departments at both Nottingham Trent University and the University of Nottingham – visits are organised to Christmas lectures and STEM activity days to all pupils to experience different courses and a day in the life of an undergraduate.
- I'm a medic/engineer events allow……
- STEM careers are discussed at the beginning of every topic in KS3.
- Yearly Ada Lovelace trip to Biocity where companies such as Boots, Rolls Royce and Elasmogen offer interactive activities allowing exploration of different aspects of STEM. Pupils partake in a challenge.