Curriculum Overview

Science

Subject Leader

Mr P Jones

Intent

Key stage 3

We designed our KS3 Science curriculum to fully cover and exceed the national curriculum for science by the end of year 9. It is based upon the AQA KS3 Science syllabus. The Syllabus organises substantive and disciplinary knowledge required in the broad categories of "Know" what the pupils need to know, including definitions of key terms, "Apply" how pupils should be able to apply this knowledge and "Extend" how the pupils might be asked to look ahead and go beyond the Key Stage 3 curriculum.

We welcome our pupils into the subject of science by beginning with an "Introduction to Science'' topic. We then build on this to introduce the individual disciplines of Biology, Chemistry and Physics in year 7 and teach topics in a carefully sequenced rotation such that knowledge is introduced in a way which allows subsequent ideas to not only be accessed but also remembered long term.

We aim to ensure that all of our pupils, regardless of prior attainment or socio economic background are able to meet their potential. As such we utilise regular knowledge quizzes to quickly identify gaps in knowledge and support pupils who need it to make good progress. We also work closely with the SEND department, making use of LSA's and learning support plans to ensure that SEND pupils make as good progress as their peers. We ensure that the learning is unpackaged, providing support where it is needed and labelling tasks as "Essential", "Challenge" or "stretch" so that all are being challenged sufficiently.

Research has shown that students learn best when they are given clear instruction and understand what is required of them. Therefore, we encourage teaching through direct instruction methods which have been effective in raising student's attainment. We also break knowledge down into bite-size topics which are then revisited over time. They also benefit from regular low stakes assessment. In order to ensure that our students develop their literacy skills, we promote reading and develop writing skills through the use of open-ended questioning and extended written response tasks such as level assessed tasks.

Biology topics

Year 9

- Cell structure and transport
- Cell division
- Organisation
- The digestive system
- Photosynthesis
- Respiration

Chemistry topics

Year 9

- Earth's atmosphere
- Hydrocarbon science
- Fractional distillation
- Chromatography and gas testing
- Earth's resources and sustainability

Physics topics

Year 9

- Solids, liquids and gases
- Changing state
- Atomic structure
- Radioactivity

In order to promote reading at Key Stage 3, the curriculum includes level assessed tasks designed to increase a student's management of extended written prose and language tasks in lesson's design to increase quality of written communication, comprehension and oracy of our students. We also teach explicit etymology.

We develop key numeracy skills by teaching them directly as and where they arise within the curriculum. These are included in the schemes of learning and planned to be taught in such a way that ensures that pupils have the key numeracy skills required to access the Key Stage 4 curriculum.

Implementation

Key stage 3

At Key Stage 3, science is taught in 8 x 60-minute lessons per fortnight.

Our curriculum is broken into topics which fall under the distinct disciplines of Biology, Chemistry and Physics. In order to ensure that knowledge is introduced in a logical sequence (such that later topics come after pre requisite knowledge has been covered) and to allow for spaced retrieval, these topics are rotated throughout the year. To help our pupils become familiar with each of the science disciplines, and to help them develop schema we block the teaching into sequences. For example, particles is followed by atoms, elements and compounds or human reproduction is followed by plant reproduction.

Schemes of learning are written by experienced specialist teachers and include a list of objectives, derived from the MNSP science syllabus, itself based upon the AQA Science KS3 Syllabus.

Science department has broken each module into learning towers that subdivide the skills from each module into a differentiated tower of outcomes.

Each topic covered has a scheme of learning overview documents arranged as outlined above. The Schemes of Learning are based on the recommendations of the EEF's "Improving Secondary Science" report and are written by expert teachers and include:

- The knowledge required distilled into objectives for pupils
- Key literacy and numeracy knowledge which need to be taught as part of the lesson.
- Suggested activities and lesson sequence - recommended by expert teachers.
- Planned practical activities.
- Links to SMSC.
- Health and safety notes.

Lessons are then designed by teachers based on the "EPIBA" model:

- Engage
- Prior learning
- Introduce new knowledge
- Build knowledge
- Apply knowledge

We also include a language and plenary focus in each lesson to showcase learning.

Understanding is checked regularly through diagnostic, directed questioning in lessons, assessment for learning and through marking. Feedback is provided through both whole class feedback using 'level assessed tasks' which demonstrate whether students are developing, meeting or exceeding age-related expectations. We give "WWW" (What went well) and "EBI" (Even better if) to ensure that teachers and pupils are aware of gaps in their knowledge and able to fill them.

To ensure that pupils remember the knowledge long term, our assessment strategy makes use of:

- Frequent low stakes quizzes - at the discretion of the teacher
- Educake quizzes
- Formative level assessed tasks - every topic
- Summative assessments – every topic

At Key Stage 3, we teach in mixed classes. This is to ensure that all pupils have access to the same curriculum but those pupils with lower KS2 prior attainment are given support to reach the same objectives through scaffolding of tasks. Higher ability pupils are provided with "stretch" tasks which either require them to utilise more demanding numeracy and literacy skills or to consider ideas which go beyond the Key Stage.

We develop pupils' scientific literacy by highlighting keywords in lessons, by modelling the use of these keywords and through use of level assessed tasks and memorisation homework's.

In order to encourage a love of reading we:

- Include tasks in the language section of the EPIBA lesson where we develop writing, comprehension or oracy.
- Have a science subscription to the New Scientists magazine which pupils are able to read when they wish to.

In order to develop curiosity and understanding of scientific enquiry, pupils are given the opportunity to design and carry out their own variations of science investigations throughout the key stage 3. We give them opportunities to plan, perform and analyse their own experiments from scratch and evaluate their approach at the end of the investigations. For example, investigating factors that explore evaporation or testing factors that impact the efficacy of rollercoasters.

We have also purchased visualisers so that lessons could be taught remotely if needed and practical work could be done via demonstration but seen clearly by all. We also offer pupils with revision guides, access to online videos and tuition. Pupil premium students have these provided for them through the school.

Intent

Key stage 4

Our KS4 Science curriculum follows the AQA GCSE Combined Science and builds upon the concepts introduced in Key Stage 3.

Due to the relatively high proportion of high prior attaining students, Key stage 4 knowledge is first introduced in year 9 by building upon and extending the ideas covered in the Key stage 3 Science syllabus.

Topics are arranged under the individual disciplines of Biology, Chemistry and Physics and are carefully sequenced such that knowledge is introduced in a way which allows subsequent ideas to not only be accessed but also remembered long term.

Biology topics

Year 10

- Communicable diseases
- Preventing and treating diseases
- Non-communicable diseases
- Nervous control
- Hormonal control

Year 11

- Variation and evolution
- Genetics and evolution
- Adaptation, interdependence and communities
- Organising ecosystems
- Biodiversity

Chemistry topics

Year 10

- Rates of reaction
- Atomic structure
- Periodic Table
- Structure and bonding

Year 11

- Chemical calculations
- Chemical changes
- Energy changes
- Electrolysis

Physics topics

Year 10

- Electric circuits
- Electricity in the home
- Energy
- Forces
- Motion
- Forces and motion

Year 11

- Wave properties
- Electromagnetic waves
- Light
- Magnetism and electromagnetism

In order to promote reading at Key Stage 4, we have access to a vast array of New Scientist magazines and these are available for pupils to borrow (when available) so that they can read more widely around the subject, but also develop their scientific literacy. We also aim to introduce extended literacy and comprehension tasks, although these are currently under production.

We develop key numeracy skills by teaching them directly as and where they arise within the curriculum. These are included in the schemes of learning and planned to be taught in such a way that ensures that pupils have the key numeracy skills required to access the Key Stage 4 curriculum.

Implementation

Key stage 4

At Key Stage 4, help students be prepared for the demands of examinations by ensuring they know and can remember more and therefore apply this knowledge.

Science is taught in 8 x 60-minute lessons per fortnight (13/14 x 60min for separate science). All pupils study the AQA Combined Science Trilogy GCSE or AQA separate science. Sets 1 have 3 separate teachers sets 3 to 5 have two teachers. All pupils are taught by specialist science teachers.

Science department has broken each module into learning towers that subdivide the skills from each module into a differentiated tower of outcomes.

Each topic covered has a scheme of learning overview document arranged as outlined above. The Schemes of Learning are based on the recommendations of the EEF's "Improving Secondary Science" report and are written by expert teachers and include:

- The knowledge required distilled into objectives for pupils.
- Key literacy and numeracy knowledge which need to be taught as part of the lesson.
- Suggested activities and lesson sequence - recommended by expert teachers.
- Planned practical activities.
- Links to SMSC.
- Health and safety notes.

To ensure that pupils remember the knowledge long term, our assessment strategy makes use of:

- Frequent low stakes quizzes - at least weekly,
- Educake assessments
- formative assessment tasks - every topic,
- Summative assessments - termly.

In order to encourage a love of reading we:

- Include reading comprehension tasks in our curriculum where we provide an article for pupils to read and reflect upon.
- Have a school subscription to the New Scientists magazine which pupils are able to read when they wish to.

We have invested the in visualisers so that lessons could be taught remotely and practical work could be done via demonstration but seen clearly by all. We also offer pupils with revision guides, access to online videos and tuition.

Allocated curriculum time

	Y9	Y10	Y11
Fortnightly lesson allocation double science	8	8	9
Fortnightly lesson allocation triple science	N/A	14	13

Year 9

Throughout the year	Unit
TRANSPORTATION IN CELLS	Our intention is to explore how structural differences between types of cells enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells. If cells are isolated at an early stage of growth before they have become too specialised, they can retain their ability to grow into a range of different types of cells. This phenomenon has led to the development of stem cell technology. This is a new branch of medicine that allows doctors to repair damaged organs by growing new tissue from stem cells.
ORGANISATION OF OUR BODY SYSTEMS	Our intention is to teach about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis.
RATE AND EXTENT	Our intention is to understand the factors that influence the rate of chemical reactions. Students explore concepts like concentration, temperature, surface area, and the presence of catalysts, which can speed up or slow down reactions. The topic also covers reversible reactions and equilibrium, where the forward and backward reactions occur at the same rate. Understanding these processes is key for applications in industries like medicine, manufacturing, and environmental science. The importance of controlling reaction rates in various contexts, like food preservation or energy production, is also highlighted.
HOW TO ANALYSE CHEMICALS	Our intention is to understand that analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work.
IMPACTS ON OUR ATMOSPHERE	Our intention is to learn that the Earth's atmosphere is dynamic and forever changing. The causes of these changes are sometimes man-made and sometimes part of many natural cycles. Scientists use very complex software to predict weather and climate change as there are many variables that can influence this. The problems caused by increased levels of air pollutants require scientists and engineers to develop solutions that help to reduce the impact of human activity.
RESOURCES AND THINKING FOR THE FUTURE	Our intention is to teach that industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also

	aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists study how human activity has affected the Earth's natural cycles, and how damaging effects can be minimised.
PRINCIPLES OF MATTER	Our intention is to teach that the particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft.
ATOMS AND RADIATION	Our intention is to teach that ionising radiation is hazardous but can be very useful. Although radioactivity was discovered over a century ago, it took many nuclear physicists several decades to understand the structure of atoms, nuclear forces and stability. Early researchers suffered from their exposure to ionising radiation. Rules for radiological protection were first introduced in the 1930s and subsequently improved. Today radioactive materials are widely used in medicine, industry, agriculture and electrical power generation.
ENERGY	Our intention is to teach the concept of energy. It emerged in the 19th century and the idea was used to explain the work output of steam engines and then generalised to understand other heat engines. It also became a key tool for understanding chemical reactions and biological systems. Limits to the use of fossil fuels and global warming are critical problems for this century. Physicists and engineers are working hard to identify ways to reduce our energy usage.
SPACE	Our intention is to teach the structure and dynamics of the universe, including the solar system, the motion of planets, and the force of gravity. It explores the life cycle of stars, from formation to their end stages like supernovae or black holes, and the evidence for the expanding universe, such as redshift. The topic also discusses the Big Bang theory, which explains the origin and evolution of the universe, highlighting the vast and ever-changing nature of space.

Science

(AQA Trilogy) Combined sciences, worth 2 GCSEs:

- 21 required practical experiments
- 7 Biology topics, 10 Chemistry topics, 7 Physics topics.
- Six 1hr 15 min papers, 70 marks each,
- 15% practical content overall.

GCSE (Trilogy) Combined Sciences:
This specification encourages the development of knowledge and understanding in science through opportunities for working scientifically. The trilogy combined course awards **two GCSEs** and the students are awarded a double grade e.g. 4-4, 4-5, 5-5, 5-6.

(AQA Trilogy) Separate sciences, worth 3 GCSEs:

- 35 required practical experiments
- 7 Biology topics, 10 Chemistry topics, 8 Physics topics.
- Six 1hr 45 min papers, 100 marks each,
- 15% practical content overall.

Maths assessment:

- 10% maths content in each biology paper
- 20% maths content in each chemistry paper
- 30% maths content in each physics paper

Topics covered **(Separate is bold)**

Biology **Paper 1** 1. Cell biology 2. Organisation 3. Infection and response 4. Bioenergetics **Paper 2** 5. Homeostasis and response 6. Inheritance, variation and evolution 7. Ecology	**Chemistry** **Paper 1** 1. Atomic structure and the periodic table 2. Bonding, structure, and the properties of matter 3. Quantitative chemistry 4. Chemical changes 5. Energy changes **Paper 2** 6. The rate and extent of chemical change 7. Organic chemistry 8. Chemical analysis 9. Chemistry of the atmosphere 10. Using resources	**Physics** **Paper 1** 1. Energy 2. Electricity 3. Particle model of matter 4. Atomic structure **Paper 2** 5. Forces 6. Waves 7. Magnetism and electromagnetism **8. Space (SEP**

How can I help my child?

- Create revision resources: mind maps, storyboards, cue cards
- Purchase CGP science revision guide (this can be done through parent pay at a discounted price)
- Use DRIP sheets and practice papers to consolidate knowledge and practice exam technique (these are distributed to students by class teachers in yr11 but electronic copies can be found via science curriculum online)
- Encourage attendance to additional modular revision sessions (these run after school in yr11)
- Use online revision resources

  BBC Bitesize: https://www.bbc.co.uk/bitesize/examspecs/z8r997h
  Educake: https://my.educake.co.uk/student-login
  Seneca: https://senecalearning.com/en-GB/

Year 10

Throughout year	Unit
ELECTRICITY	Our intention is to teach that electric charge is a fundamental property of matter everywhere. Understanding the difference in the microstructure of conductors, semiconductors and insulators makes it possible to design components and build electric circuits. Many circuits are powered with mains electricity, but portable electrical devices must use batteries of some kind. Electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing and control. The fundamentals of electromagnetism were worked out by scientists of the 19th century. However, power stations, like all machines, have a limited lifetime. If we all continue to demand more electricity this means building new power stations in every generation.
FORCES	Our intention is to teach that engineers analyse forces when designing a great variety of machines and instruments, from road bridges and fairground rides to atomic force microscopes. Anything mechanical can be analysed in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible.
THE PERIODIC TABLE	Our intention is to teach that the periodic table provides chemists with a structured organisation of the known chemical elements from which they can make sense of their physical and chemical properties. The historical development of the periodic table and models of atomic structure provide good examples of how scientific ideas and explanations develop over time as new evidence emerges. The arrangement of elements in the modern periodic table can be explained in terms of atomic structure which provides evidence for the model of a nuclear atom with electrons in energy levels.
STRUCTURE AND BONDING	Our intention is to teach that chemists use theories of structure and bonding to explain the physical and chemical properties of materials. Analysis of structures shows that atoms can be arranged in a variety of ways, some of which are molecular while others are giant structures. Theories of bonding explain how atoms are held together in these structures. Scientists use this knowledge of structure and bonding to engineer new materials with desirable properties. The properties of these materials may offer new applications in a range of different technologies.
THE BASICS OF ORGANIC CHEMISTRY	Our intention is that students learn this branch of chemistry gets its name from the fact that the main sources of organic compounds are living, or once-living materials from plants and animals. These sources include fossil fuels which are a major source of feedstock for the petrochemical industry. Chemists are able to take organic molecules and modify them in many ways to make new and useful materials such as polymers, pharmaceuticals, perfumes and flavourings, dyes and detergents.
ENERGY CHANGES	Our intention is to teach by exploring how energy is transferred during chemical reactions. This includes studying exothermic reactions, where energy is released, and endothermic reactions, where energy is absorbed. Students will learn to identify and measure energy changes, using concepts like activation energy and energy profiles. The topic also covers the role of catalysts in lowering activation energy and how energy changes can be

	applied in real-world contexts, such as in fuels and batteries. Understanding these principles is essential for grasping how energy is involved in both everyday processes and industrial applications.
ECOLOGY	Our intention is to teach that the Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic.
BIOENERGETICS	Our intention is to teach energy flow within living organisms, particularly how energy is transferred and used in biological processes. It includes topics like photosynthesis, where plants convert light energy into chemical energy, and respiration, which releases energy from food molecules. The process of aerobic and anaerobic respiration, the role of enzymes, and factors affecting these processes are also explored. Understanding bioenergetics is crucial for explaining how organisms grow, reproduce, and respond to their environment.
INFECTION AND RESPONSE	Our intention is to teach students about how pathogens, such as bacteria and viruses, cause diseases in humans, animals, and plants. The topic covers the body's defense mechanisms, including the immune system's response to infections and how vaccines and antibiotics help prevent and treat diseases. It also explores the role of drugs in medicine and how the development of drug resistance can impact treatment. Additionally, students study different types of pathogens and how hygiene, lifestyle, and public health measures can reduce the spread of infections.

Year 11

Term	Unit
WAVES	Our intention is to teach that wave behaviour is common in both natural and man-made systems. Waves carry energy from one place to another and can also carry information. Designing comfortable and safe structures such as bridges, houses and music performance halls requires an understanding of mechanical waves. Modern technologies such as imaging and communication systems show how we can make the most of electromagnetic waves.
MAGNETISM AND ELECTROMAGNETISM	Our intention is to teach that electromagnetic effects are used in a wide variety of devices. Engineers make use of the fact that a magnet moving in a coil can produce electric current and also that when current flows around a magnet it can produce movement. It means that systems that involve control or communications can take full advantage of this.
HOMEOSTASIS AND RESPONSE	Our intention is to teach the structure and function of the nervous system and how it can bring about fast responses. We will also explore the hormonal system which usually brings about much slower changes. Hormonal coordination is particularly important in reproduction since it controls the menstrual cycle. An understanding of the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility.
INHERITANCE, VARIATION AND EVOLUTION	Our intention is to teach how the number of chromosomes are halved during meiosis and then combined with new genes from the sexual partner to produce unique offspring. Gene mutations occur continuously and on rare occasions can affect the functioning of the animal or plant. These mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics.
CHEMICAL CHANGE	Our intention is to teach that understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organising their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes. It also helped biochemists to understand the complex reactions that take place in living organisms.
QUANTITATIVE CHEMISTRY	Our intention is to teach that chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions.