Curriculum Overview

Science

Subject Leader

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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 7

- Cells
- Body structure and system
- Human reproduction
- Interdependence
- Plant reproduction

Year 8

- Respiration and photosynthesis
- Health and digestion
- Variation, inheritance and evolution

Year 9

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

Chemistry topics

Year 7

- Particles
- Atoms elements and compounds
- Separating mixtures
- Introduction to reactions

Year 8

- The periodic table
- Acids and alkalis
- Metals and non-metals
- Chemical energy
- Atmosphere
- Earth's resources

Year 9

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

Physics topics

Year 7

- Energy
- Forces
- Sound and waves
- The Earth in space

Year 8

- Motion and pressure
- Light
- Energy resources
- Electricity
- Magnets and electromagnets

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 9 x 50 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 and Seneca learning quizzes
- Formative level assessed tasks - every topic,
- Summative assessments - termly.

At Key Stage 3, we teach in set classes, which start in Y7 broadly based on English setting, but become based on student progress in Science in Y8 and 9, when they have completed a full range of topics. 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 school subscription to the New Scientists magazine which pupils are able to read when they wish to.
- On lessons where we are not performing an experiment we use DEAR time as per the school policy.

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 wind turbines.

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 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 11 x 50 minute lessons per fortnight. All pupils study the AQA Combined Science Trilogy GCSE. Sets 1 and 2 have 3 separate teachers with a specialism in each discipline to encourage uptake to key stage 5. Sets 3 to 6 have two teachers. All pupils are taught by specialist science teachers. For students not at a level accessible to A level sciences we encourage these students to take B-tec applied sciences. This course has a more vocational ethos and a focus placed on extended coursework rather than terminal examinations.

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 or Seneca learning 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. Finally, we sequenced our curriculum to make sure that topics which had been covered during the national lockdown, such as the science investigation unit, were visited again over the course or through after school revision sessions.

Allocated curriculum time

	Y7	Y8	Y9	Y10	Y11
Fortnightly lesson allocation	9	9	9	11	11

Year 7

Term	Unit
1&2	CELLS The intention of the unit is to teach that multicellular organisms are composed of cells which are organised into tissues, organs and systems to carry out life processes. There are many types of cell. Each has a different structure or feature so it can do a specific job. PARTICLES The intention of the unit is to teach that properties of solids, liquids and gases can be described in terms of particles in motion but with differences in the arrangement and movement of these same particles: closely spaced and vibrating (solid), in random motion but in contact (liquid), or in random motion and widely spaced (gas). ENERGY The intention of the unit is to teach that things happen when energy is transferred from one store at the start to another at the end. When energy is transferred, the total is conserved, but some energy is dissipated, reducing the useful energy. We use models to help us understand energy and energy transfer. ATOMS, ELEMENTS AND COMPOUNDS The intention of the unit is to teach that most substances are not pure elements, but compounds or mixtures containing atoms of different elements. They have different properties to the elements they contain.
3&4	BODY STRUCTURE AND SYSTEMS The intention of the unit is to teach that the parts of the human skeleton work as a system for support, protection, movement and the production of new blood cells. Antagonistic pairs of muscles create movement when one contracts and the other relaxes. Additionally, in gas exchange, oxygen and carbon dioxide move between alveoli and the blood. Oxygen is transported to cells for aerobic respiration and carbon dioxide, a waste product of respiration, is removed from the body. Breathing occurs through the action of muscles in the ribcage and diaphragm. The amount of oxygen required by body cells determines the rate of breathing. SEPARATING MIXTURES

	The intention of the unit is to teach that a pure substance consists of only one type of element or compound and has a fixed melting and boiling point. Mixtures may be separated due to differences in their physical properties. The method chosen to separate a mixture depends on which physical properties of the individual substances are different. FORCES The intention of the unit is to teach that when the resultant force on an object is zero, it is in equilibrium and does not move, or remains at constant speed in a straight line. One effect of a force is to change an object's form, causing it to be stretched or compressed. In some materials, the change is proportional to the force applied. Additionally, mass and weight are different but related. Mass is a property of the object; weight depends upon mass but also on gravitational field strength. Every object exerts a gravitational force on every other object. The force increases with mass and decreases with distance. HUMAN AND PLANT REPRODUCTION The intention of the unit is to teach that the menstrual cycle prepares the female for pregnancy and stops if the egg is fertilised by a sperm. The developing foetus relies on the mother to provide it with oxygen and nutrients, to remove waste and protect it against harmful substances. Furthermore, plants have adaptations to disperse seeds using wind, water or animals. Plants reproduce sexually to produce seeds, which are formed following fertilisation in the ovary. INTRODUCTION TO REACTIONS The intention of the unit is to teach that metals and non-metals react with oxygen to form oxides which are either bases or acids. Metals can be arranged as a reactivity series in order of how readily they react with other substances. Some metals react with acids to produce salts and hydrogen. Additionally, Combustion is a reaction with oxygen in which energy is transferred to the surroundings as heat and light. Chemical changes can be described by a model where atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved. SOUND AND WAVES The intention of the unit is to teach that sound consists of vibrations which travel as a longitudinal wave through substances. The denser the medium, the faster sound travels. The greater the amplitude of the waveform, the louder the sound. The greater the frequency (and therefore the shorter the wavelength), the higher the pitch.
5&6	INTERDEPENDENCE

The intention of the unit is to teach that organisms in a food web (decomposers, producers and consumers) depend on each other for nutrients. So, a change in one population leads to changes in others. The population of a species is affected by the number of its predators and prey, disease, pollution and competition between individuals for limited resources such as water and nutrients.

THE EARTH'S STRUCTURE
The intention of the unit is to teach that sedimentary, igneous and metamorphic rocks can be inter converted over millions of years through weathering and erosion, heat and pressure, and melting and cooling.

THE EARTH IN SPACE
The intention of the unit is to teach that the solar system can be modelled as planets rotating on tilted axes while orbiting the Sun, moons orbiting planets and sunlight spreading out and being reflected. This explains day and year length, seasons and the visibility of objects from Earth. Our solar system is a tiny part of a galaxy, one of many billions in the Universe. Light takes minutes to reach Earth from the Sun, four years from our nearest star and billions of years from other galaxies.

Year 8

Term	Unit
1&2	RESPIRATION AND PHOTOSYNTHESIS The intention of the unit is to teach that respiration is a series of chemical reactions, in cells, that breaks down glucose to provide energy and form new molecules. Most living things use aerobic respiration but switch to anaerobic respiration, which provides less energy, when oxygen is unavailable. Additionally, plants and algae do not eat, but use energy from light, together with carbon dioxide and water to make glucose (food) through photosynthesis. They either use the glucose as an energy source, to build new tissue, or store it for later use. Plants have specially-adapted organs that allow them to obtain resources needed for photosynthesis. THE PERIODIC TABLE The intention of the unit is to teach that the elements in a group all react in a similar way and sometimes show a pattern in reactivity. As you go down a group and across a period the elements show patterns in physical properties. MOTION AND PRESSURE The intention of the unit is to teach that If the overall, resultant force on an object is non-zero, its motion changes and it slows down, speeds up or changes direction. Additionally, pressure acts in a fluid in all directions. It increases with depth due to the increased weight of fluid, and results in an upthrust. Objects sink or float depending on whether the weight of the object is bigger or smaller than the upthrust. Different stresses on a solid object can be used to explain observations where objects scratch, sink into or break surfaces. ACIDS AND ALKALIS The intention of the unit is to teach that the pH of a solution depends on the strength of the acid: strong acids have lower pH values than weak acids. Mixing an acid and alkali produces a chemical reaction, neutralisation, forming a chemical mixture called salt and water.
3&4	HEALTH AND DIGESTION The intention of the unit is to teach that the body needs a balanced diet with carbohydrates, lipids, proteins, vitamins, minerals, dietary fibre and water, for its cells' energy, growth and maintenance. Organs of the digestive system are adapted to break large food molecules into small ones which can travel in the

	blood to cells and are used for life processes. METALS AND NON METALS AND CHEMICAL CHANGE The intention of the unit is to teach that metals and non-metals react with oxygen to form oxides which are either bases or acids. Metals can be arranged as a reactivity series in order of how readily they react with other substances. Some metals react with acids to produce salts and hydrogen. LIGHT The intention of the unit is to teach that when a light ray meets a different medium, some of it is absorbed and some reflected. For a mirror, the angle of incidence equals the angle of reflection. The ray model can describe the formation of an image in a mirror and how objects appear different colours. When light enters a denser medium it bends towards the normal; when it enters a less dense medium it bends away from the normal. Refraction through lenses and prisms can be described using a ray diagram as a model. ENERGY RESOURCES The intention of the unit is to teach that we pay for our domestic electricity usage based on the amount of energy transferred. Electricity is generated by a combination of resources which each have advantages and disadvantages. Calculate the cost of home energy usage, using the formula: cost = power (kW) x time (hours) x price (per kWh).
5&6	INHERITANCE AND EVOLUTION The intention of the unit is to teach that inherited characteristics are the result of genetic information, in the form of sections of DNA called genes, being transferred from parents to offspring during reproduction. Chromosomes are long pieces of DNA which contain many genes. Gametes, carrying half the total number of chromosomes of each parent, combine during fertilisation. Additionally, natural selection is a theory that explains how species evolve and why extinction occurs. Biodiversity is vital to maintaining populations. Within a species variation helps against environment changes, avoiding extinction. ATMOSPHERE The intention of the unit is to teach that carbon is recycled through natural processes in the atmosphere, ecosystems, oceans and the Earth's crust (such as photosynthesis and respiration) as well as human activities (burning fuels).

Greenhouse gases reduce the amount of energy lost from the Earth through radiation and therefore the temperature has been rising as the concentration of those gases has risen. Scientists have evidence that global warming caused by human activity is causing changes in climate.

ELECTRICITY

The intention of the unit is to teach that we can model voltage as an electrical push from the battery, or the amount of energy per unit of charge transferred through the electrical pathway. In a series circuit, voltage is shared between each component. In a parallel circuit, voltage is the same across each loop. Components with resistance reduce the current flowing and shift energy to the surroundings. Additionally, current is a movement of electrons and is the same everywhere in a series circuit. Current divides between loops in a parallel circuit, combines when loops meet, lights up bulbs and makes components work.

EARTH'S RESOURCES

The intention of the unit is to teach that there is only a certain quantity of any resource on Earth, so the faster it is extracted, the sooner it will run out. Recycling reduces the need to extract resources. Most metals are found combined with other elements, as a compound, in ores. The more reactive a metal, the more difficult it is to separate it from its compound. Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals.

MAGNETS AND ELECTROMAGNETS

The intention of the unit is to teach that magnetic materials, electromagnets and the Earth create magnetic fields which can be described by drawing field lines to show the strength and direction. The stronger the magnet, and the smaller the distance from it, the greater the force a magnetic object in the field experiences. Additionally, an electromagnet uses the principle that a current through a wire causes a magnetic field. Its strength depends on the current, the core and the number of coils in the solenoid.

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.
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.
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.

Science

(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.

Maths assessment:

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

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.
It covers a range of topics including:

Biology	**Chemistry**	**Physics**
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	**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	**Paper 1** 1. Energy 2. Electricity 3. Particle model of matter 4. Atomic structure **Paper 2** 5. Forces 6. Waves 7. Magnetism and electromagnetism

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 but electronic copies can be found via science curriculum online)
- Encourage attendance to additional modular revision sessions (these run after school between January and April)
- Use online revision resources
  BBC Bitesize: https://www.bbc.co.uk/bitesize/examspecs/z8r997h
  Seneca: https://senecalearning.com/en-GB/
  Educake: https://my.educake.co.uk/student-login

Year 10

Throughout year	Unit
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.
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.
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.

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.
Magnets and electromagnets	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.
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.
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.