KS4 Biology Spiral Curriculum

This curriculum map ensures a cohesive and integrated learning experience, where foundational knowledge from KS3 is expanded and deepened at the GCSE level

Module 1 Cell Biology

Intent:
Cells are the basic unit of all forms of life. In this module we 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.

Summary of topics:

- Eukaryotic and prokaryotic cells
- Microscopy
- Cell differentiation and specialisation
- Transport into and out cells
- Cell division
- Stem cells

Spiral Curriculum links:

This module builds on the following KS3 foundations

- Cells as the fundamental unit of life (7A Cells tissues and organs; 8D Unicellular organisms)
- Structure and function of cells (7A Cells tissues and organs; 8D Unicellular organisms)
- Use of microscopes (7A Cells tissues and organs; Year 9 practical project)
- Simple diffusion (7G Particle Model)

Module 2 Organisation

Intent:
In this module we will learn 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. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle.
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

Summary of topics:

- Principles of organisation

- Enzymes and digestion
- The human digestive system
- The heart and blood vessels
- Blood
- Coronary heart disease and health issues
- The respiratory system
- Plant tissues, organs, and systems

Spiral Curriculum links

This module builds on the following KS3 foundations:

- Levels of organisation (7A Cells tissues and organs)
- The basics of human anatomy and physiology (7C Muscles and bones – this topic includes an introduction to the circulatory and respiratory systems; 8A Food and nutrition; 8C breathing and respiration.
- Basic plant anatomy and photosynthesis (7A Cells tissues and organs; 8B Plants and reproduction; 9B Plant growth)

Module 3 Disease

Intent:
Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill.
This section will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics

Summary of topics:

- Communicable diseases
- Viral, bacterial, fungal, and protist diseases
- Growing bacteria (triple only)
- Human defence systems
- Vaccination
- Antibiotics and painkillers
- Discovery and development of drugs
- Monoclonal antibodies (triple only)
- Non-communicable diseases including cancer

Spiral Curriculum links

This module builds on the following KS3 foundations

- Microorganisms (8D unicellular organisms)
- Introduction to disease (8D unicellular organisms and 9D Biology transition)

Module 4 Bioenergetics

Intent:
In this Module we explore how plants harness the Sun's energy in photosynthesis in order to make food. This process liberates oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration. This process will supply energy but also causes the build-up of lactic acid in muscles which causes fatigue.

Summary of topics:
- Photosynthesis
- Respiration (aerobic and anaerobic)
- Metabolism

Spiral Curriculum links:
This module builds on the following KS3 foundations:
- Photosynthesis basics (7A Cells tissues and organs; 9B plant growth)
- Cellular respiration basics (7A Cells tissues and organs; 8C breathing and respiration)

Module 5 Response

Intent:
Cells in the body can only survive within narrow physical and chemical limits. They require a constant temperature and pH as well as a constant supply of dissolved food and water. In order to do this the body requires control systems that constantly monitor and adjust the composition of the blood and tissues. These control systems include receptors which sense changes and effectors that bring about changes.
In this module we explore 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.

Summary of topics:
- Homeostasis
- The human nervous system
- Brain and eye (triple only)
- Hormonal coordination in humans
- Control of blood glucose concentration
- Hormones in human reproduction
- Plant hormones (triple)
- The kidney (triple)

Spiral Curriculum links:
This module builds on the following KS3 foundations:
- Reproduction (7B sexual reproduction in animals)

Module 6 Genetics

Intent:
In this module we will discover 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. Once new varieties of plants or animals have been produced it is possible to clone individuals to produce larger numbers of identical individuals all carrying the favourable characteristic.
Scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. In spite of the huge potential benefits that this technology can offer, genetic modification still remains highly controversial

Summary of topics:

- Sexual and asexual reproduction
- Meiosis
- DNA and the genome
- Genetic inheritance
- Inherited disorders
- Variation and evolution
- Antibiotic resistance and natural selection
- Selective breeding
- Genetic engineering
- Cloning (triple only)
- History of genetics and evolution (triple only)
- Speciation (triple biology)
- Evidence for evolution
- Fossils and extinction

Spiral Curriculum links:
This module builds on the following KS3 foundations

- Basics of reproduction (7B sexual reproduction in animals; 8B Plants and their reproduction)
- Simple genetics (9A Genetics and evolution)
- Variation in species (7D ecosystems; 9A Genetics and evolution)
- Basics of evolution and natural selection (9A Genetics and evolution)
- Fossils (8H rocks)

Module 7 Ecology

Intent:
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. These ecosystems provide essential services that support human life and continued development.

In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being

Summary of topics:

- Communities and ecosystems
- Abiotic and biotic factors
- Sampling
- Adaptations, interdependence, and competition
- Organisation of an ecosystem
- Rates of decomposition (triple only)
- Biodiversity and the effect of human interaction on ecosystems
- Trophic levels in an ecosystem (triple only)
- Food production (triple only)

Spiral Curriculum links:

This module builds on the following KS3 foundations

- Ecosystems and their components (7D ecosystems)
- Basic interdependence and food webs (7D ecosystems; 9D Biology Transition)
- Sampling (Year 9 Practical projects)
- Human impact on the environment (7D Ecosystems; 8E combustion)
- Adaptations of organisms to their environment (7D Ecosystems; 9B Plant growth)
- Plant growth and crops (9B Plant growth)

KS4 Chemistry Spiral Curriculum

Module 1 Atomic structure and the periodic table

Intent:
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.

Summary of topics:

- Atoms, elements and compounds.
- Mixtures
- The development of the model of the atom.
- Electronic structure.
- Development of the periodic table.
- Metals and non-metals.
- Groups 0, 1 and 7
- Properties of transition metals (triple only)

Spiral Curriculum links:

This module builds on the following KS3 foundations

- Physical methods of separation (7E Mixtures and Separation)
- Elements, metals and non-metals (7H Atoms, Elements and Molecules)
- Physical and chemical trends (8F The Periodic Table)
- The Periodic Table (9G Chemistry Revision)
- Ions (9H Chemistry Transition)

Module 2 Bonding, structure, and the properties of matter

Intent:

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.

Summary of topics:

- The three states of matter.
- Chemical bonds, ionic, covalent and metallic.
- How bonding and structure are related to the properties of substances.
- Structure and bonding of carbon – diamond, graphite, graphene and fullerenes.
- Bulk and surface properties of matter including nanoparticles (triple only).

Spiral Curriculum links

This module builds on the following KS3 foundations:

- Solids, liquids and gases (7G The Particle Model)
- Metal properties (8G Metals and Their Uses)
- Ions (9H Chemistry Transition)

Module 3 Quantitative Chemistry

Intent:

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.
Chemical reactions can be classified in various ways. Identifying different types of chemical reaction allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas.

Summary of topics:

- Chemical measurements, conservation of mass and the quantitative interpretation of chemical equations.
- Relative formula mass and moles.
- Use of amount of substance in relation to masses of pure substances.
- Yield and atom economy of chemical reactions (triple only).
- Using concentrations of solutions in mol/dm^3 (triple only).
- Use of amount of substance in relation to volumes of gases (triple only).

Spiral Curriculum links
This module builds on the following KS3 foundations

- Describing reactions using balanced equations (9H Chemistry Transition)

Module 4 Chemical changes

Intent:

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. The extraction of important resources from the Earth makes use of the way that some elements and compounds react with each other and how easily they can be ‘pulled apart’.

Summary of topics:

- Reactivity of series.
- Extraction of metals.
- Oxidation/reduction in terms of electrons and ionic half-equations.
- Reactions of acids, neutralisation and salt production – pH scale.

- Titrations (triple only)
- Strong and weak acids.
- Electrolysis of molten ionic compounds and aqueous solutions.
- Metal extraction via electrolysis.

Spiral Curriculum links:
This module builds on the following KS3 foundations:

- Acids, alkalis, indicators and neutralisation (7F Acids and Alkalis)
- Making compounds (7H Atoms, Elements and Molecules)
- Chemical properties (8F The Periodic Table)
- Reactions of metals with water and acids (8G Metals and their Uses)
- Displacement reactions and metal extraction (9F Reactivity)

Module 5 Energy changes

Intent:
Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds. Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. Some interactions between ions in an electrolyte result in the production of electricity. Cells and batteries use these chemical reactions to provide electricity. Electricity can also be used to decompose ionic substances and is a useful means of producing elements that are too expensive to extract any other way.

Summary of topics:

- Exothermic and endothermic reactions.
- Reaction profiles.
- Energy change of reactions.
- Chemical cells and fuel cells (triple only).

Spiral Curriculum links:
This module builds on the following KS3 foundations:

- Energy and reactions (9F Reactivity)
- Energy transfers in reactions (9H Chemistry Transition)

Module 6 The rate and extent of chemical change

Intent:

Chemical reactions can occur at vastly different rates. Whilst the reactivity of chemicals is a significant factor in how fast chemical reactions proceed, there are many variables that can be manipulated in order to speed them up or slow them down. Chemical reactions may also be reversible and therefore the effect of different variables needs to be established in order to identify how to maximise the yield of desired product. Understanding energy changes that accompany chemical reactions is important for this process. In industry, chemists and chemical engineers determine the effect of different variables on reaction rate and yield of product. Whilst there may be compromises to be made, they carry out optimisation processes to ensure that enough product is produced within a sufficient time, and in an energy-efficient way.

Summary of topics:

- Calculating rate of reaction.
- Factors which affect rate.
- Collision theory and activation energy.
- Catalysts.
- Energy change and reversible reactions.
- Dynamic equilibrium.
- Effect of changing conditions on equilibrium.

Spiral Curriculum links:
This module builds on the following KS3 foundations

- Properties of metals (8G Metals and Their Uses)
- Rate of reaction and equilibrium (9H Chemistry Transition)

Module 7 Organic chemistry

Intent:
The chemistry of carbon compounds is so important that it forms a separate branch of chemistry. A great variety of carbon compounds is possible because carbon atoms can form chains and rings linked by C-C bonds. 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.

Summary of topics:

- Crude oil, hydrocarbons and alkanes.
- Fractional distillation.
- Properties of hydrocarbons.
- Cracking.
- Alkenes, alcohols, carboxylic acids (triple only).
- Addition/condensation polymerisation (triple only).
- Amino acids, DNA and other naturally occurring polymers (triple only).

Spiral Curriculum links:
This module builds on the following KS3 foundations

- Polymers (9E Making Materials)

Module 8 Chemical analysis

Intent:

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.

Summary of topics:

- Pure substance and formulations.
- Chromatography.
- Identification of common gases.
- Identification of ions by chemical and spectroscopic means (triple only).

Spiral Curriculum links:
This module builds on the following KS3 foundations

- Chromatography (7E Mixtures and Separation)

KS4 Physics Spiral Curriculum

Module 1 Energy and energy resources

Intent:
The concept of energy emerged in the 19th century. 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.

In this module we develop students prior learning on energy stores and transfers, expanding to then calculate how much energy is stored in specific situations. We link how energy can be transferred by work and how we can tell how efficient this process is.

We develop how energy is transferred by conduction and apply these ideas to determine how different materials have unique specific heat capacities. While those doing triple science shown how there are links between the colour and texture of materials is linked to the rate of energy transfer. We build on this further to explain the link between carbon dioxide and the greenhouse effect, using the ideas of blackbody radiation.

Students then bring these ideas together to look at generating energy to be transferred to power homes. Looking at the benefits and drawbacks of using renewable and non-renewable energy resources, while looking at where future developments could be made to meet the challenges that we face in future.

Summary of topics:

- Stores and transfers of energy
- Conservation of energy
- Work done and power
- Storing energy as gravitational potential, kinetic and elastic
- Efficiency
- Transfer of energy via heating
- Infrared radiation (triple only)
- Specific heat capacity
- Renewable and non-renewable energy resources

Spiral Curriculum links:
This module builds on the following KS3 foundations

- Energy stores and transfers (7I Energy, 8C Breathing and respiration, 8E combustion, 8K Energy transfers (9Fc Energy and reactions, 9Ia Energy for movement, 9K Physics revision)
- Conservation of energy (7I Energy, 8C Breathing and respiration, 8E combustion, 8K Energy transfers, 9K Physics revision)
- Work done and Power (8K energy transfer, 9Ia energy for movement, 9Ie More machines, 9K Physics revision)
- Storing energy (7I Energy, 9K Physics revision)
- Efficiency (7I energy, 8K energy transfers, 9I Forces and motion, 9K Physics revision)
- Transfer of energy via heating (7I energy, 8K energy transfers)
- Infrared radiation (8K Energy transfers)
- Specific heat capacity (8K energy transfer, 9K physics revision)
- Renewable and non-renewable energy resources (7I Energy, 9I Force and motion, 9K physics revision)

Module 2 Electricity and electrical power

Intent:

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.

Here students develop the key ideas around charge, current and potential difference. Allowing them to apply these across a variety of components and seeing how the relationship between potential difference and current relies on the variable of resistance. After this, students look at how the rate of energy transferred can be calculated and made as efficient as possible. This is done looking at the types of current, household circuits and how transformers enable the National Grid to be over 99% efficient.

Summary of topics:

- Principles of electrical charge and fields (Triple only)
- Electrical current and potential difference
- Electrical resistance
- Electrical power, transfer and efficiency

Spiral Curriculum links

This module builds on the following KS3 foundations:

- Principles of electrical charge and fields (Triple only) (7J Electricity, 7K Forces, 8L Earth and Space, 9J Force fields and electromagnetism, 9K Physics revision, 9L Physics transition)
- Electrical current and potential difference (7J electricity, 9J Force fields and electromagnetism, 9K Physics revision, 9L Physics transition, Year 9 Practical Projects)
- Electrical resistance (7J Electricity, 9J Force fields and electromagnetism, 9K Physics revision, 9L Physics transition, Year 9 Practical Projects)
- Electrical power, transfer and efficiency (7I Energy, 7J Electricity, 8K Energy transfer, 9K Physics revision)

Module 3 Particle Model of Matter

Intent:

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. It also explains why it is difficult to make a good cup of tea high up a mountain!

Within this module students develop on the ideas shared across the chemistry and physics course of the particle model. Applying how the particle model helps explain the fixed points for a pure substance at state changes, as well as how the mass and volume affect the density of materials. We also develop understanding on how we can calculate the energy required to cause substances to change state and the forms of energy that particles store. The ideas of density and particles are applied within the context of pressure to help explain

why heating a balloon causes it to expand, and for our triple students how changing the volume affects the pressure inside a container.

Summary of topics:

- Density and state change
- Internal energy and Specific latent heat
- Pressure and temperature in gases
- Pressure and volume in gases (Triple only)

Spiral Curriculum links

This module builds on the following KS3 foundations

- Density and state change (7G The Particle Model, 8I Fluids, 9K Physics revision, 9L Physics transition)
- Internal energy and Specific latent heat (7G The Particle Model, 8I Fluids, 8K Energy Transfers, 9K Physics revision, 9L Physics transition)
- Pressure in gases (7G The particle model, 7K Forces, 8I Fluids, 9K Physics revision, 9L Physics transition)

Module 4 Atomic Structure and Nuclear Radiation

Intent:
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.

Students within this module develop their knowledge of the atom to help understand the experiments that have led us to our current understanding. Seeing how science is built on evidence and how hypotheses and models change over time. This then allows our students to model what occurs when radioactive substances decay and release radiation. Students build on this knowledge on the types of ionising radiation, their properties and their potential dangers. We investigate how these dangers can be mitigated and the effect that half life can have on radioactive sources uses and risks. Our triple students further develop a knowledge of fission and fusion, and how it has the power to both create and destroy.

Summary of topics:

- Structure of the atom
- History of the atom
- Types of radioactive emission
- Half-life
- Nuclear fusion and Fission (Triple only)

Spiral Curriculum links:
This module builds on the following KS3 foundations:

- Structure of the atom (7H Atoms, elements and molecules, 8F The Periodic table, 9G Chemistry revision, 9H Chemistry transition)
- History of the atom (7H Atoms, elements and molecules, 8F The Periodic table, 9G Chemistry revision, 9H Chemistry transition)
- Types of radioactive emission (7H Atoms, elements and molecules, 8F The Periodic table, 9G Chemistry revision, 9H Chemistry transition)

- Half-life (7H Atoms, elements and molecules, 8F The Periodic table, 9G Chemistry revision, 9H Chemistry transition)
- Nuclear fusion and Fission (Triple only) (7H Atoms, elements and molecules, 8F The Periodic table, 9G Chemistry revision, 9H Chemistry transition)

Module 5 Forces and Motion

Intent:
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.

In this module we explore how forces affect objects and how we apply Newton's three laws of motion to objects. We look how we can use machines to reduce the forces needed to carry out work and how we can resolve forces to determine the resultant force in two dimensions. We build on this to then see the effect of these forces on an object's speed and velocity through diagrams and graphs.

We apply this knowledge to real world objects to explore how objects reach terminal velocity or how forces affect elastic objects. Some will then manipulate the principles of momentum to slow cars or reduce the chances of collisions or preventing those collisions causing damage.

Our triple students continue these ideas by looking into how different variables can affect the pressure for an object within a fluid. This includes explaining why our ears may pop on a flight or why at high pressure it is more difficult to get water to boil.

Summary of topics:
- Vectors and Scalars
- Newton's laws of motion
- Moments (Triple only)
- Resolving forces
- Speed (including distance time graphs)
- Acceleration (including velocity time graphs)
- Terminal Velocity
- Forces and Braking
- Momentum (Higher only)
- Forces and Elasticity
- Pressure in fluids (Triple only)
- Upthrust (Triple only)

Spiral Curriculum links:

This module builds on the following KS3 foundations:
- Vectors and Scalars (7K Forces 8L Earth and Space, 9I Forces and motion, 9J Force fields and electromagnets, Physics transition)
- Newton's laws of motion (7K Forces, 9I Forces and motion)
- Moments (Triple only) (7K Forces, 9I Forces and motion)
- Resolving forces (7K Forces, 9I Forces and motion)
- Speed (including distance time graphs) (7K Forces, 9I Forces and motion)
- Acceleration (including velocity time graphs) (7K Forces, 9I Forces and motion)
- Terminal Velocity (7K Forces, 9I Forces and motion)
- Forces and Braking (7K Forces, 9I Forces and motion)

- Momentum (Higher only) (7K Forces, 9I Forces and motion)
- Forces and Elasticity (7K Forces, 9I Forces and motion)
- Pressure in fluids (Triple only) (7K Forces, 8I Fluids, 9I Forces and motion)
- Upthrust (Triple only) (7K Forces, 8I Fluids, 9I Forces and motion)

Module 6 Waves and Electromagnetic waves

Intent:
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.

Within this section students learn how energy and information can be transferred through the use of oscillations. We build on the principles of waves to allow students to find different ways of calculating the speed of waves and how the media that those waves travel through affects their speed and direction. This is done by using experiments to determine the features of a transverse waves and calculate the wave speed from these variables. Our triple students gain an insight into how sound waves beyond our hearing range are used and how the oscillations within the Earth itself allow us to determine the origins or earthquakes and the very structure of the Earth itself.

Students will then use these ideas to understand that electromagnetic waves come in a spectrum of frequencies, and that each part of the spectrum has specific uses and dangers.

Our triple students look more deeply at the visible light section of the electromagnetic spectrum, learning how light reflects and refracts and how we can exploit the principles of light to use lenses to see clearly and how we see different colours.

Summary of topics:
- Transverse and Longitudinal waves
- Wave properties
- Reflection and Refraction
- Sound and ultrasound waves (Triple only)
- Seismic waves (Triple only)
- Electromagnetic Spectrum
- Use and dangers of the parts of the electromagnetic spectrum
- Reflection and refraction of light (Triple only)
- Colour (Triple only)
- Lenses and their uses (Triple only)

Spiral Curriculum links:
This module builds on the following KS3 foundations
- Transverse and Longitudinal waves (7L Sound, 8J Light, 9K Physics revision)
- Wave properties (7L Sound, 8J Light, 9K Physics revision, Year 9 Practical Projects)
- Reflection and Refraction (8J Light, 9K Physics revision)
- Sound and ultrasound waves (Triple only) (7L Sound, 9K Physics revision)
- Seismic waves (Triple only) (8H Rocks)
- Electromagnetic Spectrum (8J Light, 8K Energy transfers)
- Use and dangers of the parts of the electromagnetic spectrum (8J Light, 8K Energy transfers)
- Reflection and refraction of light (Triple only) (8J Light, 9K Physics revision)
- Colour (Triple only) (8J Light, 9K revision)

- Lenses and their uses (Triple only) (8J Light)

Module 7 Electromagnetism

Intent:
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 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.

Both trilogy and triple students learn about how certain metals have a permanent magnetic field and how those magnetic fields are shaped. They then look in detail at how a wire carrying current can generate an electromagnetic field. From this, students can look into what occurs when you place a wire carrying current into a permanent one at a right angle.

Our triple students take this further, applying these principles to understand how electricity is generated using three simple things: a magnetic field, a coil of wire and relative movement between the two. They are tasked with applying the motor and generator effect principles into everyday objects such as microphones, loudspeakers, dynamos and alternators.

Summary of topics:
- Permanent Magnets and their fields
- Electromagnets and their fields
- The Motor effect
- The Generator effect (Triple only)
- Transformers (Triple only)

Spiral Curriculum links:
This module builds on the following KS3 foundations
- Permanent Magnets and their fields (7K Forces, 8L Earth and Space, 9J Force fields and electromagnets)
- Electromagnets and their fields (7K Forces, 8L Earth and Space, 9J Force fields and electromagnets)
- The Motor effect (7K Forces, 9J Force fields and electromagnets)
- The Generator effect (Triple only) (9J Force fields and electromagnets)
- Transformers (Triple only) (9J Force fields and electromagnets)

Module 8 Space (triple only)

Intent:
Questions about where we are, and where we came from, have been asked for thousands of years. In the past century, astronomers and astrophysicists have made remarkable progress in understanding the scale and structure of the universe, its evolution and ours. New questions have emerged recently. ‘Dark matter’, which bends light and holds galaxies together but does not emit electromagnetic radiation, is everywhere – what is it? And what is causing the universe to expand ever faster?

In this module our triple students look at how are solar system began, exists and will end. Firstly, developing what the solar system is and how it came to begin. This is developed further looking at how stars like our sun and those much larger are born, how they live and how they die causing all the naturally occurring elements to be made. They are tasked with understanding how different forces act on objects in space and how orbits occur due to the interactions between different objects. Lastly, we develop how we know that the universe is

expanding and what hypothesis helps explain how we think the universe came into existence and why it is expanding.

Summary of topics:

- Formation of the Solar System
- Life cycle of a Star
- Planets, Satellites and orbits
- Expanding universe

Spiral Curriculum links:

This module builds on the following KS3 foundations

- Formation of the Solar System (8L Earth and Space)
- Life cycle of a Star (7H Atoms, elements and molecules)
- Planets, Satellites and orbits (8L Earth and Space)
- Expanding universe (8L Earth and Space)