Curriculum Overview – Science

Howden School

THE CONSORTIUM ACADEMY TRUST

Shaping Positive Futures

Introduction

This document outlines the curriculum and key considerations including:

- Aims and purpose
- Alignment with the whole school provision and curriculum intent
- A summary programme of study which includes sequencing of taught content

We use the National Curriculum as our statutory foundation and broadly share its principles and aims including:

- 'To provide pupils with an introduction to the essential knowledge that they need to be educated citizens. To introduce pupils to the best that has been thought and said; and help engender an appreciation of human creativity and achievement'.
- To prepare students to be confident in themselves, to have a fulfilled and successful life beyond our school – one where they contribute positively to society.
- Our statutory curriculum is just one element in the education of every child. There is time and space in the school day and in each week, term and year to range beyond statutory specifications.
- Provision of a framework of core knowledge around which teachers can develop exciting and stimulating lessons to promote the development of pupils' knowledge, understanding and skills as part of the wider school curriculum.
- The wider school curriculum includes an extensive range of opportunities and activities that are routinely available to students, are inclusive and reflect our diverse community.

Numeracy and literacy

Teachers should take opportunities to develop pupils' mathematical fluency, spoken language, reading, writing and vocabulary within their specific discipline and in line with the expectations laid out in our school curriculum statement.

Purpose of study

'A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.' Adapted from National Curriculum, DfE, 2015.

Curriculum Aims

The Howden School curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future and develop an interest and curiosity about science and careers in science
- can review evidence, make informed choices, and articulate their knowledge and skills

Building on prior learning

Building on their learning from Key Stage 1, pupils should have secured the following knowledge by the end of their primary school science curriculum.

Biology

- Identify and describe the functions of different parts of flowering plants: roots, stem-trunk, leaves, and flowers
- Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow
- Know the part that flowers play in the life cycle of flowering plants, including pollination, seed formation, and seed dispersal.
- Identify that humans and some other animals have skeletons and muscles for support, protection, and movement.
- Explore and use classification keys to help group, identify, and name a variety of living things in their local and wider environment.
- Describe the simple functions of the basic parts of the digestive system in humans.
- Identify the different types of teeth in humans and their simple functions.
- Construct and interpret a variety of food chains, identifying producers, predators, and prey.
- Describe the difference in the life cycles of a mammal, an amphibian, an insect and a bird.
- Describe the life process of reproduction in some plants and animals.
- Describe the changes as humans develop into old age.
- Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels, and blood.
- Describe the ways in which nutrients and water are transported within animals, including humans.
- Identify how animals and plants are adapted to suit their environment in different ways, and that adaptation may lead to evolution.

Chemistry

- Compare and group together different kinds of rocks based on their appearance and simple physical properties.
- Describe in simple terms how fossils are formed when things that have lived are trapped within rock.
- Recognise that soils are made from rocks and organic matter.

- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when they are heated or cooled.
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.
- Compare and group together everyday materials based on their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.
- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.

Physics

- Compare and group together a variety of everyday materials based on whether they are attracted to a magnet and identify some magnetic materials.
- Describe magnets as having two poles.
- Identify how sounds are made, associating it with vibration.
- Recognise that sounds get fainter as the distance from the sound source increases.
- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches, and buzzers.
- Use recognised symbols when representing a simple circuit in a diagram.
- Recognise some common conductors and insulators, and associate metal with being good conductors.
- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.
- Describe the movement of the Moon relative to the Earth.
- Identify the effects of air resistance, water resistance and friction, that act between moving surfaces.
- Recognising that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
- Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.
- Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.
- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

What can students do by the end of KS2?

Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary

- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

What are the skills gaps?

- Forming hypotheses and predictions

- Recording and presenting data
- Planning experiments
- Taking accurate measurements

Curriculum Structure

The deliberate teaching of health and safety forms the foundation to building practical skills that students apply to plan valid experiments, develop a range of measuring and observing skills which build in complexity over time. The ability to analyse patterns, describing and explaining phenomena is critical to developing our student ability to think like a Scientist. We collaborate with our Mathematics department to use a common language and calculation methods across the Science and Maths based subjects. Examples include learning how to apply a line of best fit to a scatter graph, use standard form in the context of science and rearrange algebraic equations to change the subject of formulae.

<table>
<tr><th>Subject Discipline</th><th>Knowledge threads</th><th>Key Concepts</th></tr>
<tr><td>Biology</td><td>• Cells and organisms
• Infection and response
• Bioenergetics
• Homeostasis
• Inheritance
• Ecology</td><td rowspan="3">Applying Knowledge and Understanding
• Using contextual knowledge to new situations and processes

Variables
• Understanding and using independent, dependent and control variables to plan and conduct fair and valid investigations

Methods
• Communicate procedural approaches and processes

Data and graphs
• Collecting and presenting scientific results in appropriate formats

Conclusions
• Explaining patterns using scientific ideas and concepts

Evaluations
• Considering strengths and weaknesses of practice and identifying areas for improvement.</td></tr>
<tr><td>Chemistry</td><td>• Atomic structure and periodic table
• Properties of matter
• Quantitative chemistry
• Chemical changes
• Energy changes
• Rates of reaction
• Organic chemistry
• Analytical chemistry
• Atmosphere
• Using resources</td></tr>
<tr><td>Physics</td><td>• Energy
• Electricity
• Particles
• Atomic structure
• Forces
• Waves
• Magnetism and electromagnetism
• Space</td></tr>
</table>

Vocabulary

Having a rich, ambitious, broad vocabulary is vital for learners to succeed, both in school and throughout their lives.

Tier 1 vocabulary is the simplest. These are the words we use in everyday conversation, such as “put”, “get”, “walk”, etc. On the other side of the spectrum, Tier 3 vocabulary is the subject-specific vocabulary of a particular discipline. These are words that aren’t used outside of the context of a specific subject, or have a different meaning in one subject versus another. In the middle of these two tiers is Tier 2 vocabulary. Tier 2 vocabulary are challenging, ambitious words that don’t usually crop up in day-to-day conversation. These are the words that allow us to access academic texts, such as high-level literature, newspaper articles and exam papers.

At Howden School, tier 3 and tier 2 vocabulary is explicitly taught across our school curriculum. Our tier 2 vocabulary includes selected words from Coxhead’s High-incidence Academic Word List - this list provides a concise list of the most important academic words learners need to succeed in school and later life.

Curriculum Sequencing

Key Stage 3: Year 7 – Long Term Planning

	Autumn term	Spring term	Summer term
Knowledge	**Science skills and Particles** • Safety, Units, Measuring, Recording, • The Scientific method • Modelling • Theories • Particle model • Simple chemical reactions • Word equations Students learn to identifying hazards and risks in lab environments. What to do when things go wrong. How to use equipment safely including Bunsen burners. To take measurements and consider the best equipment for the task. Students will learn the 3 Models for the states of matter, and they will use the models to explain processes and phenomena. Students will also use model to represent chemical reactions and write simple word equations.	**Energy Matters** • Energy transfers • Energy in food • Electricity and basic circuits • Electricity generation • Non renewables (org chem) • Renewables • Nuclear, Chernobyl • Carbon neutral Students learn to Identify different energy types and describe examples of each. Students learn to about energy stores and transfer including energy diagrams. Students learn about the conservation of energy and how to draw energy transfer diagrams which show energy is conserved. Build and draw simple circuits. Describe the behaviour of current and voltage in series and parallel circuits. Student will learn how electricity is generated.	**Restless Earth** • Origins of the Earth • Atmospheric gases / Gas test • Geological timescales • Volcanoes and Earthquakes • Rock types • Rock cycle Students learn about geological timescales. Students learn to understand our place in the Earth’s history. Describing and explaining causes of earthquakes and volcanoes Identify the gases in the atmosphere and how volcanoes can alter these. Pupils learn how to model the rock cycle and explain abstract ideas such as rock formation. Students will use data to make predictions about eruptions and earthquakes. **Extreme sports** • Forces • Balanced and unbalanced forces

	<u>All about You</u> • MRSGREN • Cells- plant, animal • Microscopy (calculations) • Tissues and organs and systems • Reproduction • Stem cells Students learn how living things are organised so that students can appreciate the need to nurture their own health, as well as that of living things in their surroundings.	They will Identify and describe energy production types as renewable and non-renewable and evaluate carbon footprints. **<u>Ecological Disaster</u>** • Classification • Habitats • Plastics • Food chains and webs • Adaptations • Evolution • Sampling Students learn to Identify the classify groups for a variety of organisms including the reasons for being in the group. Students will name and describe different habitats. Explain adaptations. Students learn to use food chains and food webs to make predictions about populations Students learn how natural selection leads to evolution within a species.	• Forces calculations Students learn to identify and name forces. Measure forces and describe how to change the magnitude of a force. Describing and explaining features of the fastest vehicles. Drawing force diagrams and calculating resultant forces. Use idea of forces to explain or describe motion.
Skills	Development of theories Measuring with a range of apparatus Converting units Identification of key variables Carrying out simple reactions Recording observations and plotting line graphs Using a light microscope Recording observations Identification of key variables Evaluating evidence	Following instructions and procedures to draw and build circuits. Researching renewables energy resources. Evaluating energy resources Classifying, sequencing and organising food chains into food webs. Making predictions and evaluating evidence Development of theories. Sampling skills – Collecting and recording evidence.	Assessing risk Analysis of data Identification of patterns Measuring forces Planning investigations into friction and elasticity Using scales, Using SI units, Changing units Identification of key variables
Tier 3 Vocabulary	Tripod, gauze, beaker, conical flask, cylinder, test tube, boiling tube. Senses, reproduction Nucleus, cytoplasm, membrane Vacuole, chloroplast, cell wall	Kinetic, elastic, gravitational, electricity, nuclear Joules, calories Respiration Circuit Current, voltage and resistance	Tectonic Core, Mantle and crust. Lava and Magma. Seismic Thrust, upthrust, tension, drag

		Quadrat	Newtons, Newton meter
Tier 2 Vocabulary	**Investigate** **Method** **Precise** Precaution **Physical** **Energy** Evaporate, condense Magnification, resolution Specialised	**Parallel** **Series** **Chemical** Efficiency, transfer Conservation Interdependence **Environment** Ecosystem	**Cycle** **Predicted** Waves Weight Gravity Friction Air resistance
Assessment	Identifying unsafe and safe behaviours safely in labs and the workplace Naming equipment and procedures Choosing the correct equipment Describing methods Using scales, SI units, changing units Naming parts and functions for cells Describing the relationship between cells, tissues, organs and organ systems. Explain function of organs and systems. Describing process and stages in reproduction. Explain the role of stem cells and their uses.	Drawing energy transfer diagrams Building circuits and recording voltage and current reading Ability to predict outcomes and explain observations. Using the keywords to accurately describe organisms. Describing interdependence Predict how changes in one population effect another within a food webs or food chains.	Describing the structure of planet Earth Identifying rock types Describing and explaining the rock cycle and eruptions/earthquakes Interpreting force diagrams. Using force diagrams to describe motion Describing how to change a force Calculating balanced and unbalanced forces.

Key Stage 3: Year 8 – Long Term Planning

	Autumn term	Spring term	Summer term
Knowledge	**Forensics** • Hazards and risks – Hazard warning symbols • Elements, compounds and mixtures • Chemical analysis- flame tests • Solubility and Chromatography • Acids and Alkalis • Neutralisation and use of pH indicators • Pure/ impure • Melting points and boiling points	**Athlete's camp** • Health • Diet • Digestion- enzymes • Breathing • Circulation and blood/ heart • Respiration • Exercise Students learn about factors that affect health both positively and negatively. They will describe	**Material World** • Assessing Risk • Atoms • Atomic structure (basic) • Periodic table (trends and patterns) • Reactions (metals) • Word and symbol equations. Students will learn to write a risk assessment. Students learn to describe the particle models and define the atom.

	Student's revisit identifying hazards and risks in the lab and in the workplace. They will name hazard symbols and identify chemicals carrying symbols. Identify, define, draw and model elements, compounds and mixtures. Describe analytical techniques, flame tests, chromatography, and pH tests. **Space Exploration** • Big bang theory • Solar system- changing ideas • Gravity • Weight • Light years • Waves and observing space • Light and Sound (telescopes/ stars) Students learn to describe the origins of the universe and our place within it. Describe the scale of the solar system and universe. Describe how ideas about the solar system have changed and explain why the theories have altered over time. Describe how Gravity effects objects and explain factors that affect gravity. Describe methods used to measure the size and scale of the solar system.	how fitness can be measured. Collecting basic health data and analysing it. The function of the digestive system. The role of enzymes and their function. Describe the parts of the circulatory system and their function. Describe the parts of the respiratory systems and their function. Respiration as a chemical reaction with and without oxygen. Comparing the effect of exercise on health. **In the Kitchen** • Conduction (metal properties) • Convection • Radiation • Waves- IR • Emission and absorption • Specific heat capacity Identify conductors and conductors Describing the conduction of heat and electricity in metals Test metals to find the best conductors. Describe and explain convection in gases and fluids. Identify the best emitters and absorbers of radiation and make prediction based on evidence. Describe heating and colling of different substances.	Describe the basic structure of the atom. Name the key parts of the periodic table and describe the trends and pattern within the elements. Find chemical element names and explain the symbol naming systems. Describe simple chemical reactions for metals. **Old MacDonald** • Food production and population • Photosynthesis (limiting factors) • Plant cells • Leaf adaptations • Plant health • Uses of starch Describe land use in the UK and classify different types of farming. Test the best conditions for plant growth and photosynthesis. Name the organelles in plant cells and describe their function. View a cross section of a leaf and identify the key structures. Explain the adaptation. Identify and describe plant diseases and factors harmful to plants. How plant use starch.
Skills	Testing pH using different indicators Measuring melting point Paper chromatography Scale of the solar system and universe Use of standard form	Taking measurements of heart rate and breathing rate. Carrying out surveys and describing patterns in the data. Testing electrical conduction. Planning a method to investigate the best conductors. Recording multiple results and calculating a mean. Drawing bar and line graphs	Writing risk assessments Planning investigations into reactivity Making observations and recording results Drawing line of best fit graphs Interpreting evidence and writing conclusions Evaluating methods and techniques

Tier 3 Vocabulary	Atoms Molecules Solvent, Solute Litmus, Acid, Alkali, Neutralisation Pure, Impure, Soluble	Carbohydrates, protein Convection Radiation Emitters, absorbers	Alkali Halogen Photosynthesis, chlorophyll, chloroplasts, stomata,
Tier 2 Vocabulary	**Concentration** **Bond** Particle Universal **Element** **Compound**, mixtures **Period**	Pulse Recovery Conduction **Interpret**	**Formula** **Hypothesis** Risk Interpret Adaptation
Assessment	Identifying hazards and risks in the lab and in the workplace. Name hazard symbols and identify chemicals carrying symbols. Name everyday acids and alkalis Convert pH scale colour into numbers Identify, define, draw and model elements, compounds and mixtures. Describe the process of chromatography and pH tests. Write conclusions using evidence collected from analytical techniques. Describe the origins of the universe. Identify order scale of the solar system and universe. Describe ideas about the solar system and explain why they have changed. Describe and explain motion in relation to gravity. Describe methods used to measure the size and scale of the solar system.	Name factors that affect health. Describe the impact of lifestyle choices on health. Describe indicators of how fitness. Interpret health data to arrive at conclusion about risk factors. Explain using data how health could be improved. Name the parts of the digestive system and explain their function. Describe and explain the function of enzymes. Name parts of the circulatory system and explain their function. Describe the parts of the respiratory systems and their function. Describe Respiration and write word and symbol equations to represent the chemical reaction. Identify the process of heat transfer. Classify materials as conductors and conductors Describing and explain the process of conduction. Use experimental data to find the best conductors for a purpose. Describe and explain convection in gases and fluids. Identify the best emitters and absorbers, describe their function and write prediction about heating and cooling based on evidence.	Describe hazards and evaluate risks. Draw particle models and define the atom. Name parts of the periodic table and describe the trends and pattern within the table. Write word and symbol equations Describe different types of farming. Evaluate organic farming. Analyse data about farming describing patterns and trend in the data. Identify best conditions for plant growth and photosynthesis. Describe how plants use starch. Name the organelles in plant cells and describe their function. Describe how to use a microscope. Explain adaptations of cells. Identify and describe plant diseases and factors harmful to plants.

Key Stage 3: Year 9 – Long Term Planning

	Autumn term	Spring term	Summer term
Knowledge	**Keeping healthy** • Diet • Drugs • Smoking • Hormones • Menstrual cycle • Infectious diseases (STIs) • Vaccination (HPV) Students learn to describe a healthy diet. Student study the different methods used to test food. Students learn about the chemicals in vapes/ tobacco and describe how they affect health. Students learn about the effect of alcohol. Students will classify different types of drugs. Name example of hormones and describe how they affect the organism. Students learn to identify STI's and classify STI's. Students learn how vaccine prevent infection. Student research the impact vaccines have on public health. **Grand designs** • Insulation • Using natural resources • Circuits- resistance (ser/parr recap) • Electricity bills • Electromagnets • Power • Waves- communication Students learn to describe temperature gradients. Students learn to classify materials as conductors and insulators.	**Recipe of Life** • Cells chromosomes DNA • Discovery of DNA structure • Inheritance • Genetic illness • Selective breeding Students learn to describe the cell its parts and their function. Students learn to describe how features are inherited and give example of inherited features. Students study patterns in inheritance and explain them. Students learn about the process of fertilisation and how to predict the characteristics the child will inherit. Students learn about genetic illnesses and describe how they are inherited. Students learn how farmers can control inheritance through selective breeding. **Final Frontier** • Acid rain • Global warming • Climate change • Data • Solutions • Life cycle assessment/ plastics Students develop an understanding of the impact human activity has had and is having on the planet. Students learn about environmental problems, their causes and impacts. Students learn to evaluate the evidence and possible bias.	**Forces and Engineering** • Forces • Work done • Pressure • Moments • Calculations Students learn to name forces and draw examples of them with Force arrows. Students learn to calculate Speed, distance and time in race scenarios. Describing motion and how forces can change motion Building vehicles and testing them Acceleration and deceleration Calculating work done, pressure and moments. **STUDENTS BEGIN GCSE COMBINED SCIENCE BIOLOGY 1** • Cell Biology • Organisation • Infection & response • Bioenergetics See Year 10 for more detail.

	Describe how insulators prevent the transfer of heat. Evaluate the use of different materials as insulators. Understand the environmental impact when constructing a building. Understand how to build circuits, naming parts and using symbols.	Students learn about possible solutions and ways to reduce the impact of for climate change. Student study plastic as a useful material and learn to complete life cycle assessment.	
Skills	Research Evaluating evidence Draw circuit diagrams Take measurements of voltage and current Build electromagnets	Research skills and group work skills Analyse evidence Think critically about information they are provided with.	Working as a team Designing and building a gravity racer Taking measurement of time Calculating speed
Tier 3 Vocabulary	Microbes, pathogens, Bacteria, Fungi and Virus Electron, Proton, Neutron Voltage, current, resistance. Moment	Dioxide, Methane Neutralisation Concentration	Ribosomes Mitochondria Pressure
Tier 2 Vocabulary	**Evaluate** **Analyse** Complete Incomplete Gradient	**Evolution** **Sustainable** Correlation Magnification Image	**Implication** Acceleration Extension Balanced, Unbalanced, Resultant
Assessment	Identify healthy food and unhealthy foods. Describe a healthy diet. Identify food groups and describe food tests for carbohydrates, Protein and fat. Name the chemicals in tobacco. Describe how smoking and alcohol impact health. Classify different types of drugs. Identify hormones and describe how they affect the organism. Identify STI's and classify STI's. Describe and explain how vaccine prevent infection. Explain how vaccine play a positive role in public health. Describe the movement of heat energy. Classify materials as conductors and insulators.	Describe the cell its parts and their function. Describe inherited characteristics and give example. Using provided data identify and describe patterns in inheritance. Describe the process of fertilisation. Predict the characteristics a child will inherit. Name examples of genetic illnesses and describe how they are inherited. Describe the process farmers use to selectively breed. Describe the impact human activity has had and is having on the planet. Name environmental problems, the pollution that causes them and describe the impact. Evaluate data about environmental issues to assess the possible impact.	Name forces and missing forces to diagrams Describing motion and how forces can change motion. Describe the motion or change in motion for an object based on a force diagram. Calculate Speed, distance and time. Describe factors that affect acceleration and deceleration Calculating work done, pressure and moments. Describe ways to increase and decrease pressure and turning forcers.

	Analyse data to identify the most effective insulator. Evaluate the use of different materials as insulators. Identify fault in circuit and predict the behaviour of circuits.	Review evidence for signs of possible bias. Describe possible solutions and ways to reduce the impact of for climate change. Student study plastic as a useful material and learn to complete life cycle assessment.	

Key Stage 4 Year 10 – Long Term Planning AQA GCSE Combined Science Trilogy

	BIOLOGY	**CHEMISTRY**	**PHYSICS**
Knowledge	<u>Cell Biology</u> • Structures • Functions • Mitosis and Meosis. • Stem cells Students should be able to develop an understanding of size and scale in relation to cells, tissues, organs and systems. Students learn that cells are the basic unit of all forms of life. Students learn the cell structures and about cell differentiation. Students learn why cell division happens and to compare mitosis and meiosis. Student will learn about Gene expression and function. Students study stem cells, their function and stem cell technology. <u>Organisation</u> • Organs • Transport systems Students learn about organ systems and their roles. The human digestive system, food and nutrition.	<u>Atomic structure</u> • Periodic table • Elements • Physical and chemical properties • Atomic models Students learn about the periodic table, its structure and organisation. Students study the historical development of the periodic table. 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. Students should be able to represent the electronic structures of the first twenty elements of the periodic table in both forms <u>Structures and Bonding</u> • Physical and chemical properties • Bonding theories • Materials Students learn how chemists use the theories of structure and bonding to explain the physical and chemical properties of materials. That analysis of structures shows that atoms can be arranged	<u>Energy</u> • Energy types • Output and transfer • Fossil fuels Students learn that 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. Students learn that the limits to the use of fossil fuels and global warming are critical problems for this century. The link between work done (energy transfer) and current flow in a circuit is covered. <u>Electricity</u> • Charge • Conduction • Circuits • Power Students learn that electric charge is a fundamental property of matter everywhere. That the difference in the microstructure of

	Students learn about the chemicals in the blood and the movement of dissolved materials within the circulatory system. Students learn that damage to any of these systems can be debilitating if not fatal. Students learn about the progress in medical techniques, with regards to coronary heart disease. Effect of improved diet and lifestyle. Plant's transport system and how environmental conditions effect plant cells. <u>Infection & response</u> • Pathogens • Disease • Immune system Students learn that pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. Students learn that microbes can produce toxins that damage tissues and make us feel ill. Students will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Students study the function of the immune system. The look at the risks from unusual or dangerous diseases, the role of vaccination and antibiotics. <u>Bioenergetics</u> • Photosynthesis • Respiration Students learn that plants can harness the Sun's energy in photosynthesis to make food. That 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	Students study examples of Giant lattice structures. That 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. <u>Quantitative Chemistry</u> • Compound formulae • Reaction equations • Chemical symbols Students use quantitative analysis to determine the formulae of compounds and the equations for 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. <u>Chemical changes</u> • Predictions • Complex reactions Students learn that experimenting with chemical reactions in a systematic way and organizing their results logically. Students learn about the reaction of metal with oxygen and acids. Students learn about the reaction of metal oxide and metal carbonates acids. Students learn about new materials and processes.	conductors, semiconductors and insulators makes it possible to design components and build electric circuits. Students learn that electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing, and control. <u>Particle model of matter</u> • Particle behaviour • Applications • Pressure and temperature Students learn how the particle model is used to predict the behaviour of solids, liquids and gases and its 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. <u>Atomic structure</u> • Nuclear forces • Radiation Students learn about the structure of the atom, nuclear forces and stability. Students learn about ionising radiation, that it is hazardous but can be very useful. They will learn about the discovery of radiation and how ideas about radiation have changed. Early researchers suffered from their exposure to ionising radiation. Students learn how radioactive materials are used in medicine, industry, agriculture and electrical power generation.

	transfers the energy that the organism needs to perform its functions. That anaerobic respiration and lactic acid in muscles causes fatigue.	Understand the complex reactions that take place in living organisms. The extraction of important resources from the earth. <u>Energy Changes</u> • Energy transfer • Electricity production Students learn that energy changes are an important part of chemical reactions. About the transfer of energy leading to the breaking and formation of bonds. Students study Exothermic reactions and Endothermic reactions. Students learn about heating and cooling effect in a range of everyday applications. Students learn that some interactions between ions in an electrolyte result in the production of electricity and how cells and batteries use these chemical reactions to provide electricity.	
Skills	**Required practical - Microscopes** • Recognise, draw and interpret images of cells. • Calculate magnification, image size and actual size • Use models and analogies to develop explanations of how cells divide. **Required practical - Osmosis** • Recognise, draw and interpret diagrams that model osmosis **Required practical - Food tests** **Required practical - Enzyme.** • Use models to explain enzyme action. • Make observation and draw blood cells seen under a microscope. • Interpret data about risk factors for specified diseases	**Required practical - Preparation of a pure, dry sample of a soluble salt** • Investigate pH changes when a strong acid neutralises a strong alkali. • Recognise and use expressions in decimal form. • Use ratios, fractions and percentages. • Make estimates of the results of simple calculations. • Translate information between graphical and numeric form. • Mixing of reagents to explore chemical changes and/or products. **Required practical - Electrolysis** • Safe use of a range of equipment to separate chemical mixtures. • Explain how testing a prediction can support or refute a new scientific idea.	**Required practical - Specific heat capacity** • Recall and apply equations to calculate the energy change involved when the temperature of a material changes. • Measure energy transferred. • Calculate efficiency. **Required practical - Resistance of a wire** • Translate information between graphical and numeric form. **Required practical - Investigate I–V characteristics of a variety of circuit elements** • Measure the melting point for a substance. • Interpret graphs showing the heating of ice. **Required practical: Measuring densities** • Assess danger from different radioactive sources.

	Required practical - Photosynthesis • Make observation and drawing of a transverse section of leaf. • Process data from investigations involving stomata and transpiration rates to find arithmetic means. • Use different sampling techniques and calculate surface areas and volumes. • Solve simple algebraic equations.	**Required practical - Exothermic and Endothermic reaction investigation** • Drawing and interpreting appropriate graphs from data to determine rate of reaction. • Plot two variables from experimental or other data. Determine the slope and intercept of a linear graph. Draw and use the slope of a tangent to a curve as a measure of rate of change	• Model half-life • Draw half-life graphs
Tier 3 Vocabulary	Diffusion Osmosis Pathogen Vector Parasite Oxidation	Atomic, Subatomic Covalent, Ionic, lattice Reactivity, Oxidation Salt Titration Exothermic, Endothermic, Activation	Gravitational Potential difference Voltmeter, Ammeter Ohm, Coulomb Ionisation, Alpha, Beta, Gamma, Geiger counter
Tier 2 Vocabulary	**Area** **Qualitative** Dissolve Absorb Microbe Specialised	**Accurate** Reactions, classify, Behaviour Quantitative Formulae **Reject** Rate Bond	**Output** **Resource** **Generation** Transfer **Nuclear** Dose Penetration
Assessment	Name cells organelles and describe their functions. Describe cell differentiation and describe the role of different cells within the body. Evaluate the practical risks and benefits, as well as social and ethical issues, of the use of stem cells in medical research and treatments. Name organ systems and describe their roles/functions Name the part of the human digestive system and describe the function of different parts. Classify food types and describe nutrition. Explain how different diet and lifestyle choices effect health.	Describe the periodic table and its organisation. Describe the structure of the modern periodic table and use the idea of groups and periods to explain atomic structure. Identify the subatomic particles and describe their properties. Draw electron structures for atoms in the first 20 elements. Name and describe historical models of the atom and explain why the models changed. Identify bonding types and explain the physical and chemical properties of materials.	Name examples of energy. Complete energy transfer diagrams. Calculate input or output energy and efficiency. Explain how to reduce energy losses. Describe how we can make fossil fuels last longer. Calculate savings from reducing energy usage. Explain how reducing fossil fuel use reduces global warming. Describe specific energy changes such as falling, lifting an object, fuelling a vehicle. Name materials which are good conductors and good insulators.

	Name the chemicals in the blood and predict the movement of dissolved materials within the circulatory system. Recognise, draw and interpret diagrams that model diffusion. Describe the role of the heart and possible circulatory problems. Explain how progress in medical techniques, can reduce risk and treat coronary heart disease. Evaluate risks related to use of blood products. Evaluate methods of treatment bearing in mind the benefits and risks associated with the treatment. Name the pathogen types and give examples of infections caused by them. Describe how microbes can produce toxins that damage tissues and make us feel ill. Describe how we can avoid infection and limit the spread of disease. Describe and explain the function of the immune system. Evaluate the risks from unusual or dangerous diseases, vaccination and the overuse of antibiotics. Describe how plants can harness the Sun's energy in photosynthesis to make food. Describe plant transport systems and how plants use starch. Use data to relate limiting factors to the cost effectiveness of adding heat, light or carbon dioxide to greenhouses. Explain how the atmosphere has changed over time and why it has changed. Describe aerobic respiration and anaerobic respiration using word equations. Investigations into the effect of exercise on the body.	Name examples of small molecules, polymers or giant structures from diagrams showing their bonding. Identify substances as metallic giant structures from diagrams showing their bonding. Use theories of bonding to explain how atoms are held together in these structures. Identify signs of chemical reactions and rank reactions in terms of reactivity. Classify types of chemical reaction. Describe patterns in reactions and explain them. Describe and explain how the formulae of compounds and the equations can be deduced from reacting quantities. Describe and predict the reactions between... • metal with oxygen • metal and acids • metal oxide and acid • metal carbonates acids Describe the extraction of important resources from the earth and how the ores can be chemically processed. Describe energy changes in chemical reactions. Students study Exothermic reactions and Endothermic reactions. Students learn about heating and cooling effect in a range of everyday applications. Describe and explain energy profile diagrams. Calculate missing values from energy profile diagrams.	Describe electric charge and how its electrons behave in terms of attraction and repulsion from terminals. Name uses for electricity and identify high lower and low power devices. Calculate power. Explain the link between energy, power and time. Describe the relationship between the resistance of a thermistor and temperature. Describe relationship between the resistance of an LDR and light intensity Describe particle models for solids liquids and gases. Explain material behaviour using the particle model. Describe and explain changes of state using kinetic theory. Draw graphs to displaying how states of matter change as materials are heated identifying key changes. Describe ionisation and why it is dangerous. Describe the discovery of radiation. Explain why ideas about radiation have changed. Describe the danger from radiation and different types of radiation. Describe half-life and explain how to calculate it. Describe significant medical and industrial uses of radioactivity.

Key Stage 4: Year 11 – Long Term Planning AQA GCSE Combined Science Trilogy

	Biology	Chemistry	Physics
Knowledge	<u>Homeostasis & Response</u> • Nervous system • Glucose • Hormones Students learn about the human endocrine system and the importance of homeostasis. Students learn the structure and function of the nervous system. Students learn about the control of blood glucose concentration and diabetes. Students study hormones in human reproduction and contraception. **Higher tier - The use of hormones to treat infertility. Negative feedback.** <u>Inheritance, variation & Evolution</u> • Reproduction • Cell division including revisiting mitosis and meosis • Genetics • Evolution Students learn about sexual and asexual reproduction. Students will learn about DNA and the human genome. Students learn how to draw genetic cross diagrams and determine gender from them. Students study genetic inheritance and genetic diseases. Students study selective breeding and assess its impact. Students learn about classification and Variation. Students study Evolution and Evidence for evolution. Fossils and Extinction.	<u>Rates of reaction</u> • Activation Energy • Energy change • Equilibrium Students learn about collision theory and activation energy. They study the factors which affect the rate of chemical reactions including heat, concentration, surface area catalysts and pressure. Students will calculate the rate of reaction and study reversible reactions and energy changes and reversible reactions. **Higher tier - The effect of changing concentration/temperature/pressure on equilibrium** <u>Organic chemistry</u> • Fossil Fuels • Distillation • Hydrocarbons • Alkenes and polymerisation Students learn about the process of fossil fuel formation. The naming systems for alkanes and alkenes. Students build on their knowledge of separation techniques and look at the fractional distillation process. Students learn to describe the patterns in the fractions from crude oil in terms of flammability, boiling point, colour and viscosity. Students study the properties and structures of hydrocarbons – Alkanes and Alkenes.	<u>Forces</u> • Scalars and vectors • Motion change • Energy transfer • Elasticity • Pressure • Newton's Laws • Momentum Students learn about scalar and vector quantities. Students identify examples of contact and non-contact forces. Students learn about gravity, balanced and unbalanced and they develop their ability to draw forces diagrams. Students will use force diagrams to calculate resultant force and predict motion changes. Students learn about work done and energy transfer. They will investigate Forces and elasticity. They will also study pressure in a fluid and atmospheric pressure. Students learn to describe motion along a line and calculate. Students draw and interpret distance-time graphs and speed time graphs. Students will measure acceleration and factors effecting it. Students learn Newton's Laws of motion and factors affecting braking distance and stopping distance. **Higher tier - Momentum is a property of moving objects. Conservation of momentum. Pressure in a fluids.** <u>Waves</u> • Properties • Emission and absorption

	Students learn about antibiotic resistant bacteria and how they have evolved. Students study genetic engineering <u>Ecology</u> • Abiotic and biotic factors • Adaptation • Decomposition • Biodiversity Students learn about communities and levels of organization. Students learn about adaptations how they help organisms survive. Students study how materials are cycled and decomposition. They will look at waste management, land use, deforestation and revisit global warming. Students learn about the importance of biodiversity and maintaining biodiversity.	Students learn about the cracking process including the conditions. <u>Chemical analysis</u> • Formulations • Chromatography Students learn about pure substances and define formulations. Students study chromatography and gas tests. They will complete gas test for hydrogen, oxygen and carbon dioxide. Students will also learn about tests for chlorine gas. <u>Chemistry of the Earth's Atmosphere</u> • Composition and change • Pollutants Students learn about the composition of the Earth's atmosphere and how it has changed. They will revisit oxygen production and photosynthesis, carbon dioxide the role plants play in reducing the level in the atmosphere. Students learn about the greenhouse gases and climate change. Students learn about their carbon footprint and its reduction. <u>Using the Earth's resources</u> • Classification • Water Treatment Students learn to identify resources required for life on Earth. Resources will be classified as finite/renewable/sustainable. Students learn about potable water and water treatment methods. Students study the Life cycle assessment and carry them out. They will also look at ways of reducing the use of resources.	Students learn about examples of transverse and longitudinal waves. They will study the properties of waves. Students learn about types of electromagnetic waves, their properties and the uses and applications of electromagnetic waves. Students will investigate the emission and absorption of infrared radiation. <u>Magnets and Electromagnets</u> • Poles • Fields • Electromagnetism Students learn about the poles of a magnet, magnetic fields and how to view them. Students learn about the movement of poles within a magnetic field. Students investigate factors affecting electromagnetism. **Higher tier - Fleming's left-hand rule, Electric motors.**

		Higher tier - Alternative methods of extracting metals.	
Skills	**Required practical - Reaction time, Variables** • Use of apparatus, recording measurements. • Safe and ethical use of a living organisms (plants or animals). • Translate data into graphs. **Required practical - Field investigations** • Use of apparatus, recording measurements • Safe and ethical use of a living organisms (plants or animals) • Use sampling techniques to study distribution and abundance of organisms. • Develop hypotheses. • Plan experiments to test hypotheses. • Use of transects and quadrats. • Estimates of population size. • Understand principles of sampling. • Use mean, mode and median. • Plot and draw appropriate graphs.	**Required practical - Rates of reaction** • Plan experiments or devise procedures. • Record a range of measurements accurately. • Use an appropriate number of significant figures. • Safe and careful handling. • Draw conclusion from data collected. • Develop hypotheses. • Evaluate methods and suggest possible improvements. • Make estimates of the results of simple calculations. • Translate data into graphs. • Measure of rate of change. **Required practical - Water Purification** • Use of appropriate apparatus • Measurement of pH in different situations. • Draw conclusion from data collected. • Separate chemical mixtures including. evaporation/distillation and chromatography • Safe use of appropriate heating devices. **Required practical – Chromatography** • Separate chemical mixtures including. evaporation/distillation and chromatography • Record a range of measurements accurately.	**Required practical - Force and extension** • Plan experiments or devise procedures. • Carry out experiments with correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. • Translate data from one form to another. • Plot two variables from experimental or other data • Carry out and represent mathematical and statistical analysis. • Use an appropriate number of significant figures in calculation. **Required practical – Acceleration** • Use apparatus and techniques to measure motion. • Develop hypotheses. • Evaluate methods and suggest possible improvements. • Present and interpret observations and data. • Present reasoned explanations including relating data to hypotheses. • Use SI units. **Required practical – Waves** • Use of appropriate apparatus • Present observations and other data using appropriate methods.
Tier 3 Vocabulary	Stimulus, Response Receptors Neurone, Effector, Muscle Reflex Diabetes, Glucose, Glucagon, Insulin	Particles, Collisions, Kinetic, Rate, Activation, Heat, Catalysts Hydrocarbons, mixtures, Alkanes and Alkenes, Saturated Formulations, Chromatography,	Tension Extension Moment Amplitude, Frequency, Wavelength Electromagnetic

	Hypoglycaemia and Hyperglycaemia Oestrogen, testosterone, Progesterone Pituitary Chromosomes Abiotic, Biotic	Solubility Limewater Photosynthesis, Respiration, Eruptions Potable Filtration and Distillation	Ultraviolet, Infrared, Microwaves, Radio waves Poles, Magnetic fields,
Tier 2 Vocabulary	**Domain** Variation Inherited Environmental Extinction Ecosystem Adaptation Decomposition Deforestation Biodiversity	**Cycle** Equilibrium Substance Pure, impure Reversible and irreversible **Finite** **Sustainable** **Publish** Recycling	Scalar and Vector Resultant Longitudinal **Transmit** Transverse Spectrum
Assessment	Describe the human endocrine system and homeostasis. Name significant structure in the endocrine system and hormones. Describe the CNS. Name senses and sensory organs. Describe reflex actions and non-reflex responses. Describe and explain control of blood glucose concentration and diabetes. Name the hormones in human reproduction and contraception. Describe and explain the role of hormones in contraception. **Describe and explain the use of hormones to treat infertility.** Describe classification and Variation providing examples. Describe sexual and asexual reproduction. Describe where DNA is stored and what is made from. Describe the human genome. Draw genetic cross diagrams and determine gender from them. Name genetic diseases,	Describe and explain how different factors affect the rate of a chemical reaction using the idea of collision theory and activation energy. Calculate the rate of reaction. Describe reversible reactions and energy changes and reversible reactions. **Explain the effect of changing concentration/temperature/pressure on equilibrium** Describe the formation of fossil fuel Describe crude oil as a mixture of hydrocarbons. Name and draw molecules of alkanes and alkenes. Describe and explain the separation techniques fractional distillation. Describe the patterns in the fractions from crude oil. Describe the process of cracking and the conditions used. Describe pure substances and define formulations.	Give examples of scalar and vector quantities. Name examples of contact and non-contact forces. Describe the behaviour of object in gravitational fields. Identify examples of balanced and unbalanced. Draw and complete forces diagrams. Calculate resultant force and predict motion changes. Describe and Calculate work done. Calculate extension and elastic potential energy. Describe motion along a line and calculate speed, time and distance. Draw and interpret distance-time graphs and speed time graphs. Calculate acceleration. Describe Newton's Laws of motion. Describe braking distance and stopping distance and the factors affecting them. **Calculate Momentum** Describe waves transverse and longitudinal and give examples. Describe the properties of waves. Name EM waves, give examples, uses and describe the EM spectrum. Describe emission and absorption of infrared radiation and make predictions.

	describe their causes and show their inheritance with genetic cross diagrams. Describe selective breeding and assess its impact. Describe the process of natural selection leading to Evolution. Identify the key Evidence for evolution. Describe the formation of Fossils and how they can support the theory of Evolution. Describe Extinction and its causes. Describe and explain how antibiotic resistant develop and evolve. Give examples of genetic engineering and describe its uses. Describe communities and how they are organization. Identify adaptations how they help organisms survive. Describe how materials are cycled and decomposition. Describe waste management, land use, deforestation and global warming. Explain the importance of biodiversity and maintaining biodiversity.	Describe analytical techniques such as chromatography and gas tests. Interpret data from analytical techniques. Describe the composition of the Earth's atmosphere and explain how it has changed. Name greenhouse gases and explain the process of climate change. Evaluate evidence for climate change. Describe carbon footprint and how it can be reduced. Identify resources required for life on Earth. Classified as finite/renewable/sustainable. Evaluate resources and their use. Describe potable water and water treatment methods. Describe Life cycle assessment and apply the process to products. Describe ways of reducing the use of resources. **Describe and explain alternative methods of extracting metals.**	Identify poles of a magnet and describe attraction and repulsion. Draw magnetic fields. Describe and explain factors affecting electromagnetism. **Make predictions using Fleming's left-hand rule.** **Describe Electric motors and explain their function.**