Curriculum Statement
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. At The Trafalgar School students will be taught essential aspects of scientific knowledge, methodology and process. Through the building up of a body of key foundational knowledge and concepts, students will be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They will be encouraged to understand how science can be used to explain observations, predict how things will behave and analyse causes.
Curriculum Intent & *Impact
Students will be taught scientific language *so that* ***they can describe the phenomena they have observed and 'communicate like a scientist'.**
Students will develop their use of scientific vocabulary, including the use of scientific nomenclature, units and mathematical representations *so that* ***they can solve scientific problems, interpret data and draw conclusions.**
Students will develop an understanding of the nature, processes and methods of science through varied science enquiries *so that* ***they can answer scientific questions about the world around them.**
Students will develop their confidence in working scientifically *so that* ***they are able to use a variety of approaches to investigate scientific questions.**
Students will develop their ability to evaluate scientific claims through critical analysis of the methodology, evidence and conclusions, both qualitatively and quantitatively *so that* ***they can make informed decisions.**
Students will learn to apply observational, practical, modelling, enquiry, problem-solving and mathematical skills, both in the laboratory and in the field and in other environments *so that* ***they can work scientifically.**
Students will learn that science is about working objectively, modifying explanations to take account of new evidence and ideas *so that* ***they can question existing ideas.**
Students will develop an awareness that science progresses through a cycle of hypothesis, practical experimentation, observation, theory development and review *so that* ***they can review real world information and make informed life choices.**
Students will use conceptual models and theories to make sense of the observed diversity of natural phenomena *so that* ***they can explain the world around them.**
Students will have the foundations for understanding the natural world and to enhance their lives in an increasingly technological society *so that* ***they can lead a life fulfilled**.
Beyond lessons students will have opportunities to participate in the annual Science Fair. This event will provide students with an opportunity to investigate a science, technology, engineering or maths question that they are interested in, formulate and test their own hypothesis before their work is presented at the annual Science Fair evening.

Year 7

	Terms 1 and 2				Terms 3 and 4			Terms 5 and 6		
Units	Transition	Cells & Systems	Matter, Atoms & Elements	Forces	Plants & Photosynthesis	Pure & Impure Substances	Electricity & Magnetism	Reproduction	Acids & Alkalis	Energy Stores & Pathways
Key Learning	Students learn about health and safety in the Science laboratory and learn to use a variety of Science equipment including a Bunsen burner.	Students learn about the structure of plant and animal cells. They learn to prepare slides and use a microscope. They also learn about muscles	Students learn why solids, liquids and gases behave as they do. They learn to define atoms, elements, compounds and mixtures and are introduced to	Students learn how to represent forces and calculate resultant forces. They learn about moments and pressure. Students investigate how	Students learn about photosynthesis and how leaves are adapted to their function. They learn about food chains, food webs and interdependence.	Students learn about separation techniques including filtration, evaporation, distillation and chromatography. They also learn about diffusion and dissolving.	Students learn how to draw circuit diagrams and measure current and voltage. They learn to define and calculate resistance. They learn about static electricity	Students learn about reproduction in humans including the structure and function of the reproductive organs, fertilisation, gestation and birth.	Students learn about acids and alkalis and how to identify their pH using a range of indicators. They learn about neutralisation and making salts.	Students learn about different energy stores. They learn about heat energy transfers through conduction, convection and radiation.

		and the skeleton.	the Periodic table.	a spring stretches.			and electromagnets.			
Assessment		Creating a Model Cell.	Investigating Ice Cubes practical.	Parachute practical recording results and drawing a graph.	Predator Prey graphs.	Describing methods for Separating techniques.	Electricity & Magnetism end of topic test.	Reproduction end of topic test.	Investigating antacids practical	Multiple choice assessment.
Homework	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.

Year 8									
	Terms 1 and 2			Terms 3 and 4			Terms 5 and 6		
Units	Nutrition & Digestion	Speed & Motion	Earth & Atmosphere	The Periodic Table	Waves, Light & Sound	Gas Exchange & Respiration	Chemical Reactions	Inheritance, Chromosomes & Genes	Space Physics
Key Learning	Students will learn about the key nutrients required to maintain a healthy human diet along with the consequences of imbalances in the diet, how tissues and organs are adapted for their function within the digestive system and the importance of bacteria and enzymes in the human digestive system. They will also carry out food tests and how to determine the energy content in food.	Students will learn about the quantitative relationship between average speed, distance and time. Students will be able to use the equation speed = distance ÷ time and represent a journey on a distance-time graph. Students will investigate and be able to explain the forces being needed to cause objects to stop or start moving, or to change their speed or direction of	Students will learn about the structure of the Earth and the differences between rock types, along with how they were formed. Students will be able to recall the key properties of different rock types and explain the events involved in the rock cycle. They will also learn about the differences between polymers, composites and ceramics- going on	Students will learn about the history and development of the Periodic Table, including the arrangement of elements and their properties. Students will revisit atoms and elements and be introduced to the structure of the atom, including sub atomic particles. They will investigate the reactions of metals and the reactivity of metals along with how metals can be extracted.	Students will learn about the properties of both sound and light waves and be able to use diagrams to represent the transmission of light through different objects and explain colour and the function of the eye. Students will investigate the speed of sound.	Students will learn about the processes of breathing and respiration and how breathing rate is altered with exercise. Students will learn how the structures involved with these key processes are adapted for their function and how the rate of diffusion can be altered.	Students will learn to use word and symbol equations to represent reactions. Students will be able to explain how atoms are rearranged during chemical reactions. The will study combustion, oxidation and thermal decomposition reactions along with the reactions of metals and	Students will learn the structure of DNA and how characteristics are inherited. They will study human evolution and the classification system along with completion within and between the species. Students will learn about the reasons behind extinction and why conservation is important.	Students will learn the structure of the solar system, how the universe was created and why we have day and night and seasons. Students will study eclipses and the phases on the moon and learn about the importance of scientific developments in relation to our understanding of the scale of the universe

		motion, in qualitative terms.	to why we use certain materials for certain tasks/applications.				metal oxides and endothermic and exothermic reactions and how catalysts alter chemical reactions.		and is their life on other planets.
Assessment	Extended writing task on the stages, adaptations and process of digestion.	Car velocity investigation.	Earth and Atmosphere assessment.	The Periodic Table end of topic test.	Waves, light and sound test.	Extended writing task the journey of oxygen molecule.	Chemical reactions end of topic test.	Inheritance, chromosomes & Genes end of topic test.	Multiple choice assessment.
Homework	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.

Year 9										
	Terms 1 and 2			Terms 3 and 4				Terms 5 and 6		
Units	Adaptation, Interdependence & Competition	Atomic Structure	Molecules & Matter	Cell Biology	The Periodic Table	Energy Transfer by Heating	Cell Division	Organisation & the Digestive System	Structure & Bonding	Energy Resources
Key Learning	Students will learn about the importance of communities and factors that affect communities. They will be able to measure the distribution and abundance of organisms and describe competition in animals and plants. Students will be able to describe how	Students will learn about the history of the atom, evidence that supports the current model of the atom. They will learn the sub atomic particles within the atom, their charges and how to deduce the number of each of these particles. They will learn how	Students will learn about the properties of the states of matter and what is meant by melting and boiling point. They will learn about internal energy and specific latent heat. Students will be able to explain how gases create pressure and how pressure	Students will learn the similarities & differences between prokaryotic & eukaryotic cells along with specialisation in both animal & plant cells. Students will be able to describe what can be seen under electron microscopes and how to	Students will learn about the history and development of the periodic table. They will be able to link electronic structures to the periodic table and explain the trend in reactivity of the alkali metals and halogens. Students will be able to state the	Students will learn how energy is transferred and infrared radiation. They will learn how to reduce the rate of energy transfer, especially in the home and how to calculate specific heat capacity. Students will be able to discuss the ways in	Students will learn the role of chromosomes in cells, the importance of the cell cycle and how cells divide via mitosis. They will be able to explain how differentiation varies in animals and plants and the use of stem cells.	Students will be learn how cells are organised into tissues and tissues form organs. They will learn the structures involved in human digestion and how these are adapted. They will also learn how the digestive system works, including the	Students will be able to explain how atoms form ions and that melting and boiling point is dependant of the nature of particles and the forces between them. Students will learn about ionic, covalent and metallic substances and how the	Students will learn about how energy demands are met and the fuels used to generate electricity. They will learn about how wind, water, the sun and Earth can be used to generate electricity and the impact of different fuels

	animals and plants are adapted to survive.	to represent the electronic structure of an atom and ion and how to explain separation techniques.	changes the volume of a gas. Students will be able to complete pressure equations.	carry out magnification calculations. They will be able to explain the process of osmosis, diffusion and active transport & the adaptations of organisms for exchanging materials, including surface area to volume calculations.	properties of the transition elements.	which homes are heated.		role of enzymes, stomach acid and bile.	structure and bonding of substances is linked to their properties. Students will learn about nanoparticles and their current and potential application.	on the environment.
Assessment	Adaptation, Interdependence & Competition test.	Atomic structure and molecules and matter test.		Cell biology end of unit test.	Extended writing task explaining the reactivity of group one & group seven elements.	Multiple choice assessment.	Cell biology and Division end of unit assessment.	Extended writing task on the process and adaptations for digestion.	Structure and bonding end of unit exam.	Multiple choice assessment.
Homework	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.	Learning of key facts and key words. Preparation for assessments.

Key Stage 4 Biology: Separate Science

Year 10

	Terms 1 and 2		Terms 3 and 4		Terms 5 and 6	
Units	B4 Organising Animals & Plants B5 Communicable Diseases	B6 Preventing & Treating Disease B7 Non-Communicable Diseases	B8 Photosynthesis B9 Respiration	B10 The Human Nervous System	B12 Homeostasis in Action	B17 Organising an Ecosystem B18 Biodiversity & Ecosystems
Key Learning	Students will learn about the components of blood, how it flows around the body and the structure and function of the heart and human gas exchange system. They will be able to describe organ systems in a plant and how substances are transported in plants. Students will learn about the process of transpiration and the role of stomata and guard cells. Students will also learn about what health is and how pathogens are spread. They will be able to explain how bacteria multiply and how infection can be prevented. Students will be able to name examples of bacterial, viral, fungal disease and those caused by protists. Students will be able to explain the human and plant defence response.	Students will learn how the immune system works and how the process of vaccination prevents disease. They will be able to explain the use of antibiotics and painkillers and the stages involved in developing new drugs. Students will learn how monoclonal antibodies are produced and be able to explain how they are used, including evaluating their advantages and disadvantages. Students will learn about non communicable diseases and lifestyle factors, they will learn the difference between a benign and malignant tumour and how cancer spreads. They will learn about risk factors for disease and the treatments for cancer.	Students will learn about the factors that affect the rate of photosynthesis and how to represent this process using equations. They will be able to explain how plants use glucose and how humans can both measure and manipulate the rate of photosynthesis. Students will learn about the biochemistry of the process or aerobic and anaerobic respiration and why these processes are so important. They will be able to explain how the body responds to additional demands for energy and what metabolism is, including the role of the liver in this process.	Students will learn why it is important to control the internal environment and the key elements of control systems. Students will be able state the structure of the nervous system and explain why it is needed. Students will be able to explain how reflexes work and why these are important to the body. Students will also be able to state the structure of the brain and how scientists are able to map the brain along with how the structure of the eye is related to its function and the problems associated with the eye.	Students will learn about how the body maintains eternal conditions, including temperature and water levels. Students will be able to describe how waste products are removed from the body and the function of the kidney. Students will be able to describe the use of dialysis and kidney transplants along with the advantages and disadvantages of these treatments.	Students will learn about feeding relationships and how materials are cycled, including the water and carbon cycles, along with the factors that affect the rate of decomposition. Students will learn about biodiversity and the effects of growth of the human population. They will be able to discuss the impact of human activity on the earth and how pollutants form. They will be able to state the causes and effects of global warming and impact of deforestation and destroying peat bogs. Students will be able to evaluate the effects of environmental change on the distribution of organisms and why it is important to maintain biodiversity. Students will be able to explain the transfer of biomass and create pyramids of biomass.
Assessment	B4 end of unit test.		Combined B5 and B6 end of unit test.		PPE paper 1	
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Biology: Separate Science

Year 11

	Terms 1 and 2		Terms 3 and 4	
Units	B11 Hormonal Coordination	B13 Reproduction	B14 Variation & Evolution	B15 Genetics & Evolution
Key Learning	Students will learn the organs of the endocrine system and the role of the pituitary gland. Students will be able to name key hormones and how they affect the human body. Students will be able to explain how blood glucose level is controlled and the importance of negative feedback loops. Students will learn about the changes that occur at puberty, the control of the menstrual cycle and fertility treatments. Students will also learn about the plant hormones and responses and how plant hormones can be used commercially.	Students will learn the differences between sexual and asexual reproduction and be able to describe the process of mitosis. Students will be able to state how fungi, plants and malaria parasites reproduce. Students will learn about DNA, its structure and how DNA controls protein synthesis. Students will learn about gene mutations, how inheritance works and how to represent genetic crosses. They will also learn about inherited disorders and how these are screened for.	Students will learn about the factors that make individuals different from one another and the process of natural selection and evolution. They will learn about the processes of selective breeding and genetic engineering along with cloning. They will be able to discuss the ethical considerations associated with genetic technologies and the advantages and disadvantages of these techniques.	Students will learn about the history of genetics and the theories of evolution. They will be able to discuss why ideas and theories were accepted or rejected and the evidence used to support the theory of evolution. Students will be able to describe fossil records and extinction along with antibiotic resistance. Students will also learn about the principles of the classification system and how these systems have changed with technological developments.
Assessment	B10 end of unit test (assessing learning from year 10)	Paper 1 PPE	Paper 2 PPE	
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Biology: Combined Science

Year 10

	Terms 1 and 2		Terms 3 and 4		Terms 5 and 6	
Units	B4 Organising Animals & Plants	B5 Communicable Diseases B6 Preventing & Treating Disease	B7 Non-Communicable Diseases B8 Photosynthesis	B9 Respiration	B10 The Human Nervous System	B17 Organising an Ecosystem B18 Biodiversity & Ecosystems
Key Learning	Students will learn about the components of blood, how it flows around the body and the structure and function of the heart and human gas exchange system. They will be able to describe organ systems in a plant and how substances are transported in plants. Students will learn about the process of transpiration and the role of stomata and guard cells.	Students will also learn about what health is and how pathogens are spread. They will be able to explain how bacteria multiply and how infection can be prevented. Students will be able to name examples of bacterial, viral, fungal disease and those caused by protists. Students will be able to explain the human defence response. Students will learn how the immune system works and how the process of vaccination prevents disease. They will be able to explain the use of antibiotics and painkillers and the stages involved in developing new drugs.	Students will learn about non communicable diseases and lifestyle factors, they will learn the difference between a benign and malignant tumour and how cancer spreads. They will learn about risk factors for disease and the treatments for cancer. Students will learn about the factors that affect the rate of photosynthesis and how to represent this process using equations. They will be able to explain how plants use glucose and how humans can both measure and manipulate the rate of photosynthesis.	Students will learn about the biochemistry of the process or aerobic and anaerobic respiration and why these processes are so important. They will be able to explain how the body responds to additional demands for energy and what metabolism is, including the role of the liver in this process.	Students will learn why it is important to control the internal environment and the key elements of control systems. Students will be able state the structure of the nervous system and explain why it is needed. Students will be able to explain how reflexes work and why these are important to the body.	Students will learn how materials are cycled within the community. They will learn about the water and carbon cycles. Students will learn about biodiversity and the effects of growth on the human population. They will be able to discuss the impact of human activity on the earth and how pollutants form. They will be able to state the causes and effects of global warming and impact of deforestation and destroying peat bogs. Students will be able to explain why it is important to maintain biodiversity.
Assessment	B4 end of unit test.		Combined B5, B6 and B7 end of unit test.		Paper 1 PPE	
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments	GCSE exam questions, learning key facts and formulae, revision for assessments	GCSE exam questions, learning key facts and formulae, revision for assessments	GCSE exam questions, learning key facts and formulae, revision for assessments	GCSE exam questions, learning key facts and formulae, revision for assessments	GCSE exam questions, learning key facts and formulae, revision for assessments

Key Stage 4 Biology: Separate Science

Year 11

	Terms 1 and 2		Terms 3 and 4	
Units	B11 Hormonal Coordination	B12 Reproduction	B13 Variation & Evolution	B14 Genetics & Evolution
Key Learning	Students will learn the organs of the endocrine system and the role of the pituitary gland. Students will be able to name key hormones and how they affect the human body. Students will be able to explain how blood glucose level is controlled and the importance of negative feedback loops. Students will learn about the changes that occur at puberty, the control of the menstrual cycle and fertility treatments.	Students will learn the differences between sexual and asexual reproduction and be able to describe the process of mitosis. Students will learn about DNA and how inheritance works. Students will be able to use diagrams to represent genetic crosses. They will also learn about inherited disorders and how these are screened for.	Students will learn about the factors that make individuals different from one another and the process of natural selection and evolution. They will learn about the processes of selective breeding and genetic engineering. They will be able to discuss the ethical considerations associated with genetic technologies and the advantages and disadvantages of these techniques.	Students will be able to describe evidence for evolution and fossil records along with extinction and antibiotic resistance. Students will also learn about the principles of the classification system and how these systems have changed with technological developments.
Assessment	B10 end of unit test (assessing learning from year 10).	Paper 1 PPE	Paper 2 PPE	
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Chemistry: Separate Science

Year 10

	Terms 1 and 2		Terms 3 and 4		Terms 5 and 6	
Units	C4 Chemical Calculations	C5 Chemical Changes C6 Electrolysis	C7 Energy Changes	C8 Rates & Equilibrium	C13 The Earth's Atmosphere	C14 The Earth's Resources
Key Learning	Students will learn what relative atomic mass is and how it is calculated. They will be able to calculate the formula mass of a compound, number of moles and mass in grams of a substance. Students will be able to balance equations, use equations to calculate the masses of reactants and products and balance equations using masses. Students will also be able to calculate chemical yield and atom economy. They will be able to express concentration, carry out a titration and complete associated calculations. Students will learn how to calculate the volume of gases.	Students will learn about the reactivity series and to explain displacement reactions using ionic equations. They will learn about oxidation and reduction and the extraction of metals. They will learn about how salts are made and neutralisation reactions. Students will be able to use the pH scale and explain how pH is determined. Students will be able to explain what happens in electrolysis and predict the products of electrolysis, using equations to represent these reactions. They will be able to explain why electrolysis is used and use half equations.	Students will learn energy cannot be created or destroyed in a chemical reaction and how to distinguish between endothermic and exothermic reactions. They will be able to describe the uses of energy from endothermic and exothermic reactions and create and interpret reaction profiles. They will be able to define activation energy and complete bond energy calculations. Students will learn about chemical cells, batteries and fuel cells and be able to write half equations for the electrodes in fuel cells.	Students will learn what is meant by the rate of reaction and how it is measured. They will be able to calculate the mean rate of reaction and use different methods to collect data on the rate of reaction. Students will be able to describe the factors that affect the rate of reaction, using collision theory. Students will learn about reversible reactions and dynamic equilibrium and how changing conditions affects reversible reactions.	Students will learn how the theory of our atmosphere developed and the evidence used to support these theories. They will learn the key changes that have occurred in the atmosphere over time. Students will be able to describe global warming, the greenhouse effect and the impact of environmental pollutants.	Students will be able to distinguish between finite and renewable resources and explain the process of water treatment. They will also learn how metals are extracted from their ores and how to carry out life cycle assessments. Students will be able to explain the importance of reusing and recycling materials.
Assessment	C4 Chemical Calculations end of unit test	Writing a method to explain how to prepare a pure dry sample of a hydrated salt.	C6 and C7 Electrolysis Energy changes end of unit test.	C8 end of unit test.	Google form assessment Paper 1 PPE	LCA extended writing task
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Chemistry: Separate Science

Year 11

	Terms 1 and 2		Terms 3 and 4	
Units	C9 Crude Oil & Fuels	C10 Organic Reactions C11 Polymers	C12 Chemical Analysis	C15 Using our Resources
Key Learning	Students will learn about what crude oil is made up of and how it is separated into fractions. They will be able to represent alkanes using chemical and display formulae and how chain length affects the properties of hydrocarbons. Students will learn about combustion reactions and how to test for the products of combustion. They will be able to describe the process of cracking and how alkanes differ from alkenes.	Students will learn about the alkenes, alcohols, carboxylic and esters and how to represent these structures using displayed structural formulae. The students will learn about combustion and addition reactions of alkenes and the reactions and uses of alcohols. Students will learn how to recognise and represent polymers. Students will learn the principles of condensation polymerisation and how polyesters are formed. They will also be able to describe natural polymers and the structure on DNA.	Students will learn what pure and impure substance are and how melting point data and chromatography can be used to distinguish these substances from one another. They will learn what a formulation is and how to determine R_f values. They will be able to describe the positive test for gases and both positive and negative ions. Students will learn about how to interpret results from instrumental analysis.	Students will learn about rusting and useful alloys along with the properties of polymers, glass, ceramics and composites. They will learn about the Haber process and how fertilisers can be made, both in the lab and on an industrial scale.
Assessment	Explaining the properties of hydrocarbons and the process of fractional distillation	C10 Organic Reactions and C11 Polymers combined end of unit assessment. PPE paper	Identifying an unknown substance practical and exam question. PPE paper 2	
Homework		GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Chemistry: Combined Science

Year 10

	Terms 1 and 2		Terms 3 and 4		Terms 5 and 6	
Units	C4 Chemical Calculations	C5 Chemical Changes	C6 Electrolysis	C7 Energy Changes	C13 The Earth's Atmosphere	C14 The Earth's Resources
Key Learning	Students will learn what relative atomic mass is and how it is calculated. They will be able to calculate the formula mass of a compound, number of moles and mass in grams of a substance. Students will be able to balance equations, use equations to calculate the masses of reactants and products and balance equations using masses. They will also learn how to express concentration.	Students will learn about the reactivity series and to explain displacement reactions using ionic equations. They will learn about oxidation and reduction and the extraction of metals.	Students will be able to explain what happens in electrolysis and predict the products of electrolysis, using equations to represent these reactions. They will be able to explain why electrolysis is used and use half equations.	Students will learn energy cannot be created or destroyed in a chemical reaction and how to distinguish between endothermic and exothermic reactions. They will be able to describe the uses of energy from endothermic and exothermic reactions and create and interpret reaction profiles. They will be able to define activation energy and complete bond energy calculations.	Students will learn how the theory of our atmosphere developed and the evidence used to support these theories. They will learn the key changes that have occurred in the atmosphere over time. Students will be able to describe global warming, the greenhouse effect and the impact of environmental pollutants	Students will be able to distinguish between finite and renewable resources and explain the process of water treatment. They will also learn how metals are extracted from their ores and how to carry out life cycle assessments. Students will be able to explain the importance of reusing and recycling materials.
Assessment	C4 Chemical Calculations end of unit test.	Writing a method to explain how to prepare a pure dry sample of a hydrated salt.	C6 and C7 Electrolysis Energy changes end of unit test.		Google form assessment Paper 1 PPE	LCA extended writing task
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Chemistry: Combined Science

Year 11

	Terms 1 and 2		Terms 3 and 4	
Units	C8 Rates & Equilibrium		C9 Crude Oils & Fuels	C12 Chemical Analysis
Key Learning	Students will learn what is meant by the rate of reaction and how it is measured. They will be able to calculate the mean rate of reaction and use different methods to collect data on the rate of reaction. Students will be able to describe the factors that affect the rate of reaction, using collision theory. Students will learn about reversible reactions and dynamic equilibrium and how changing conditions affects reversible reactions.		Students will learn about what crude oil is made up of and how it is separated into fractions. They will be able to represent alkanes using chemical and display formulae and how chain length affects the properties of hydrocarbons. Students will learn about combustion reactions and how to test for the products of combustion. They will be able to describe the process of cracking and how alkanes differ from alkenes.	. Students will learn what pure and impure substance are and how melting point data and chromatography can be used to distinguish these substances from one another. They will learn what a formulation is and how to determine R_f values. They will be able to describe the positive test for gases.
Assessment	C8 end of unit test.	PPE paper 1	Explaining the properties of hydrocarbons and the process of fractional distillation. PPE paper 2	Google form assessment
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Physics: Separate Science

Year 10

	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Units	P1 Conservation & Dissipation of Energy	P4 Electric Circuits	P5 Electricity at Home	P7 Radioactivity	P8 Forces in Balance	P9 Forces in Motion
Key Learning	Students will learn how energy is stored and transferred. They will learn how to calculate the energy stored in a moving object or in an object when it is lifted or stretched.	Students will learn how to calculate the charge flow in an electric circuit. They will learn how to calculate the resistance and potential difference in circuits.	Students will learn about mains electricity and how to calculate the power of an appliance.	Students will learn about the structure of the atom and sub-atomic particles. They will learn how an unstable nucleus changes when it emits radiation and why the radiation it emits is harmful. Students will learn about nuclear fission and nuclear fusion	Students will learn the difference between a scalar and a vector quantity. They will learn how to find the resultant of two forces and how to resolve a force into perpendicular components. Students will learn about moments and how to find the centre of mass of an object.	Students will learn the difference between speed and velocity and what we mean by acceleration. They will learn to draw and interpret distance-time and velocity-time graphs.
Assessment	P1 end of topic test.	P4 end of topic test.	P5 end of topic test (open book)	P7 end of topic test.	Paper 1 PPE covering P1-P7.	
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Physics: Separate Science

Year 11

	Term 1		Term 2	Term 3	Term 4
Units	P9 Forces in Motion	P10 Forces & Motion	P11 Forces & Pressure P12 Waves Properties	P13 Electromagnetic Waves, P14 Light	P15 Electromagnetism, P16 Space
Key Learning	Students will learn the difference between speed and velocity and what we mean by acceleration. They will learn to draw and interpret distance-time and	Students will learn how to investigate the relationship between force, mass and acceleration. They will learn what is meant by terminal velocity and the difference between mass and weight. Students will	Students will learn about pressure on surfaces and pressure in fluids. Students will learn about transverse and longitudinal waves and how to describe them. They will learn about sound waves, ultrasound and seismic waves.	Students will learn about the electromagnetic spectrum. They will learn how these waves are used in communications and how they are used to form images.	Students will learn about the reflection and refraction of light and how lenses can be used to form images. Students will learn about magnetism and electromagnetic fields. They will learn about the motor effect, the generator effect and transformers. Students will learn about the formation of the Solar System and the life history of a star.

	velocity-time graphs.	learn about the conservation of momentum and investigate how a spring behaves when it is stretched.			They will learn about the beginning and the future of the Universe.
Assessment	P9 end of topic test	Paper 1 PPE Hooke's Law practical.	P12 end of topic test.	P13 Google form assessment.	Paper 2 PPE
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Physics: Combined Science						
Year 10						
	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Units	P1 Conservation & Dissipation of Energy	P4 Electric Circuits	P4 Electric Circuits P5 Electricity at Home	P7 Radioactivity	P8 Forces in Balance	P9 Motion
Key Learning	Students will learn how energy is stored and transferred. They will learn how to calculate the energy stored in a moving object or in an object when it is lifted or stretched.	Students will learn how to calculate the charge flow in an electric circuit. They will learn how to calculate the resistance and potential difference in circuits. They will complete required practical's investigating resistance and different components.	Students will learn about mains electricity and how to calculate the power of an appliance.	Students will learn about the structure of the atom and sub-atomic particles. They will learn how an unstable nucleus changes when it emits radiation and why the radiation it emits is harmful.	Students will learn the difference between a scalar and a vector quantity. They will learn how to find the resultant of two forces and how to resolve a force into perpendicular components. Students will learn how to find the centre of mass of an object	Students will learn the difference between speed and velocity and what we mean by acceleration. They will learn to draw and interpret distance-time and velocity-time graphs.
Assessment	P1 end of topic test.	Resistance of a wire practical.	P4 end of topic test.	P7 end of topic test.	P8 end of topic test.	Paper 1 PPE covering topics P1-P7.
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Key Stage 4 Physics: Combined Science

Year 11

	Term 1		Term 2	Term 3	Term 4
Units	P9 Forces in Motion	P10 Forces & Motion	P12 Waves Properties	P13 Electromagnetic Waves	P15 Electromagnetism
Key Learning	Students will learn the difference between speed and velocity and what we mean by acceleration. They will learn to draw and interpret distance-time and velocity-time graphs	Students will learn how to investigate the relationship between force, mass and acceleration. They will learn what is meant by terminal velocity and the difference between mass and weight. Students will investigate how a spring behaves when it is stretched.	Students will learn about transverse and longitudinal waves and how to describe them. They will learn about sound waves and ultrasound.	Students will learn about the electromagnetic spectrum. They will learn how these waves are used in communications and how they are used to form images.	Students will learn about magnetism and electromagnetic fields. They will learn about the motor effect and the electric motor.
Assessment	P9 end of topic test	Paper 1 PPE Hooke's Law practical.	P12 end of topic test.	P13 Google form assessment.	P15 end of topic assessment.
Homework	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.	GCSE exam questions, learning key facts and formulae, revision for assessments.

Core Knowledge & Skills – Progression Mapping - Biology

Concept	Intervention	Emerging	Developing	Mastering	Extending	Beyond
Cell Biology	Students can use a microscope. Students can identify animal and plant cells. Students can state the number of chromosomes in the human body and gametes.	Students can state why microscopes are useful in the study of cell biology. Students can identify the main organelles within cells. Students can describe key terms associated with cell division. Students can define the terms growth and differentiation. Students can state the stem cells are not adapted and that plant stem cells can be used to create clones.	Students can prepare a microscope slide. Students can identify specialised cells. Students can describe the processes of diffusion, osmosis and active transport. Students can explain why clones are genetically identical. Students can list some arguments for and against the use of stem cells.	Students can calculate total magnification. Students can describe how the structure of specialised cells is linked to their function. Students can compare the structure of a specialised and a generalised animal cell. Students can describe the adaptations of specialised plant cells. Students can describe the differences between diffusion, osmosis and active transport. Students can suggest how a cell that carries out active transport is adapted to this function. Students can calculate surface area to volume ratio. Students can describe situations where mitosis occurs. Students can describe differences between embryonic and adult stem cells and how stem cells can be used to treat medical conditions.	Students can rearrange the magnification formula and measure the size of cells. Students can compare and contrast the magnification and resolution obtained by using light and electron microscopes. Students can predict which way substances will move across a cell membrane. Students can explain why surface area affects the rate of diffusion. Students can explain the factors that affect transport in cells. Students can describe how the effectiveness of exchange surfaces is increased and use ideas about surface area to volume ratio to describe why multicellular organisms need exchange surfaces. Students can explain the reasons for ethical and religious objections to use of stem cells in medicine.	Students can discuss how the structure of specialised plant cells is related to their function within an organ and the whole organism. Students can explain the mechanisms that lead to turgid or flaccid plant cells and plasmolysis. Students can explain how temperature and concentration gradient affect the rate of diffusion. Students can use the terms isotonic, hypotonic, or hypertonic to explain the movement of water across a cell membrane. Students can link ideas about diffusion to explain how the adaptations of exchange surfaces increase their effectiveness. Students can calculate the surface area to volume ratio of a sphere. Students can explain in detail what happens at each stage of the cell cycle. Students can evaluate the use of stem cells
Organisation	Students can state examples of cells, tissues, organs, and organ systems. Students can name organs found in a given organ system. Students can order cells, tissues, organs and organ systems according to their relative sizes.	Students can state the function of some of the organs of the digestive system. Students can state simply what happens to food during digestion. Students can describe the functions, structure of the heart and ways the heart can stop functioning effectively.	Students can describe the function of some of the organs of the digestive system. Students can state the function and structure of each food molecule in the diet. Students can carry out a food test and record results in a table. Students can state how key organs aid	Students can state the structure of enzymes and explain their function within human digestion. For each food molecule, students can: name the enzyme that acts on it, where it is produced and which products are formed. Students can use the lock and key theory to explain	Students can explain temperature and pH. Students can calculate the mean rate of an enzyme catalysed reaction. Students can apply knowledge of the function of food molecules in the body to give diet advice. Students can suggest what a food contains using results	Students can suggest the function of glandular, epithelial and muscular tissue in organs. Students can explain, in detail, what happens during digestion. Students can explain how enzymes speed up reactions and control metabolism. Students can draw tangents in order to

	Students can state the components of blood and types of blood vessels.	Students can describe how heartbeat is maintained and the use of pacemakers/artificial hearts. Students can list the structure involved in gas exchange. Students can recognise plant organs and state their function.	digestion. Students can state that temperature and pH affect enzyme activity. Students can state the function and adaptation of different plant structures Students can describe transpiration, how it is measured and the factors that affect the rate of transpiration.	why the shape of an enzyme is vital for it to function. Students can describe the function of bile. Students can describe the adaptations of the components of blood. Students can explain how the structure of blood vessels relates to their function. Students can describe the problems that can develop in blood vessels in the human heart and the advantages and disadvantages of each treatment. Students can describe how structure of gas exchange are adapted for their function. Students can explain how plant tissues are adapted for their function.	from food tests, evaluating the observed data collected. Students can explain the importance of a double circulatory system. Students can evaluate the use of stents and statins in treating problems with blood vessels. Students can evaluate the use of treatments for heart problems. Students can explain the factors that affect transpiration	calculate the rate of a reaction. Students can explain the differences between the composition of inhaled and exhaled air. Students can suggest functions for unknown plant tissues. Students can use a light microscope to draw a cross-section of a leaf and calculate scale. Students can explain in detail how stomata control transpiration. Students can suggest reasons for differences in the number and distribution of stomata, as well as their adaptations. Students can describe the differences between a moving bubble potometer and a mass potometer.
Infection & Response	Students can describe health as a state of physical and mental wellbeing. Students can state some causes of ill health. Students can state the way communicable diseases are spread. Student can describe bacterial growth. Students can state the difference between antiseptics, disinfectants, and antibiotics.	Students can name some communicable and non-communicable diseases and list some risk factors that are linked to an increased rate of a disease. Students can describe the ways communicable. Students can describe why people are vaccinated. Students can state that vaccines contain dead or inactive forms of a pathogen. Students can state the causes for diseases and describe suitable treatments. Students can describe how the body defends itself from pathogens. Students can describe the signs of plant disease and how plants	Students can explain how vaccinations work. Students can describe how pathogens cause disease. Students can describe the steps in creating bacterial cultures and explain when certain treatments should be used, as well as describe how the spread of disease can be reduced. Students can describe how human body defence mechanisms stop the entry of pathogens. Students can describe how a plant disease is detected and the methods used to identify the cause. Students can explain how disease damages a plant. Students can describe how antibiotics work. Students can describe	Students can suggest the links between lifestyle and health. Explain how pathogens are passed from one organism to another and suggest how the spread can be prevented. Students can describe the uses of monoclonal antibodies. Students can describe how new medical drugs are tested and trialled for safety, effectiveness, toxicity, efficacy, and dose. Students can explain how resistant bacteria arise. Students can decide if a risk is causal. Students can analyse data to assess the risks and benefits of disease treatment. Students can describe causal mechanisms	Students can use an example to explain how scientific method has been applied to help prevent the spread of disease. Students can explain why viral infections are more difficult to prevent than bacterial. Students can explain how reduced or overactive immune system can cause illness. Students can explain in detail how pregnancy tests work. Students can describe how monoclonal antibodies are used. Explain how vaccinations reduce the spread of disease. Describe the impact of some non-communicable diseases. Evaluate the risks of disease	Students can explain what is meant by exponential growth and analyse a graph showing it. Students can suggest how plant disease effects food security. Students can explain in detail how and why ion deficiencies affect plant growth. Students can interpret information from a scientific article to explain how plant-to-plant communication can be used as a form of defence. Students can explain and evaluate the uses of monoclonal antibodies. Students can suggest reasons for the correlation between exercise and

		respond to disease. Students can describe some health problems associated with lifestyle choices.	what is meant by antibiotic resistant bacteria.	for the link between exercise and health. Describe the impact of lifestyle choices on unborn babies.	treatment. Students can identify risk factors from data.	health, and decide which are causal.
Photosynthesis & Respiration	Students can describe how plants get the materials they need for growth. Students can state the word equation for photosynthesis. Students can state the word equation for respiration. Students can list ways organisms use energy.	Students can describe what is required for photosynthesis. Students can list the factors that affect photosynthesis. Students state the factors affect the rate of photosynthesis. Students can describe how heart rate, breathing rate, and breath volume change with exercise. Students can describe why cells respire anaerobically.	Students can understand and use the inverse square law and light intensity in the context of photosynthesis. Students can balance the equation for photosynthesis Students can balance the equation for respiration. Students can explain how heart rate, breathing rate, and breath volume change with exercise. Students can define metabolism and list some metabolic reactions.	Students can escribe all the ways in which plants use glucose, including how they make proteins. Students can describe the ways to increase plant growth. Students can describe how factors limit the rate of photosynthesis. Students can describe how a leaf is adapted for photosynthesis. Students can compare and contrast aerobic and anaerobic respiration. Students can describe the role of the liver.	Students can explain how adaptations of the leaf make photosynthesis efficient. Students can explain why photosynthesis is an endothermic reaction. Students can explain how carnivorous plants are adapted. Students can explain how and why plants convert glucose to starch for storage.	Students can evaluate the use of greenhouses and hydroponics in terms of economics. Students can explain why stores of glycogen change with exercise Students can explain the link between protein consumption and concentration of urea.
Homeostasis & Response	Students can name some human internal conditions that are controlled. Students can show the pathway of a control system as receptor, coordination centre, effector. Students can identify reflex actions and describe why they are important. Students can describe how hormones are released. Students can state the types and treatments for diabetes. Students can state the function of the thermoregulatory centre. List how water is lost from the body. State the function of the kidneys and what kidney failure is.	Students can identify the structure of the brain and eye. Students can describe what happens during the menstrual cycle. Students can describe what contraception is, including examples. Students can describe the function of adrenaline and thyroxine. Students can describe the growth and plant responses. Students can describe how temperature and water levels are monitored and controlled. Students can describe how the body removes waste products. Students can explain why family members are usually a good choice for an organ donor.	Students can describe how the eye works. Students can describe how information is passed along neurones. Students can describe the events involved in reflex actions. Students can describe the function of the brain, neurones and eye. Students can describe the role of hormones released by endocrine glands. Students can describe what happens when blood glucose levels become too high or too low. Students can describe the difference in the causes and treatment of Type 1 and Type 2 diabetes. Students can describe the processes carried out by the kidney. Students can suggest why urine composition changes.	Students can describe how regions of the brain have been mapped to particular functions. Students can describe the structure or synapses. Students can explain in detail the changes to the eye in response to changes in light intensity. Students can interpret and explain diagrams of negative feedback control. Students can compare and contrast the changes to boys and girls during puberty. Students can name the hormones involved in the menstrual cycle, explain their function and where they are produced. Students can explain how contraceptives work and list the advantages and	Students can explain why internal conditions must be maintained. Students can explain in detail how the nervous system coordinates a response. Students can explain in detail how impulses travel across a synapse. Students can describe infertility, its causes and treatments. Students can explain why plants need tropisms. Students can describe some uses of plant hormones (gibberellins, ethene, and auxins) in agriculture, horticulture and the food industry. Students can observe the effects of plant hormones. Students can explain, in detail, how mechanisms lower or raise body temperature.	Students can apply knowledge of synapses to explain the effects of drugs. Students can evaluate the benefits and risks of investigating and treating brain disorders. Students can consider ethical dilemmas surrounding brain research. Students can evaluate the risks and benefits of surgery to treat long and short sightedness. Students can apply knowledge of the processes of filtering and selective reabsorption to diagnose problems and suggest treatments for patients using results from a urine test. Students can suggest and explain suitable concentrations of substances in dialysis fluid.

	Describe organ transplants and their advantages of disadvantages.		Students can state how dialysis works and the advantages and disadvantages of this treatment.	disadvantage of each method. Students can explain the process of selective reabsorption and function of ADH. Students can compare the advantages and disadvantages of treating kidney failure using dialysis or kidney transplant.	Students can suggest an effect of liver failure on the body. Students can explain how the production of ADH will change in given situations and how these changes will affect the amount of water in the urine. Students can use economic, social, and ethical arguments to evaluate treating kidney failure by dialysis or kidney transplant.	Students can apply knowledge of what affects the rate of diffusion to explain how dialysis is made efficient.
Inheritance & Variation	Students can define sexual and asexual reproduction and name some organisms that use either sexual or asexual reproduction. Students can list some examples of variation and classify traits as being due to genetic causes, environmental causes, or both.	Students can give reasons why and organism reproduces sexually or asexually. Students can describe mutations and the theory of evolution by natural selection. Students can give a reason why embryos might be screened and describe concerns about this process.	Students can describe the differences between sexual and asexual reproduction. Students can describe the process of mitosis and meiosis Students can describe the relationship between DNA, genes and chromosomes and how the four bases make a code. Students can describe some of the benefits of studying the human genome. Students can describe the steps used in genetic engineering to produce GM organisms and why GM crops are beneficial. Students can use the terms allele, dominant, recessive, homozygous and heterozygous correctly. Students can describe a phenotype when given the genotype. Students can use a Punnett square diagram to predict the outcome of a monohybrid cross using the theory of probability.	Students can compare and contrast sexual and asexual reproduction. Students can solve complex calculations to determine the number of possible gametes formed during meiosis. Students can carry out a genetic cross to show sex inheritance and use direct proportion and simple ratios to express the outcome of a genetic cross. Students can use named examples of genetic disorders and use genetic crosses to explain how these are passed on.	Students can suggest and explain the advantages and disadvantages of using both asexual and sexual methods of reproduction. Students can explain why you only get the expected ratios in a genetic cross if there are large numbers of offspring. Students can use a family tree to work out whether an individual is likely to be homozygous or heterozygous for particular alleles.	Students can explain why knowledge of the genomes of other species is useful, how the costs of genome sequencing have and the possible issues surrounding genome sequencing. Students can describe the steps involved in producing a protein inside the cell. Students can explain how the order of bases determines the type of protein made. Students can evaluate in detail the use of genetic engineering to cure inherited disorders. Students can use a genetic cross to predict the probability of a child inheriting a genetic disorder.

Genetics & Evolution	Students can state and describe some important discoveries in gene theory. Students can state Darwin developed the theory of evolution via natural selection.	Students can describe the stages of evolution by natural selection. Students can give evidence to support the theory of natural selection and state why Darwin's ideas were not initially accepted. Students can recall what a fossil is and how fossils are used as evidence for natural selection. Describe extinction and the causes for extinction. Students can describe antibiotic resistance and list some ways in which scientists can slow down the development of new strains of antibiotic resistant bacteria. Students can describe classification, how to classify animals and how ideas re classification have changed over time. Students can name domains and use the binomial system.	Students can describe the theories proposed by Mendel, Darwin and Lamarck. Discuss why the theories of evolution were not initially accepted. Explain the evidence used to support the theories of evolution. Students can describe the steps in the process of speciation. Students can describe how fossils are formed, used as evidence for evolution by natural selection, use fossil diagrams to explain evolution and explain why the fossil record is not complete. Students can describe how other organisms can cause an animal or plant to become extinct and identify strengths and weaknesses in two different theories of mass extinction. Students can explain why scientists need to develop new antibiotics.	Students can describe the classification system, developed by Carl Linnaeus, to include the order of the taxonomic groups. Students can identify genus and species from a scientific name. Students can explain why a binomial naming system is useful. Students can describe why the three-domain system was proposed. Students can draw several conclusions from a simple evolutionary tree.	Students can use a Punnett square to draw conclusions from the results of Mendel's experiments. Students can suggest why Mendel's work was not recognised during his lifetime, but the work of Watson and Crick was. Students can explain why Lamarck's theory is no longer accepted in the vast majority of cases but could still be correct. Students can explain how and why theories, such as how evolution takes place, change over time. Students can explain why scientists eventually accepted Darwin's theory.	Students can suggest how new species of organisms evolved. Students can evaluate the use of fossils as evidence for evolution by natural selection and how life first formed. Students can suggest alternative hypotheses for why an organism became extinct. Students can evaluate in detail the need to conserve endangered plants. Students can evaluate two theories of mass extinction to come to a conclusion about which is more believable. Students can summarise the reasons why the development of new antibiotics is unlikely to keep up with the emergence of new strains of antibiotic resistant bacteria. Students can compare and contrast the Linnaean system with the three-domain system.
Ecology	Students can describe what is meant by ecosystem, population and community. Students can list some resources that living things need. Students can use a given example to describe why one species relies on another. Students can describe biodiversity.	Students can state the meaning of the terms producer, consumer, predator and prey and give examples of each. Students can identify producers, consumers, predators, and prey in a food chain. Students can describe what a graph shows about how the numbers of predators and prey change over time.	Students can define the terms community, population, habitat, ecosystem, abiotic factor and biotic factor. Students can describe what a stable community is and give an example. Students can suggest how one species relies on another.	Students can identify levels in a food web and describe what happens to a population in a food web when another population changes. Students can describe the events in the decay cycle. Students can describe the processes of eutrophication and bioaccumulation. Students can describe some effects of human population growth.	Students can describe why a good level of biodiversity is important to the future of the human species. Students can explain the impact of pollution, using word and symbol equations.	Students can explain why interdependence is important in maintaining a stable community. Students can evaluate in detail food chains/webs as models to show feeding relationships. Students are able to make predictions based on data on a predator–prey relationship. Students can explain in detail how pollution affects biodiversity.

Core Knowledge & Skills – Progression Mapping – Chemistry

Concept	Intervention	Emerging	Developing	Mastering	Extending	Beyond
Atomic Structure & The Periodic Table	Students can classify familiar substances as elements, mixtures or compounds. Students can list different separation techniques. Students can use the Periodic Table to find the symbols or names of given elements and state how the elements are arranged in the periodic table. Students can list the models proposed for atoms. Students can state the relative charges and masses of sub-atomic particles. Students can state what and ion and isotope is. Students can list the typical properties of transition elements.	Students can state the structural arrangement of atoms and use diagrams to represent their structure. Students can describe how electronic structure is linked to the periodic table. Students can name group 1 and 7 elements and state the trend in reactivity shown by these groups. Students can list the significant models for ordering the elements.	Students can describe familiar chemical reactions with balanced symbol equations including state symbols. Students can describe the basic structure of an atom. Students can explain, including diagrams, the difference between a pure element, a mixture and a compound. Students can write the standard electronic configuration notation from a diagram for the first 20 elements. Students can describe how the elements are arranged in groups and periods in the periodic table.	Students can balance a given symbol equation. Students can describe different separation techniques. Students describe the differences between the plum-pudding model and the nuclear model of the atom. Students describe atoms using the atomic model. Students can use atomic number and mass numbers to determine the number of sub-atomic particle. Students can explain why elements in the same group react in a similar way. Students can explain why the periodic table was a breakthrough in how to order elements. Students can explain in terms of electronic structure how the elements are arranged in the periodic table. Students can interpret the formula and names of familiar transition metal compounds. Students can write balanced symbol equations.	Students can explain how the chemical properties of a mixture relate to the chemical it is made from. Students can explain how atoms form ions. Students can explain how evidence from scattering experiments changed the model of the atom. Students can explain why atoms have no overall charge and the charges on ions. Students can describe isotopes using the atomic model. Students can use atomic number and mass numbers of familiar ions to determine the number of each sub-atomic particle. Students can explain the reactivity of group 1 and 7 elements. Students can use the nuclear model to explain how the outer electrons experience different levels of attraction to the nucleus.	Students can use chemical symbols of atoms to produce the chemical formulae. Students can explain the significance of chemical symbols. Students can describe unfamiliar chemical reactions with more complex balanced symbol equations, including state symbols. Students can explain, in detail, separation techniques. Students can justify why the model of the atom has changed over time and evaluate the current model of the atom. Students can recognise and describe patterns in sub-atomic particles of elements listed in the Periodic Table. Students can make predictions for how an element will react. Students can use electronic structure to explain the trends in properties of Group 1 and Group 7 elements. Students can explain how and why the ordering of the elements has changed over time.
Structure & Bonding	Students can identify the three states of matter and their state symbols. Students can describe the process of melting, freezing, boiling and condensing. Students can use the	Students can state the particles involved in ionic and covalent bonding. Students can describe, with an example, how an atom becomes an ion and deduce the charges on an ion. Students can state simply	Students name familiar examples of ionic, covalent and metallically bonded substances. Students can describe an intermolecular force. Students can state a definition of nanoscience.	Students use data to determine the state of a substance at a given temperature. Students can explain, in terms of particles, the energy and temperature of a substance	Students can use the particle model to describe how energy, movement and attraction between particles change as a substance is heated or cooled. Students can suggest why substances	Students can apply the models to make predictions of the physical properties of substances. Students can draw dot and cross diagrams and ball and stick diagrams for unfamiliar small molecules. Students

	particle model to draw a representation of how particles are arranged in the three states of matter.	what happens to food during digestion. Students can describe an ionic lattice. Students can state the properties of ionic, covalent and metallic substances. Students can describe ionic, covalent and metallic bonding. Students can state the main properties of ionic, covalent and metallic substances.	Students can describe how surface area to volume ratio increases as particle size decreases. Students can state how key organs aid digestion. Students can state that temperature and pH affect enzyme activity. Students can state the function and adaptation of different plant structures. Students can state nanoparticles have new uses and list the advantages and disadvantages of using nanoparticles.	when it is at the melting point or boiling point. Students can explain how electron transfer allows ionic bonding to occur and use dot and cross diagrams to represent substances formed. Students can interpret the formulae of familiar ionic compounds to determine the number and type of each ion present. Students can explain the properties of ionic, covalent and metallic substances. Students can create dot and cross diagrams to represent covalent bonding. Students can identify substances that would have weak intermolecular forces. Students can recognise the structure of a fullerene or nanotube in diagrams and prose.	have different melting and boiling points from each other. Students can draw ionic compounds and suggest the charge on unfamiliar ions. Students can explain in detail the properties of ionic, covalent and metallic bonding. Students can suggest how double and triple covalent bonds can be formed. Students can draw dot and cross diagrams and ball and stick diagrams for unfamiliar small molecules. Students can suggest how double and triple covalent bonds can be formed. Students can use molecular models of graphene, nanotubes and fullerenes to explain their properties. Students can evaluate the use of nanoparticles and nanotechnology	can suggest how the properties of a double covalent bond could be different to the properties of a single covalent bond. Students can suggest how the properties of a double covalent bond could be different to the properties of a single covalent bond. Students can justify the use of a model to explain the physical properties of substances Students can describe in detail the uses. Students can evaluate different models of metallic bonding. Students can explain in detail, including labelled diagrams, how alloying affects the structure and bonding in metals and its effect on properties. Students can quantitatively explain the relationship between surface area to volume ratio and particle size and its effect on properties and convert standard form into a variety of length units.
Quantitative Chemistry	Students use the periodic table to identify the relative atomic mass for the first 20 elements. Students can calculate the relative formula mass for familiar compounds when the formula is supplied and is without brackets.	Students can state the definition of theoretical yield, actual yield and percentage yield. Students can calculate percentage yield when actual yield and theoretical yield are given. Students can calculate the formula mass of substances when the formula is given. Students can balance simple equations. Students can state a definition of atom economy.	Students can calculate the concentration of a solution in g/dm^3 when given the mass of solute in g and volume of solution in dm^3. Students can accurately read the volume on a burette to 1 decimal place and identify concordant results.	Students can identify the limiting reactants in a chemical reaction. Students can calculate the relative formula mass for unfamiliar compounds when the formula is given. Students can state the units for the amount of substance. Students can explain why chemical equations must be balanced. Students can calculate atom economy and percentage yield when	Students can explain how concentration of a solution can be changed. Students can calculate the mass of solute (in g) in a solution when given the concentration in g/dm^3 and volume in dm3 or cm^3. Students can carry out a titration to determine the end point of a reaction and complete associated calculations. Students can explain the effect of a	Students can explain why relative atomic masses may not be a whole number. Students can interpret balanced symbol equations in terms of mole ratios. Students can use balanced symbol equations to calculate reacting masses. Students can explain why the sum of the formula masses of the reactants is the same as the sum of the formula masses of the

				the actual yield is given and the mass of the limiting reactant is given. Students can list reasons why actual yield is often lower than theoretical yield. Students can calculate the concentration of a solution, number of moles and mass of solute. Students can calculate the amount in moles of gas in a given volume at room temperature and pressure.	limiting reactant on the amount of product made. Students can calculate the percentage yield using a variety of units and conversion and justify why percentage yield can never be above 100%. Students can justify the use of a pipette, burette and indicator for end point of a titration, evaluating the errors involved in reading these instruments.	products. Students can calculate the mass of a chemical when any volume and concentration is given.. Students can calculate the unknown concentration of a reactant in a neutralisation reaction when the volumes are known and the concentration of one reactant is also known.
Chemical Changes	Student list the order of common metals in the reactivity series. Students can use general equations to write specific word equations for metals listed in the reactivity series reacting with oxygen, water and acid. Students recall displacement reactions and use the reactivity series to determine if they will occur. Students can describe how metals can be extracted. Students can describe the pH scale and recall an example of an alkaline, neutral, basic, and acidic chemical.	Students can describe what is required for photosynthesis. Students can define oxidation and reduction in terms of oxygen. Students can recall a definition of a salt and name salts produced in reactions. Students can write general equations for metals, metal carbonates and alkalis reacting with acids. Students can safely use universal indicator to classify a solution as acidic or alkaline.	Students can safely prepare a pure, dry sample of a soluble salt from an insoluble base and a dilute acid. Students can balance the equation for photosynthesis. Students recall a general equation for a base reacting with an acid and use it to write specific word equations.	Students can describe oxidation and reduction in terms of gain or loss of oxygen. Students can predict observations for the metals listed in the reactivity series reacting with oxygen, water and acid. Students can explain why a displacement reaction occurs. Students can write word equations and straightforward balanced symbol equations for displacement reactions. Students can explain why some metals are found un-combined in the Earth's crust.	Students can identify which species has been oxidised/ reduced in a chemical reaction. Students can write a balanced symbol equation, with state symbols, to describe metals, metal carbonates and metal hydroxide reacting with acids. Students can describe a method to prepare a pure, dry sample of a soluble salt. Students can describe the relationship between alkalis and bases. Students can recall examples of strong and weak acids and describe how an acid or alkali can be concentrated or dilute/weak or strong.	Students can justify uses of metals in the reactivity series based on their chemical reactivity. Students can write balanced symbol equations, with state symbols, for the metals listed in the reactivity series reacting with oxygen, water and acid. Students can evaluate the investigation of metals plus acid Students can describe displacement reactions using an ionic equation. Students can determine and explain which species is oxidised and which species (metal atom or ion) is reduced in a displacement reaction in terms of electron transfer. Students can create ionic half equations for metal hydroxide/oxide/carbonate and acid. Students can evaluate how universal indicator or a data logger can be used to determine the approximate

						pH of a solution. Students can use ionic equations to explain how solutions can a weak or strong acid or alkaline Students can quantitatively explain how the concentration of hydrogen ions relates to the pH number.
Electrolysis	Students can define electrolysis. Students can state that aluminium can be extracted from aluminium oxide using electrolysis.	Students can state the products of electrolysis. Students can write a word equation to describe the electrolysis. Students can safely electrolyse a solution, with guidance provided.	Students can describe electrolysis in terms of movement of ions. Students can write a balanced symbol equation including state symbols for the overall electrolysis of a molten ionic compound. Students can predict the products formed at each electrode and state that hydrogen can be produced at the cathode when some solutions are electrolysed. Students can describe the electrolysis of aluminium oxide.	Students can explain why electrolysis is an expensive metal extraction method and illustrate this with the extraction of aluminium. Students can explain why cryolite is added to aluminium oxide in the industrial extraction of aluminium.	Students can explain why electrolysis can only occur when an ionic compound is molten or in aqueous solution. Students can describe electrolysis with half equations at the electrodes. Students can explain the classification of the reactions at each electrode as oxidation or reduction. Students can compare and contrast the electrolysis of a compound in solution with its electrolysis as a molten compound.	Students can explain how hydrogen ions and hydroxide ions can be present in solutions, including a balanced symbol equation with state symbols, for the reversible reaction in which water ionises. Students can evaluate in detail an investigation they have planned and carried out, commenting on their methodology and quality of the data collected.
Energy Changes & Rates	Students can define exothermic and endothermic reactions and state that energy is conserved in a chemical reaction. Recall a definition for rate of reaction.	Students can state a use of an exothermic reaction and an endothermic reaction. Students can write word equations for familiar reactions. Students can safely describe and follow a method to monitor rate of reaction and state the units for rate of reaction. Students can describe how surface area of a solid can be increased. Students can state that chemical reactions can only occur when a collision occurs with enough energy. Students can list the factors that can	Students can define activation energy. Students can sketch a generic reaction profile diagram for an exothermic or endothermic reaction. Students can describe how temperature, changing concentration, gas pressure and surface area affects the rate of reaction. Students can describe how adding a catalyst affects the rate of reaction. Students can define a reversible reaction and state an example. Students can write a word equation for a familiar reversible reaction.	Students can explain why chemical reactions need activation energy to start them. Students can explain, using observations from calorimetry, how to classify a reaction as exothermic or endothermic. Students can explain in detail how to carry out a calorimetry experiment. Students can explain how an energy change from a chemical reaction can be used. Students can write balanced symbol equations for familiar reactions. Students can generate a specific reaction profile diagram for	Students can identify bonds broken in reactants and new bonds made in products of a reaction. Students can explain, using the particle model, how reactants become products in a chemical reaction. Students can explain why bond breaking is endothermic and bond making is exothermic. Students can define bond energy and identify all the bonds that break and are made in a chemical reaction. Calculate the energy needed to break the reactant bonds and the	Students can evaluate in detail the uses of exothermic and endothermic reactions. Students can explain in terms of bond energies how a reaction is either exothermic or endothermic. Students can describe an electrochemical cell with half equations and ionic equations. Students can explain why the reactions in an electrochemical cell are redox reactions and determine which species is oxidised or reduced in an

		affect the rate of a chemical reaction.	Students can state whether a reversible reaction is exothermic or endothermic in the reverse direction if the forward direction is stated.	a given chemical reaction when its energy change is also supplied. Students can describe a simple cell and battery. Students can give an example of a non-rechargeable battery. Students can describe a hydrogen fuel cell and state some uses for hydrogen fuel cells. Students can state that hydrogen fuel cells could be an alternative to rechargeable cells and batteries. Students can calculate the mean rate of reaction and the rate of reaction at a specific time. Students can use collision theory to explain how temperature, changing concentration, gas pressure, surface area and the addition of a catalyst affects the rate of reaction. Students can explain, with an example, the industrial use of a catalyst. Students can describe a familiar reversible reaction using a balanced symbol equation and predict observations when conditions are changed. Students can explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction. Students can define a dynamic equilibrium. Students can describe a closed system.	energy released when the product bonds are made. Students can calculate the energy change for a reaction, including the correct unit. Students can plan, carry out and evaluate the errors in a calorimetry investigation. Students can explain how a hydrogen fuel cell produces electricity and list the advantages and disadvantages of hydrogen fuel cells. Students explain why there is more than one unit for rate of reaction. Students can explain why many collisions do not lead to a chemical reaction. Students can interpret a rate of reaction graph, including calculating the rate of reaction at specific times in a chemical reaction. Students can describe how to achieve dynamic equilibrium and how rate of the forward reaction compares to rate of the backward reaction in a dynamic equilibrium. Students can Describe Le Chatelier's Principle. Students can explain how changing conditions for a system at dynamic equilibrium affects the rate of the forward and reverse reactions. Students can predict the effect on yield of changing temperature, concentration, or pressure in a given equilibrium system.	electrochemical cell. Students can describe the reactions in fuel cells using balanced symbol and half equations. Students can plot and use a graph to calculate the gradient to measure the initial rate of reaction and calculate 1 / t and plot a graph with a more meaningful line of best fit. Students can justify a chosen method for a given reaction to monitor the rate of reaction. Students can describe an unfamiliar reversible reaction, using a balanced symbol equation with state symbols. Students can justify the use of reversible reactions in the lab and items available in the home. Students can explain in detail the energy changes in an equilibrium system. Students can explain why the concentration of chemicals in a dynamic equilibrium remains constant. Students can predict the effect on the rate of forward and reverse reactions by applying the Le Chatelier's Principle when the conditions of a dynamic equilibrium are changed.

Organic Chemistry	Students can describe the composition of crude oil.	Students can describe the composition of crude oil. Students can state a definition of a hydrocarbon and an alkane. Students can define complete and incomplete combustion. Students can write a word equation to describe the complete and incomplete combustion of a hydrocarbon.	Students can explain why fractional distillation is used to separate crude oil into fractions. Students can name the different fractions from crude oil and state a use for each fraction. Students can explain how to test for the products of complete combustion. Students can define the process of cracking and generate a word equation to describe cracking. Students can recognise and give examples of alkenes. Students can recognise the functional group in an alcohol and a carboxylic acid. Students can name for the first four primary alcohols and the first four carboxylic acids. Students can state that fermentation can be used to make ethanol. Students can list some chemical properties of the first four alcohols. Students can recognise the formula and structure of ethanol and state some of its use. Students can draw the displayed structural formulae for the products of the addition reactions between alkenes and hydrogen, water (steam), or a halogen. Students can compare and contrast the reactivity of alkanes and alkenes. Students can define a monomer and a polymer. Students can state some uses of poly(ethene) and poly(propene) and write a word equation for the	Students can explain in detail how fractional distillation is used to separate crude oil into fractions. Students can explain how chain length affects the properties of crude oil fractions. Students can describe the process of cracking, including conditions and generate a balanced symbol equation to describe cracking. Students can describe a chemical test to show an alkene is present. Students can explain the differences between complete and incomplete combustion. Students can write balanced symbol equations for the complete and incomplete combustion of hydrocarbons. Students can describe how the trend in colour, viscosity, flammability and boiling point changes as the length of the hydrocarbon chain changes. Students can describe how the properties of a fraction of crude oil make it appropriate for its use. Students can apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane. Students can compare and contrast the reactivity of alkanes and alkenes. Students can name ethyl ethanoate from its formula. Students can recognise a carboxylic acid from its name or formula and list	Students can use balanced symbol equations to calculate amounts of reactants or products in a combustion reaction. Students can justify the use of a given fuel over another. Students can explain the similarities and differences between alkanes and alkenes. Students can predict the word and balanced symbol equations to describe reactions between alkenes and hydrogen, water (steam), or a halogen. Students can compare and contrast the reactivity of alkanes and alkenes. Students can draw the structural and displayed formulae for ethyl ethanoate. Students can describe the reactions of alcohols, including using word equations. Students can explain the relationship between ethanol and ethanoic acid. Students can describe why carboxylic acids are acidic. Students can use word equations to describe the reactions of carboxylic acids with metal carbonates and with alcohols. Students can describe how to make an ester. Students can describe how monomers become polymers. Students can draw the monomer for an addition polymer when the structure of the polymer is given. Students can draw an addition polymer structure	Students can use examples to explain the process of cracking and why it is so important to the petrochemical industry. Students can explain why solutions of ethanol have a pH of 7. Students can compare and contrast the reactivity of alkanes and alkenes. Students can explain, using ionic equations, why carboxylic acids are weak acids. Students can predict the products of the reactions of a range of carboxylic acids with metal carbonates and with alcohols. Students can explain the term volatile in terms of molecular forces. Students can plan an investigation to determine the relative energy transferred to the surroundings by the combustion of different alcohols. Students can explain why monomers for addition polymers must be unsaturated. Students can explain the process of addition polymerisation in detail, including using balanced symbol equations and the concept of atom economy. Students can explain how the repeating unit of a polymer relates to the monomer. Students can predict the products of condensation polymerisation and explain this process in detail, including using equations.

			formation of poly(ethene) and poly(propene).	some chemical properties of carboxylic acids. Students can describe an ester and state some uses of this class of compounds. Students can draw the structural and displayed formulae for the first four primary alcohols and the first four carboxylic acids. Students can state an example of a natural polymer and what DNA stands for. Students can describe the relationship between sugar as a monomer and starch or cellulose as a polymer. Students can describe the relationship between amino acids as a monomer and protein as a polymer. Students can name the monomers used to make DNA.	when the structure of the monomer is given.	Students can compare and contrast in detail, giving appropriate examples, the two methods of polymerisation. Students can predict the products of condensation polymerisation using natural monomers. Students can explain in detail the process of condensation polymerisation with natural monomers, including using equations. Students can explain how amino acids react together in an acid–base reaction. Students can explain the shape of the DNA polymer, how nucleotides form DNA and the purpose of DNA.
Chemical Analysis	Students can state what a pure substance is. Students can state what a formulation is.	Students can describe how melting point and boiling point data can be used to identify pure substances. Students can describe a use of chromatography. Students can describe and safely carry out a method to make a paper chromatogram. Students can identify hydrogen, carbon dioxide and oxygen from a laboratory test. Students can state an example of an instrumental technique.	Students can describe how to calculate Rf values. Students can safely carry out the following tests: flame test, metal ions using sodium hydroxide, carbonates halides and sulphate ions. Students can write a word equation for the reaction between sodium hydroxide and a specified metal salt solution. Students can list some of the advantages and disadvantages of instrumental techniques. Students can state a use for flame emission spectroscopy.	Students can list some of the advantages and disadvantages of instrumental techniques. Students can explain how chromatography separates solutes. Students can use a chromatogram to determine if a sample is pure or impure. Students can explain and interpret the results used to identify a gas that is present. Students can identify a metal ion from the colour of a flame or the colour of the hydroxide precipitate. Students can write balanced symbol equations, including state symbols, for the production of an insoluble metal hydroxide. Students	Students can compare and contrast instrumental techniques with simple laboratory tests. Students can describe the main processes of flame emission spectroscopy. Students can explain how flame emission spectroscopy is an improvement on flame tests. Students can write balanced symbol equations, including state symbols, for the reactions of limewater with carbon dioxide and hydrogen with oxygen. Students can explain the results of gas tests.	Students can explain why different substances and different conditions will have different Rf values. Students can write balanced symbol equations, including state symbols, for the reactions of limewater with carbon dioxide and hydrogen with oxygen. Students can write balanced ionic equations, including state symbols, for simple laboratory tests for carbonate, halide, or sulfate ions. Students can explain in detail how to identify a compound from the results of simple laboratory tests. Students can write balanced ionic equations, including state

				can explain why a flame test cannot be used to identify a mixture of metal solutions. Students can identify the presence of carbonate, a specific halide, or sulfate ions and create balanced symbol equations for these reactions.		symbols, for simple laboratory tests for carbonate, halide, or sulfate ions. Students can evaluate the use of instrumental techniques. Students can explain how metal ions emit light when in a flame. Students can interpret results from flame emission spectroscopy when data is given.
The Earth's Atmosphere & Resources	Students can describe the Earth's early atmosphere. Students can list some human uses of the Earth's resources. Students can give examples of a finite and a renewable resource. Students can state an example of a natural product that is supplemented or replaced by agricultural or synthetic products. Students can define the term corrosion. Students can state what is required for iron to rust and list some ways to prevent rusting. Students can state the elements in steel and bronze.	Students can describe how oxygen was formed in the development of the atmosphere. Students can describe the greenhouse effect and environmental pollutants. Students can state the changes in the composition of the atmosphere over time. Students can explain the process of making water potable and explain why this is important. Students can state the difference between a metal before and after being alloyed and list some common examples of alloys and their uses. Students can describe the properties of a thermosetting and thermosoftening plastic.	Students can describe how carbon monoxide and soot (carbon) can be made from the incomplete combustion of fossil fuels. Students can complete word equations to describe how atmospheric pollutants can be made. Students can explain LCA's and the importance of reusing and recycling products. Students can describe the difference between LD and HD poly(ethane). Students can describe how to make soda-lime glass and borosilicate glass and clay ceramics. Students can state examples of clay ceramics and composites. Students can state the purpose and conditions of the Haber process.	Students can describe a theory for the development of the Earth's atmosphere and state how oceans formed. Students can complete word equations to describe how atmospheric pollutants can be made. Students can explain, using word equations, how gases were formed in the atmosphere and how oceans were formed. Students can describe some of the health impacts of environmental pollutants. Students can explain the difference between pure water and potable water and how potable water is produced. Students can explain in detail how phytomining and bioleaching extract metals. Students can explain the limits of LCAs and evaluate products in detail using LCAs. Students can write a word equation to describe the Haber process. Students can state what a fertiliser is, its uses and create word equations for the formation of fertilisers. Students can	Students can explain how oceans formed, the greenhouse effect and how this is affected by human activity. Students can explain the possible effects of global climate change and why they are difficult to predict. Students can explain possible methods to reduce greenhouse gas emissions and the problems in trying to reduce greenhouse gas emissions Students can use balanced symbol equations to show how atmospheric pollutants are formed. Students can valuate evidence to suggest if global warming is man-made or natural. Students can understand data and interpret information using orders of magnitude to compare. Students can explain the role of chemistry in improving agricultural and industrial processes. Students can draw conclusions consistent with information provided from graphs, charts, tables, and prose and evaluate the validity of the data.	Students can explain the limits of the theory for the development of the Earth's atmosphere and why it has changed. Students can use balanced symbol equations to explain how gases were formed in the atmosphere and explain how oceans were formed. Students can explain why the composition of the Earth's atmosphere has not changed much for 200 million years. Students can use balanced symbol equations to explain how carbon dioxide forms sedimentary rock and how methane and ammonia were removed from the atmosphere Students can explain the difference between global warming and the greenhouse effect. Students can evaluate the negative social, economic, and environmental consequences of atmospheric pollution. Students can suggest and explain methods to reduce atmospheric pollution. Students can evaluate the

				name the elements in NPK fertilisers, where raw materials come from and the formulae for these chemicals. Students can describe the process of rusting, using equations. Students can explain how thermosetting plastics and thermosoftening plastics are different in terms of structure and bonding.	Students can evaluate the ease of obtaining potable water from waste, ground, or salt water. Students can explain in detail how and why waste water is processed before it is released into the environment. Students can write ionic equations to explain metal extraction techniques and identify the species being oxidised or reduced. Students can evaluate biological methods of metal extraction. Students can describe the different conditions used to make poly(ethene) and how the structure of poly(ethene) affects its properties and therefore its uses. Students can compare quantitatively the physical properties of glass and clay ceramics, polymers, composites, and metals. Students can describe the Haber process with the help of a balance symbol equation including state symbols and explain how changing conditions effects this process. Students can compare and contrast the industrial and laboratory production of fertilisers. Students can write balanced symbol equations for the reactions to make components of NPK fertilisers.	environmental, economic and social impacts of reusing and recycling products. Students can evaluate ways of reducing the use of limited resources. Students can write balanced equations to describe rusting and identify species that are oxidised and reduced. Students can evaluate rust prevention techniques and suggest which is best for a specific purpose. Students can use data on the properties of unfamiliar alloys to explain a suitable alloy for a given purpose. Students can evaluate an alloy in terms of its properties and uses. When data about the properties of a material is provided, classify it and suggest a suitable material for a given purpose. Students can justify why the conditions used in the Haber process are a compromise and explain the effect of an iron catalyst on the rate and position of equilibrium in the Haber process. Students can evaluate the importance of fertilisers for agriculture, write ionic equations for reactions to make fertilisers. Students can calculate the concentration of an ammonia solution from the results of a titration. Students can evaluate the composition of fertilisers. Students can evaluate

						different processes to make NPK fertilisers and write ionic equations to illustrate the reactions to make NPK fertilisers.

Core Knowledge & Skills – Progression Mapping – Physics						
Concept	Intervention	Emerging	Developing	Mastering	Extending	Beyond
Energy Conservation & Dissipation	Students can state some types of energy store. Students can state that energy in measured in joules. Students can name some electrical devices and identify their useful energy transfers.	Students can identify changes in energy stores. Students can state that energy is conserved. Students can calculate the work done by a force. Students can identify materials as insulators or conductors.	Students can describe a wide range of different energy stores in different contexts. Students can apply the principle of conservation of energy and use it to explain why efficiency cannot be greater than 100%. Students can calculate the gravitational potential energy of an object.	Students can explain energy dissipation into the surroundings. Students can calculate the kinetic energy of an object. Students can use and rearrange the efficiency equation. Students can describe how different home insulation methods reduce heat transfer.	Students can perform calculations using rearrangements of the kinetic energy equation. Students can use the specific heat capacity equation in a wide range of contexts.	Students can combine several equations to solve complex problems. Students can describe the greenhouse effect in terms of absorption, emission and wavelengths of electromagnetic radiation. Students can compare and evaluate different insulation methods in terms of cost effectiveness .
Energy Resources	Students can state some fuels used to generate electricity. Students can list some renewable energy resources.	Students can identify fuels as renewable and non-renewable. Students can describe some advantages and disadvantages of renewable energy systems.	Students can list some environmental effects of burning fossil fuels and issues related to use of nuclear fuels.	Students can describe the effects of acid rain and climate change and describe techniques to reduce the harmful products of burning fossil fuels.	Students can compare the operation of hydroelectric, wave and tidal systems in terms of reliability, cost and power output.	Students can evaluate and debate different methods of electrical generation in terms of sustainability and impact on the environment.
Forces	Students can list some contact and non-contact forces. Students know forces are measured in Newtons.	Students can use arrows to represent forces. Students can calculate moments using the moment equation. Students can state factors that will increase pressure acting on a surface.	Students can categorise quantities as scalar or vector. Students can calculate resultant forces. Students can use the equation to calculate pressure on a surface.	Students can apply the equation for moments. Students can explain how to find the centre of mass of an object. Students can explain why pressure increases with depth in a liquid.	Students can draw a scaled vector diagram to find a resultant force vector. Students can derive the equation p=hρg.	Students can find the resultant of two forces at an obtuse angle by drawing a scale diagram. Students can perform a wide range of pressure calculations including conversions of areas and forces with SI multiplier prefixes.
Forces & Motion	Student can rank everyday speeds in order of slowest to fastest. Students can list some units for measuring speed.	Students can calculate speed. Students can describe an objects motion from a distance-time graph. Students can state the factors that affect the stopping distance of a car.	Students can rearrange the speed equation to calculate distance travelled or time. Students can calculate acceleration. Students can state the difference between mass and weight.	Students can describe a velocity-time graph. Students can use a tangent to determine the speed of an object from a distance-time graph. Students can calculate momentum. Students can use the	Students can calculate the distance travelled from the area under a velocity- time graph. Students can explain in terms of forces why an object reaches terminal velocity. Students can apply the law of conservation of	Students can rearrange the equation $v^2 - u^2 = 2as$ and use it to solve complex problems. Students can explain how forces in impacts can be reduced.

				principle of conservation of momentum to explain how objects behave in explosions.	momentum to calculate objects velocities before and after collisions.	
Waves	Students can list some examples of waves. Students can state the law of reflection. Students know that a reflected sound wave is called an echo. Students can describe the visible spectrum as a continuous series of colours.	Students can state that waves transfer energy from one place to another without the transfer of matter. Students can identify the wavelength and amplitude of a transverse wave. Students know that sound is caused by vibrations. Students can give some examples of electromagnetic waves. Students can give a range of uses of electromagnetic waves. Students can explain the colour of objects in terms of reflection of parts of the spectrum. Students can identify convex and concave lenses.	Students can define and compare transverse and longitudinal waves. Students can use the wave equation to calculate wave speed, frequency and wavelength. Students can state the human hearing range and define ultrasound as being sounds above 20.000Hz. Students can list the electromagnetic spectrum in order of wavelength. Students can describe how different electromagnetic waves are used in communications. Students can describe the colour of objects in different colours of light and through different filters.	Students can describe reflection and refraction of mechanical and electromagnetic waves. Students can describe the properties of a sound in terms of amplitude and frequency. Students can describe the structure and function of the human ear. Students can describe the internal structure of the Earth. Students can describe how and why electromagnetic waves are used in a range of scenarios and link their use to their properties. Students can describe images as real, virtual, inverted, enlarged, reduced.	Students can explain refraction in terms of wave speed changing in different media. Students can describe how ultrasound can be used in a variety of settings. Students can compare the 3 types of seismic wave. Students can compare the properties and effects of different types of electromagnetic radiation. Students can construct ray diagrams to show image formation by a convex and a variety of object positions.	Students can perform multistage calculations involving period, frequency, wave speed and wavelength. Students can interpret an ultrasound trace to calculate the position of flaws in a metal object. Students can interpret seismographs to determine the difference in speeds of seismic waves. Students can explain how ionisation can lead to cell death or damage to DNA. Students can evaluate the doses of ionising radiation received through a variety of occupations and medical treatments.
Electricity	Students can state some examples of static electricity. Students know that a complete circuit is needed for an electric current to flow. Students can identify some electrical components from their symbols. Students can recognise dangerous use of electricity. Students can identify the live, neutral and earth in a 3 pin plug.	Students know that objects become electrically charged by friction. Students can draw and interpret simple circuit diagrams. Students can identify components from simple V-I graphs. Students can identify circuits as series or parallel. Students can state that the UK mains supply is 230V and 50Hz ac.	Students can describe electrical charge in terms of transfer of electrons. Students can describe how to measure electric current and voltage in a circuit Students can calculate resistance using the equation V=IR. Students can calculate the power of an electrical device.	Students can describe an electric current in terms of electron flow. Students can describe the operation and effect of a range of electrical components including resistors and diodes. Students can describe and compare an alternating and direct current. Students can calculate the current flowing in a device and select the correct size fuse to use.	Students can describe the shape of a field around a point charge or charged sphere. Students can use the equation Q=It in a range of problems. Students can explain the purpose of fuses, earthing, circuit breakers and plastic casings in electrical safety. Students can analyse a.c. traces from an oscilloscope to determine the voltage and frequency.	Students can apply their knowledge to a range of problems involving series and parallel circuits. Students can perform calculations involving the rearrangement of the equations Q=It and E=VQ and use algebra to derive E=VIt and P=IV.
Magnetism & Electromagnetism	Students can name the poles of a magnet. Students know the Earth has a magnetic field.	Students can list magnetic materials. Students can describe the interaction of magnetic poles. Students can use a compass to	Students can describe the shape of a magnetic field around a bar magnet. Students can describe how to increase the strength of	Students can use the right hand cork screw rule to determine the direction of the field around a wire. Students can use Flemings	Students can explain why an iron core increases the strength of an electromagnet. Students can describe the operation	Students can explain why relative motion of a wire through a magnetic field is required to produce induction. Students can

		identify the poles of a magnet. Students can describe the structure of a transformer. Students can identify parts of the National Grid.	an electromagnetic. Students can describe the motor effect. Students can describe electromagnetic induction in a wire. Students can describe the structure of a transformer.	left hand rule to determine the direction of the force on a conductor. Students can describe the operation of a simple transformer.	of an electric motor. Students can perform calculations involving rearranging the equation F=BIl. Students can use the transformer equation to calculate input and output voltages.	describe the operation of a dc generator and its output. Students can use transformer equations in a variety of situations to calculate, power, voltage, current and efficiency.
Particle Model of Matter	Students know that all matter is made up of particles. Students can identify substances as solids, liquids and gases. Students can state that heating a material will increase its internal energy.	Students can identify and describe changes of state. Students can calculate the volume of a regular shaped object and measure its mass. Students can state that the temperature of a gas is related to the kinetic energy of the gas particles.	Students can describe the particle arrangements in solids, liquids and gases. Students can calculate the density of an object. Students can describe pressure as being caused by collisions of gas particles with the walls of its container.	Students can use the latent heat equations to calculate the energy required for a substance to change state. Students can describe the relationship between an increase in temperature of a fixed volume of gas and the increase in pressure.	Students can use the density equation on a wide variety of calculations. Students can explain in detail the behaviour of particles during changes of state.	Students can use the concept of potential and kinetic energy to explain changes in internal energy. Students can explain Brownian motion in terms of particle behaviour and collisions.
Atomic Structure	Students know that all matter is made up of atoms. Students know that nuclear radiation can be hazardous.	Students can name the 3 sub atomic particles. Students can identify the nuclear model of the atom. Students can identify the atomic and mass number from nuclear notation. Students can name the 3 types of nuclear radiation. Students know that both fission and fusion can release energy.	Students can define an isotope. Students can define half life. Students can describe some uses of radioactive isotopes. Students can list the 3 types of nuclear radiation in order of their penetration power. Students can define nuclear fission and nuclear fusion. Students know that the Sun fuses hydrogen nuclei to form Helium nuclei .	Students can describe the structure and properties of alpha, beta and gamma radiation. Students can describe the Rutherford scattering experiment and its implications. Students can calculate a half-life from a decay curve. Students can describe the process of nuclear fission in a nuclear reactor.	Students can complete decay equations for alpha and beta decay. Students can explain how radioactive isotopes are selected for their use in terms of half-life and emission type. Students can complete calculations involving half-life and count rate to solve complex problems. Students can explain how a chain reaction in nuclear fission can lead to an explosion.	Students can explain why Rutherford's experiment led to the rejection of the Plum Pudding model of the atom. Students can explain how radioactive isotopes are used in a range of situations including carbon dating and medical tracers. Students can evaluate a variety of storage and disposal solutions for nuclear waste. Students can explain the complexities of carrying out nuclear fusion on Earth.
Space	Students can list a variety of objects in the solar system. Students can state that the Moon is a natural satellite of the Earth.	Students can describe the relative motion of the Sun, Moon and Earth. Students can list some uses of artificial satellites.	Students can describe the Sun as a main sequence, stable star. Students can state that a galaxy showing red shift is moving away from us. Students can state that the Big Bang model is the currently accepted model for the early universe.	Students can describe the life cycle of a star like our Sun including identifying the different stages. Students can describe the different orbits of a variety of satellites. Students can describe how the frequency or wavelength of a wave can be altered by the Doppler effect.	Students can describe the relationship between radius of orbit and speed of orbit. Students can explain how red shift is used to demonstrate that the Universe is expanding.	Students can explain why the force acting on an object travelling in a circle must be at right angles to the direction of motion. Students can explain how CMBR supports the Big Bang model .