CHEMISTRY CURRICULUM JOURNEY

Together we belong, develop character and achieve excellence.

Curriculum overview

Our Chemistry curriculum develops pupils' understanding of matter, its structure, properties and transformations. It moves from particles, elements, compounds and foundational reactions through increasingly demanding study of bonding, quantitative chemistry, energy changes, rates, equilibrium, organic chemistry, analysis and the behaviour of substances at atomic and molecular level. Across the curriculum, pupils learn to explain chemical change using models and evidence, apply mathematical thinking, work safely and accurately, and evaluate chemistry's contribution to industry, society and the environment.

BUILDING ON KEY STAGE 2 SCIENCE

- Materials and their properties: comparing and grouping materials, including hardness, solubility, transparency, electrical and thermal conductivity, and response to magnets.
- Changes of materials: dissolving, separation by filtering, sieving and evaporation, reversible and irreversible changes, and recognising that some changes produce new materials.
- Earth materials: rocks, soils and fossils, providing foundations for later work on the Earth, resources and environmental chemistry.
- Working scientifically: planning enquiries, controlling variables, making accurate measurements, recording data, drawing conclusions and using evidence to support explanations.

How the curriculum builds from these foundations

Key Stage 3	Key Stage 4	Key Stage 5
Pupils develop particle and atomic models, distinguish elements, compounds and mixtures, use separation techniques, study acids and reactions, and connect chemistry to the Earth, resources and climate. Practical work builds safe laboratory habits, observation, measurement, graphing and evaluation.	Pupils explain structure, bonding and chemical change in greater depth. They develop quantitative methods, energy and rate models, electrochemistry, organic chemistry, chemical analysis and environmental chemistry, alongside rigorous required-practical and mathematical work.	Pupils integrate physical, inorganic and organic chemistry. They use atomic orbitals, thermodynamics, kinetics, equilibria, spectroscopy, synthesis and transition-metal chemistry to analyse unfamiliar problems and evaluate experimental evidence.

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
7	1	**Particles & Mixtures**	Building on KS2 knowledge of separating mixtures through filtration, students learn different ways to separate mixtures based on different properties of matter. Students define key properties of solids, liquids, and gases and explain the particle model of matter.	**Composites:** To learn how to separate mixtures **Components:** **Knowledge:** Different states of matter and their particle diagrams Properties of states of matter Predicting the state of matter at different temperatures using heating curves Definition of diffusion Definitions of key words (Solute, solvent, solute, saturated, solution, insoluble) Choosing appropriate separation techniques dependent on the mixture How to carry out each separation technique and the key steps in each **Skills:** Observe diffusion in solutions Carry out the following separation techniques (Filtration, Evaporation, Chromatography) Observe simple distillation Calculate Rf values in chromatography to identify substances in mixtures Interpret a heating curve	By the end of this unit, students will be able to: Draw particle diagrams for states of matter Identify mixtures Use key words (Solute, solvent, solute, saturated, solution, insoluble) Define diffusion Know how to carry out separation techniques (Filtration, Evaporation, Chromatography and simple distillation) Identify pure substances in mixtures using chromatography Predict the state of matter at different temperatures	**States of Matter** **Particle** **Evaporation** **Condensation** **Solute** **Saturated** **Distillation** **Chromatography** **Filtration** **Mixtures** **Pure**	**Previous (Year 5):** Solids, liquids and gases Separation of mixtures using filtering, sieving and evaporating Dissolving and changing states **Future (Year 8):** Physical and chemical changes Use of separation techniques in chemical reactions
7	1	**Super Scientist**	Students begin to develop their working scientifically skills by using lab equipment, identifying hazards and variables to conduct basic investigations.	**Composites:** To learn how to stay safe in a laboratory **Components:** **Knowledge:** Rules of a laboratory Different hazard symbols Parts of a Bunsen burner Uses of basic laboratory apparatus **Skills:** Carry out basic equipment skills using basic laboratory equipment Use a Bunsen burner safely	By the end of this unit, students will be able to: Identify basic laboratory apparatus Identify main hazard symbols and state their meanings Identify hazards in the laboratory Carry out basic equipment skills Use a Bunsen burner safely	**Hazard** **Apparatus** **Bunsen burner** **Thermometer** **Mass balance** **Measurement** **Average/Mean**	**Previous (Year 6):** Taking repeated measurements, using a range of scientific equipment, Observing the world **Concurrent (Physics & Biology):** Identifying variables Planning and recording data Graph skills Forming conclusions **Future (Year 8):** Forming risk assessments Developing observational skills Further graph skills
7	2	**The Earth**	The Earth's structure links to subject topics in geography at KS3. Builds on KS2 knowledge by teaching rock classification based on properties and explaining the processes of the rock cycle, including formation and	**Composites:** To learn about the different types of rocks that make up the Earth's surface and how they form **Components:** **Knowledge:**	By the end of this unit, students will be able to: Label a diagram of the layers of the Earth Name the 3 types of rock State difference between igneous, sedimentary and metamorphic rocks	**Atmosphere** **Igneous** **Sedimentary** **Metamorphic** **Magma/Lava** **Weathering**	**Previous (Year 6):** The Earth structure Volcanoes Rocks and fossils **Future (Year 8):** Composition of the atmosphere

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			transformation of igneous, sedimentary, and metamorphic rocks.	Different layers of the inside of the Earth Three main types of rock, examples and their properties Types of weathering and differences from erosion Rock cycle **Skills:** How to investigate crystal size in rocks Data analysis	Identify the type of weathering based on information given Use the rock cycle to explain how material in rocks is recycled.	**Erosion** **Mantle** **Crust** **Core**	Recycling Carbon cycle Greenhouse effect Combustion Atmospheric pollutants
7	2	**Acids & Alkalis**	Building on KS2 knowledge of chemical changes with comparisons to physical changes. Student's build knowledge of the first foundational reaction; acids and alkalis.	**Composites:** To learn what acids and alkalis are and how they react together **Components:** **Knowledge:** Examples of acids and alkalis Properties of acids and alkalis What is a neutralisation reaction What is an indicator and examples of indicators **Skills:** Use the pH scale to identify if a substance is an acid or an alkali Use indicators to identify the pH of different substances Investigate the effect of antacids in neutralisation reactions How to write word equations for neutralisation reactions	By the end of this unit, students will be able to: Identify acids and alkalis based on their names Name an indicator Identify a substance as an acid, neutral or alkali substance based on the pH and colour in universal indicator State hazards of acids and alkalis Write neutralisation word equations	**Acids** **Alkalis** **Salts** **Indicators** **Neutralisation** **pH Scale** **Reactants** **Products**	**Previous (Year 5):** Irreversible changes make new materials using acid and bicarbonate of soda **Future (Year 8):** Identifying chemical and physical changes Products of metal and acid reactions
7	2	**Atoms & Compounds**	Students are introduced to the world of elements by exploring the periodic table of elements. This is developed by exploring compounds and how elemental properties change.	**Composites:** To learn about atoms and the difference between elements and compounds **Components:** **Knowledge:** How to distinguish between elements and compounds Definition of keywords (atom, elements, compounds) Identifying properties of metals and non-metals How the periodic table is arranged in terms of groups, periods, metals and non-metals Chemical reactions are atoms rearranging to form new substances **Skills:** Writing word equations Use the periodic table to	By the end of this unit, students will be able to: Definition of atom, element and compound State properties of metals and non-metals Identify metals and non-metals on the periodic table Use the periodic table to name elements or get the element symbol Use groups and periods on the periodic table Write simple word equations	**Atoms** **Elements** **Compounds** **Groups** **Periods** **Reactants** **Products** **Properties** **Metals** **Non-metals**	**Previous (Year 5):** Irreversible changes make new materials Compare materials based on properties (hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets **Future (Year 8):** Chemical formula Chemical equations Properties of metals and non-metals Reactivity of metals and their reactions

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				identify elements Practice good health and safety in a chemistry practical			
8	1	**Metals & Acids**	Following on from acids and alkalis in year 7, student's build knowledge of more foundational reactions such as displacement, oxidation, thermal decomposition and metal reactions.	**Composites:** To learn the different reactions that metals are involved in **Components:** **Knowledge:** Properties of metals and non-metals Meaning of key physical properties (i.e. malleable, ductile, brittle, etc) Observations of group 1 metals and water Reactivity series of metals How metals are extracted from the Earth What is a displacement reaction What is an oxidation reaction Products of metals and metal compounds reactions with acids Forming a salt name using the metal and acid used Test for hydrogen & carbon dioxide gas **Skills:** Identifying properties of metals and non-metals using examples Making observations of group 1 metals in water, displacement reactions and oxidation of metals How to write word equations for group 1 metals and water, displacement, oxidation and metal reactions. How to test for hydrogen gas and carbon dioxide gas How to carry out metal reactions using acids and microscale displacement reactions.	By the end of this unit, students will be able to: State the properties of metals and non-metals State observations of group 1 metals and water Identify how reactive a metal is using practical observations Write word equations for group 1 metals and water, displacement, oxidation and metal/acid reactions. Describe how to test hydrogen and carbon dioxide gas State the positive result for hydrogen and carbon dioxide gas Carry out metal reactions using acids and microscale displacement reactions. Predict the name of a salt produced using names of the reactants in the reaction	**Metals** **Non-metals** **Properties** **Reactivity** **Displacement** **Oxidation** **Native Metals** **Acids** **Alkali Metals** **Observation** **Malleable** **Ductile**	**Previous (Year 7):** Identifying acids and their properties Identifying metals and their properties Simple word equations **Future (Year 10):** Reactivity series of metals Extraction of metals from ores Displacement Electrolysis Redox reactions Acid/Alkali Titrations *(Triple science only)*
8	1	**Atomic Structure Project**	Taking students understanding of the atom further from year 7, students are led through the history of the atom and how models have developed over time via a research-based project.	**Composites:** How was the model of the atom developed **Components:** **Knowledge:** Sub-atomic particles in an atom Plum pudding model Nuclear model **Skills:**	By the end of this unit, students will be able to: State the three sub-atomic particles inside an atom and what order they were discovered in Name two atomic models that were developed Name and identify the nucleus and shells in the nuclear model	**Model** **Plum pudding Model** **Nuclear Model** **Alpha Particle** **Scattering**	**Previous (Year 7):** Atoms and elements **Future (Year 9/10)** Sub-atomic particles and their masses and charges Electronic structure Atomic models Alpha scattering experiment

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	1			Using supplied data to identify trends in atomic sizes and melting/boiling point Applying theoretical knowledge to an atomic model building project			
8	1	**Introduction to Chemical Reactions**	Following on from acids and alkalis in year 7, student's build knowledge of more foundational reactions such as displacement, oxidation, thermal decomposition and metal reactions.	**Composites:** To learn how atoms rearrange to form new substances **Components:** **Knowledge:** Chemical changes vs physical changes Understanding chemical formulae Law of conservation of mass **Skills:** Making observations Naming elements and how many atoms of each in a chemical formula How to calculate the mass of a substance using the law of conservation of mass How to balance a symbol equation	By the end of this unit, students will be able to: State the differences between a chemical change and a physical change Identify a chemical or physical change Decode basic chemical formulae State the law of conservation of mass Apply the law of conservation of mass to a reaction Balance a simple chemical equation	**Conservation of mass** **Formulae** **Reactants** **Products** **Irreversible** **Chemical change** **Physical Change** **Chemical Symbols**	**Previous (Year 7):** Identifying acids and alkalis Neutralisation reactions using household products Using universal indicator and the pH scale **Future (Year 9):** Acid strength and concentration Acid reactions with different metal compounds Preparation of a soluble salt Law of conservation of mass Chemical formulae Relative formula mass
8	1	**Aspiring Scientist**	Understand how to conduct accurate measurements and evaluate risks in laboratory experiments.	**Composites:** To learn how to work safely and minimise hazards in a laboratory **Components:** **Knowledge:** Know the rules of a laboratory Hazard symbols Difference between risk, hazard and control measures Components of a simple risk assessment Examples of observations **Skills:** How to write a simple risk assessment for a practical activity Observing reactions and describing observations	By the end of this unit, students will be able to: Recall names of hazard symbols and their meanings Identify hazards and state how to reduce the risk of harm Know the difference between hazard and risk State observations for a stated chemical reaction Apply a written risk assessment to a practical activity	**Hazard** **Apparatus** **Observation** **Risk Assessment** **Risk** **Control** **Method** **Volume** **Mass**	**Previous (Year 7):** Equipment skills Hazard Symbols Identifying variables Planning and recording data Graph skills Forming conclusions **Concurrent (Physics & Biology):** Graph skills Evaluating data **Future (Year 9):** Observational skills Forming basic risk assessments Equipment skills Hazard Symbols Graph skills Simple Method Writing
8	2	**Energy in Chemical Reactions**	Develops understanding of exothermic and endothermic reactions and their energy changes. Teaches methods to measure and calculate reaction rates using techniques like gas production, mass change, and graphs.	**Composites:** To learn about how reactions can be made faster or slower What are endothermic and exothermic reactions **Components:** **Knowledge:**	By the end of this unit, students will be able to: Use collision theory to state how changing concentration, temperature, surface area or catalyst affects the rate of a reaction Define endothermic and	**Reaction** **Reactants** **Products** **Equation** **Collision** **Activation Energy** **Endothermic**	**Previous (Year 7):** Chemical reactions as the rearranging of atoms to form new substances Simple word equations **Future (Year 10):** Endothermic and Exothermic reactions

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Collision theory Factors that affect rates of reaction Ways to measure the rate of a reaction What does endothermic and exothermic mean Examples and uses of endothermic and exothermic reactions What is thermal decomposition **Skills:** Carry out an investigation into the effect of catalysts on a reaction Practice drawing a graph using data gathered in an investigation Investigate endothermic and exothermic reactions by their change in temperature How to write word equations for thermal decomposition reactions	exothermic State examples of endothermic and exothermic reactions Identify an endothermic or exothermic reaction by its temperature change Describe a thermal decomposition reaction Write a word equation for thermal decomposition	**Exothermic** **Thermal Decomposition** **Kinetic**	Reaction profile diagrams Bond energy calculations *(Higher tier only)* Factors affecting the rate of reactions Measuring rates of reaction Investigating rates using volume of gas experiment and disappearing cross experiment
8	**2**	**Climate & The Earth**	Earth's early atmosphere and how the atmosphere has changed with human activities and the impact of climate change. Builds on the Earth from year 7 with respect to finite resources.	**Composites:** To learn about how the atmosphere of the Earth has changed and how humans are contributing to change **Components:** **Knowledge:** Different types of resources on the Earth Difference between recycling and reusing Life cycle assessments How did the atmosphere form and comparisons to Mars Composition of the atmosphere today Carbon cycle Greenhouse gases and the greenhouse effect What is climate change and the effects of climate change Combustion (types and products) Air pollutants and effects on the environment **Skills:** Using data to compare atmospheres of Earth and Mars Label the carbon cycle Write combustion word equations Practice drawing line graphs using data gathered from	By the end of this unit, students will be able to: State how the atmosphere was formed and what gases were released Evaluate products using data in a life cycle assessment State the composition of the Earth's atmosphere today Describe how the greenhouse effect works State ways human activities are increasing the greenhouse gas levels State the effects of climate change Write word equations combustion reactions Name pollutants that are released into the air State effects of pollutants on the environment	**Atmosphere** **Recycling** **Finite** **Greenhouse Gases** **Greenhouse effect** **Combustion** **Climate** **Pollutants** **Photosynthesis** **Reusing**	**Previous (Year 7):** The Earth structure Rock types and rock cycle Weathering and erosion **Future (Year 9):** Composition of the atmosphere Early atmosphere Changing the atmosphere Greenhouse effect Global climate change Carbon footprint Atmospheric pollutants

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				an investigation How to use data to evaluate products for a life cycle assessment			
9	1	**Chemistry of the atmosphere**	Builds on year 8 knowledge of the atmosphere, including the early atmosphere and climate change, by exploring carbon footprints, greenhouse gases, and strategies for reducing emissions. Expands understanding of human impact on the environment.	**Composites:** To learn about how the atmosphere of the Earth has changed in the past How human activities are causing global warming and climate change **Components:** **Knowledge:** Composition of the Earth's atmosphere today How the atmosphere formed in the early Earth How the atmosphere has changed since the early Earth The four main greenhouse gases How greenhouse gases trap heat on the Earth The human activities that are increasing greenhouse gas emissions Definition of "carbon footprint" Difference between global warming and climate change Effects of global warming Combustion and incomplete combustion of fuels **Skills:** Using graphs to make conclusions about carbon dioxide levels and the temperature of the Earth Write chemical equations for complete and incomplete combustion	By the end of this unit, students will be able to: State the composition of the Earth's atmosphere today Describe the changes in the atmosphere over last 4.6 billion years State ways carbon dioxide levels decreased, and oxygen levels increased Describe how the greenhouse effect works State ways human activities are increasing the greenhouse gas levels Define carbon footprint State effects of global warming Write word and symbol equations for complete and incomplete combustion	**Atmosphere** **Greenhouse Gases** **Greenhouse effect** **Combustion** **Climate Change** **Global warming** **Pollutants** **Photosynthesis** **Carbon Footprint** **Radiation**	**Previous (Year 7-8):** The Earth structure The carbon cycle The early Earth's atmosphere The greenhouse effect and climate change Combustion reactions Acid rain **Future (Year 10):** Alternative methods for using finite resources Sustainable development Combustion and incomplete combustion of hydrocarbons
9	1	**Atomic Structure**	Explores the structure of the atom and the properties subatomic particles. Introduces isotopes and the calculation of relative atomic mass. Builds on Year 7 knowledge of mixtures and separation techniques by deepening understanding of atomic composition and the periodic table.	**Composites:** To learn about sub-atomic particles, isotopes and relative atomic mass. **Components:** **Knowledge:** Difference between elements, compounds and mixtures Equipment used in filtration, crystallisation (previous named evaporation at KS3), distillation and chromatography Masses and charges of sub-atomic particles Definition of isotope	By the end of this unit, students will be able to: Identify atoms, elements, compounds and mixtures by their particle diagrams State the masses and charges of an atom Calculate numbers of sub-atomic particles in given data Calculate relative atomic mass Define isotopes Describe how to separate a mixture by applying the correct separation technique	**Atom** **Compounds** **Solute** **Distillation** **Chromatogram** **Filtration** **Mixtures** **Pure** **Isotopes** **Nucleus** **Shells** **Proton** **Neutron**	**Previous (Year 7-8):** Define atom, element, compound and mixture How to separate mixtures (filtration, evaporation, distillation, chromatography) Introduction to atomic structure and sub-atomic particles **Future (Year 10):** How atomic models have changed over time How the periodic table was developed and the use of relative atomic mass

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	1			**Skills:** Label a diagram of an atom Identify elements, compounds and mixtures from particle diagrams Calculate relative atomic mass using isotope data Draw and write electron configurations for the 1st 20 elements Carry out different separation techniques (filtration, crystallisation, distillation, chromatography)		**Electron** **Relative Atomic Mass**	Properties and reactions of group 0, 1 and 7 elements
9		**Master Scientist**	Students further develop their working scientifically skills conducting more complex investigations, and writing clear, structured methods to record and communicate their procedures and findings.	**Composites:** To learn how to write precise methods for experiments **Components:** **Knowledge:** Know the rules of a laboratory Basic equipment symbols and uses Components of a scientific method **Skills:** How to use basic laboratory equipment Draw diagrams using laboratory equipment symbols How to write a method for a given prompt How to self-evaluate a method through experimental work	By the end of this unit, students will be able to: Select appropriate laboratory apparatus and use properly Write a method for a given prompt Self-evaluate and improve a method using experimental work	**Hazard** **Apparatus** **Measurement** **Observation** **Method** **Volume** **Mass**	**Previous (Year 8):** Observational skills Forming basic risk assessments Equipment skills Hazard Symbols Graph skills **Concurrent (Physics & Biology):** Graph skills Using equations Observational skill development Writing risk assessments **Future (Year 10):** Improving experiments Errors & Uncertainties Peer Review Observational skill development Forming more detailed risk assessments
9	2	**Bonding & Structure**	An introduction into the three main types of chemical bonding between atoms. Students' study macro concepts in year 9, exploring the properties of ionic, covalent and metalling bonding. Develops on students' knowledge of the particle model in KS3.	**Composites:** To learn about the three types of compounds and the properties they exhibit **Components:** **Knowledge:** Three types of chemical bond Properties of ionic compounds What causes substances to conduct electricity Properties of simple and large covalent compounds Definition of monomer & polymer Explaining why a substance is solid/liquid/gas in terms of forces Definition of the term "allotrope" Properties of giant covalent compounds (specifically graphite, diamond, fullerenes)	By the end of this unit, students will be able to: State properties (state at room temperature, forces, electrical conductivity, soluble in water) for ionic, simple covalent, large covalent and giant covalent compounds Predict state of matter for substances using melting/boiling point data Explain the uses of diamond and graphite Draw a polymer repeating unit from a monomer and vice versa Explain why a substance is solid/liquid/gas	**States of Matter** **Ionic** **Covalent** **Metallic** **Properties** **Soluble** **Intermolecular** **Electrostatic** **Conductivity** **Ions** **Allotropes** **Intermolecular** **Polymer** **Monomer** **Giant ionic lattice** **Giant covalent structure** **Fullerenes**	**Previous (Year 7-8):** States of matter and changing states Identifying metal and non-metal elements Define properties **Future (Year 10):** Ions and how to draw them Forming ionic formulae using charges Modelling ionic and covalent compounds using dot-cross diagrams Metallic bonding and alloys Nanoparticles and their uses *(Triple science only)*

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Definition of the term "fullerene" Uses of fullerenes **Skills:** Predict the state of matter of a substance with given melting/boiling point data Draw a polymer repeating unit from a monomer and vice versa			
9	**2**	**Quantitative Chemistry**	Building on students' knowledge of foundational chemical reactions in year 7 and 8. Students develop their understanding through applying the law of conservation of mass. Leading into calculating relative formula mass and percentage composition of elements in compounds.	**Composites:** To learn and apply the law of conservation of mass to chemical reactions **Components:** **Knowledge:** The law of conservation of mass Explaining mass changes in open system reactions Identify relative atomic masses (A_r) on the periodic table Difference between A_r and M_r **Skills:** Calculate relative formula mass (M_r) Calculate the percentage composition of an element in a compound Calculate the mass of an element using the law of conservation of mass How to prepare a sample of magnesium oxide from magnesium	By the end of this unit, students will be able to: Calculate relative formula mass State the law of conservation of mass Calculate masses using the law of conservation of mass Calculate the percentage of an element in a compound Explain why mass increases or decreases in an open system	**Relative Atomic Mass** **Relative Formula Mass** **Conservation** **Composition** **Element** **Compound** **Reactant** **Products** **Formulae** **Open/Closed System**	**Previous (Year 7-8):** Interpreting chemical formulae Conservation of mass Naming compounds Difference between elements and compounds **Future (Year 10):** Using moles Balancing chemical equations Calculating reacting masses Calculating concentration of solutions Calculating atom economy, percentage yield and volume of gases *(Triple science only)*
9	**2**	**Chemical Changes**	Builds knowledge of acid and alkali composition, reaction equations, pH indicators, and how metal compounds react with acids to form salts.	**Composites:** To learn how metal compounds react with acids in neutralisation reactions. **Components:** **Knowledge:** Names of common acids and alkalis Difference between strong & weak acids *(Higher tier only)*. The neutralisation ionic equation Components of the pH scale with associated colouring using universal indicators Names of different indicators How to name salts (ionic compounds) How to predict products of different metal compound reactions with acids	By the end of this unit, students will be able to: Name three common acids Identify alkalis by the hydroxide, oxide or carbonate name Name ionic salts Describe how to prepare a pure, dry sample of a soluble salt Write word equations for different metal reactions State ionic equation for neutralisation Describe why weak acids have higher pH's *(Higher tier only)* State colours of indicators in acids and alkalis	**Acids** **Alkalis** **Salt** **Indicators** **Neutralisation** **pH Scale** **Reactants** **Products** **Soluble** **Excess** **Filtration** **Crystallisation**	**Previous (Year 7-8):** Identifying acids and alkalis Neutralisation reactions using household products Using universal indicator and the pH scale Identifying chemical and physical changes Products of metal and acid reactions **Future (Year 10):** Reactivity series of metals Extraction of metals from ores Electrolysis Redox reactions Acid/Alkali Titrations *(Triple science only)*

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				Skills: Carry out neutralisation reactions Classify acids and alkalis using indicators Carry out the required practical for making a soluble salt using previously learnt techniques Write word equations for metal reactions			
10	**1**	**Bonding & Structure**	Students deepen their understanding of bonding by studying electron interactions in covalent, ionic, and metallic bonds.	**Composites:** To learn how ionic, covalent and metallic bonds form using electrons **Components:** **Knowledge:** Properties of ionic compounds What causes substances to conduct electricity Properties of simple and large covalent compounds Explaining why a substance is solid/liquid/gas in terms of forces Properties of giant covalent compounds (specifically graphite, diamond, fullerenes) Defining the term “ion” Describing how ionic bonds form using a dot-cross diagram Definition of an alloy Explaining why alloys are stronger materials Evaluating the uses of nanoparticles for a purpose *(Triple science only)* Comparing ‘nano’ dimensions to typical dimensions of atoms and molecules *(Triple science only)* **Skills:** How to predict the state of matter of a substance with given melting/boiling point data Draw dot-cross diagrams for simple covalent compounds and ionic compounds Work out the of ionic compounds using ion charges Calculate the surface area to volume ratio of nanoparticles *(Triple science only)*	By the end of this unit, students will be able to: Form ionic formulae using ion charges Explain properties of ionic, covalent and metallic substances Draw dot-cross diagrams for ionic and simple covalent compounds Describe how ionic bonds form using a dot-cross diagram Evaluate the uses of nanoparticles for a purpose *(Triple science only)* Calculate the surface area to volume ratio of nanoparticles *(Triple science only)*	**States of Matter** **Ionic** **Covalent** **Metallic** **Ions** **Dot-Cross Diagram** **Alloys** **Shells** **Electrons** **Full Outer Shell**	**Previous (Year 9):** States of matter Different types of bonding Properties of ionic and covalent compounds Allotropes of carbon **Future (Year 11):** Application of knowledge to different contexts Comparing ionic, covalent and metallic properties and linking it to their structures
10	**1**	**Atomic Structure & The**	Developing students	**Composites:**	By the end of this unit,	**Atom**	**Previous (Year 9):**

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		Periodic Table	understanding of the atom, the evolution of atomic models and of the periodic table is taught. Students examine trends and reactivity patterns in Groups 0, 7, and 1, deepening understanding of element properties and their placement in the periodic table.	To learn about how the atomic model and periodic table have developed over time **Components:** **Knowledge:** Who discovered the sub-atomic particles, and in which order they were discovered Describing the plum pudding model Comparing the plum pudding model and the nuclear model The alpha scattering experiment The order of elements in the modern periodic table versus previous periodic tables Dmitri Mendeleev's periodic table and problems with the periodic table Location of metals, non-metals, group 1, group 7 and group 0 are found in the periodic table Names of group 1, group 7 and group 0 Explaining the reactivity and melting/boiling points of group 1 and group 7 and group 0 Predicting properties of group 1 and group 7 and group 0 Comparing reactions and properties of group 1 metals and transition metals *(Triple science only)* **Skills:** Identify different models from diagrams State observations of group 1 metals in water Writing word equations for group 1 water reactions and displacement reactions (for group 1 and group 7)	students will be able to: Describe the alpha scattering experiment, its observations and conclusions that disproved the plum pudding model Compare and contrast the plum pudding and nuclear models Describe the development of the periodic table including how Mendeleev overcame problems with it Explain properties and reactivity of group 1, 7 and 0 elements Compare reactions and properties of group 1 metals and transition metals *(Triple science only)*	**Compounds** **Proton** **Neutron** **Electron** **Relative Atomic Mass** **Noble Gases** **Alkali Metals** **Halogens** **Alpha particle** **Nucleus** **Plum pudding model** **Nuclear model** **Model** **Atomic Number** **Atomic Weight**	Elements, compounds and mixtures Basic diagram of an atom Masses, charges and locations of sub-atomic particles Calculating relative atomic mass Electron configuration of elements Separation techniques Isotopes **Future (Year 11):** Recall of core knowledge Application of knowledge to different contexts
10	**1**	**Energy Changes**	Deepening understanding of exothermic and endothermic reactions by exploring reaction profile diagrams and bond energy.	**Composites:** To depict endothermic and exothermic reactions as reaction profile diagrams and as an overall energy change value **Components:** **Knowledge:** Definition of the terms "endothermic" and "exothermic" Examples and uses of	By the end of this unit, students will be able to: Define endothermic and exothermic State examples and uses of endothermic and exothermic reactions Define activation energy Describe a method for investigating temperature changes in chemical reactions State variables for the	**Endothermic** **Exothermic** **Observation** **Activation Energy** **Reactants** **Products** **Bond Energy** **Surroundings** **Insulated**	**Previous (Year 8):** Defining exothermic and endothermic Identifying endothermic and exothermic reactions based on temperature changes Examples and uses of exothermic and endothermic reactions **Future (Year 11):** Application of temperature changes practical to

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				endothermic and exothermic reactions Definition of activation energy Components of a reaction profile diagram Bond formation and bond breaking are exothermic and endothermic processes Method for investigating temperature changes in chemical reactions including how to improve the method Variables for the temperature changes investigation **Skills:** Calculate overall energy changes using bond energies *(Higher tier only)* Draw and label a reaction profile diagram showing activation energy, overall energy change, reactants and products.	temperature changes investigation Calculate overall energy changes using bond energies *(Higher tier only)* Draw and label a reaction profile diagram		different reactions Improving investigating involving exothermic and endothermic reactions How cells, batteries and fuel cells convert chemical energy into electrical energy *(Triple science only)*
10	**1**	**Using Resources**	Develop students' understanding of how natural and finite resources are obtained, used, and managed sustainably.	**Composites:** To learn how the use of natural and finite resources is changing so we can live sustainably **Components:** **Knowledge:** Meaning of the terms (natural resource, finite resource, renewable) Difference between reuse and recycling Four stages of a life cycle assessment Definition of potable water and differences from pure water How potable water is obtained from freshwater, seawater and wastewater Method of analysing water samples for pH and mass of dissolved solids Method for distilling water samples to obtain pure water. Use of alloys *(Triple science only)* Comparing thermosoftening and thermosetting polymers. *(Triple science only)* Examples of composites *(Triple science only)* **Skills:** Comparing product life cycle data to evaluate products	By the end of this unit, students will be able to: Describe how to obtain potable water from freshwater, seawater and wastewater Compare product life cycle data to evaluate products for a specific use Describe a method for analysing and purifying water samples Compare and explain how the properties of materials are related to their uses and select appropriate materials *(Triple science only)*	**Finite** **Natural resource** **Renewable** **Recycling** **Reusing** **Sustainable Development** **Potable Water** **Wastewater** **Freshwater** **Sedimentation** **Filtration**	**Previous (Year 8):** Differences in recycling and reusing materials Earth's resources (non-renewable and renewable) Carbon cycle Filtration techniques **Future (Year 11):** Using life cycle assessment data to evaluate products Comparing methods for obtaining potable water Corrosion *(Triple science only)* Components of fertilisers *(Triple science only)* The Haber process *(Triple science only)*

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				for a specific use Carry out the required practical for analysing and purifying samples of water Explaining how the properties of materials are related to their uses and select appropriate materials *(Triple science only)*			
10	**1**	**Expert Scientist**	Students further develop their working scientifically skills, enhancing their critical thinking by designing and conducting investigations, analysing data, and refining methods to improve accuracy and reduce errors or uncertainties.	**Composites:** To learn how to plan and improve experiments **Components:** **Knowledge:** Know the rules of a laboratory What are observations Components of planning an investigation Different ways to improve investigations and prevent errors **Skills:** Choosing the correct equipment for a specific purpose Describing observations for a range of reactions Evaluating a method and improving it	By the end of this unit, students will be able to: Describing observations for a range of reactions Predict observations for a given reaction Evaluate a method and make improvements to it	**Hazard** **Apparatus** **Measurement** **Observation** **Improving** **Mean** **Method** **Repeatable** **Accurate**	**Previous (Year 9):** Observational skills Forming basic risk assessments Equipment skills Hazard Symbols Graph skills Simple Method Writing **Concurrent (Physics & Biology):** Math skills Evaluating data Uncertainties Peer Review Process **Future (Year 11):** Application of theory to investigative practice Errors and improving investigations Evaluating data Peer review process
10	**2**	**Rate & Extent of Chemical Change**	Understand collision theory, its application to reaction rates and the impact on industrial reactions.	**Composites:** To learn how particles react together to form products and how we can alter reactions to speed up or slow down **Components:** **Knowledge:** Components of collision theory Definition of activation energy What is rate of reaction How particles collisions change when temperature, concentration, surface area, pressure or presence of catalyst are changed. The impact changes have on the rate of a reaction Method for measuring the volume of gas when concentration is changed. Method for measuring a change in turbidity of a solution when concentration is changed. Variables for the volume of a gas and disappearing cross investigations.	By the end of this unit, students will be able to: State the two components of collision theory Recall the definition of activation energy Describe how particles collisions change when temperature, concentration, surface area, pressure or presence of catalyst are changed. Describe the impact changes have on the rate of a reaction Describe a method for measuring the volume of gas when concentration is changed. Describe a method for measuring a change in turbidity of a solution when concentration is changed. State variables for the volume of a gas and disappearing cross investigations. Describe a rate graph in terms of collisions and change in rate. Calculate the rate of a	**Collision** **Concentration** **Particles** **Temperature** **Pressure** **Catalyst** **Surface Area** **Activation Energy** **Tangent** **Rate of Reaction** **Gradient**	**Previous (Year 8):** Rates of reaction theory How to measure the rate of a reaction Plotting a rate graph **Future (Year 11):** Reversible reactions Le Chatelier’s principle

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				How to improve the volume of gas investigation. Describing a rate graph in terms of collisions and change in rate. **Skills:** Calculate the rate of a reaction using a graph Calculate the rate of a reaction between two points on a graph Draw tangents on a rate graph *(Higher tier only)* Carry out the volume of a gas and disappearing cross investigations. Plot a rate of reaction graph and draw a line of best fit using gathered data	reaction using a graph Draw tangents on a rate graph *(Higher tier only)* Plot a rate of reaction graph and draw a line of best fit using gathered data		
10	**2**	**Chemical Changes**	Understanding the reactivity of metals and the application of electrolysis for extracting metals. Builds on knowledge from the foundational chemical reactions topic in year 8 and interleaving the bonding & structure topic.	**Composites:** To learn how metal reactivity determines how metals are extracted from natural resources **Components:** **Knowledge:** Names and formulae of common acids and alkalis Process of Phytomining and bioleaching as an alternative to copper mining *(Higher tier only)* The order of reactivity for metals including the use of non-metals carbon and hydrogen The reactivity series and using it to state how metals should be extracted from its ore Definition of oxidation and reduction in terms of oxygen (and electrons *(Higher tier only)*) The process of electrolysis The use of molten cryolite in the electrolysis of aluminium oxide Why electrodes must be replaced in the electrolysis of aluminium oxide Indicators used in titration *(Triple science only)* What an end point is *(Triple science only)* Method for carry out a titration including errors and improvements *(Triple science only)* **Skills:** Write word equations for	By the end of this unit, students will be able to: Describe the processes of phytomining and bioleaching and give pros and cons for each *(Higher tier only)* Give names and formulae of common acids and alkalis Recall the order of reactivity for metals including the use of non-metals carbon and hydrogen Define oxidation and reduction in terms of oxygen (and electrons *(Higher tier only)*) Describe the process of electrolysis Explain the use of molten cryolite in the electrolysis of aluminium oxide Explain why electrodes must be replaced in the electrolysis of aluminium oxide Describe a method for carry out a titration using a suitable indicator *(Triple science only)* Write word equations for metal reactions, displacement reactions and reduction with carbon Predict products of molten and aqueous electrolysis Write half equations for products of electrolysis *(Higher tier only)* Write ionic equations for the overall reaction of electrolysis *(Higher tier only)*	**Phytomining** **Bioleaching** **Leachate** **Reactivity** **Ore** **Electrolysis** **Reduction** **Oxidation** **Discharged** **Redox** **Half Equation** **Formulae** **Reactant** **Products** **Aqueous** **Molten**	**Previous (Year 9):** Acids and alkalis Acid strength and concentration Acid reactions with different metal compounds Preparation of a soluble salt **Future (Year 11):** Application of knowledge to different contexts for acids & alkalis, electrolysis and metal reactivity Half equation mastery *(Higher tier only)* Mastery of calculating titration values *(Triple science only)*

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				metal reactions, displacement reactions and reduction with carbon How to predict products of molten and aqueous electrolysis Write half equations for products of electrolysis *(Higher tier only)* Write ionic equations for the overall reaction of electrolysis *(Higher tier only)* Working out which element is oxidised and reduced in redox reactions. Carry out the electrolysis required practical and make observations Carry out the titration required practical *(Triple science only)* Calculate the unknown concentration of a substance using titration data *(Triple science only)*	Calculate the unknown concentration of a substance using titration data *(Triple science only)*		
10	**2**	**Quantitative Chemistry**	Students extend their learning in mass conservation by mastering the concepts of balancing chemical equations, exploring substance amounts (moles), reacting masses, and concentration	**Composites:** To extend the use of mass conservation to calculate substance amounts **Components:** **Knowledge:** The law of conservation of mass Mass changes in open system reactions Difference between A_r and M_r Why high atom economy is a greener process *(Triple science only)* State symbols Equations for calculating moles *(Higher tier only)*, concentration Equation for calculating atom economy, percentage yield and gas volume *(Triple science only)* **Skills:** Balance chemical equations Calculate moles *(Higher tier only)* Balance chemical equations using moles and ratio *(Higher tier only)* Calculate the mass of a substance using the mass of a limiting reactant *(Higher tier only)* Calculate the concentration of substances	By the end of this unit, students will be able to: Describe why high atom economy is a greener process *(Triple science only)* Balance chemical equations Calculate moles *(Higher tier only)* Balance chemical equations using moles and ratio *(Higher tier only)* Calculate the mass of a substance using the mass of a limiting reactant *(Higher tier only)* Calculate the concentration of substances in g/dm^3 or mol/dm^3 Calculate percentage yield and atom economy *(Triple science only)* Calculate the volume of gas and use this to calculate mass of products *(Triple science only)*	**Relative Atomic Mass** **Relative Formula Mass** **Conservation** **Element** **Compound** **Avogadro's Constant** **Reactant** **Products** **Formulae** **Limiting Reactant** **Moles** **Concentration** **Ratio**	**Previous (Year 9):** Relative formula mass Percentage composition of elements in compounds Conservation of mass **Future (Year 11):** Using multiple mathematical equations to calculate unknown values in chemical reactions Converting between units

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				How to convert volume units Calculate percentage yield and atom economy *(Triple science only)* Carry out an investigation for evaluating reactions for atom economy and percentage yield *(Triple science only)* Calculate the volume of gas and use this to calculate mass of products *(Triple science only)*			
11	**1**	**Chemical Analysis**	Building on knowledge of chromatography and purity learnt in the atomic structure topic in year 9, students explore formulations and analytical techniques for identifying and testing substances.	**Composites:** Consolidating knowledge of chromatography to explore formulations and purity To learn how to test for the presence of different gases **Knowledge:** Definition of a formulation Method for separating a mixture using paper chromatography Using chromatograms to conclude the identification of substances in a mixture Spotting errors in paper chromatography Method for testing for chlorine, hydrogen, oxygen and carbon dioxide gases Positive gas test result descriptions Colours of common metal ions in a flame and in sodium hydroxide *(Triple science only)* How to test for carbonates, sulphates, halides and what a positive result is *(Triple science only)* Advantages of instrumental analysis over chemical analysis *(Triple science only)* **Skills:** Identifying pure substances on chromatograms Identifying unknown substances on chromatograms visually and using Rf values How to calculate an Rf value Identify an unknown gas using gas testing Carry out ion testing using flame tests and chemical testing. *(Triple science only)* Identify a compound using the results of ion testing.	By the end of this unit, students will be able to: Describe a method for analysing a mixture using paper chromatography Calculate Rf values for a substance on a chromatogram Identify errors and give solutions in chromatography Identify substances in a mixture in paper chromatography using position and Rf value Define formulation Describe gas tests and state what a positive result is. Recall colours of flame test and chemical tests *(Triple science only)* Describe a method for testing the ions in a substance giving what positive results look like *(Triple science only)* Compare instrumental analysis and chemical analysis *(Triple science only)*	**Element** **Compound** **Mixture** **Pure** **Chromatography** **Chromatogram** **Soluble** **Insoluble** **Retention Factor** **Positive Result**	**Previous (Year 9):** Chromatography process Calculating Rf values Purity on chromatograms **Future (Year 12):** Ion and gas testing (Qualitative analysis) Analytical techniques (Mass Spectrometry & Infrared Spectroscopy)

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				(Triple science only)			
11	**1**	**Organic Chemistry**	Expanding on their understanding of fossil fuels and combustion, students delve into the chemistry of alkanes and alkenes, exploring the industrial processes of fractional distillation and cracking to create useful products.	**Composites:** To learn how crude oil is made and processed to produce different hydrocarbon compounds **Components:** **Knowledge:** Definition of crude oil, hydrocarbons and homologous series First 4 members of the alkane family General formula for alkanes Chemical test for alkenes Process and products of fractional distillation What is a fraction Why short-chain hydrocarbons are more useful and in demand Properties of short and long chain hydrocarbons Cracking and reaction conditions Define monomer and polymer Properties of polymers First 4 members of the alkene, alcohol and carboxylic acid families *(Triple science only)* General formula for alkenes *(Triple science only)* Reactions of alkene, alcohol and carboxylic acids *(Triple science only)* Functional groups for alkanes, alkenes, alcohols, carboxylic acids *(Triple science only)* Fermentation of yeast and uses of alcohol *(Triple science only)* What an ester is *(Triple science only)* Addition and condensation polymerisation *(Triple science only)* Examples of natural polymers *(Triple science only)* **Skills:** Write chemical equations for cracking Use a general formula to work out the formula for an alkane Draw products of alkene reactions *(Triple science only)* Draw monomers from displayed formulas of	By the end of this unit, students will be able to: Define crude oil as a mixture Define hydrocarbon Identify alkanes and alkenes as homologous series' Name the first 4 members of the alkane family Recall and use the general formula for alkanes Describe the chemical test for alkenes and give the positive result Describe the process of fractional distillation and identify fractions Explain why short-chain hydrocarbons are more useful and in demand State reaction conditions needed for cracking Complete cracking equations Name the first 4 members of the alkene, alcohol and carboxylic acid families *(Triple science only)* Recall and use the general formula for alkenes *(Triple science only)* Write products of reactions of alkenes, alcohols and carboxylic acids *(Triple science only)* State the functional groups in alkanes, alkenes, alcohols, carboxylic acids *(Triple science only)* Explain the reaction conditions used for the fermentation of yeast *(Triple science only)* Recall the name of the ester Ethyl ethanoate *(Triple science only)* Recognise addition polymers *(Triple science only)* State examples of natural polymers *(Triple science only)* Draw products of alkene reactions *(Triple science only)* Draw monomers from displayed formulas of polymers and vice versa *(Triple science only)*	**Crude Oil** **Plankton** **Alkanes** **Alkenes** **Homologous Series** **Fractional Distillation** **Boiling Point** **Hydrocarbon** **Flammability** **Cracking** **Thermal decomposition** **Formulae**	**Previous (Year 10):** Non-renewable and finite resources Distillation process Balancing chemical equations Hydrocarbons **Future (Year 12):** Nomenclature Different functional groups Homologous series Types of formulae Isomerism Reaction mechanisms Reactions and properties of alkanes, alkenes, alcohols and haloalkanes Addition polymerisation

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				polymers and vice versa *(Triple science only)* How to work out what the small molecule is during condensation polymerisation *(Triple science only)*			
11	1	**Energy Changes**	Students will be deepening their understanding of energy use in chemical reactions by learning about how bond breaking and bond formation has associated energy uses and how to apply this theory to calculations.	**Composites:** Consolidating understanding of exothermic and endothermic reactions by applying knowledge to different chemical contexts. **Components:** **Knowledge:** Definition of the terms “endothermic” and “exothermic” Examples and uses of endothermic and exothermic reactions Components of a reaction profile diagram Method for investigating temperature changes in different chemical reactions including how to improve the method Variables for the temperature changes investigation Chemical reactions that make up cells and batteries *(Triple science only)* How non-rechargeable and rechargeable batteries work *(Triple science only)* Comparisons of fuel cells with rechargeable cells and batteries *(Triple science only)* **Skills:** Calculate overall energy changes using bond energies *(Higher tier only)* Draw and label a reaction profile diagram showing activation energy, overall energy change, reactants and products. Use data from cells to categorise metal reactivity *(Triple science only)* Half equations for the electrode reactions in a hydrogen fuel cell *(Triple science only)*	By the end of this unit, students will be able to: Identify endothermic and exothermic reactions State examples and uses of endothermic and exothermic reactions Describe a method for investigating temperature changes using different reactants State variables for the temperature changes investigation Calculate overall energy changes using bond energies *(Higher tier only)* Draw and label a reaction profile diagram Interpret data for reactivity of metals *(Triple science only)* Evaluate the use of cells *(Triple science only)* Evaluate the use of hydrogen fuel cells with rechargeable cells and batteries *(Triple science only)* Write half equations for the electrode reactions in a hydrogen fuel cell *(Triple science only)*	**Endothermic** **Exothermic** **Observation** **Activation Energy** **Reactants** **Products** **Bond Energy** **Surroundings** **Insulated**	**Previous (Year 10):** Endothermic and Exothermic reactions Reaction profile diagrams Bond energy calculations *(Higher tier only)* **Future (Year 12):** Enthalpy Enthalpy profile diagrams Calorimetry Bond enthalpies Hess’ Law and Enthalpy cycles
11	1	**Chemical Changes**	Students consolidate and link together their understanding of neutralisation reactions to different practical scenarios.	**Composites:** Consolidating understanding of how metals react with acids and how a metal’s	By the end of this unit, students will be able to: Name three common acids Recall formulae of	**Salt** **Formulae** **Electrolysis**	**Previous (Year 10):** Reactivity of metals Alternative extraction methods for copper *(Higher*

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
			Students also revisit the process of electrolysis and apply the theoretical concept to industrial applications	reactivity affects how it is extracted from natural resources. To apply the understanding of practical techniques by applying them to different chemical contexts. **Components:** **Knowledge:** Names of common acids and alkalis The neutralisation ionic equation Components of the pH scale with associated colouring using universal indicators Names of different indicators How to name salts (ionic compounds) How to predict products of different metal compound reactions with acids Formulae for hydrochloric acid, nitric acid and sulphuric acid The reactivity series and using it to state how metals should be extracted from its ore The process of electrolysis The use of molten cryolite in the electrolysis of aluminium oxide Why electrodes must be replaced in the electrolysis of aluminium oxide Difference between strong & weak acids *(Higher tier only)*. Process of Phytomining and bioleaching as an alternative to copper mining *(Higher tier only)* Definition of oxidation and reduction in terms of oxygen (and electrons *(Higher tier only)*) Indicators used in titration *(Triple science only)* What an end point is *(Triple science only)* Method for carry out a titration including errors and improvements *(Triple science only)* **Skills:** Predict the colour of acids and alkalis using indicators Applying a required practical method for making a soluble salt to different chemical reactants Write word equations for	hydrochloric acid, nitric acid and sulphuric acid Identify alkalis by the hydroxide, oxide or carbonate name Name ionic salts Describe how to prepare a pure, dry sample of any stated soluble salt State ionic equation for neutralisation Predict colours of indicators in acids and alkalis Describe the process of electrolysis Explain the use of molten cryolite in the electrolysis of aluminium oxide Explain why electrodes must be replaced in the electrolysis of aluminium oxide Write word equations for metal reactions, displacement reactions and reduction with carbon Predict products of molten and aqueous electrolysis Describe why weak acids have higher pH's *(Higher tier only)* Calculate the change in pH or concentration of hydrogen ions *(Higher tier only)* Describe the processes of phytomining and bioleaching *(Higher tier only)* State benefits and drawbacks of phytomining and bioleaching *(Higher tier only)* Define oxidation and reduction in terms of oxygen (and electrons *(Higher tier only)*) Write half equations for products of electrolysis *(Higher tier only)* Write ionic equations for the overall reaction of electrolysis *(Higher tier only)* Describe a method for carry out a titration using a suitable indicator *(Triple science only)* Calculate the unknown concentration of a substance using titration data *(Triple science only)*	**Reactivity** **Excess** **Oxidation** **Reduction** **Half Equations** **Ion** **Reactants** **Products**	*tier only)* Acids and alkalis Redox Electrolysis Titrations *(Triple science only)* **Future (Year 12):** Metal reactions Salts Oxidation numbers Redox reactions Acids and Bases Titrations

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				metal reactions, displacement reactions and reduction with carbon Working out which element is oxidised and reduced in redox reactions. How to predict products of molten and aqueous electrolysis Stating observations for electrolysis investigations Calculate the change in pH or concentration of hydrogen ions *(Higher tier only)* Write half equations for products of electrolysis *(Higher tier only)* Write ionic equations for the overall reaction of electrolysis *(Higher tier only)* Apply a required practical method for doing a titration to any acid and alkali reaction. *(Triple science only)* Calculate the unknown concentration of a substance using titration data *(Triple science only)*			
11	**1**	**Quantitative Chemistry**	Students consolidate their learning of using mathematical equations to calculate different quantities by applying the concepts to different contexts.	**Composites:** Consolidating understanding of the law of conservation of mass and using it to calculate the amounts of substances in different chemical reactions and scenarios **Components:** **Knowledge:** The law of conservation of mass Explaining mass changes in open system reactions Why high atom economy is a greener process *(Triple science only)* State symbols Equations for calculating moles *(Higher tier only)*, concentration Equation for calculating atom economy, percentage yield and gas volume *(Triple science only)* **Skills:** Calculate relative formula mass (M_r) Calculate the percentage composition of an element in a compound	By the end of this unit, students will be able to: State the law of conservation of mass Explain why mass increases or decreases in an open system Calculate relative formula mass Calculate masses using the law of conservation of mass Calculate the percentage of an element in a compound Calculate the concentration of substances in g/dm^3 or mol/dm^3 Balance chemical equations Calculate moles *(Higher tier only)* Calculate the mass of a substance using the mass of a limiting reactant *(Higher tier only)* Describe why high atom economy is a greener process *(Triple science only)* Calculate percentage yield and atom economy *(Triple science only)* Calculate the volume of gas and use this to calculate mass of products *(Triple*	**Relative Atomic Mass** **Relative Formula Mass** **Conservation** **Element** **Compound** **Reactant** **Products** **Formulae** **Limiting Reactant** **Moles** **Concentration**	**Previous (Year 10):** Balancing chemical equations Calculate quantities of substances (moles, concentration) Calculate and use relative formula/atomic mass Atom economy, percentage yield, volume of gases *(Triple science only)* **Future (Year 12):** Amount of substance (moles) Gas volumes Percentage yield Atom economy Concentration Chemical equations

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Calculate the mass of an element using the law of conservation of mass Balance chemical equations Calculate moles *(Higher tier only)* Calculate the mass of a substance using the mass of a limiting reactant *(Higher tier only)* Calculate the concentration of substances (including the conversion of volume units *(Higher tier only)*) Calculate percentage yield and atom economy *(Triple science only)* Calculate the volume of gas and use this to calculate mass of products *(Triple science only)*	*science only)*		
11	**1**	**Bonding & Structure**	Students strengthen their understanding of different types bonding between atoms by applying their knowledge to different scenarios. Students are equipped to explain physical properties of compounds.	**Composites:** Consolidating knowledge of ionic, covalent, and metallic bonding helps us understand why substances with these types of bonds have certain properties **Components:** **Knowledge:** What causes substances to conduct electricity Definition of monomer & polymer Diagrams of fullerenes Uses of fullerenes Properties of ionic compounds Properties of simple and large covalent compounds Explaining why a substance is solid/liquid/gas in terms of forces Properties of giant covalent compounds (specifically allotropes of carbon i.e. graphite, diamond, fullerenes) Defining the term “ion” Describing how ionic bonds form using a dot-cross diagram Definition of an alloy Why alloys are stronger materials Evaluating the uses of nanoparticles for a purpose *(Triple science only)* Comparing ‘nano’ dimensions to typical dimensions of atoms and molecules *(Triple*	By the end of this unit, students will be able to: Predict state of matter for substances using melting/boiling point data Explain the uses of diamond and graphite Draw a polymer repeating unit from a monomer and vice versa Form ionic formulae using ion charges State properties (state at room temperature, forces, electrical conductivity, soluble in water) for ionic, simple covalent, large covalent and giant covalent compounds Explain properties of ionic, covalent and metallic substances Draw dot-cross diagrams for ionic and simple covalent compounds Describe how ionic bonds form using a dot-cross diagram Evaluate the uses of nanoparticles for a purpose *(Triple science only)* Calculate the surface area to volume ratio of nanoparticles *(Triple science only)*	**Covalent** **Ionic** **Metallic** **Intermolecular** **Electrostatic** **Delocalised** **Electron** **Alloys**	**Previous (Year 10):** Formation of ionic, covalent and metallic bonds Properties of ionic, covalent and metallic compounds Ions and Ionic formulae **Future (Year 12):** Types of formulae Covalent bonding Ionic bonding Structures of ionic and covalent compounds Shapes of molecules Electronegativity & polarity Intermolecular forces Hydrogen bonding

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				science only) **Skills:** How to predict the state of matter of a substance with given melting/boiling point data Draw a polymer repeating unit from a monomer and vice versa Draw dot-cross diagrams for simple covalent compounds and ionic compounds Work out the of ionic compounds using ion charges Identifying the type of chemical bond using the name of a compound. Calculate the surface area to volume ratio of nanoparticles *(Triple science only)*			
11	**1**	**Atomic Structure & The Periodic Table**	Students consolidate their understanding of atomic structure, subatomic particles, and isotopes, while examining trends and reactivity patterns in Groups 0, 7, and 1. They apply this knowledge to different scenarios, strengthening their grasp of atomic models, the periodic table, and relative atomic mass, building on prior learning of mixtures and separation techniques.	**Composites:** Consolidating knowledge of atoms, isotopes, and atomic mass helps us understand how ideas about atoms and the periodic table have changed over time **Components:** **Knowledge:** Equipment used in filtration, crystallisation, distillation and chromatography Masses and charges of sub-atomic particles Definition of isotope Who discovered the sub-atomic particles, and in which order they were discovered Comparing the plum pudding model and the nuclear model The alpha scattering experiment The order of elements in the modern periodic table versus previous periodic tables Ways in which Dmitri Mendeleev's periodic table overcame problems with the periodic table Names of group 1, group 7 and group 0 Explaining the reactivity and melting/boiling points of group 1 and group 7 and group 0 Predicting properties of	By the end of this unit, students will be able to: Identify atoms, elements, compounds and mixtures by their particle diagrams State the masses and charges of an atom Calculate numbers of sub-atomic particles in given data Calculate relative atomic mass Define isotope Describe how to separate a mixture by applying the correct separation technique Describe the alpha scattering experiment, its observations and conclusions that disproved the plum pudding model Compare and contrast the plum pudding and nuclear atomic models Describe the development of the periodic table including how Mendeleev overcame problems with it Explain properties and reactivity of group 1, 7 and 0 elements Compare reactions and properties of group 1 metals and transition metals *(Triple science only)*	**Nucleus** **Shell** **Proton** **Neutron** **Electron** **Alpha Particle** **Atomic Weight** **Atomic Number** **Relative Atomic Mass**	**Previous (Year 10):** Development of the atom Development of the periodic table Trends and reactions of group 1, group 7 and group 0 **Future (Year 12):** Atomic structure and development of the atom Isotopes, relative isotopic mass and relative atomic mass Periodicity Trends of element groups Electron shells and orbitals Electronic structure

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				group 1 and group 7 and group 0 Describe methods for separating mixtures using filtration, crystallisation, distillation and chromatography Comparing reactions and properties of group 1 metals and transition metals *(Triple science only)* **Skills:** Label a diagram of an atom Identify elements, compounds and mixtures from particle diagrams Calculate relative atomic mass using isotope data Draw and write electron configurations for a stated element Identify different atomic models from diagrams State observations of group 1 metals in water Writing word equations for group 1 water reactions and displacement reactions (for group 1 and group 7)			
11	2	**Chemistry of the Atmosphere**	Consolidating learning from year 9 by expanding student's understanding of the impact humans have on the environment including the changes to the composition of the atmosphere historically compared to the present day.	**Composites:** To explain the ways in which the Earth's atmosphere has changed in the past and how human activities are causing further change. **Components:** **Knowledge:** Composition of the Earth's atmosphere today How the atmosphere formed in the early Earth How carbon dioxide and oxygen levels have changed since the early Earth and the reasons for the change The four main greenhouse gases How greenhouse gases trap heat on the Earth The human activities that are increasing greenhouse gas emissions Definition of "carbon footprint" Effects of global warming Effects of having different atmospheric pollutants in the atmosphere **Skills:** Using graphs to make conclusions about carbon	By the end of this unit, students will be able to: State the composition of the Earth's atmosphere today Describe the changes in the atmosphere over last 4.6 billion years Explain why carbon dioxide levels decreased and oxygen levels increased Describe how the greenhouse effect works in terms of wavelengths of EM radiation State ways human activities are increasing the greenhouse gas levels Define carbon footprint and how to lower it State effects of global warming State effects of sulphur dioxide, oxides of nitrogen, carbon particulates, carbon dioxide and carbon monoxide in the atmosphere Write chemical equations for combustion reactions	**Atmosphere** **Greenhouse Gases** **Greenhouse effect** **Combustion** **Climate Change** **Global warming** **Pollutants** **Photosynthesis** **Carbon Footprint** **Radiation**	**Previous (Year 9):** Composition of the atmosphere Early atmosphere Changing the atmosphere Greenhouse effect Global climate change Carbon footprint Atmospheric pollutants **Future (Year 12):** Polymers and the environment Haloalkanes and the environment

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				dioxide levels and the temperature of the Earth Write word and symbol equations for complete and incomplete combustion How to apply theoretical knowledge to data-based questions			
11	**2**	**Using Resources**	Deepening students' understanding of how life cycle assessments are used to ensure that products are developed to minimize their impact on the environment. Students also consolidate their learning on how potable water is obtained by various methods	**Composites:** To apply knowledge of potable water, life cycle assessments to data-based questions to evaluate materials or methods of analysis **Components:** **Knowledge:** Meaning of the terms (natural resource, finite resource, renewable) Difference between reuse and recycling Four stages of a life cycle assessment Definition of potable water and differences from pure water How potable water is obtained from freshwater, seawater and wastewater Use of alloys *(Triple science only)* Comparing thermosoftening and thermosetting polymers. *(Triple science only)* Examples of composites *(Triple science only)* Definition for corrosion *(Triple science only)* Conditions needed for rusting *(Triple science only)* What is sacrificial protection *(Triple science only)* The Haber process (sources of reactants, reaction conditions justification) *(Triple science only)* Names of salts produced in treating phosphate rock with different acids *(Triple science only)* Production of fertilisers in industrial and laboratory settings *(Triple science only)* **Skills:** How to compare product life cycle data to evaluate products for a specific use How to compare methods for	By the end of this unit, students will be able to: Describe how to obtain potable water from freshwater, seawater and wastewater Compare product life cycle data to evaluate products for a specific use Compare methods for obtaining potable water from freshwater and wastewater Compare and explain how the properties of materials are related to their uses and select appropriate materials *(Triple science only)* State conditions needed for rusting *(Triple science only)* Explain the use of sacrificial protection *(Triple science only)* Explain the trade-off between rate of production and position of equilibrium *(Triple science only)* Compare the production of fertilisers in industrial and laboratory settings *(Triple science only)*	**Finite** **Natural resource** **Renewable** **Recycling** **Reusing** **Sustainable Development** **Potable Water** **Wastewater** **Freshwater** **Sedimentation** **Filtration**	**Previous (Year 10):** Natural, finite and renewable resources Recycling and reusing Potable water and processes for producing potable water Stages of life cycle assessments Alloys, polymers, ceramics and composites *(Triple science only)* **Future (Year 12):** Polymerisation reactions Polymer waste The Haber process and equilibrium Organic fuels

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				obtaining potable water from freshwater and wastewater Explaining how the properties of materials are related to their uses and select appropriate materials *(Triple science only)* Use knowledge of corrosion to evaluate the results of a corrosion investigation *(Triple science only)* Apply principles of equilibrium to the Haber process *(Triple science only)*			
11	**2**	**Rate & Extent of Chemical Change**	Building on collision theory by exploring reversible reactions and Le Chatelier's Principle, understanding how dynamic equilibrium is established and controlled in industrial processes	**Composites:** To learn how particles react together to form products and how we can alter reactions to speed up or slow down **Components:** **Knowledge:** Components of collision theory Definition of activation energy How particles collisions change when temperature, concentration, surface area, pressure or presence of catalyst are changed. The impact changes have on the rate of a reaction Method for measuring the volume of gas when concentration is changed. Method for measuring a change in turbidity of a solution when concentration is changed. Variables for the volume of a gas and disappearing cross investigations. How to improve the volume of gas investigation. Describing a rate graph in terms of collisions and change in rate. Symbol for a reversible reaction Definition for equilibrium Le Chatelier's Principle *(Higher tier only)* Effects of changing concentration, temperature and pressure on a reversible reaction's product yield *(Higher tier only)* **Skills:**	By the end of this unit, students will be able to: State the two components of collision theory Recall the definition of activation energy Describe how particles collisions change when temperature, concentration, surface area, pressure or presence of catalyst are changed. Describe the impact changes have on the rate of a reaction State variables for the volume of a gas and disappearing cross investigations. Calculate the rate of a reaction at a given time(s) using a graph Plot a rate of reaction graph and draw a line of best fit using given data Apply the method for measuring a volume of gas to different chemical contexts Define equilibrium Draw tangents on a rate graph *(Higher tier only)* State Le Chatelier's Principle *(Higher tier only)* Predicting the effect of changing concentration, temperature and pressure on a reaction's equilibrium position *(Higher tier only)*	**Collision** **Concentration** **Pressure** **Catalyst** **Surface Area** **Activation Energy** **Rate of Reaction** **Gradient** **Reversible** **Equilibrium**	**Previous (Year 10):** Factors affecting the rate of reactions Measuring rates of reaction Rate graphs Investigating rates using volume of gas experiment and disappearing cross experiment **Future (Year 12):** Reaction rates Catalysts Boltzmann distribution Le Chatelier's Principle Equilibrium constant Kc

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Calculate the rate of a reaction at a given time(s) using a graph Draw tangents on a rate graph *(Higher tier only)* Plot a rate of reaction graph and draw a line of best fit using given data Apply the method for measuring a volume of gas to different chemical contexts Predicting the effect of changing concentration, temperature and pressure on a reaction's equilibrium position *(Higher tier only)*			
12	**1**	**Basic Concepts in Organic Chemistry** Building on the study of organic compounds such as alkanes, alkenes, alcohols, carboxylic acids, and esters from GCSE and Triple Science, students now learn to name complex branched-chain compounds using the IUPAC system. They are also introduced to reaction mechanisms, starting with simple substitution reactions.		**Composites:** To learn how to name organic compounds (nomenclature) and deduce their formulae. To learn about the chemical structure and bonding involved in organic molecules To study the reactions of organic molecules and to gain an introduction to reaction mechanisms. **Components:** **Knowledge:** Understand the nature of covalent bonding in organic compounds. Sigma (σ) bonds and pi (π) bonds in molecules Key types of organic reactions (substitution, addition, elimination, oxidation) Physical properties (e.g. boiling points, solubility) of alkanes and alkenes Combustion reactions of hydrocarbons. Chemical reactivity of alkanes and alkenes and their reactions with halogens Addition reactions of alkenes **Skills:** How to name and write the formulae for compounds in various homologous series: Alkanes Alkenes Alcohols Haloalkanes Other key organic functional groups How to identify and use different formula types:	By the end of this unit, students will be able to: Understand and use organic chemical nomenclature: Name organic compounds according to IUPAC rules. Recognise and name members of homologous series such as alkanes, alkenes, alcohols, haloalkanes. Write and interpret different types of chemical formulae: Empirical formula Molecular formula General formula Structural formula Displayed formula Skeletal formula Understand the concept of isomerism: Define and identify structural isomers Recognise and explain stereoisomerism in alkenes Explain the nature of covalent bonding in organic molecules: Understand sigma (σ) and pi (π) bonds. Predict molecular shapes using electron pair repulsion theory (VSEPR). Classify organic reactions into key types: Substitution Addition Elimination Oxidation Understand and describe reaction mechanisms: Free radical substitution (e.g. halogenation of alkanes) Electrophilic addition (e.g.	**Nomenclature** **Homologous Series** **Functional groups** **Alkyl** **Aliphatic** **Alicyclic** **Aromatic** **Saturated** **Unsaturated** **Isomers** **Structural Isomerism** **Stereoisomerism** **Mechanisms** **Substitution** **Free Radicals** **Electrophile** **Formulae** **Skeletal** **Alkanes** **Alkenes** **Addition Polymerisation**	**Previous (Year 11):** Alkanes/Alkenes Combustion reactions of alkanes Chemical test for alkenes General formula for alkanes/alkenes Properties of hydrocarbon chains **Future (Year 13):** Aromatic and carbonyl compounds Carboxylic acids Amines and Amino acids Optical isomerism Nucleophilic addition reactions Electrophilic substitution reactions Chemical testing Nomenclature

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Structural formula Displayed formula Skeletal formula Empirical formula Predicting the shapes of organic molecules using electron pair repulsion theory (VSEPR). Draw detailed mechanisms for: Free radical substitution Electrophilic addition Nucleophilic substitution Elimination reactions	reactions of alkenes) Nucleophilic substitution (e.g. in haloalkanes) Elimination reactions (e.g. formation of alkenes from alcohols or haloalkanes) Interpret and draw reaction mechanisms using curly arrows to show the movement of electron pairs. Understand the concept of hydrocarbons as fuels: Learn about the combustion of alkanes and alkenes. Recognise environmental issues related to incomplete combustion and pollutants.		
12	**1**	**The Periodic Table**	Qualitative chemistry introduced to identify unknown compounds. These tests link back to Year 7 with simple test tube reactions e.g. H2 squeaky pop test etc. Patters of reactivity and periodicity linked to GCSE Group 1+7 – now with evidence of orbitals and sub-shells as a new A-level concept.	**Composites:** To learn more about the structure of the periodic table and the trends across periods and groups. To understand the reactivity, properties and trends of group 2 elements. To understand the reactivity and properties of group 7 elements. **Components:** **Knowledge:** Structure of the periodic table in terms of periods and groups. Trends in atomic radius, ionisation energy, and melting points across periods and down groups. How periodicity affects chemical and physical properties. Physical and chemical properties of group 2 elements. Reactivity of group 2 with water, oxygen, and dilute acids. Use of Group 2 compounds as bases Trends in reactivity and solubility of group 2 hydroxides and sulphates. Physical and chemical properties of group 7 elements. Trends of group 7 elements with respect to: Boiling points	By the end of this unit, students will be able to: Describe how the periodic table is arranged in terms of increasing atomic number. Explain the organisation of elements into periods and groups, and how this relates to their electron configurations and recurring chemical properties. Define and identify periodicity, recognising trends in properties across a period Describe and explain the trend in atomic radius across a period and down a group. Describe and explain the trend in first ionisation energy across a period or down a group Relate trends to atomic structure, nuclear charge, electron shielding, and atomic radius. Predict and explain trends in melting and boiling points across Period 2 and Period 3. Describe and explain the physical and chemical properties of Group 2 elements: Trends in reactivity and atomic properties Reactions with water, acids, and oxygen Understand and explain the use of Group 2 compounds	**Periodicity** **Ionisation Energy** **Lattice** **Electronegativity** **Electrostatic** **Delocalised electrons** **Gaseous** **Electron configuration** **Bases** **Halogens** **Disproportionation Reactions** **Redox** **Oxidation numbers** **Quantitative** **Qualitative**	**Previous (Year 11):** Development of the periodic table Order of the modern periodic table Electronic structure Atomic radius Metallic Bonding Halogens Properties and Displacement Reactions Ion Testing *(Triple science only)* **Future (Year 13):** Transition elements Precipitation reactions Qualitative analysis of cations and anions Gas tests Quantitative analysis

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Reactivity Displacement reactions Halide ion tests using silver nitrate and ammonia solutions. Disproportionation reactions (e.g. chlorine in water and alkalis). **Skills:** 1. How to write chemical equations for reactions of group 2 and group 7 elements 2. How to use periodic trends to predict properties and reactions of unfamiliar elements	in neutralising acids and treating acidic soils. Describe and explain the properties of Group 7 elements (the halogens): Trends in physical properties Reactivity trends and displacement reactions Reactions with metals and non-metals Explain the trend in oxidising power of Group 7 elements and their displacement reactions. Describe disproportionation reactions involving chlorine Understand the uses and risks of chlorine in water treatment. Use periodic trends and patterns to predict the properties and reactions of unfamiliar elements.		
12	**1**	**Electrons, Bonding and Structure**	Building on student's core knowledge of atomic structure and how atoms bond. Students are introduced to the concept of atomic orbitals and the role of electrons in ionic and covalent bonding interleaving the importance of intermolecular forces and polarity.	**Composites:** To revisit core knowledge about electrons, ionic and covalent bonding from our GCSEs To extend our understanding about the arrangement of electrons in atoms, their role in ionic and covalent bonding and how they influence the shape and polarity of molecules. To learn about the different types of intermolecular forces **Components:** **Knowledge:** Structure of an atom including the masses and charges of protons, neutrons and electrons Meaning of atomic number, mass number, atomic mass, relative atomic mass, relative isotopic mass and isotopes. Arrangement of electrons in shells, sub-shells (s, p, d) and orbitals Aufbau principle, Pauli exclusion principle, and Hund's rules for electron configurations. Formation of ionic bonds, covalent bonds, dative (coordinate) bonds and metallic bonds. What are London forces	By the end of this unit, students will be able to: Describe the structure of an atom in terms of protons, neutrons, and electrons. Explain the arrangement of electrons in shells, sub-shells (s, p, d), and orbitals. Apply the Aufbau principle, Pauli exclusion principle, and Hund's rule to determine electron configurations. Write full and shorthand electron configurations for elements and ions. Explain the nature of ionic bonding, including electron transfer and the formation of oppositely charged ions. Describe covalent bonding Explain dative covalent (coordinate) bonding, where both electrons in the bond come from the same atom. Describe metallic bonding Describe and compare intermolecular forces, including: London forces (induced dipole–dipole) Permanent dipole–dipole interactions Hydrogen bonding Explain how intermolecular forces affect physical properties Use electron pair repulsion	**Cations** **Anions** **Energy Levels** **Sub-shells** **Atomic orbitals** **Tetrahedral** **Square planar** **Trigonal planar** **Pyramidal** **Linear** **Electronegativity** **Bond Polarity** **Ionic** **Covalent** **Lattice** **Dative/Co-ordinate** **Permanent dipole-dipole** **Induced dipole-dipole** **Hydrogen bonding** **Intramolecular** **Intermolecular** **Delta-positive** **Delta-negative** **Spontaneous dipoles** **Lone pairs**	**Previous (Year 11):** Atomic structure Electronic structure Ionic bonding Covalent bonding **Future (Year 13):** Transition elements and their properties Complex ions Shapes of complex ions Optical isomerism Properties of organic molecules

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				(induced dipole-dipole), permanent dipole-dipole interactions and hydrogen bonding How London forces (induced dipole-dipole), permanent dipole-dipole interactions and hydrogen bonding form How intermolecular forces affect physical properties How lone pairs affect bond angles and molecular geometry. **Skills:** 3. How to represent electron configurations in full and shorthand notation. 4. How to use electron pair repulsion theory (VSEPR) to predict molecular shapes. 5. Identify shapes based on the number of bonding and lone pairs:	theory (VSEPR) to predict and explain the shapes of molecules and ions. Recognise and name molecular shapes Explain the effect of lone pairs of electrons on bond angles and molecular shape. Understand the difference between sigma (σ) and pi (π) bonds.		
12	1	**Atoms and Reactions**	Building on core calculations covered in GCSE, students apply their knowledge to titration calculations, reinforcing concepts from triple science chemistry. Exam skills critical to extrapolate information from the question.	**Composites:** To revisit core knowledge from our GCSEs about the atom and isotopes. To expand our skills in calculating different chemical quantities such as moles (amount of substance) and writing chemical equations (including ionic and half equations) To learn more about acids and bases in neutralisation reactions **Composites:** **Knowledge:** Structure of an atom including the masses and charges of protons, neutrons and electrons Meaning of atomic number, mass number, atomic mass, relative atomic mass, relative isotopic mass and isotopes. Concept of the mole and Avogadro's constant Meaning of acid, base, and alkali. Examples of common acids and alkalis (e.g. HCl, H_2SO_4, NaOH, NH_3). Products of neutralisation reactions Assigning oxidation numbers	By the end of this unit, students will be able to: Describe the structure of an atom, including the positions, relative masses, and charges of protons, neutrons, and electrons. Define isotopes and explain how they differ in terms of neutrons while retaining identical chemical properties. Calculate relative isotopic masses and relative atomic masses (Ar) using given data. Understand the concept of the mole and use Avogadro's constant to convert between number of particles, moles, and mass. Perform mole calculations involving various quantities such as mass, concentration, volume, and molar gas volume Determine empirical and molecular formulae from given data. Calculate percentage yield and atom economy in chemical reactions and explain their importance in sustainable chemistry. Write and balance chemical equations accurately, including state symbols.	**Formulae** **Isotopes** **Relative atomic Mass** **Relative isotopic mass** **Relative molecular mass** **Molar mass** **Amount of substance** **Concentration** **Atom economy** **Percentage yield** **Stoichiometry** **Gas volumes** **Titrations** **Standard solution** **Bronsted-lowry acids/bases** **Dissociation** **Neutralisation** **Indicators** **Redox** **Oxidation numbers**	**Previous (Year 11):** Atomic structure and isotopes Chemical equations and formulae Moles and Reacting masses Strong and weak acids Concentration Redox reactions Gas Volumes Percentage yield and atom economy *(Triple science only)* Titrations *(Triple science only)* Acids and alkalis **Future (Year 13):** Use of calculations to calculate quantities Redox titrations pH and Buffer calculations Conjugate acids and bases

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				to elements in compounds and ions. Identify oxidation and reduction in terms of oxygen gain/loss, electron transfer and change in oxidation number **Skills:** How to calculate: Relative atomic mass Moles from mass, volume, and concentration Molar gas volumes at room temperature and pressure (24.0 dm^3 mol^{-1}) Use empirical and molecular formulae. Apply percentage yield and atom economy calculations in practical contexts. Construct and interpret ionic equations, including: Precipitation reactions Acid–base reactions Redox reactions Write equations for reactions involving: Acids and metals Acids and carbonates Acids and bases/alkalis Construct and interpret redox equations.	Write and interpret ionic equations for reactions Define acids, bases, and alkalis, and recognise common examples. Describe and write equations for neutralisation reactions Assign oxidation numbers to elements in compounds and ions according to standard rules. Identify oxidation and reduction processes based on electron transfer, changes in oxidation number and the loss or gain of electrons Write balanced redox equations using oxidation numbers to track electron changes.		
12	**2**	**Organic Synthesis and Analytical Techniques**	Students revisit the technique of distillation first introduced in year 7 in connection with techniques such as reflux to prepare and purify organic compounds. Students also gain understanding of modern analytical techniques such as infrared (IR) spectroscopy and mass spectrometry (MS). These skills allow them to interpret data, determine molecular structures, and confirm the identity and purity of organic substances.	**Composites:** To learn how to plan and carry out organic synthesis To learn and apply analytical techniques such as IR spectroscopy and mass spectrometry **Components:** **Knowledge:** Infrared (IR) spectroscopy for functional group analysis Deducing possible synthetic routes connecting different organic functional groups. **Skills:** Planning and carry out organic syntheses. Using key practical techniques (distillation, reflux, purification) How to identify organic compounds using (test-tube reactions, physical data) How to analyse and apply reaction mechanisms. Selecting suitable reaction conditions for different	By the end of this unit, students will be able to: Plan and carry out organic synthesis routes involving multiple steps and functional group transformations. Describe and perform key practical techniques used in organic chemistry, including: Distillation Reflux Purification techniques (e.g. separation, drying, recrystallisation) Measuring melting and boiling points Deduce possible synthetic routes connecting different organic functional groups. Apply reaction pathways and mechanisms to unfamiliar synthesis problems. Predict the outcomes of multi-step syntheses, including identifying intermediates and reagents needed. Use test-tube reactions to	**Reflux** **Distillation** **Density** **Boiling Points** **IR Spectroscopy** **Mass Spectrometry** **Spectra** **Mass to charge ratio** **Oxidation** **Synthetic Routes** **Reaction Pathways**	**Previous (Year 11):** Separation techniques (i.e. Distillation, chromatography, filtration, crystallisation) Ion testing *(Triple chemistry only)* Gas tests **Future (Year 13):** Qualitative analysis (chemical testing) Gas tests Titrations IR spectroscopy Mass spectrometry Nuclear magnetic resonance spectroscopy Combining analytical techniques Purification techniques

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				organic transformations. Solving unfamiliar problems by applying mechanistic and synthetic knowledge to new contexts.	identify organic functional groups (e.g. tests for alkenes, carbonyl compounds, carboxylic acids, phenols, and haloalkanes). Interpret infrared (IR) spectra to: Identify the presence of functional groups. Recognise characteristic absorption peaks Understand the principles of mass spectrometry: Use molecular ion peaks to determine molecular mass. Analyse fragment ions to deduce structures. Interpret combined spectral data (IR, mass spectrometry, and elemental analysis) to identify organic compounds. Develop problem-solving skills in deducing structures and identities of organic molecules from given experimental data and reaction information.		
12	**2**	**Physical Chemistry**	Students gain knowledge and understanding of the important chemical ideas that underpin the study of inorganic and physical chemistry. Student's prior knowledge on (enthalpy) changes, rates of reaction and equilibrium is expanded upon. Students develop important qualitative practical skills and mathematical skills in studying enthalpy changes and reaction rate.	**Composites:** To learn about enthalpy and calorimetry To learn about reaction rates through Hess's law and Maxwell-Boltzmann distribution curves To deepen our understanding of dynamic equilibrium and Le Chatelier's Principle **Components:** **Knowledge:** Definitions of: Enthalpy change of formation Enthalpy change of combustion Enthalpy change of neutralisation How factors such as temperature, concentration, surface area, and catalysts affect reaction rates. Maxwell–Boltzmann distribution curves. Economic and environmental benefits of catalysts. Dynamic equilibrium and how it's established in closed systems.	By the end of this unit, students will be able to: Define and use key enthalpy terms: Enthalpy change of formation (ΔH_f) Enthalpy change of combustion (ΔH_c) Enthalpy change of neutralisation (ΔH_n) Perform calorimetry experiments to calculate enthalpy changes using temperature change and energy transfer equations. Use Hess's Law to calculate unknown enthalpy changes from enthalpy cycles or enthalpy data. Explain how reaction rate is affected by temperature, concentration (or pressure for gases), surface area of solid reactants or the presence of a catalyst Interpret and explain Maxwell–Boltzmann distribution curves, including the effects of temperature and catalysts on molecular energy distribution and reaction	**Enthalpy** **Exothermic** **Endothermic** **Activation Energy** **Hess's Law** **Enthalpy cycles** **Bond Enthalpy** **Enthalpy of Combustion** **Enthalpy of Neutralisation** **Enthalpy of Formation** **Collision Theory** **Gradient** **Catalyst** **Boltzmann Distribution** **Calorimetry** **Homogenous** **Heterogeneous** **Equilibrium** **Limitations**	**Previous (Year 11):** Energy changes Bond energy *(Higher tier only)* Rates of reaction Factors affecting rates of reaction Measuring rates of reaction Equilibrium Reversible reactions Le Chatelier's Principle *(Higher tier only)* **Future (Year 13):** Bond enthalpy Lattice enthalpy Born-Haber Cycles Entropy Free Energy

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Le Chatelier's principle **Skills:** How to carry out calorimetry experiments to calculate enthalpy changes. Using Hess's Law to calculate enthalpy changes from enthalpy cycles and data. Interpret Maxwell–Boltzmann distribution curves. Appling Le Chatelier's principle to predict how changing conditions affect equilibrium position.	rates. Describe the benefits of using catalysts in industrial and environmental contexts, including economic efficiency and reduced energy consumption. Understand the concept of dynamic equilibrium in reversible reactions within closed systems, where the rates of the forward and reverse reactions are equal. Apply Le Chatelier's Principle to predict and explain the effects of changes in; concentration, pressure, or temperature on the position of equilibrium, and describe how systems adjust to counteract imposed changes.		
12	**2**	**Alcohol and Haloalkanes**	Continuing the building of knowledge from the previous topic on basic concepts. Student's initial understanding of alcohols in Triple Science GCSE is expanded on in oxidising alcohols. Year 12 students are then introduced to nucleophilic substitution reactions of haloalkanes linking in their knowledge of bond enthalpies and polarity to explain reactivity of cabon-halide bonds.	**Composites:** To explore the chemistry of alcohols and haloalkanes **Components:** **Knowledge:** Differences in chemical reactivity and reaction outcomes of alcohols based on their class Physical properties of alcohols Oxidation reactions of alcohols: Dehydration of alcohols to form alkenes. Substitution reactions of alcohols to produce haloalkanes. Structure and reactivity of haloalkanes. Nucleophilic substitution mechanisms in haloalkanes. Factors affecting the reactivity of different haloalkanes: **Skills:** Classify alcohols as primary, secondary, or tertiary based on their molecular structure. Classify alcohols based on the outcomes of oxidation reactions Conduct experiments to compare the rate of hydrolysis of various haloalkanes.	By the end of this unit, students will be able to: State properties of alcohols Classify alcohols and haloalkanes (primary, secondary, tertiary), Describe reactions of alcohols. Describe oxidation reactions of alcohols identify products based on the type of alcohol. Describe dehydration and substitution reactions of alcohols. Describe and write nucleophilic substitution reactions of haloalkanes and factors affecting reactivity. Describe the hydrolysis of haloalkanes State experimental methods for comparing rates of hydrolysis of haloalkanes	**Alcohols** **Properties** **Primary** **Secondary** **Tertiary** **Polarity** **Hydrogen bond** **Hydroxyl group** **Halide** **London forces** **Combustion** **Oxidation** **Elimination** **Substitution** **Oxidising Agents** **Dehydration** **Nucleophile**	**Previous (Year 11):** Alcohol structure and reactions with sodium, air, water and oxidising agents Uses of alcohols Use of bromine water to test for alkenes Halogenation of alkenes **Future (Year 13):** Aromatic and carbonyl compounds Carboxylic acids Amines and Amino acids Optical isomerism Nucleophilic addition reactions Electrophilic substitution reactions Chemical testing Nomenclature

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Relate experimental observations to bond strengths, polarity and steric effects Make conclusions about the relative reactivity of different haloalkanes.			
13	**1**	**Nitrogen compounds, polymers and synthesis**	Reactions of organic compounds containing nitrogen atoms are explored in this topic. Students also are introduced to chirality as an extension of the learning in isomerism. Year 13 deepen their learning of synthesis by gaining knowledge in synthesising products using multi-stage routes.	**Composites:** To learn about the chemistry of amines and amino acids To extend our understanding of polymers To plan the synthesis of organic molecules through a series of chemical reactions To learn mechanisms for different types of addition and substitution reactions **Components:** **Knowledge:** Structure and classification of primary, secondary, and tertiary amines. Basicity of amines and their reactions with acids. Preparation methods for amines, including reduction of nitriles and nitro compounds. Reactions of amines in substitution and neutralisation processes. General structure of α-amino acids. Acid-base behaviour of amino acids and the formation of zwitterions. Formation of peptide bonds in condensation reactions between amino acids. Formation of addition polymers (from alkenes) and condensation polymers (from diols, dicarboxylic acids, amino acids, or diamines.) Hydrolysis of polymers under acidic or alkaline conditions. Uses of reflux, distillation and other separation techniques in synthesis **Skills:** Drawing repeat units of common synthetic and biological polymers (e.g. polyesters, polyamides, proteins). Planning synthetic routes linking organic compounds	By the end of this unit, students will be able to: Describe the structure, classification, and reactions of amines. Understand the structure and properties of amino acids Describe how peptide bonds are formed during condensation reactions between amino acids. Understand the structure and reactions of amides and nitriles. Explain the formation, structure, and uses of polymers, including: Discuss issues related to the disposal, degradation, and environmental impact of polymers. Plan organic syntheses, including: Multistep synthetic pathways Selecting suitable reagents, conditions, and methods for each step Construct reaction pathways linking different functional groups. Interpret organic reaction mechanisms relevant to nitrogen compounds and polymer formation. Develop problem-solving skills in deducing structures of organic compounds from analytical data (e.g. IR, mass spectrometry, NMR). Suggest synthetic strategies for organic compounds, including appropriate reagents and conditions for each stage of a synthesis. Apply practical organic techniques in the preparation, purification, and identification of nitrogen-containing organic compounds and polymers.	**Aromatic** **Synthesis** **Carbonyl** **Condensation Polymers** **Functional Groups** **Homologous Series** **Amino Acids** **Acyl Chlorides**	**Previous (Year 12):** Polymers Addition polymerisation Polymer environmental problems Electrophilic addition reactions Nucleophilic substitution reactions Reaction mechanisms Reflux, distillation and separation techniques

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Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				through a series of reactions. How to carry out purification techniques (e.g., recrystallisation, drying, distillation). Interpret reaction pathways and connect different functional groups. Drawing mechanisms for: Nucleophilic substitution in haloalkanes Electrophilic addition in alkenes Nucleophilic addition in carbonyl compounds Deduce possible synthetic routes involving: Functional group conversion Multiple-step organic syntheses			
13	**1**	**Aromatic compounds, carbonyls and acids**	With focus on aromatic organic compounds and their reaction pathways. Students develop an understanding of how organic compounds can be transformed through multi-step reaction mechanisms.	**Composites:** To learn about the chemistry of aromatic and carbonyl compounds To extend our understanding of carboxylic acids To plan the synthesis of organic molecules through a series of chemical reactions To learn mechanisms for different types of addition and substitution reactions **Components:** **Knowledge:** Structure and bonding in benzene Experimental evidence for benzene's stability with the Kekulé model. Effects of substituents on benzene ring reactivity and positions of substitution (activating/deactivating groups) Structure and reactions of aldehydes and ketones. Structure, reactions and properties of carboxylic acids. Derivatives of carboxylic acids (acyl chlorides, esters). Esterification reactions and hydrolysis of esters (acidic and alkaline). Acylation reactions of acyl chlorides. Electrophilic substitution reactions of benzene:	By the end of this unit, students will be able to: Describe the bonding and delocalised structure of benzene, and explain its stability compared to alkenes. Compare the reactivity of benzene and alkenes with electrophiles. Describe and explain the mechanisms of electrophilic substitution reactions in benzene, including: Nitration Halogenation Alkylation Acylation Understand the structure, properties, and reactions of phenols, including their increased reactivity relative to benzene. Describe the acid-base behaviour of phenols and their reactions with alkalis and bromine. Describe the structure and properties of carbonyl compounds (aldehydes and ketones). Explain the reactions of carbonyl compounds, including: Oxidation Reduction to alcohols Nucleophilic addition with HCN (hydroxynitrile formation) Use qualitative tests to	**Aromatic** **Synthesis** **Carbonyl** **Functional Groups** **Homologous Series** **Acyl Chlorides** **Mechanism** **Solubility** **Electrophile** **Nucleophile** **Free Radical**	**Previous (Year 12):** Reactions of alcohols Reactions of haloalkanes Reactions of alkenes Nucleophiles / Electrophiles Electrophilic addition reactions Nucleophilic substitution reactions Oxidation / Reduction Reaction mechanisms

CHEMISTRY CURRICULUM JOURNEY | YEAR 7 TO YEAR 13

Year	Semester	Scheme of Learning	Powerful Knowledge / Threshold Concept links	Composites and their components	End Points	Word Revolution	Curriculum Connections
				Nitration Halogenation Friedel–Crafts alkylation and acylation Nucleophilic addition reactions of carbonyl compounds: Reaction with hydrogen cyanide Reduction reactions to alcohols. **Skills:** How to use chemical tests to distinguish aldehydes and ketones: Tollens' reagent Fehling's solution Brady's reagent (2,4-DNPH) Draw detailed reaction mechanisms for: Electrophilic substitution in aromatics Nucleophilic addition to carbonyls How to apply knowledge of mechanisms and functional group interconversions in multi-step organic syntheses. How to plan and interpret synthetic pathways connecting aromatic, carbonyl, and acid derivatives.	distinguish between aldehydes and ketones. Describe the structure, reactions, and acid-base behaviour of carboxylic acids. Understand and explain reactions of carboxylic acids and their derivatives, including: Esterification Hydrolysis of esters Reactions of acyl chlorides Apply practical organic techniques for preparation, purification, and identification of organic compounds. Interpret and explain organic reaction mechanisms for key reactions within this topic. Construct synthetic routes and reaction pathways involving aromatic compounds, carbonyls, and carboxylic acids.		
13	**1**	**Energy**	Year 13 introduces lattice enthalpy, building on Hess's Law studied in Year 12. This connects the concept of reaction mechanisms to physical chemistry, deepening their understanding of thermodynamic principles	**Composites:** To build on our knowledge of enthalpy changes in reactions through learning about lattice enthalpy To learn about entropy and the concept of free energy **Components:** **Knowledge:** Definitions of: Enthalpy change of formation Enthalpy change of combustion Enthalpy change of neutralisation Concept of average bond enthalpy. Explain why calculated enthalpy changes using bond enthalpies may differ from experimental values. What is entropy (S) and how disorder affects it. What is free energy change (ΔG):	By the end of this unit, students will be able to: Define and use key enthalpy terms, including: Enthalpy change of formation (ΔH_f) Enthalpy change of combustion (ΔH_c) Enthalpy change of neutralisation (ΔH_n) Perform and interpret calorimetry experiments to determine enthalpy changes. Use the equation $q=mc\Delta T$ to calculate heat energy changes from experimental data. Apply Hess's Law and enthalpy cycles to calculate unknown enthalpy changes. Understand and use the concept of average bond enthalpy. Estimate enthalpy changes of reactions using average	**Lattice** **Enthalpy** **Hess's Law** **Thermodynamic** **Born Haber** **Enthalpy Cycles** **Enthalpy of Hydration** **Enthalpy of Solution** **Enthalpy of Formation** **Free Energy** **Entropy** **Redox** **Electrode Potential** **Feasibility**	**Previous (Year 12):** Hess's Law Enthalpy change of formation Enthalpy change of combustion Enthalpy change of neutralisation Bond Enthalpy and associated calculations

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				How free energy relates to enthalpy and entropy changes. **Skills:** Carry out and interpret calorimetry experiments How to use the equation q = mcΔT to calculate heat energy changes. How to apply Hess's Law and enthalpy cycles to calculate unknown enthalpy changes. Estimating enthalpy changes of reactions using bond enthalpies. Predicting changes in entropy for physical and chemical changes. Using the free energy equation (ΔG = ΔH – TΔS) Predicting the feasibility of a reaction based on the sign of ΔG.	bond enthalpies. Explain why calculated enthalpy changes using bond enthalpies may differ from experimental values. Define entropy (S) and explain how disorder affects it. Predict changes in entropy for physical and chemical changes. Understand and use the concept of free energy change (ΔG) and relate it to enthalpy and entropy changes. Use the equation $\Delta G = \Delta H - T\Delta S$ Predict the feasibility of a reaction based on the sign of ΔG. Explain the role of energy changes in industrial and biological processes, considering efficiency, sustainability, and environmental impact.		
13	1	**Rates, Equilibrium and pH**	Year 13 takes learning in reaction rates and dynamic equilibrium and extends to apply mathematical skills to predict the extent, speed and feasibility of a chemical reaction. Students then explore acids and bases in the context of buffers and calculating pH.	**Composites:** To extend our study of energy, reaction rates and equilibria **Components:** **Knowledge:** What is rate of reaction and how it is measured Factors that affect reaction rate: Concept of dynamic equilibrium in closed systems. How changing conditions influence the value and position of equilibrium. Definition of acids and bases using the Brønsted–Lowry model. **Skills:** How to determine orders of reaction from experimental data. Writing rate equations and calculating the rate constant (k). Using concentration–time and rate–concentration graphs to determine reaction orders. Applying the Arrhenius equation to calculate activation energy. Applying Le Chatelier's	By the end of this unit, students will be able to: Define rate of reaction and explain how it is measured. Explain the effects of temperature, concentration, pressure, and catalysts on reaction rate using collision theory. Interpret and draw Maxwell–Boltzmann distribution curves and explain how temperature and catalysts affect molecular energy distribution. Calculate rates of reaction from experimental data Describe the role, action, and benefits of catalysts, including their ability to lower activation energy and provide alternative reaction pathways. Understand the concept of dynamic equilibrium in reversible reactions within closed systems. Apply Le Chatelier's Principle to predict and explain the effects of changes in concentration, pressure, and temperature on the position of equilibrium. Calculate and use the equilibrium constant (Kc)	**Orders** **Rate Constant** **Rate Determining Step** **Equilibrium** **Bronsted-Lowry Acids/Bases** **pH** **Buffers** **Neutralisation**	**Previous (Year 12):** Acids and bases Neutralisation reactions Titrations Reaction rates Catalysts Maxwell-Boltzmann distribution Le Chatelier's' Principle K_c equilibrium constant

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				principle to predict how changes in temperature, concentration, or pressure affect equilibrium position. Calculating and interpret equilibrium constants (Kc and Kp). Calculating the pH of strong and weak acids. Using the acid dissociation constant (Ka) and convert between Ka and pKa. Interpreting pH curves from titrations, identifying equivalence and buffer regions. Calculating the pH of buffer solutions and explain their role in resisting pH change. Plan and conduct experiments to measure rates of reaction, equilibrium positions, pH and buffer capacity How to interpret experimental data to solve problems involving rate equations, equilibrium constants, acid–base calculations	for homogeneous reactions. Interpret the magnitude of Kc to assess the position of equilibrium and the extent of a reaction. Define acids, bases, and alkalis in terms of proton transfer. Use the Brønsted–Lowry theory to identify conjugate acid–base pairs in chemical reactions. Calculate the pH of strong acids and strong bases from concentration data. Use the ionic product of water (Kw) to calculate pH values in aqueous systems. Calculate the pH of weak acids using the acid dissociation constant (Ka). Understand the function and importance of buffer solutions in resisting changes in pH when small amounts of acid or alkali are added. Calculate and predict pH changes in buffer systems after the addition of acids or alkalis. Explain the working of buffer solutions using equilibrium principles and describe their practical uses (e.g. biological and industrial applications).		
13	**2**	**Transition Elements**	Transition elements were introduced to year 13 students in year 10 Triple Science GCSE. Year 13s look at the chemical and physical properties of transition elements linking in their previous learning in isomerism and redox reactions	**Composites:** To learn about the properties of transition metals, the complex ions they form, their reactions and how they are involved in redox reactions **Components:** **Knowledge:** Definition of a transition metal Properties of transition metals Complex ion formation and their associated colours Variable oxidation states Catalytic behaviour of transition metals including examples such as the Haber process and Contact process Ligand substitution reactions and the stability of complexes.	By the end of this unit, students will be able to: Define transition elements State properties of transition elements Recognise variable oxidation states of transition metals Recall the catalytic behaviour of transition metals including examples such as the Haber process and Contact process Understand the formation of complex ions including coordination numbers and their shapes Explain the role of ligands in complex ion formation Describe ligands as monodentate, bidentate, and multidentate ligands Write equations for ligand substitution reactions Identify and explain types of isomerism in transition	**Transition Element** **D-block** **Ligand** **Complex** **Stereoisomerism** **Precipitation** **Substitution** **Redox**	**Previous (Year 12/GCSE):** Physical properties of transition metals in comparison to group 1 metals *(Triple science only)* Haber process Contact process Shapes of molecules Redox Titrations Optical & geometric isomerism

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				Skills: Draw complex ion structures using different ligands and metal ions Identify types of ligands (monodentate, bidentate and multidentate) Determine the shape of complex ions (e.g., octahedral, square planar, tetrahedral). How to write balanced redox equations involving transition metal ions. How to recognise the variable oxidation states of transition metals. To carry out and interpret precipitation reactions and ligand substitution reactions. How to use qualitative analysis to identify transition metal ions	metal complexes Describe redox reactions involving transition metals, including redox titrations Describe the electron transfer processes in complex ions Explain the catalytic behaviour of transition metals Understand the role of transition metals in biological systems and industrial processes. Describe how to conduct qualitative analysis for identifying transition metal ions Apply theoretical knowledge to practical and unfamiliar scenarios, interpreting experimental results involving transition metal chemistry.		
13	**2**	**Organic Analysis**	Here students are introduced to nuclear magnetic resonance spectroscopy (NMR) to analyse the structure of organic compounds. Students are guided into combining this with previously learnt techniques such as IR spectroscopy and mass spectrometry. Types of chromatography are introduced expanding on an idea which was introduced in year 7.	**Composites:** To learn how to identify reactions using different chemical tests To apply titration experiments to determine different quantities To learn and apply analytical techniques such as IR spectroscopy, mass spectrometry and nuclear magnetic resonance spectroscopy **Components:** **Knowledge:** Interpretations of precipitation reactions. Gas tests for carbon dioxide, hydrogen, and ammonia. Infrared (IR) spectroscopy technique and locations of functional groups on IR spectra Mass spectrometry (MS) and its use for molecular mass using fragmentation patterns Nuclear Magnetic Resonance (NMR) spectroscopy Proton (^{1}H) NMR spectra (chemical shifts, splitting patterns, integration) Carbon-13 (^{13}C) NMR spectra (chemical shifts,	By the end of this unit, students will be able to: Perform qualitative analysis using test-tube reactions to identify different cations, anions and gases Carry out quantitative analysis techniques, including: Acid–base titrations Redox titrations Back titrations Calculations involving concentrations, molar masses, and purity Understand and interpret infrared (IR) spectroscopy data to: Identify functional groups in organic compounds Recognise characteristic absorption peaks Interpret mass spectrometry (MS) data to: Determine molecular masses Identify molecular ion peaks and fragment patterns Understand and interpret nuclear magnetic resonance (NMR) spectroscopy, including: ^{1}H NMR: chemical shifts, integration, splitting patterns	**Aromatic** **Synthesis** **Functional Groups** **Homologous Series** **Chromatography** **NMR**	**Previous (Year 12):** IR Spectroscopy Mass Spectrometry Paper Chromatography Gas Chromatography Qualitative analysis (Test tube reactions)

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				splitting patterns, integration) **Skills** How to perform test-tube reactions to identify cations and anions How to use test sequences logically to identify unknown substances. How to carry out titration experiments to determine concentration and volumes How to apply redox titrations involving iron(II), manganate(VII), and other species. How to calculate moles, concentrations, and reacting volumes from experimental data. How to interpret infrared (IR) spectroscopy to identify functional groups. How to use mass spectra to determine molecular mass How to interpret proton (^{1}H) NMR spectra (chemical shifts, splitting patterns, integration) How to identify chemical environments and deduce molecular structures How to plan and perform qualitative and quantitative analysis experiments. How to use multiple analytical techniques together to deduce the identity of unknown compounds. How to apply techniques to unfamiliar contexts in synthesis, purification, and analysis.	^{13}C NMR: chemical shifts and peak interpretation Combine data from IR, MS, and NMR spectra to deduce the structures of unknown organic compounds. Develop practical skills in experimental analysis, focusing on accuracy, reliability, and method evaluation. Apply analytical and problem-solving skills to interpret data, verify results, and suggest improvements to procedures.		