Chemistry Overview Plan

Whole school curriculum intent
Develop a broad and balanced curriculum that enables students to learn, recall and apply knowledge and skills across different contexts, supported by a robust and consistent approach to assessment. This will lead to successful and resilient lifelong learners who can cope in a range of changing contexts.

Key stage 3/4 subject curriculum intent
➔ Science teaching at TQEA will develop a deep understanding of a range of scientific ideas in the subject disciplines of biology, chemistry and physics. Pupils will make connections between these subject areas and become aware of many of the big ideas underpinning scientific knowledge and understanding. To support this, the design of Knowledge Organisers has been carefully planned and aligned to the curriculum narrative. KOs are carefully embedded into the curriculum structure to ensure that this meets the need for improving literacy and provides opportunities for retrieval practice. This also ensures that new key language is introduced, explained and modelled when building on prior learning. ➔ Pupils will be able to decide on the appropriate type of scientific inquiry to undertake to answer their own questions and develop a deeper understanding of factors to be considered when collecting, recording, processing and evaluating data. They will develop their literacy, numeracy and ICT skills in a range of practical and theoretical contexts. ➔ We will enrich our curriculum by giving pupils opportunities to equip themselves with the tools needed to access their learning, for example, by research projects, visiting speakers and visits to local and national sites of scientific interest, both physically and virtually. ➔ Incorporate the 4 pillars of curriculum design ensuring that we produce students that can compete nationally and globally in any career: Personal Development and Empowerment; Subject Capital; Employability Capital; Social and Cultural Capital ➔ For some students, studying the sciences will provide the platform for more advanced studies, establishing the basis for a wide range of careers. For others, it will be their last formal study of subjects that provide the foundations for understanding the natural world and will enhance their lives in an increasingly technological society. ➔ Science is changing our lives and is vital to the world's future prosperity. The sciences will be taught in ways that ensure students have the knowledge to enable them to develop curiosity about the natural world and an appreciation of the relevance of science to their everyday lives.

Year Group		Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Year 7	Topic	**Introduction to science**	**Particle model and separating**	**Atoms and Elements**		**Chemical Reactions**	
	Core knowledge from this topic	• Identify careers that involve science outside of the obvious (N) • How we stay safe in the lab (N) • How we draw scientific equipment (N) • How we use a Bunsen Burner (N) • How we use the scientific equipment in a practica (N) • Interpret graphs to describe what they show (N) • Recognise the scientific method (N): • Identify Variables • Design a valid experiment • Write a method • Analyse simple data • Draw simple bar charts • Evaluate an experiment (N)	• What the difference is between solids, liquids and gases • Describe and explain the properties of solids, liquids and gases (N) • Describe and explain the particle behaviour of solids, liquids and gases (N) • Describe and explain diffusion • Identify the changes of state • Describe how we can separate mixtures • Carry out a practical to separate the components of rock salt (N) • Describe what is meant by solubility • Describe and explain what happens in distillation (N) • Describe and explain what happens in chromatography (N)	• What atoms and elements are (N) • What compounds are (N) • What mixtures are and the differences between all three (N) • What polymers are (N) • What other materials there are (N) • What problems are caused by plastics (N)		• What an exothermic reaction is (N) • What an endothermic reaction is (N) • How we can investigate temperature change in reactions (N) • What catalysts are and what they do (N) • What happens in combustion (N) • What fuels are (N) • What thermal decomposition is (N) • What chemical and physical changes are (N)	
	Links to the national curriculum	• ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience • make predictions using scientific knowledge and understanding • select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate • use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety • make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements • apply mathematical concepts and calculate results	• the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure • changes of state in terms of the particle model. • the concept of a pure substance • mixtures, including dissolving • diffusion in terms of the particle model • simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography • the identification of pure substances. • energy changes on changes of state (qualitative)	• a simple (Dalton) atomic model • differences between atoms, elements and compounds • chemical symbols and formulae for elements and compounds • properties of ceramics, polymers and composites (qualitative)		• chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations • combustion, thermal decomposition reactions • what catalysts do. • exothermic and endothermic chemical reactions (qualitative)	

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		● present observations and data using appropriate methods, including tables and graphs ● interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions ● All these skills will then be ongoing through years 7-11.			
	Previous content that this topic builds upon	From KS2 NC: ● asking relevant questions and using different types of scientific enquiries to answer them ● setting up simple practical enquiries, comparative and fair tests ● making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers ● gathering, recording, classifying and presenting data in a variety of ways to help in answering questions ● recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables ● reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions ● using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions ● identifying differences, similarities or changes related to simple scientific ideas and processes ● using straightforward scientific evidence to answer questions or to support their findings	From KS2 NC: ● compare and group materials together, according to whether they are solids, liquids or gases ● observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) ● use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating ● demonstrate that dissolving, mixing and changes of state are reversible changes ● know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution ● compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets	From KS1 NC ● identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses From KS2 NC: ● give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic From previous KS3 ● 'Particle model and separating' from Autumn term	From KS2 NC: ● observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) ● demonstrate that dissolving, mixing and changes of state are reversible changes explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda. From previous KS3 ● 'Particle model and separating' from Autumn term Yr 7 ● 'Atoms and elements' and naming compounds from Spring term Yr 7
	Key vocabulary	variables, independent, dependent, control, fair test, measurements, valid, repeatable, mean average, calculate, prediction, hypothesis, valid, metod, results, table, graph, bar chart, axes, label, units, equipment, beaker, test-tube, boiling tube, Bunsen burner, spatula, conical flask, funnel, filter, evaporating bowl, measuring cylinder, stirring rod, gauze, tripod, diagram, conclusion, evaluation, reproducible, the scientific method	solid, liquid, gas, melting, freezing, evaporating, boiling, condensing, sublimation, deposition, properties, particles, forces, energy, organised, random, properties, particle model, diffusion, separation, filtration, filtrate, evaporation, distillation, solvent, solute, solution, soluble, insoluble, purify, chromatography, Rf value	atom, element, periodic table, compound, mixture, pure, ratio, polymer, materials, ceramic, composites, function, properties, biodiversity, environmental issues, impact	exothermic, endothermic, activation energy, energy change, heat, temperature, energy level diagram, thermometer, thermal decomposition, combustion, oxidation, catalyst, fuel, fire triangle, chemical, physical, reversible, irreversible
	Development of cultural capital	https://www.khanacademy.org/science/high-school-biology/hs-biology-foundations/hs-biology-and-the-scientific-method/a/the-science-of-biology The scientific method worksheet Required practicals: ● investigation into how the volume of a beaker affects the time taken for a tealight to go out ● Investigation into the effectiveness of different Bunsen flames	● https://courses.lumenlearning.com/cheminter/chapter/solid-liquid-and-gas/ effects of cooling mercury- and how the same substance on different planets can be a different state ● Techniques for separating mixtures- use of filtration and distillation to gain pure water ● Use of chromatography in forensic science ● How salt stops the roads from freezing ● How poison gas can be used in war Required practicals: ● Separating rock salt and application to survival skills ● Chromatography ● DEMO distillation **FOCUS CAREER:** FORENSIC SCIENCE	● https://theconversation.com/marine-debris-biodiversity-impacts-and-potential-solutions-2131 Impact of plastics on biodiversity ● Discovery of new materials and their applications- nanoscience, vantablack etc. **FOCUS CAREER:** MATERIALS ENGINEER	● use of catalysts in industry linked to profit ● biological washing powder- pros and cons ● uses of exothermic and endothermic reactions Required practicals: ● Identifying Exo/ Endothermic reactions ● Products of combustion ● Observation of signs of a chemical reaction ● Comparison of catalysts with hydrogen peroxide **FOCUS CAREER:** CHEMICAL TECHNICIAN, PHARMACIST, CRIMINAL INVESTIGATOR
	Development of reading	Intro to Science- The scientific method word doc- students read and come up with another example to show they have understood the task-	https://courses.lumenlearning.com/cheminter/chapter/solid-liquid-and-gas/ effects of cooling mercury- and how the same substance on different planets can be a different state Methods for separating techniques	Chem- KS3 A, E, C, M Plastic problems word doc- TLDR task to summarise Research on uses of new materials- could introduce the idea of nanoscience and its new applications	Tim's Story task (in file)- students have to identify whether the reactions mentioned are physical or chemical and be able to explain their reasons Case Study of Helen Sharman -who went from being a chemist for the Mars chocolate company to the first Briton in space!
	Concepts – what will students be able to do	● Identify careers that involve science ● Describe how we stay safe in the lab ● Draw scientific equipment ● Learn how to use a Bunsen Burner ● Use the scientific equipment in a practical	● Describe the properties and particle behaviour of the states of matter; ● Explain how state changes occur ● Define pure substance	● Describe the structure of an atom, including charge and mass of each subatomic particle ● Describe the differences between elements, compounds and mixtures and be able to identify each from a particle picture	● Describe a chemical reaction as being the rearrangement of particles to make a new substance ● use chemical formula to represent a chemical reaction in an equation

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	at the end of the topic	• Interpret graphs to describe what they show
		• Use the scientific method to
		  • Identify Variables
		  • Design a valid experiment
		  • Write a method
		  • Analyse simple data
		  • Draw simple bar charts
		  • Evaluate an experiment
			• Describe a range of separation techniques and explain how they work	• Use the periodic table to identify elements
				• Classify materials and describe how their properties link to their functions
				• Be able to identify symbols and formulae for elements and common compounds
					• describe combustion and thermal decomposition reactions and link these to endothermic and exothermic reactions.
					• Describe the use of catalysts and (briefly) how they work

Year Group		**Autumn 1**	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
Year 8	**Topic**	**<u>Acids and Alkalis</u>**		**<u>The Periodic table</u>**		**<u>Atmosphere and human impact</u>**	**<u>Rock Cycle</u>**
	Core knowledge from this topic	• What acids and alkalis are (N) • What the pH scale is (N) • What happens in neutralisation (N) • Properties of metals and nonmetals (N) • What happens when we react acids and metals (N) • What happens in a displacement reaction (N) • What happens in an oxidation reaction (N)		• What the properties of metals and non-metals are • What the periodic table is and how to use it (N) • How the periodic table is arranged (N) • What the properties of Group I metals are(N) • What the properties of Group VII are (N) • What happens in displacement reactions		• What the atmosphere is (N) • The importance of the carbon cycle (N) • What happens in global warming (N) • How humans are impacting on the Earth (N) • Why we should recycle	• What the structure of the Earth involves (N) • The difference between weathering and erosion (N) • How sedimentary and metamorphic rocks are formed (N) • How igneous rocks are formed (N) • What the rock cycle is (N) • How we can extract metals from the Earth (N)
	Links to the national curriculum	• defining acids and alkalis in terms of neutralisation reactions • the pH scale for measuring acidity/alkalinity; and indicators • reactions of acids with metals to produce a salt plus hydrogen • reactions of acids with alkalis to produce a salt plus water		• the varying physical and chemical properties of different elements • the principles underpinning the Mendeleev Periodic Table • the Periodic Table: periods and groups; metals and non-metals • how patterns in reactions can be predicted with reference to the Periodic Table • The properties of metals and non-metals • the chemical properties of metal and non-metal oxides with respect to acidity. • Oxidation and displacement reactions		• Earth as a source of limited resources and the efficacy of recycling • the carbon cycle • the composition of the atmosphere • the production of carbon dioxide by human activity and the impact on climate	• the composition of the Earth • the structure of the Earth • the rock cycle and the formation of igneous, sedimentary and metamorphic rocks
	Previous content that this topic builds upon	From KS1 NC: • identifying and classifying • identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock • describe the simple physical properties of a variety of everyday materials • compare and group together a variety of everyday materials on the basis of their simple physical properties • identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses • find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching. From KS2 NC • compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets From previous KS3 • 'Atoms and elements' and naming compounds from Spring term • Word equations from 'atoms and elements', idea of some substances being corrosive		From KS2 NC: • observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) From previous KS3: • Writing equations from 'chemical reactions', • 'Acids and Alkalis'- displacement reactions		From KS1 NC • Recognise that environments can change and that this can sometimes pose dangers to living things From KS2 NC: • Identifying scientific evidence that has been used to support or refute ideas or arguments	from KS1 NC: • recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago From KS2 NC: • compare and group together different kinds of rocks on the basis of their appearance and simple physical properties • describe in simple terms how fossils are formed when things that have lived are trapped within rock • recognise that soils are made from rocks and organic matter From previous KS3 • 'Metal reactions- displacement reactions and reactivity • 'Atoms and elements' and naming compounds from Spring term Yr 7 • 'Atoms and elements'- word equations • structure of the Earth and rocks from Geography

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	Key vocabulary	pH scale, acid, alkali, base, neutral, neutralisation, hazard, indicator, salt, symbol equation, word equation, effectiveness, corrosive, reactants, products, indigestion, chemical reaction, displacement,	metals, non-metals, periodic table, elements, groups, periods, properties, physical, pattern, reactivity, alkali metals, alkali-earth metals, halogens, noble gases, chemical data, Mendeleev, chemical reaction, reactivity series, displacement, oxidation, particle diagrams, equations, balancing	atmosphere, gases, nitrogen, oxygen, carbon dioxide, argon, percentages evolution, carbon cycle, human activities, fossil fuels, respiration, photosynthesis, decay, microbes, carbon stores, impact, global warming, heat, trapped, emit, reflect, greenhouse gases, climate change, consequences, recycling, limitations, efficiency, biodiversity, sea-levels	crust, mantle, core, layers, volcanoes, biological, chemical and physical weathering, erosion, corrosion, limestone, acid rain, reaction, sedimentary, metamorphic, igneous, intrusive, extrusive, heat, pressure, transportation, deposition, burial, cementation, minerals, petrified, fossils, cooling rate, crystals, ores, extraction, electrolysis, reduction, reactivity, native
	Development of cultural capital	• Uses of acids and alkalis • reason for stonework becoming damaged (acid rain) • Acid attacks in the news Required practicals: • Identifying acids and alkalis using indicators • comparisons of indicators • Reactions of acids and metals • Displacement reactions **FOCUS CAREER:** TOXICOLOGIST	• A greater understanding of the complexity and beauty of the periodic table, and how it has developed over time • How in science, models change as new evidence and discoveries come to light **FOCUS CAREER:** METALLURGIST,	• Impact of humans on our planet • Impact of using fossil fuels and the need to find new technology to harness renewable energy (links to PHYSICS) **FOCUS CAREER:** ENVIRONMENTAL CHEMIST, Climate change Analyst	• How fossils tell us about the path • The role of the rock cycle in the make- up of our planet and the resources • The impact of weathering and erosion **FOCUS CAREER:** GEOLOGIST, ARCHEOLOGIST, ENVIRONMENTAL SCIENTIST, CONSTRUCTION
	Development of reading	https://www.softschools.com/language_arts/reading_comprehension/science/122/acids_and_bases/ Chem- KS3 Acids and Alkalis- How Are Acids and Alkalis dangerous word doc- students need to summarise the article	Chem- KS3 Development of the periodic table word document: make a timeline using the information	Chem- KS3 Atmosphere Biomass 101 word document. Students summarise the sheet in no more than 50 words.	Chem- KS3 Rocks and fossils word document. Contains comprehension questions on quarrying and mining
	Concepts – what will students be able to do at the end of the topic	• Define acids, alkalis, bases and explain the pH scale; • Write word equations for acid reactions • Name salts • Describe what happens in a neutralisation reaction	• The properties of metals and nonmetals compared to each other and why they are suited to particular jobs. • Describe how the periodic table is arranged in terms of groups and periods, and where the divide is between metals and nonmetals. • Describe (briefly) how Mendeleev was able to arrange the periodic table, and use it to predict the properties of elements not yet discovered • Look at group I (alkali metals) and VII (halogens) in terms of their properties, similarities and differences. • Write word equations for the reactions of metals and nonmetals with oxygen and describe the acidity of each • Define displacement reaction and be able to write the word equations for displacement reactions and explain why they can/ cannot happen	• The composition of the atmosphere and how it has changed over time • How humans are impacting on the fine balance of CO_2 in the air. • Describe and explain the impact of burning fossil fuels. • Explain the greenhouse effect • Suggest ways that we can preserve finite resources	• The three types of rocks and their properties- sedimentary, igneous and metamorphic. • How the rocks are able to change from one type to another over millions of years in the 'rock cycle'. • Describe how the earth is structured and how we know this. • Explain how we are able to use electrolysis and reduction with carbon to extract metals from their ores which are found in the ground

Year Group		Autumn Term 1	Autumn Term 2	Spring Term 1	Spring Term 2	Summer Term 1	Summer Term 2
Year 9	**Topic**	**Atomic Structure (C1)**	**Bonding and equations (C1)**	**Periodic table and bonding (C1)**	**Types of reaction (C1)**	**Metals and Electrolysis (C1)**	**Energy Changes (C1)**
	Core knowledge from this topic	• What atoms, elements and compounds are • How electrons are arranged in atoms (N) • How the structure of the atom was discovered (N) • What are the differences between compounds and mixtures • How gases are identified (N) • How chromatography works (RP)	• How metal and non-metals form bonds (N) • How nonmetals form bonds (N) • How metals form bonds (N) • How we write chemical equations • What chemical equations tell us (N)	• How the periodic table is arranged • How scientists developed the periodic table (N) • How metals and nonmetals are different • How Group I elements behave (N) • How Group VII elements behave (N) • How we explain the trend in reactivity of Group I and VII (N) • What happens when Group I and Group VII react together • How Transition metals differ from Group 1 metals (T)	• How metals react with oxygen • How metals react with water • How metals react with acids • What displacement reactions are and why they happen • What the reactivity series is and how we can use it • What exothermic and exothermic reactions are • How we can measure temperature changes in solutions (RP) • How we can test for metal ions (T) • How we test for non-metal ions (T) • Identifying Chemicals using ion testing (T) • Instrumental methods used for chemical analysis (T)	• Where we get metals from • Methods that can be used to extract copper (N) • What electrolysis is and how it works (N) • Describe how aluminium is extracted from its ore (N) • What corrosion is and how it is prevented (T)	• How energy is involved in chemical reactions • What a reversible reaction is (N) • What energy levels are, and how to interpret them (N) • Calculate energy changes given bond energy information[H only] (N)

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	Links to the national curriculum (AQA Specification links)	5.1.1 A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes 5.2.2 The three states of matter 5.8 Chemical Analysis (C2)	5.2.1 Chemical bonds, ionic, covalent and metallic;	5.1.2 The Periodic table	5.4.1 Reactivity of metals 5.5.1 Energy Changes	5.4.1 Reactivity of metals 5.4.3 Electrolysis	5.5.1 Energy Changes
	Previous content that this topic builds upon	• Particle model and Separation techniques covered in KS3 'Particle model and separating' • Test for hydrogen carried out in KS3 'Acids and Alkalis • Basic atom structure from KS3 'Atoms, Elements, compounds and mixtures'	• Writing of word equations from KS3 'Bonding and Equations' • Structure of the atom from KS4 'Atomic Structure'	• Properties of metals and nonmetals from KS3 • Arrangement of periodic table into periods and groups from KS3 • Knowledge of atoms and their structure from 'Atomic Structure'. • Word equation construction from KS4 'Bonding and Equations'	• Exothermic and endothermic reactions in KS3 'Chemical reactions'. • Reactions of metals from 'Chemical reactions' in KS3. • Displacement reactions from 'metal reactions' in KS3 • Word equation construction from KS4 'Bonding and Equations'.	• Metal as resource from KS3 'Atmosphere and Human Impact' • Displacement reactions from 'metal reactions' in KS3	• Exothermic and endothermic reactions from KS4 'Types of reaction' • Types of bond (double and single covalent bonds) from KS4 'Bonding and equations'
	Key vocabulary	Atom, electron, proton, neutron, nucleus, energy levels/ shells, electron arrangement, isotope, atomic mass, atomic number, element, compound, mixture, gas tests, separation, filtration, evaporation, distillation, chromatography, soluble, insoluble, Rf value, solvent, solute, hydrogen, chlorine, oxygen, carbon dioxide, litmus paper, bleaches, squeaky pop, limewater *Democritius, Dalton, Thompson, Rutherford, Bohr, Chadwick*	Gain, lose, ionic, covalent, metallic, dot-cross diagrams, charge, bond, share, delocalised electrons, valence electrons, ions, electrostatic attraction, chemical equation, symbol equation, balance, conservation of mass, molecules, reactants, products, melting point, boiling point, state change, solid, liquid, gas, 2D and 3D representations, limitations, freezing, melting, evaporation, condensation, sublimation	Metals, non-metals, periods, groups, atomic structure, observations, similarities, differences, reactions, displacement, trend, reactivity, shielding, lattice, inert, unreactive, Noble gases, valence electrons, *Newlands, Mendeleev, Dalton,*	Oxidation, reduction, reactivity, observations, salt, displacement, reactivity series, exothermic, endothermic, application, temperature,heat, surroundings mean average, anomalous, reversible, solutions, formation	Native, ore, reduction, oxidation, reactivity, smelting, low-grade ores, phytomining, bioleaching, displacement, electrolysis, ionic, electrolyte, electrode, anode, cathode, anion, cation, molten, solution, half-equations, OILRIG, cryolite, energy, carbon dioxide, electrons	Exothermic, endothermic, energy change, reversible, energy level diagrams, catalyst, activation energy, bond-breaking, bond-making, ΔH, bond energies
	Development of cultural capital	• A greater understanding of the complexity and beauty of the periodic table- being able to identify groups, electron structure, mass of atoms and link to their size. • Appreciation of how small the scales of chemistry are. • Use of separation techniques for cleaning water- PROBLEM SOLVING • Concept of models changing over time- science is always willing to change if new evidence is found ('How did the atom change?' Task) • RP- Use of chromatography to identify unknown substances- forensics, food etc **FOCUS CAREER:** CHROMATOGRAPHY ANALYST	• How models may be used that are not perfect, as long as we are aware of the limitations • How the bonding of substances relates to their properties and uses in society • Use of aluminium over gold as conductor in wires **FOCUS CAREER:** COMPUTATIONAL CHEMIST	• A greater understanding of the complexity and beauty of the periodic table, and how it has developed over time- idea of how if the evidence doesn't fit, you have to change the theory. • Recognition of how electron arrangement is linked to reactivity, allowing students to make predictions about elements they haven't come across before **FOCUS CAREER:** SCIENCE WRITER	• Uses of exothermic and endothermic reactions in everyday life- sports ice packs and hand warmers • Sacrificial metals on boats- Mg and zinc used to prevent rusting • Why copper is used to make pipes in terms of its reactivity • Verdigris on buildings (statue of Liberty) • RP- Identifying Exo and Endothermic reactions • TRIPLE RP- ion testing **FOCUS CAREER:** CHEMICAL TECHNICIAN	• Linking extraction of metals using reduction to climate change • Finite resources and the importance of recycling • Cost of metals linked to how expensive they are to extract • Using plants to extract minerals from the ground (phytomining) **FOCUS CAREER:** METALLURGIST	• Use of different types of reactions in everyday life. • How energy is generated in chemical reactions • Uses of catalysts in industry to make reactions more economically viable, and profits larger • Use of reversible reactions in batteries to make rechargeable batteries **FOCUS CAREER:** CATALYTIC CHEMIST
	Development of reading	History of the atom, names of scientists involved, how the nucleus was discovered (Bill Bryson, 'A short History of Nearly everything' 175-187) What is an atom comprehension document	https://www.visionlearning.com/en/library/Chemistry/1/Chemical-Bonding/55 The history of the chemical bond	Development of the periodic table and the names of the scientists involved (Bill Bryson, 'A short History of Nearly everything' 138-145) https://www.rsc.org/periodic-table/history/about History of the periodic table including scientists not needed for GCSE	Reading and following methods https://www.dummies.com/education/science/chemistry/the-common-types-of-chemical-reactions/ Types of chemical reaction	Articles on extraction of metals, linking to climate change https://greenerideal.com/news/business/0617-metal-extraction/	https://electronics.howstuffworks.com/everyday-tech/battery5.htm rechargeable batteries and how thhey work
	Concepts – what will students be able to do at	• Describe the difference between atoms, elements, compounds and mixtures • describe the structure of an atom	• Describe what happens in ionic, covalent and metallic bonding • Explain why bonds are formed in terms of electronic structure • Identify types of bonding from the names/ formulae of compounds	• Describe how the periodic table has changed over time as new discoveries about atoms and elements were made.	• Describe the reactions of metals with oxygen, water and acids. • Construct word and balanced symbol equations for the reactions.	• Describe the reactivity series, and link to how metals are extracted from their ores. • Describe how copper can be extracted	• Define reversible reactions and describe the energy changes • Describe, draw and explain energy level diagrams for endothermic and exothermic reactions

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	the end of the topic	• describe and carry out the tests for oxygen, hydrogen, carbon dioxide and chlorine • describe and explain how mixtures can be separated	• Construct word and symbol equations and balance them	• Describe the trends in reactivity of groups I and VII, and how they combined. • Explain the reactivity of Group 0 elements.	• Define displacement and predict the reactions of metals with ionic compounds. • Define endothermic and exothermic reactions and give examples. • Plan an experiment to find what type of reaction is happening. • Analyse the outcomes of an experiment	• Describe the fundamentals of how more reactive metals are extracted using electrolysis • Explain the economic and environmental impact of extracting metals	• Calculate energy changes for reactions when given the bond energies [H]

Year Group		Autumn Term 1	Autumn Term 2	Spring Term 1	Spring Term 2	Summer Term 1	Summer Term 2
Year 10	Topic	**Bonding, Structure and Properties (C1)**	**Acids and Bases (C1)**	**Electrolysis 2- solutions**	**Rates of reaction (C2)**	**Atmosphere (C2)**	**Water (C2)**
	Core knowledge from this topic	• How substances change state • What an ionic bond is • How we can explain the properties of ionic compounds (N) • How we can explain the properties of simple covalent molecules (N) • How we can explain the properties of giant covalent molecules (N) • What fullerenes are (N) • How we can explain the properties of metals (N) • How we can explain the properties of polymers (N) • What alloys are and their properties (T) • What ceramics, polymers and composites are used for (T)	• What acids and alkalis are • What happens in neutralisation (N) • How we can make and collect salts from acids and bases (N) • How we can make and collect salts from acids and carbonates (N) • How acids react with metals (N) • The difference between weak and strong acids (N) • What titrations are (T) • How we can calculate the unknown concentration of acids and alkalis RP (T)	• Recap on electrolysis • What happens during the electrolysis of solutions (N) • What happens when salt solutions are electrolysed (RP) • What chemical cells and batteries are (T) • What fuel cells are (T)	• How we measure the rate of reaction (N) • How chemical reactions happen (collision theory) (N) • How surface area affects the rate (N) • How concentration and pressure affect rate (N) • How temperature affects the rate of a reaction (N) • How catalysts affect rate of a reaction	• What the Early atmosphere on Earth was like (N) • How the composition of the Earth's atmosphere has changed (N) • What greenhouse gases are, and their impact on the environment	• How Chemistry plays a role in sustainable development (N) • What potable water is and how we produce it (N) • How desalination works (N) • How wastewater is treated (N) • How reverse osmosis can be used to purify water [H] (N)
	Links to the national curriculum (if applicable)	5.2.1 Chemical bonds 5.2.2 Bonding and properties 5.2.3 Structure and bonding of carbon	5.4.2 Reactions of acids	5.4.3 Electrolysis	5.6.1 Rates of reaction	5.9 Chemistry of the atmosphere	5.10.1 Using the Earth's resources
	Previous content that this topic builds upon	• Structure of the atom and bonding from KS4 'Atomic Structure', 'Bonding and Equations', 'Periodic table' • Properties of plastics from KS3 'Atoms, Elements, Compounds and Mixtures'	• Acids and metals from KS3 'Metal reactions' • Acids, alkalis and bases from KS3 'Acids, alkalis' • Atomic structure from KS4 'Atomic Structure' • Ions from 'Bonding and equations' • Metals and acids from KS4 'Types of reaction'	• Follows on from 'metals and electrolysis' in year 9	• Follows on from 'Energy changes' in year 9 • Movement in particles from KS3 'Particle Model and Separating'	• Follows on from 'Earth' in year 8, and links into Geography • Impact of CO_2 from KS4 'Metals and Electrolysis'	• Idea of renewable and non-renewable covered both in year 8 and year 9 Physics • Distillation being used to separate substances KS3 'Particle model and separating'; KS4 'Atomic Structure' • Osmosis from Biology 'Cell Transport'

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	Key vocabulary	States, limitation of models, ionic, covalent, metallic, electrons, gain, lose, share, valence, full outer shell, properties, giant structures, lattice, formulae, fullerene, allotrope, diamond, graphite, graphene, melting point, boiling point, conductivity, hardness, strong, weak, energy, nanoscience, nanoparticle, nanotechnology, alloy, malleable, ductile, polymer, monomer, thermosoftening, thermosetting, intermolecular, intramolecular, forces, bonds, molecules, ions	Acid, alkali, base, pH, neutral, neutralisation, ionic equation, solution, salt, end-point, carbonates, oxidised, reduced, strong acid, weak acids, concentration, dilute, concentrated, excess, H+ ions, OH- ions, indicator	Electrolysis, reactivity, ionic, electrolyte, electrode, anode, cathode, anion, cation, molten, solution, half-equations, OILRIG, oxidation, reduction	Rate, collision theory, surface area, volume, tangent, concentration, temperature, pressure, catalyst, collisions, frequency, successful, increase, activation energy	Proportions, atmosphere, percentage, theories, evidence, evaluate, nitrogen, oxygen, argon, carbon dioxide, photosynthesis, respiration, combustion, greenhouse gas, radiation, climate change, global warming, trapped, temperature, consequences, scale, risk, environment, habitat, extinction, impact, carbon cycle, drought, ice-caps, flooding	Sustainable, unsustainable, renewable, non-renewable, finite, infinite, natural, synthetic, potable, microbes, pure, chlorination, fluoride, screening, sedimentation, aerobic, anaerobic, effluent, sewage sludge, biomass, biogas, energy, digestion, organic, reservoir, rivers, water cycle, desalination, reverse osmosis [H], radiation, UV, ozone
	Development of cultural capital	• Uses of substances based on their properties • Uses of metals based on their properties • Uses of new technology- application of graphene in electronics **FOCUS CAREER:** MATERIALS ENGINEER	• Linking to acid attacks in the news • Corrosion of metals • Acid rain and the impact on biodiversity and the environment • RP- Acid + base → salt • RP Acid + base → insoluble salt • TRIPLES RP- Titration **FOCUS CAREER:** TOXICOLOGIST	• Linking to production of hydrogen for clean energy • Uses of electrolysis in industry • RP- Electrolysis in solutions **FOCUS CAREER:** FUEL CELL ENGINEER	• Link to industry and the rate of production of chemicals • Cookies bake faster at higher temperatures. • Why a fridge keeps food stuffs fresher • Bread dough rises more quickly in a warm place than in a cool one. • Low body temperatures slow down metabolism • Catalysts and the Kursk explosion (PROBLEM SOLVING) • RP- Rates Experiments- measuring rates using gas syringe, change in mass, light intensity **FOCUS CAREER:** EXPERIMENTAL CHEMIST	• Global warming in the news and the threatening impact on wildlife and humans • How other planets have similar atmospheres to early Earth, and how we could populate them • Fake news- climate change deniers **FOCUS CAREER:** ENVIRONMENTAL CHEMIST, Climate change Analyst	• Water shortages (water as a finite resource) • Ways to reduce water use • Dangers of drinking dirty water • Adding fluoride to drinking water as a contentious issue, • Use of energy to make water safe • Meaning of sustainability • RP- Distillation of water and testing for ions **FOCUS CAREER:** HYDROLOGIST
	Development of reading	Newspaper articles on new carbon technology and the uses https://projects.ncsu.edu/project/bio183de/Black/chemistry/chemistry.html#:~:text=Life%20is%20based%20on%20carbon,can%20form%20four%20covalent%20bonds. Organic molecules- the chemistry of life http://www.bris.ac.uk/Depts/Chemistry/MOTM/diamond/diamond.htm diamond as molecule of the month	Newspaper articles on acid attacks http://www.scienceclarified.com/everyday/Real-Life-Chemistry-Vol-2/Acids-and-Bases-Real-life-applications.html Uses of acids in the real world- Forensic applications- cleaning guns to get serial numbers	https://www.engineeringenotes.com/metallurgy/electrolysis/top-7-applications-of-electrolysis-industries-metallurgy/24168 uses of electrolysis	https://edu.rsc.org/lesson-plans/catalysts-rates-of-reaction-and-what-sank-the-kursk-14-16-years/94.article Catalysts and the Kursk worksheet (hydrogen peroxide leading to the sinking)	https://climate.nasa.gov/evidence/ NASA guide to climate change and how we know it is real Newspaper articles on climate change (get at the time)	Chem Water- Fluoridation of drinking water NHS article- word doc. Students need to write an opinion on whether we should/ shouldn't fluoridate water
	Concepts – what will students be able to do at the end of the topic	• Explain why ionic, covalent and metallic structures have certain properties and how this links to their uses. • Describe and explain uses of new carbon technology • Describe and explain the difference between thermosetting and thermosoftening and polymers	• Describe the reactions of acids, and carry out practicals to make a range of different salts • Explain why some acids are stronger than others	• Describe how electrolysis is used to separate ionic solutions • Explain how the reactivity of substances affects the products of electrolysis in solutions	• Describe how to measure the rate of a reaction • Explain why chemical reactions happen in terms of collision theory • Explain how concentration, surface area, temperature, pressure and the presence of a catalyst affect the rate of a chemical reaction	• Describe how the atmosphere has changed from millions of years ago to now, and explain how the levels of gases have changed. • Explain the greenhouse effect, describe its implications for organisms on the planet	• Describe how water is made safe to drink and how it is treated after it has gone down the drain. • Evaluate methods of water purification • Describe the role chemistry has to play in sustainable development.

Year Group		Autumn Term 1	Autumn Term 2	Spring Term 1	Spring Term 2	Summer Term 1	Summer Term 2
Year 11	Topic	**Chemistry calculations (C1)**	**Crude Oil (C2)**	**Equilibrium (C2)**			

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	Core knowledge from this topic	• How chromatography is used to identify substances • How to calculate the mass of compounds (N) • How to use RFM in chemical equations (N) • How to use moles to balance equations (N) • Explain how mass changes in reactions (N) • Define and calculate concentration (N) • Calculate mass of reactants and products in chemical reactions (N) • What yield and atom economy are (T) • How we calculate volumes of gases (T)	• What crude oil is (N) • How crude oil is separated into useful parts (N) • How alkanes are used (N) • What cracking is (N) • What atmospheric pollutants are and their effect • Why we should recycle • What Life Cycle Assessments (LCAs) are (N) • What alkenes are and their reactions (T) • What alcohols are and their reactions (T) • What carboxylic acids are and their reactions (T) • What happens in polymerisation (T) • What amino acids are (T)	• Describe what dynamic equilibrium is and link to reactions (N) • Predict how changes in conditions will affect Equilibrium (N) • What the Haber process is (T) • How fertilisers are produced			
	Links to the national curriculum (if applicable)	5.3 Quantitative Chemistry	5.7.1 Carbon compounds as fuel and feedstock 5.10.2 Life Cycle assessments	5.6.2 Reversible reactions and Equilibrium			
	Previous content that this topic builds upon	• Chromatography from 'Atomic Structure' in KS4 • Compounds and constructing symbol equations from 'bonding and equations'	• Builds on the concept of finite and infinite from 'Water' in KS4 • 'Renewable and non-renewable' fromKS3 and KS4	• Reversible reactions covered in 'Types of reactions' and 'Rates of reactions' in KS4			
	Key vocabulary	Chromatography, soluble, insoluble, Rf value, solvent, solute, relative atomic mass, relative formula mass, compound, mole, avogadro's number, chemical reaction, reactants, products, concentration, dm^3, limiting reactant, theoretical mass *Avogadro*	Crude oil, hydrocarbon, saturated, alkane, methane, ethane, propane, butane, general formula, properties, fractional distillation, vapourised, condensed, column, different boiling points, separation, viscosity, flammability, volatile, fuel, cracking, alkenes, double bond, unsaturated, bromine water, pollutants, sulphur dioxide, carbon dioxide, particulates, acid rain, global warming, greenhouse gas, global dimming, limited, environmental impact, mining, quarrying, recycling, energy, raw materials, life cycle assessment, manufacture, disposal, use, lifetime, transportation	Reversible, Le Chatelier, molecules, concentration, temperature, pressure, dynamic equilibrium, predict, explain, yield *Haber*			
	Development of cultural capital	• Use of chromatograms to identify dyes in food • Use of dilution to make substances different concentrations (hairdressers etc) **FOCUS CAREER:**	• Awareness of the issues surrounding the use of fossil fuels and the energy used to extract them, and the energy they produce • Alternative materials- paper v plastic etc • Impact of atmospheric pollutants, and importance of recycling **FOCUS CAREER: Geoscientist/ Petroleum Engineer**	• Importance of getting conditions right in industry to get the greatest yield and manufacture a product quickly **FOCUS CAREER:**			
	Development of reading		Chem Water- LSA Plastic or paper bag- word doc. Plastic or paper bag article from BBC, then leading onto students writing an opinion	https://courses.lumenlearning.com/boundless-chemistry/chapter/equilibrium/ Chem Equilibrium comprehension			
	Concepts – what will	• Calculate relative formula mass and percentage composition	• Describe and explain how crude oil is separated using fractional distillation.	• Predict and explain the effect of changing conditions on a reversible reaction			

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	students be able to do at the end of the topic	• Recognise the importance of the mole and Avogadro's number in Chemistry • Balance equations using calculations • Calculate the number of moles present in a substance • Calculate theoretical mass of a reaction and identify limiting reactants • Calculate concentration of a solution	• Describe the alkanes and alkenes and how they are different. • Explain how the properties of hydrocarbons affect their use as fuels. • Describe methods of making more useful fuels and the byproducts. • Describe the impact of using fossil fuels, and the importance of recycling. • Explain what a LCA is and be able to carry one out for a set product.				