Key Stage 4 Curriculum Overview

Progression from Key Stage 3 and optional progression through Post-16 : Chemistry

	Autumn Term	Spring Term	Summer Term
Year 9			Students at the end of Key Stage 3 will be able to: Have an understanding of the fundamentals of matter and materials and how chemical reactions occur and chemistry of the Earth, including the Big ideas' in Chemistry: how atoms are arranged and organised, how chemical reactions occur and are measured, How the periodic table is organised and how elemnts are used in the everyday world and how the earth is structure and how we use the resources provided by the earth. Have an understanding of key scientific investigative proceedures and understand how to answer scientific questions about the natural world around them, including recording, collection and analysisng data, evaluating proceedures and identify further questions. Be able to critially think about the uses and implications of science and scientific advancements today and for the future Be devloping the ability to read and interpret scientific text Describe associated processes and key characteristics in common language, beginning to use technical terminology accurately and precisely building an extended specialist vocabulary. Be able to apply their mathematical knowledge to their understanding of science, including collecting, presenting and analysing data, using numerical values and mathematical representations.

			Be able to relate scientific explanations to phenomena in the world around them and use modelling and abstract ideas to develop and evaluate explanations.
Year 10	Atomic structure and the periodic table – models of the atom and reactivity of elements Bonding and structure – covalent bonding, properties of covalent compounds and polymers Quantitative chemistry – balancing equations, moles calculations and concentration calculations Chemical changes – making salts and extracting metals	Chemical changes – electrolysis, half equations Energy – Reaction profiles Rates and equilibrium – Collison theory, Effects of changes in pressure, temperature, surface area and concentration	Organic chemistry – fractional distillation, burning fuels Chemical analysis – chromatography Atmosphere – History of the atmosphere, greenhouse effect and greenhouse gases Earths resources – Treating waste water RSE – See separate SOL
Year 11	Review of atomic structure and the periodic table Bonding – summary and fullerenes and graphene Quantitative chemistry – reacting masses calculations, volumes of gases Chemical changes – strong and weak acids, insoluble salts and electrolysis of aqueous solutions Energy – calculating bond energies and energy practical	Rates and equilibrium – dynamic equilibrium and altering conditions Organic chemistry – Cracking Chemical analysis – purity and analysis summary Atmosphere – Climate change and pollutants Earths resources – Alternative methods of extracting metals	Revision and exam preparation

By the end of Key Stage 4 students should be able to:

Understanding of how the complex and diverse phenomena of both the natural and man-made worlds can be described in terms of a number of key ideas which are of universal application, and which can be illustrated in the separate topics set out below. These ideas include:

- Matter is composed of tiny particles called atoms and there are about 100 different naturally-occurring types of atoms called elements
- Elements show periodic relationships in their chemical and physical properties
- Periodic properties can be explained in terms of the atomic structure of the elements
- Atoms bond either by transferring electrons from one atom to another or by sharing electrons
- The shapes of molecules (groups of atoms bonded together) and the way giant structures are arranged is of great importance in terms of the way they behave
- Reactions can occur when molecules collide and do so at different rates due to differences in molecular collisions
- Chemical reactions take place in only three different ways: • proton transfer • electron transfer • electron sharing
- Energy is conserved in chemical reactions so can therefore be neither created nor destroyed.

Students should have understanding of:

Atomic structure and the Periodic Table • a simple model of the atom consisting of the nucleus and electrons, relative atomic mass, electronic charge and isotopes • the number of particles in a given mass of a substance Science • the modern Periodic Table, showing elements arranged in order of atomic number • position of elements in the Periodic Table in relation to their atomic structure and arrangement of outer electrons • properties and trends in properties of elements in the same group • characteristic properties of metals and non-metals • chemical reactivity of elements in relation to their position in the Periodic Table.

Structure, bonding and the properties of matter • changes of state of matter in terms of particle kinetics, energy transfers and the relative strength of chemical bonds and intermolecular forces • types of chemical bonding: ionic, covalent, and metallic • bulk properties of materials related to bonding and intermolecular forces • bonding of carbon leading to the vast array of natural and synthetic organic compounds that occur due to the ability of carbon to form families of similar compounds, chains and rings • structures, bonding and properties of diamond, graphite, fullerenes and graphene.

Chemical changes • determination of empirical formulae from the ratio of atoms of different kinds • balanced chemical equations, ionic equations and state symbols • identification of common gases • the chemistry of acids; reactions with some metals and carbonates • pH as a measure of hydrogen ion concentration and its numerical scale • electrolysis of molten ionic liquids and aqueous ionic solutions • reduction and oxidation in terms of loss or gain of oxygen.

Energy changes in chemistry • Measurement of energy changes in chemical reactions (qualitative) • Bond breaking, bond making, activation energy and reaction profiles (qualitative).

Rate and extent of chemical change • factors that influence the rate of reaction: varying temperature or concentration, changing the surface area of a solid reactant or by adding a catalyst • factors affecting reversible reactions.

Chemical analysis • distinguishing between pure and impure substances • separation techniques for mixtures of substances: filtration, crystallisation, chromatography, simple and fractional distillation • quantitative interpretation of balanced equations • concentrations of solutions in relation to mass of solute and volume of solvent.

Chemical and allied industries • life cycle assessment and recycling to assess environmental impacts associated with all the stages of a product's life • the viability of recycling of certain materials • carbon compounds, both as fuels and feedstock, and the competing demands for limited resources • fractional distillation of crude oil and cracking to make more useful materials • extraction and purification of metals related to the position of carbon in a reactivity series.

Earth and atmospheric science • evidence for composition and evolution of the Earth's atmosphere since its formation • evidence, and uncertainties in evidence, for additional anthropogenic causes of climate change • potential effects of, and mitigation of, increased levels of carbon dioxide and methane on the Earth's climate • common atmospheric pollutants: sulphur dioxide, oxides of nitrogen, particulates and their sources • the Earth's water resources and obtaining potable water.

- **Working scientifically – across all science disciplines**
- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
- Evaluate risks.
- 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 sampling techniques.
- apply mathematical concepts and calculate results
- 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
- present reasoned explanations, including explaining data in relation to predictions and hypotheses
- evaluate data, showing awareness of potential sources of random and systematic error
- identify further questions arising from their results.
- understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- use and derive simple equations and carry out appropriate calculations
- undertake basic data analysis including simple statistical techniques.