"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less." — Marie Curie

Completing the cycle: from "abstract" chemistry to real world applications

Chemistry: Phase 5 (Y12-13) Outcomes

Key Knowledge **Pupils will know:**	Key Skills **Pupils will be able to:**
Key Threshold Concepts • Chemists use evidence gained from observations and experiments to build models and theories • Matter is built from atoms interacting and bonding through electrostatic forces. The structure of matter affects its physical and chemical properties, and influences how substances react chemically. • By identifying patterns in chemical behaviour we can predict the properties of substances and how they can be transformed into new substances by chemical reactions. This allows us to design new materials of use to society. • The understanding of how chemical bonds are made and broken by the movement of electrons allows us to predict patterns of reactivity. • The energy changes that take place during chemical reactions can be used to predict both the extent and the rate of such reactions. **Subject-specific Knowledge** • Core principles of organic chemistry • Core principles of inorganic chemistry • Rates and equilibria • Transition metals and organic nitrogen chemistry **Cross –Curricular Knowledge** • How society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society • Consider ethical issues in the treatment of humans, other organisms and the environment	**Know and understand content:** - Recognise, recall, and show understanding of scientific knowledge - Select, organise and communicate relevant information in a variety of forms. **Apply knowledge and understanding of science and *how science works':*** - Analyse and evaluate scientific knowledge and processes - Apply scientific knowledge and processes to unfamiliar situations - Assess the validity, reliability and credibility of scientific information **Working scientifically:** - Demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods - Make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy - Analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways

Science is a history of corrected mistakes – Karl Popper

There is no such thing as a spontaneous reaction

Chemistry: Phase 4 (Y9 - 11) Outcomes

Key Knowledge **Pupils will know:**	Key Skills **Pupils will be able to:**
Key Threshold Concepts • Atoms consist of sub-atomic particles. • Elements show periodic relationships in their chemical and physical properties , which can be explained in terms of the atomic structure of the elements. • The shapes of molecules and the way giant structures are arranged is of great importance in terms of the way they behave. • There are barriers to reaction so reactions occur at different rates. • Energy is conserved in chemical reactions so can therefore be neither created nor destroyed. **Subject-specific Knowledge** - Atomic structure and the periodic table - Bonding, structure, and the properties of matter - Quantitative chemistry - The rate and extent of chemical change - Energy changes - Organic chemistry - Chemical analysis - Chemistry of the atmosphere - Using resources **Cross –Curricular Knowledge** - Mathematical knowledge learned between year7 and year 11. - The industrial revolution and global warming - Government use of renewable and non-renewable energy resources	**Apply understanding:** - Apply and make sense of all aspects of working scientifically in unfamiliar experimental contexts - Includes using observations and processing data **Evaluate:** - Evaluate evidence, both data and literature, to draw conclusions **Working scientifically:** - Understand the development of scientific thinking - Use appropriate methods to conduct and evaluate practical investigations - Apply the cycle of collecting, presenting and analysing data - Use appropriate scientific vocabulary, quantities, units, symbols and nomenclature **Apply mathematical knowledge:** - Arithmetic and numerical computation - Data handling - Algebra - Graphs - Geometry and trigonometry

Magic is just science that we don't understand yet – Arthur C Clark

Zoom in on tangible processes to better understand scientific concepts

Science: Phase 3 (Y6 - 8) Outcomes

Key Knowledge **Pupils will know:**	Key Skills **Pupils will be able to:**
Key Threshold Concepts - Science is about working objectively, modifying explanations to take account of new evidence and ideas and subjecting results to peer review. - The fundamental units of living organisms are cells, which may be part of highly adapted structures. - Living organisms are interdependent and show adaptations to their environment - Matter is composed of tiny particles called atoms - Elements show periodic relationships in their chemical and physical properties. - Physical laws and models are expressed in mathematical form. **Subject-specific Knowledge** - Structure and function of living organisms - Material cycles and energy - Interactions and interdependencies - Genetics and evolution - The particulate nature of matter - The periodic table - Pure and impure substances - Chemical reactions and energetics - Earth and atmosphere - Energy - Forces and motion - Waves - Electricity and electromagnetism - Space physics **Cross –Curricular Knowledge** - Rearranging equations. - The environmental impacts of the industrial revolution. - Human reproduction within PSHE	**Experimental skills and investigations** - Ask questions and develop a line of enquiry - Make predictions using scientific knowledge and understanding - Select, plan and carry out the most appropriate types of scientific enquiries to test predictions - Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work - Make and record observations and measurements using a range of methods for different investigations - Evaluate the reliability of methods and suggest possible improvements **Analysis and evaluation** - Present observations and data using appropriate methods - 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 **Measurement** - Use SI units and IUPAC nomenclature - Use and derive simple equations and carry out appropriate calculations - Undertake basic data analysis including simple statistical techniques

Science is a way of thinking much more that it is a body of knowledge – Carl Sager

Reconciling observations of the world with current scientific understanding

Science: Phase 2 (Y2 - 5) Outcomes

Key Knowledge **Pupils will know:**	Key Skills **Pupils will be able to:**
Key Threshold Concepts - Science is about working objectively, modifying explanations to take account of new evidence and ideas and subjecting results to peer review. - Living things can be classified into broad groups based on similarities and differences. - Everyday materials can be grouped together on the basis of their properties - Some changes result in the formation of new materials and this is not usually reversible **Subject-specific Knowledge** - Living things and their habitats - Plants - Animals, including humans - Uses of everyday materials - Rocks - Light - Forces and magnets - States of matter - Sound - Electricity - Properties and changes of materials - Earth and space **Cross –Curricular Knowledge** - Human reproduction within PSHE - Rocks and earth within geography	**Scientific attitudes** - Understand the world scientifically by exploring, talking about, testing and developing ideas about everyday phenomena and the relationships functions and interactions between living things and familiar environments **Experimental skills and investigations** - Ask relevant questions and use different types of scientific enquiries to answer them - Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary - Set up simple practical enquiries, comparative and fair tests - Make systematic and careful observations **Analysis and evaluation** - Gather, record, classify and present data of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs - Report and present findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations - Use results to draw simple conclusions, make predictions for new values, suggest improvements and set up further comparative and fair tests - Identify differences, similarities or changes related to simple scientific ideas and processes - Identify scientific evidence that has been used to support or refute ideas or arguments **Measurement** - Take measurements with increasing accuracy, using a range of equipment, including thermometers and data loggers

The world is beautiful to look at, but even more beautiful to understand – Brian Cox

Looking curiously at the world around us

Science: Phase 1 (N - 2) Outcomes

Key Knowledge **Pupils will know:**	Key Skills **Pupils will be able to:**
Key Threshold Concepts - Science is about looking closely at the world around us, making observations, asking questions, and thinking about how we could find the answers. - We can affect the things around us. - Not every object, place, living thing, and material is the same. - There are often explanations for the changes, events, and other observations we make of the world around us. - If we look closely at the world around us, we can often find explanations for what we see. - Materials have different properties and these affect what they are used for. - Living things find what they need to stay healthy in the environment around them. - Different living things need different things to stay healthy and survive. **Subject-specific Knowledge** - Living things and their habitats - Basic structure of common plants and animals, including humans - Properties of everyday materials - Changes across the four seasons - Differences between things that are living, dead, and things that have never been alive - Simple food chains - What animals and plants need to survive, grow, and stay healthy, and how they obtain these things - The shapes of solids can be changed by squashing, bending, twisting and stretching **Cross-curricular Links** - PSHE: healthy lifestyles - Maths: bar charts, venn diagrams, carroll diagrams,	**Scientific attitudes** - Know that science can help us to understand what we observe in the world around us - Look at the world with curiosity and a desire to understand more E**xperimental skills and investigations** - Ask relevant questions and know that they can be answered in different ways - Make careful observations - Perform simple tests - Observe things carefully using simple equipment **Analysis and evaluation** - Identify and classify living things and materials by their basic structures or properties - Use observations to suggest answers to questions - Gather and record data to help answer questions **Measurement** - Take measurements using simple equipment