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Chemistry in Curriculum for Wales

Curriculum planning support

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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | | | | **Descriptions of learning from curriculum** |
| **Chemistry as a science** | | | | | | |
| **How do we think about chemistry?** | Chemists develop and use models to help explain phenomena, represent things that cannot be easily visualised, highlight specific features and simulate or predict behaviour | Apply the particle  model to:   * explain the arrangement of particles in each state of matter * explain what happens when a solute is dissolved in a solvent | Use the particle model to explain what happens during  changes of state  Use the particle model to explain diffusion in liquids  and gases  Use appropriate particle diagrams to distinguish  between an element, compound and mixture | | Recognise that an atomic model is not a representation of reality  Describe how new experimental evidence led to changes in the atomic model | I can…   * describe different types of chemical reactions explain their uses and identify any effects of the products formed * use different methods to analyse materials in order to understand their composition * describe how various materials need different techniques in order to separate and refine them * use a range of models to explain and make predictions |
| Standardised representations in chemistry, such as symbols, equations and diagrams, allow clear communication between chemists and within the global society | Take accurate measurements, including appropriate units, and make observations during practical experiments | Distinguish between a reactant and a product and express what happens during an experiment/reaction  in terms of a word equation  Name common elements and compounds | Identify chemical symbols of elements and understand the meaning of subscripts within a chemical formula  Interpret the meaning of chemical formulae in terms of a ratio of elements within a compound  Convert word equations into symbol equations  Understand the law of the conservation of mass and can apply this to chemical reactions | Calculate formula mass Understand the meaning of  coefficients in terms of reacting  ratios  Convert appropriate units Use state symbols  Calculate atom economy and use  this to discuss sustainability |
| Mathematics is integral to chemistry to produce and analyse quantitative results, and to help us predict chemical behaviour |
| Chemists group and classify things such as substances, particles, structures and reactions, in order to build understanding of what exists, identify patterns  and trends, and develop scientific explanations | Understand that materials and substances can be grouped according to their physical or chemical properties (for example, metals and non-metals) | Distinguish between a group and a period on the periodic table  Use data to describe trends in physical properties of a  group  Apply knowledge of trends to predict properties | | Be aware of the developments in chemistry that lead to the modern periodic table  Understand that elements have been grouped in the periodic table due to their similar chemical properties  Relate an element’s position in the periodic table to its atomic structure |



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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | | | | **Descriptions of learning from curriculum** |
| **Chemistry as a science (continued)** | | | | | | |
| **How do we do chemistry?** | Chemists use current understanding in chemistry to help them choose appropriate processes  and methods to answer new questions, where appropriate analysis of observations and evidence  can lead to the development  of new understandings | Follow a method Identify hazards  Record data appropriately using appropriate SI units | Propose a question that can be tested practically  Present data as an appropriate graph  Describe trends in data and form a basic conclusion based on experimental evidence | Explain the associated risks  of hazards  Understand the importance  of repeating an experiment  Process data e.g. handling anomalies and calculating a mean  Evaluate the designed method and identify reasons for anomalous results  Experience of reporting the outcome of an investigation to my peers  Explain trends in data | Design an investigative method including variables and suitable parameters to be tested  Carry out a risk assessment  e.g. hazards, related risks and preventative measures  Relate conclusions back the original question and the underlying chemical concept(s)  Evaluate an investigative procedure and suggests improvements and further work to be carried out  Relate suggested improvements to a scientific investigation to their effect on data collected  Use ICT to process and present  data | I can…   * research, devise and use suitable methods of inquiry to investigate my scientific questions * use my findings to draw valid conclusions * evaluate and identify ways of improving   the reliability of data, taking anomalies into account   * choose the most appropriate format for the storage and interrogation of data |
| Empirical enquiry into the material world requires the use of a range of practical techniques, to  produce valid, accurate and reproducible evidence | Accurately measure the mass of a substance using a balance  Accurately measure the volume of a liquid using a measuring cylinder  Safely use a Bunsen burner to a heat substance  Accurately measure the temperature of a substance | Use different indicators  to measure pH  Have knowledge of appropriate glassware and apparatus and their functions  Know the meaning of common hazard symbols | Experience of filtration and crystallisation (evaporation)  Carried out paper chromatography | Experience of distillation carried out using quick-fit apparatus  Carried out rudimentary distillation using common glassware  Select a suitable separation technique for a given mixture  Carried out displacement reactions and made conclusions based on my results |

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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | | | | **Descriptions of learning from curriculum** |
| **Chemical concepts** | | | | | | |
| **What are things made of?** | Bulk properties of substances in different phases can be explained in terms of the nature and interactions of their constituent particles | Identify if a material is a metal, ceramic or polymer based on its physical properties  Distinguish between a chemical property and a physical property  Understand that substances can exist as different states (solid, liquid and gas)  Understand what is meant by melting point and boiling point of a substance | Describe physical properties of polymers  Explain how to alter physical properties of a polymer Describe changes of state  Understand what is meant by a solution, solvent and  solute  Understand that different elements and compounds have different properties due to their difference in structure | | Understand that solubility is a property of a substance that can change with temperature  Understand the difference between  a dilute and concentrated solution  Explain why evaporation may occur before the boiling point of a substance is reached  Understand that mixtures can be separated because the properties of its constituents is unchanged | I can…   * use different methods to analyse materials in order to understand their composition * describe how various materials need different techniques in order to separate and refine them * describe and explain the properties of different types of matter and relate these to how they are used |
| All matter is made of one or more chemical substances, which have unique properties and chemical composition  Atoms or ions of elements (of which there are only a relatively small number) combine in different  ratios and structures to produce the huge variety of compounds that exist |  | Understand that:   * elements are made of the same type of atom * different elements are summarised in the periodic table and that each element as a symbol * a compound is made up of more than one type of atom chemically bonded in a fixed ratio * properties of a compound are different to those of elements made up of its constituent atoms * a mixture can be made up of different elements and/ or compounds that are not   chemically combined and can therefore be separated | Understand that an element or compound can be made up of a single giant structure or separate molecules  Recall that an element can also be made up of separate atoms  Link the structure of the element or compound to it having a high or low melting/boiling point. | Name chemical compounds when given the formula using the international system of units (SI)  Understand that the formula represents the ratio of atoms in the compound  Recognise that the periodic table contains over 100 elements and that they are arranged in groups and periods and ordered by atomic number  Recognise that elements and compounds can be made up of atoms, ions§ and molecules  **§** at this stage a basic understanding that atoms can be charged species that we call an ion is sufficient, development of the understanding of ions is in progression step 5 |



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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | | | | **Descriptions of learning from curriculum** |
| **Chemical concepts (continued)** | | | | | | |
| **How do we find out what**  **things are made of?** | Differences in chemical and physical properties can be used to identify, quantify and separate substances |  | Distinguish between a pure and impure substance  Use melting point data to determine purity  Identify if a substance is acidic, neutral or alkaline using various indicators | Describe changes of  state  Understand that different elements and compounds have different chemical properties | Explain how different separation techniques separate mixtures in relation to changes of state and/or solubility  Select an appropriate separation technique for a given purpose | I can…   * use different methods to analyse materials in order to understand their composition * describe how various materials need different techniques in order to separate and refine them * describe and explain the properties of different types of matter and relate these to how they are used * describe different types of chemical reactions, explain their uses and identify any effects of the products formed |
| **How do we explain how substances behave?** |  |  |  |  | Recall the relative mass and charge of sub-atomic particles |
| Atomic models have been developed to explain physical and chemical phenomena | Describe the key features of the structure of an atom based on the nuclear model of an atom | Use the periodic table to deduce the number of sub- atomic particles in an atom of an element  Understand that the relative  atomic mass of an atom is due to the number of protons and neutrons |
| Models for different types  of chemical bonding and structure have been developed to explain physical and chemical  properties of substances |  |  | Recognise that giant structures are held together by strong electrostatic forces and that  there are weaker electrostatic forces between separate molecules | Have an appreciation for electrostatic attraction. Understand that positive and negative charges attract and that it is this force that holds atoms and molecules together |

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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | | | | **Descriptions of learning from curriculum** |
| **Chemical concepts (continued)** | | | | | | |
| **How can substances be made and changed?** | Chemical reactions result in the formation of new substances, through rearrangement of the bonding between atoms or ions, resulting  in observable changes in  physical properties  Whether or not a reaction occurs spontaneously can be explained in terms of energy transfer and entropy (dispersion) | Understand the key observations that show a chemical change (reaction) has occurred e.g. colour change | Understand that word equations represent what happens during a chemical reaction  Recognise that during a chemical reaction mass  is conserved. The mass of reactants is equal  to the mass of the  products. | Convert word equations into symbols equations (when given formulae)  Explain conservation of mass in a chemical reaction by the idea that atoms are rearranged, no atoms are created or destroyed  Categorise a reaction as exothermic  or endothermic  Describe trends in reactivity of key groups of the periodic table and am aware that elements have been  placed in a reactivity series based on historical experimental data | Understand that a balanced equation represents reacting ratios of substances  Use the idea of conservation of atoms to balance a chemical equation  Categorise a reaction as oxidation, precipitation or decomposition  Understand that during a reaction energy can be lost to or taken from the surroundings  Use the reactivity series to explain why  displacement happens  Understand what is happening during a neutralisation reaction | I can…   * describe how various materials need different techniques in order to separate and refine them * describe and explain the properties of different types of matter and relate these to how they are used * describe different types of chemical reactions, explain their uses and identify any effects of the products formed * use my knowledge of chemical reactions to explain what happens when conditions are changed |
| Formation of a product is dependent on the reaction rate and equilibrium position, both of which can be influenced by a number of factors |  |  |  | Recognise that reactions can be reversible |
| Reactions can be designed to synthesise specific products with new properties  Synthesis routes can be optimised to maximise yield and to minimise waste and pollution |  | Recognise that reactions have a purpose and are designed to make a new product with new, often more desirable properties such as baking  and metal extraction | | |

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| **Big question** | **Key ideas** | **Progression step 4 – suggested progression** | **Descriptions of learning from curriculum** |
| **Chemistry and the world** | | | |
| **What is the impact of chemistry?** |  | Know that analytical chemistry is used to study the environment, including monitoring the environmental impacts of  man-made chemicals | I can…   * explain how   the impact of our actions contribute to the changes in the environment and biodiversity   * describe the impacts of science and technology, past and present, on society * review my own opinions based on new scientific evidence * select relevant scientific knowledge   from a range of evidence sources to evaluate claims presented as scientific facts   * describe different types of chemical reactions, explain their uses and identify any effects of the products formed |
|  | Understand that there are limitations and difficulties to using real-world samples |
| Using analytical processes, chemistry can help us to explain natural phenomena and the impact of systems at different scales, enabling us to understand ourselves, our world and the wider universe | Explain real-life scenarios using chemistry concepts. For example, the link between particle theory and wet clothes drying over time, or the link between chemical reactions and metabolism in animals  Recognise that chemistry has contributed to understanding the causes, effects and solutions in relation to climate change.  Understand that several underlying chemical concepts are required to explain many phenomena, for example in climate change:   * the effects of gases in the atmosphere on warming of the Earth’s surface * the production of gases from human activity such as burning fuels and agriculture * the effect of increased temperature on sea level via melting of ice and by water expanding * the idea that carbon dioxide levels in the atmosphere depend on its production and absorption processes |
|  | **Possible contexts:** monitoring air pollution, importance of water, water pollution, plastics and links to materials and their properties  (such as biodegradability), climate monitoring, chemistry in the home, chemistry of cooking , chemistry of our garden/plants/agriculture |
|  | Understand that industrial processes are used to convert raw materials into useful products |
| Using understanding of chemistry, we can produce new substances and materials, and develop useful chemical processes, to enrich our lives and address local and global challenges | Know that chemistry can be used to make novel materials, for example medicines and materials for clothing or building shelters Appreciate that these novel materials have properties that would not otherwise be available  Recognise that cost-benefit analysis and considerations of sustainability are important in understanding the impacts of producing novel materials on an industrial scale  Chosen examples should reflect a wide range of contexts and applications and, ideally, be situated within local, national and global contexts such as energy, environment, food, health and water  **Possible contexts:** metal extraction, mobile phone technology, sustainability of processes and materials used, pharmaceutical/biochemistry, chemical engineering (scaling up), various contemporary materials, clothing/textiles, greenhouse gas emissions |
| Decisions about uses of chemistry are subject to social, economic, environmental and political influences. The importance of drawing on evidence and having an awareness of the potential implications of chemistry at individual, local, national and global levels must be recognised | Appreciate that there are always ethical and moral implications to the development of new technologies, and economic and political influences on which new technologies are developed and how they are managed  Realise that identifying these impacts is important and should be discussed and debated, showing which aspects are backed up by evidence and which are opinion  Understand that in many cases the ethical, moral, economic and political issues surrounding chemistry may have conflicting influences. The arguments for and against production of new technologies involves marshalling evidence and ideas and weighing up conflicting views  **Possible contexts:** climate change (with a green chemistry focus) , making decisions about how we get our  energy , mining, use of materials that are made from finite resources |