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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 particlemodel 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 duringchanges of state Use the particle model to explain diffusion in liquidsand gases Use appropriate particle diagrams to distinguishbetween an element, compound and mixture | Recognise that an atomic model is not a representation of realityDescribe 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/reactionin terms of a word equationName common elements and compounds | Identify chemical symbols of elements and understand the meaning of subscripts within a chemical formulaInterpret the meaning of chemical formulae in terms of a ratio of elements within a compoundConvert word equations into symbol equationsUnderstand the law of the conservation of mass and can apply this to chemical reactions | Calculate formula mass Understand the meaning ofcoefficients in terms of reactingratiosConvert appropriate units Use state symbolsCalculate atom economy and usethis 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 patternsand 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 tableUse data to describe trends in physical properties of agroupApply knowledge of trends to predict properties | Be aware of the developments in chemistry that lead to the modern periodic tableUnderstand that elements have been grouped in the periodic table due to their similar chemical propertiesRelate 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 processesand methods to answer new questions, where appropriate analysis of observations and evidencecan lead to the developmentof new understandings | Follow a method Identify hazardsRecord data appropriately using appropriate SI units | Propose a question that can be tested practicallyPresent data as an appropriate graphDescribe trends in data and form a basic conclusion based on experimental evidence | Explain the associated risksof hazardsUnderstand the importanceof repeating an experimentProcess data e.g. handling anomalies and calculating a meanEvaluate the designed method and identify reasons for anomalous resultsExperience of reporting the outcome of an investigation to my peersExplain trends in data | Design an investigative method including variables and suitable parameters to be testedCarry out a risk assessmente.g. hazards, related risks and preventative measuresRelate conclusions back the original question and the underlying chemical concept(s)Evaluate an investigative procedure and suggests improvements and further work to be carried outRelate suggested improvements to a scientific investigation to their effect on data collectedUse ICT to process and presentdata  | 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, toproduce valid, accurate and reproducible evidence   | Accurately measure the mass of a substance using a balanceAccurately measure the volume of a liquid using a measuring cylinderSafely use a Bunsen burner to a heat substanceAccurately measure the temperature of a substance | Use different indicatorsto measure pHHave knowledge of appropriate glassware and apparatus and their functionsKnow the meaning of common hazard symbols | Experience of filtration and crystallisation (evaporation)Carried out paper chromatography | Experience of distillation carried out using quick-fit apparatusCarried out rudimentary distillation using common glasswareSelect a suitable separation technique for a given mixtureCarried 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 propertiesDistinguish between a chemical property and a physical propertyUnderstand 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 polymersExplain how to alter physical properties of a polymer Describe changes of stateUnderstand what is meant by a solution, solvent andsoluteUnderstand 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 temperatureUnderstand the difference betweena dilute and concentrated solutionExplain why evaporation may occur before the boiling point of a substance is reachedUnderstand 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 differentratios 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 moleculesRecall that an element can also be made up of separate atomsLink 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 compoundRecognise that the periodic table contains over 100 elements and that they are arranged in groups and periods and ordered by atomic numberRecognise 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 substanceUse melting point data to determine purityIdentify if a substance is acidic, neutral or alkaline using various indicators | Describe changes ofstateUnderstand that different elements and compounds have different chemical properties | Explain how different separation techniques separate mixtures in relation to changes of state and/or solubilitySelect 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 elementUnderstand that the relativeatomic mass of an atom is due to the number of protons and neutrons |
| Models for different typesof chemical bonding and structure have been developed to explain physical and chemicalproperties of substances  |  |  | Recognise that giant structures are held together by strong electrostatic forces and thatthere 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, resultingin observable changes inphysical 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 reactionRecognise that during a chemical reaction massis conserved. The mass of reactants is equalto the mass of theproducts. | 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 exothermicor endothermicDescribe trends in reactivity of key groups of the periodic table and am aware that elements have beenplaced in a reactivity series based on historical experimental data | Understand that a balanced equation represents reacting ratios of substancesUse the idea of conservation of atoms to balance a chemical equationCategorise a reaction as oxidation, precipitation or decompositionUnderstand that during a reaction energy can be lost to or taken from the surroundingsUse the reactivity series to explain whydisplacement happensUnderstand 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 propertiesSynthesis 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 ofman-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 animalsRecognise 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 availableRecognise that cost-benefit analysis and considerations of sustainability are important in understanding the impacts of producing novel materials on an industrial scaleChosen 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 managedRealise that identifying these impacts is important and should be discussed and debated, showing which aspects are backed up by evidence and which are opinionUnderstand 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 ourenergy , mining, use of materials that are made from finite resources |