

Chemistry Progression Framework

		Key areas			
Organisers	Experiences and outcomes	National 3	National 4	National 5	Higher Unit
Properties and uses of substances	<p>Periodic table and properties and uses of elements relative to their positions. SCN 3-15a <i>Explore groups 1, 7 and 0 and their organisation in the periodic table.</i></p> <p>Atomic structure and bonding connect to the properties of substances with their possible structures. SCN 4-15a <i>Formulae and equations are introduced. Concepts of covalent and ionic bonding and resulting structures.</i></p> <p>Properties of compounds are different from their constituent elements. SCN 3-15b <i>Explore the difference between pure substances and mixtures.</i></p>	<p>Chemical structure Elements, compounds and mixtures. Chemical and physical properties of elements related to position in the periodic table. Chemical formulae (including prefixes) of two element compounds.</p>	<p>Atomic structure and bonding related to properties of materials Basic atomic structure including electron arrangement. Covalent bonding as electron sharing and ionic bonding of electron transfer. Physical properties of substances linked to bonding. Chemical formulae of two element compounds. Symbol equations from word equations.</p>	<p>Atomic structure and bonding related to properties of materials Nuclide notation. Isotopes and relative atomic mass, ions and ionic bonding. Covalent molecular, covalent network and ionic lattices. Physical properties of chemicals explained through bonding. Chemical and ionic formulae including group ions.</p>	<p>Atomic structure and bonding related to properties of materials Periodicity Periodic trends and underlying patterns and principles. Electro-negativity.</p> <p>Structure and bonding Intermolecular and intramolecular forces and their role in determining a material's physical properties.</p>
	<p>How the universe has evolved over time. SCN 4-06a <i>The formation of elements.</i></p>		<p>Nuclear chemistry Formation of elements, Background radiation.</p>	<p>Nuclear chemistry Radiation process, alpha, beta and gamma radiation. Specific properties mass, charge and ability to penetrate different materials. Nuclear equations. Uses of radioactive isotopes Half-life. Use of isotopes to date materials.</p>	

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	<p>Pure substances and mixtures and physical methods for separating mixtures into their components. SCN 3-16a</p> <p>SCN 4-16b <i>Concept that mass is converted during chemical change and use of calculations involving balanced equations.</i></p>			<p>Formulae and reaction quantities Balanced equations. Gram formula mass, the mole calculations relating mass, volume of solutions, concentration and moles. Calculations based on balanced equations.</p>	<p>Getting the most from reactants Calculate quantities of reagents and products and excess, percentage yield and atom economy.</p>
Earth's materials	<p>Society's energy needs, the risks and benefits of different energy sources, including those produced from plants. SCN 4-04a</p> <p>Formation and use of fossil fuels. Responsible use and conservation of finite resources. SCN 4-04b</p>	<p>Fuels and energy Environmental impact of using different energy sources.</p>	<p>Fuels Formation and extraction processes for crude oil. Fractional distillation, cracking. The use of fuels and their environmental impact on the carbon cycle. Alternative energy source including biomass.</p>	<p>Energy from fuels Energy calculations involving $E_h = cm\Delta T$ (There is no requirement to calculate enthalpy per mole.)</p>	<p>Esters, fats and oils Condensation reactions. Saturated and unsaturated fats and oils. Melting points of oils and fats through intermolecular bonding.</p>
	<p>Materials derived from crude oil and their uses. The importance of carbon compounds in our lives. SCN 4-17a</p>		<p>Hydrocarbons The study of straight chained: alkanes, C1–C8 alkenes C2–C8. To include their physical, chemical properties, general formulae, structural formulae and uses. Unsaturated and saturated hydrocarbons.</p>	<p>Homologous series The study of cycloalkanes and branched chain alkanes and alkenes (up to C8). To include their physical, chemical properties, general formulae, systematic names, structural formulae, uses, and isomers. Reactions — combustion and addition.</p>	<p>Proteins Enzymes, amino acids, dietary proteins, condensation reaction amide link/peptide link. Digestion, enzyme hydrolysis.</p>

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	<p>Extraction of useful substances from natural resources. SCN 3-17b</p> <p><i>Explore common fractions and their importance</i></p> <p>Fertiliser composition and use. Potential problems associated with over use. Calculations of percentage composition. SCN 4-03a</p>	<p>Everyday consumer products Food Plants for food. Oils and carbohydrates from plants. Nutrients in plants. Essential oils from plants — uses and identification.</p> <p>Plants to products Plants used to make everyday consumer products.</p>	<p>Everyday consumer products Food Alcoholic drinks sources and production. Units in drinks and health issues. Analysis of carbohydrates. Benedict's and iodine solution. Solubility of carbohydrates. Competing demands for carbohydrates as food or fuel.</p> <p>Plants to products Practical based activity on products derived from plants which have enhanced everyday life.</p>	<p>Everyday consumer products Uses of alcohols and carboxylic acids: to include their physical, chemical properties. For straight chain alcohols and carboxylic acids (C1-C8) general formulae, systematic naming, structural formulae. Manufacture of esters as a use of alcohols and carboxylic acids. Uses of esters.</p>	<p>Everyday consumer products Chemistry of cooking Flavours in foods. Influence of functional groups on solubility, boiling points and volatility. Aldehydes and ketones. Uses, carbonyl functional group, structural and molecular formulae. Oxidation. Effect of heat on proteins,</p> <p>Oxidation of food Alcohols. Hydrogen bonding. Diol, triols. Primary, secondary and tertiary oxidation reactions. Carboxylic acids. Reactions, include reduction and reactions with bases. Oxidation of edible oils. Antioxidants. Ion-electron equations for the oxidation.</p> <p>Soaps, detergents and emulsions Production, cleaning action and uses of soaps and detergents. Emulsion and emulsifiers and their formation and use in food.</p> <p>Fragrances Essential oils from plants: properties, uses and products. Terpenes: functional group, structure and use. Oxidation of terpenes.</p>

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					Skin care Formation of free radicals in UV light, sunburn and sun-block. Structure, reactivity and reactions of free radicals. Reaction of free radical scavengers to prevent chain reactions.
Materials and chemical changes	Indicators of chemical reactions. Controlling the rate of reactions. SCN 3-19a <i>Investigate the factors that can affect the rate of reactions.</i>	Rates of reaction Indicators of chemical reactions.	Rates of reaction Reactions monitored and graphs interpreted.	Rates of reaction Average rate of reaction calculated from graph to show change in rate of reaction as reaction progresses.	Controlling the rate Collision theory. Reaction profiles, including activation energy. Catalysts. Energy distribution diagrams showing effect of temperature changes on successful collisions. The effect of temperature on the reaction rate in terms of kinetic energy of particles.
	Properties of acids and bases. pH — measuring and adjusting and the significance of pH in everyday life. SCN 3-18a <i>Formation and naming of simple salts and situations in which pH levels cannot be returned.</i> Simple chemical cells and the factors which affect the voltage produced. SCN 3-10a	Acids and bases Concentrated vs. dilute. pH scale and indicators. Environmental impact of non-metal oxides. Neutralisation reactions including naming of salts. Uses of common neutralisation reactions.	Acids and bases The effect of soluble oxides on the pH of water. Soluble oxides and their environmental impact of non-metal oxides. Uses of acids in food and drink and their impact on health. Selection of chemicals for salt formation.	Acids and bases Dissociation of water into hydrogen and hydroxide ions. pH is related to the concentration of hydrogen and hydroxide ions in pure water, acids and alkalis. Neutralisation titration.	

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	<p>Metals in an electrochemical series and their use in chemical cells. Position of metals in the electrochemical series and voltage and direction of current. SCN 4-10a</p> <p>The latest developments in chemical cells technology and their impact on society. Fuel cells. SCN 4-10b</p>		<p>Metals and alloys Determination of the reactivity series using reactions of metals. Displacement reactions. Corrosion, physical and chemical protection of metals. Electrochemical series and electrochemical cells. Voltage and electroplating. Extraction of metals related to their reactivity. Composition, uses and physical properties of alloys.</p>	<p>Metals Metallic bonding and resulting electrical conductivity. Balanced ionic equations for reactions of metals, extraction of metals and reduction reactions. Electrochemical cells including a non-metal electrode. Reactions of metals — electrons flow, redox reaction, oxidation, reduction. Fuel cells and rechargeable batteries.</p>	<p>Oxidising and reducing agents Elements, molecules and group ions as oxidising and reducing agents. Ion electron redox equations. Everyday uses of strong oxidising agent.</p>
	<p>Novel materials and the scientific basis of their properties and the impacts on society. SCN 4-16a</p>	<p>The properties of materials Testing the properties of materials and investigating their uses.</p>	<p>Materials Polymers, monomers, name of polymers, thermosoftening and thermosetting plastics, properties, uses and combustion of plastics, biodegradable plastics. Advantages and disadvantages of natural versus synthetic polymers. Ceramic materials properties and uses. Development of new materials, unique properties. Reuse and recycle materials.</p>	<p>Properties of plastics Addition and condensation polymerisation including polythene and polyesters. Representation of the structure of monomers and polymers, natural polymers.</p>	

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	Metals in an order of reactivity, and relate to their everyday uses. SCN 4-19b <i>Order of reactivity from the results of experiments involving metals, oxygen, water and acid. The uses of certain metals to protect iron from rusting can be explored and related to their position relative to iron in the electrochemical series. Methods of extracting metals from ores in relation to their position in the reactivity series. Test for hydrogen gas. Learners develop word and formulae equations.</i>		Energy changes of chemical reactions Recognising and uses of exothermic and endothermic reactions.		Chemical energy Enthalpy. Hess's law. Bond enthalpies.
			Fertilisers Plant nutrients, and elements, natural and synthetic fertiliser.	Fertilisers The Haber process to produce ammonia. Commercial production of nitrate fertilisers. Percentage mass compositions of fertilisers.	Getting the most from reactants Factors influencing the design of industrial process including cost availability of reactants and the environmental issues. Equilibria Reversible reactions. Dynamic equilibria.
	Energy changes in chemical reactions. SCN 4-19a <i>Exothermic reactions and endothermic reactions and the practical application of reactions.</i>	Chemical analysis Environmental testing.	Chemical analysis Qualitative analysis of the environment including pH and flame testing.	Chemical analysis Techniques for monitoring the environment and methods for reducing pollution and titration with calculations.	Chemical analysis Chromatography. Volumetric titrations.

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					Research Unit Research the chemistry underlying a given topical issue using a number of sources. Plan and carry out practical work using common apparatus and techniques, to investigate an aspect of the topic. Prepare a scientific communication stating the aim, results and conclusions.