

Co-teaching Entry Level Certificate and GCSE Combined Science: Synergy Chemistry

Component 3 – Elements, mixtures and compounds

Component 4 – Chemistry in our world

This resource guides you through co-teaching our Entry level Certificate (ELC) Science and Foundation Tier GCSE Combined Science: Synergy specifications. Our ELC is ideal for students who may not achieve a grade 1. It's also a valuable motivational tool to build confidence for your Foundation Tier students.

Chemistry: Component 3 – Elements, mixtures and compounds

ELC Outcomes	Summary of content covered in ELC	Same theme covered in Combined but extra content	New content on same topic Rest of Combined Foundation content
1. Atoms and elements	<p>All substances are made of atoms.</p> <p>An atom is the smallest part of an element.</p> <p>The elements are shown in the periodic table and elements in the same group of the periodic table have similar properties.</p>	4.5.1.1 Atomic number and the periodic table	<p>4.1.2.1 Scientific models of the atom</p> <p>4.9 Key ideas</p> <p>4.1.2.3 Sub-atomic particles</p> <p>4.1.2.2 The size of atoms</p> <p>4.1.2.5 Electrons in atoms</p> <p>4.5.1.3 Group 0</p> <p>4.5.1.4 Group 1</p> <p>4.5.1.5 Group 7</p>
2. Elements and compounds	<p>Atoms combine with different atoms to form a compound.</p> <p>Compounds can be made by metals</p>	4.5.2.1 Chemical equations	4.6.2.1 Types of chemical bonding

	<p>combining with non-metals or by non-metals combining with other non-metals. Simple reactions can be described as word equations.</p>		
Practical development	<p>Investigate the reaction when magnesium burns in oxygen (air) to produce magnesium oxide.</p> <p>Compare the properties of iron and sulphur with those of iron sulphide.</p>		
3. States of matter	<p>The three states of matter are solid, liquid and gas. Definitions of the changes between the three states using the terms melting, boiling, condensing and freezing. Simple particle model to explain the states of matter.</p>	<p>4.1.1.1 A particle model</p>	<p>4.6.2.3 Properties of ionic compounds</p>
Practical development	<p>Investigate the changes in state from ice to steam.</p>		
4. Forms (allotropes) of carbon	<p>Diamond and graphite are both forms of carbon but with different</p>	<p>4.8.1.1 Bonding and structure in forms of carbon</p>	

	structures that determine their properties.		
Practical development	Investigate the properties of graphite as a lubricant and for writing.		
5. Mixtures	<p>Mixtures contain two or more substances which are not chemically combined.</p> <p>The appropriate method to separate mixtures by filtration, distillation, crystallisation or chromatography</p>	4.7.3.2 Making salts (includes filtration and crystallisation)	4.1.1.5 Meanings of purity
Practical development	<p>Use filtration / distillation / crystallisation to separate substances.</p> <p>Compare the time needed to filter mixtures of water and calcium carbonate with different particle sizes.</p>	<p>Required practical 17: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner and a water bath or electric heater to evaporate the solution.</p> <p><i>cf Neutralisation.</i></p>	
6. Chromatography	<p>Describe how to separate mixtures by chromatography.</p> <p>Recognise that in paper chromatography, a solvent moves through the paper carrying</p>	4.2.2.4 Chlorophyll and other plant pigments	

	different compounds different distances.		
Practical development	Investigate the different colours in inks or food colours using paper chromatography	Required practical 9 – Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate R_f values.	
7. Extraction of metals from their ores	<p>Unreactive metals are found in the Earth as metals.</p> <p>Most metals are found as compounds that need chemical reactions to extract the metal.</p> <p>Metals less reactive than carbon can be extracted by heating the metal ore with carbon.</p> <p>An ore is a rock containing enough metal to make it economic to extract it and large amounts of rock have to be quarried or mined to get metal ores.</p> <p>The effects of extracting metals can be reduced by recycling.</p>	4.8.2.1 Metal extraction by reduction of oxides	<p>4.5.1.2 Metals and non-metals</p> <p>4.7.5.2 Electrolysis (including the required practical 21: Investigate what happens when aqueous solutions are electrolysed using inert electrodes.)</p> <p>4.8.2.8 Life cycle assessment</p> <p>4.8.2.9 Recycling</p>
Practical development	Model smelting by extracting copper from malachite or lead from galena using carbon		

8. Properties of metals	Metals have giant structures of atoms with strong bonds between the atoms so most metals have high melting points. Properties of metals Relate uses of metals to their properties. Including copper and aluminium.	4.6.2.7 Properties of metals	
Practical development	Compare properties such as conductivity or density of some metals.		
9. Alloys	Most metals in everyday use are alloys. An alloy is produced by mixing a small amount of other elements with a metal – such as steel.	4.6.2.7 Properties of metals	
Practical development	Investigate the melting points of tin, lead and solder. Investigate the hardness of different alloys or steels.		
10. Polymers	Polymers are made from small molecules called monomers joined together in very long chains.	4.6.2.4 Covalent bonding	

	<p>The uses of polymers are related to their properties.</p> <p>Polymers are not biodegradable (not broken down by microbes) and there are problems with the disposal of polymers.</p>		
Practical development	Compare the biodegradability of different polymers and other materials		

Chemistry: Component 4 – Chemistry in our world

ELC Outcomes	Summary of content covered in ELC	Same theme covered in Combined but extra content	New content on same topic Rest of Combined Foundation content
1. Acids and metal reactions	Acids react with some metals to produce hydrogen. Hydrochloric acid produces chlorides. Sulfuric acid produces sulphates. Write word equations for the reactions when given the names of the reactants. Describe and carry out the test for hydrogen	4.7.3.1 Reactions of acids	
Practical development	Investigate the reactions of magnesium, zinc and iron with hydrochloric and sulfuric acids. Investigate the amount of hydrogen produced when acids react with metals		
2. Neutralisation	An acid is neutralised by an alkali or base to produce a salt and water. An acid is neutralised by a carbonate to produce a	4.7.3.2 Making salts 4.7.3.1 Reactions of acids	4.7.3.4 The pH scale and neutralisation 4.7.5.4 Tests for gases

	<p>salt, water and carbon dioxide.</p> <p>Write word equations for the reactions when given the names of the reactants.</p> <p>Describe and carry out the limewater test for carbon dioxide.</p>		
Practical development	<p>Investigate the neutralisation of acids by bases, alkalis and carbonates.</p> <p>Produce solid salt crystals by evaporation of a salt solution.</p>	<p>Required practical 17: Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat diluted acid and a water bath or electric heater to evaporate the solution.</p>	
3. Energy and rate of reaction	<p>Describe reactions that transfer energy to the surroundings so that temperature increases.</p> <p>Describe reactions that take in energy from the surroundings so the temperature decreases.</p>	4.7.3.3 Energy changes and reactions	4.7.4.4 Activation energy
Practical development	<p>Investigate the temperature changes that take place in combustion, oxidation and neutralisation reactions.</p>	<p>Required practical 18: Investigate the variables that affect the temperature changes of a series of reactions in solutions. For example acid plus metals, acid plus carbonates, neutralisations, displacements of metals.</p>	

	Investigate the temperature changes when ammonium chloride dissolves in water or citric acid reacts with sodium hydrogen carbonate		
4. Increasing the rate of a chemical reaction.	Describe the increase in the rate of a reaction caused by increasing: <ul style="list-style-type: none"> • temperature • concentration of reactants • surface area of reactants or by adding a catalyst. Measure and record: <ul style="list-style-type: none"> • time for a reactant to be used up. • volume of gas produced • time for a solution to change colour/clarity 	4.7.4.6 Catalysts	4.7.4.1 Factors that affect reaction rates 4.7.4.3 The effect of temperature, concentration and pressure on rates of reaction 4.7.4.8 Reversible reactions 4.7.4.9 Dynamic equilibrium
Practical development	Investigate how to make a chemical reaction go faster.	Required practical 19: Investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity.	
5. Changes in Earth's atmosphere	Development of the Earth's current atmosphere.	4.4.1.1 Development of the Earth's atmosphere	

	Photosynthesis and changes in the early atmosphere.		
Practical development	Investigate the production of oxygen by aquatic plants in different conditions by counting bubbles		
6. The current atmosphere	Carbon dioxide from the early atmosphere has been locked up as carbonates and fossils in rocks. The present composition of the Earth's atmosphere	4.4.1.1 Development of the Earth's atmosphere	
Practical development	Compare the amount of carbon dioxide in fresh air and exhaled air		
7. Crude oil and fuels	Crude oil is a mixture of a large number of compounds. Fractional distillation to produce useful fuels, such as petrol and diesel.	4.8.1.2 Hydrocarbons in crude oil 4.8.1.3 Fractional distillation of crude oil	4.8.1.4 Cracking hydrocarbons
Practical development	Compare prepared samples of fractions from crude oil/ demonstration		

	of fractional distillation of prepared crude oil sample.		
8. Burning fuels	<p>The products of total combustion of a fuel are carbon dioxide, water vapour and oxides of nitrogen. Some fuels produce sulphur dioxide when burned.</p> <p>Partial combustion due to a limited air supply results in the production of carbon monoxide and, often, soot particles.</p> <p>Potential harm to the environment by burning fossil fuels:</p> <ul style="list-style-type: none"> • oxides of sulphur and nitrogen (N_{ox}) cause acid rain and may harm human health. • carbon monoxide can cause death. • solid particles can cause global dimming and harm human health. 	4.4.1.6 Pollutants that affect air quality	

<p>Practical development</p>	<p>Investigate the products of combustion.</p> <p>Compare 'roaring' and 'safety' Bunsen burner flames.</p> <p>Investigate the production of acid rain (spray a large cotton wool 'cloud' with water; hold above burning matches; squeeze the 'cloud' over a UI solution).</p>		
<p>9. Human influences on the atmosphere</p>	<p>Carbon dioxide is produced by burning fossil fuels.</p> <p>Methane is produced from landfills and farming.</p> <p>The effects of increased carbon dioxide and methane on the temperature of the atmosphere.</p>	<p>4.4.1.4 Human impacts on the climate</p>	<p>4.4.1.3 The greenhouse effect</p> <p>4.4.1.5 Climate change: impacts and mitigation</p>
<p>10. Water for drinking</p>	<p>Safe drinking water has few dissolved substances and low levels of microbes.</p>	<p>4.4.1.8 Sources of potable water</p>	<p>4.8.2.8 Life cycle assessment</p>

	Safe drinking water is produced by filtration and sterilisation.		
Practical development	<p>Distil a salt water solution to produce fresh water.</p> <p>Investigate the amount of dissolved solids in water from different locations by evaporating samples and weighing residues.</p>	<p>Required practical 11: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</p> <p>(<i>cf</i> ELC Biology Component 2 Outcome 7)</p>	