# Co-teaching Entry Level Certificate and GCSE Combined Science: Trilogy

## Chemistry

**Component 3 – Elements, mixtures and compounds**
**Component 4 – Chemistry in our world**

This resource provides guidance for co-teaching our new Entry Level Certificate (ELC) Science and Foundation Tier GCSE Combined Science: Trilogy specifications. Our ELC is designed for students who may not achieve a grade 1, but you can also use it as a 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 |
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| 1. Atoms and elements | All substances are made of atoms.<br>An atom is the smallest part of an element.<br><br>The elements are shown in the periodic table and elements in the same group of the periodic table have similar properties. | 5.1.1.1<br>Extra parts – atomic symbols (first 20, Group 1 and Group 7)<br><br>5.1.2.1<br>Arrangement of the periodic table in terms of electronic structure. | 5.1.1.3<br>Development of the model of the atom.<br><br>5.1.2.2<br>Development of the periodic table. | 5.11 Key ideas<br><br>5.1.1.4<br>Relative electrical charges of subatomic particles.<br>5.1.1.5<br>Size and mass of atoms<br>5.1.1.6<br>Relative atomic mass<br>5.1.1.7<br>Electronic structure<br>5.1.2.4<br>Group 0<br>5.1.2.5<br>Group 1<br>5.1.2.6 |
| 2. Elements and compounds | Atoms combine with different atoms to form a compound.<br>Compounds can be made by metals combining with non-metals or by non-metals combining with other non-metals. Simple reactions can be described as word equations. | 5.1.1.1<br>Extra parts – energy changes; formulae and naming compounds; symbol equations. | | Group 7<br>5.2.1<br>Chemical bonds, ionic, covalent and metallic. |

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| Practical development | Investigate the reaction when magnesium burns in oxygen (air) to produce magnesium oxide.<br><br>Compare the properties of iron and sulfur with those of iron sulphide. | | | |
| 3. States of matter | The three states of matter are solid, liquid and gas.<br>Definitions of the changes between the three states using the terms melting, boiling, condensing and freezing.<br>Simple particle model to explain the states of matter. | 5.2.2.1<br>Predictions of state based on data; explanations of changes of state based on energy changes.<br>5.2.2.2<br>State symbols | | 5.2.2.3<br>Properties of ionic compounds<br>5.2.2.4<br>Properties of small molecules |
| Practical development | Investigate the changes in state from ice to steam. | | | |
| 4. Forms (allotropes) of carbon | Diamond and graphite are both forms of carbon but with different structures that determine their properties. | 5.2.3.1 Diamond<br>5.2.3.2 Graphite<br>Details of bonding | 5.2.3.3<br>Graphene and fullerenes | |
| Practical development | Investigate the properties of graphite as a lubricant and for writing. | | | |
| 5. Mixtures | Mixtures contain two or more substances which are not chemically combined. | 5.1.1.2<br>More complex definition of mixture.<br>Inclusion of fractional distillation | | 5.8.1.1 Pure substances<br>5.8.1.2 Formulations |

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| | The appropriate method to separate mixtures by filtration, distillation, crystallisation or chromatography | | | |
| Practical development | Use filtration/distillation/ crystallisation to separate substances.<br><br>Compare the time needed to filter mixtures of water and calcium carbonate that has different particle sizes. | | | |
| 6. Chromatography | Describe how to separate mixtures by chromatography.<br><br>Recognise that in paper chromatography, a solvent moves through the paper carrying different compounds different distances. | 5.8.1.3<br>Chromatography – definitions of phases; use of $R_f$ and correct use of significant figures; differences between pure and impure substances. | | |
| Practical development | Investigate the different colours in inks or food colours using paper chromatography. | Required practical 12 (6) – 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 | Unreactive metals are found in the Earth as metals.<br>Most metals are found as compounds that need | 5.4.1.3<br>Extraction of metals and reduction:<br>• Definition of reduction and identification of | 5.1.2.3<br>Metals and non-metals in terms of electronic structure. | 5.3 Quantitative chemistry<br>5.4.1.1 Metal oxides<br>5.4.3 Electrolysis (including the required practical 9: Investigate what happens |

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| | chemical reactions to extract the metal.<br>Metals less reactive than carbon can be extracted by heating the metal ore with carbon.<br>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.<br>The effects of extracting metals can be reduced by recycling. | which substances are reduced/oxidised.<br>• Interpretation of data relating to metal extraction.<br><br>5.10.2.2<br>Ways of reducing the use of resources – part relevant to metals | | when aqueous solutions are electrolysed using inert electrodes.)<br>5.10.2.1 Life cycle assessment<br>5.10.2.2 Ways of reducing the use of resources |
| 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.<br>Properties of metals.<br>Relate uses of metals to their properties. eg copper and aluminium. | 5.2.2.7<br>Properties of metals and alloys: arrangement of atoms in layers.<br>5.2.2.8<br>Metals as conductors – explanation of conductivity in terms of electrons. | | |
| Practical development | Compare the properties such as conductivity or density of some metals. | | | |

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| 9. Alloys | Most metals in everyday use are alloys.<br>An alloy is produced by mixing a small amount of other elements with the metal eg steel. | 5.2.2.7<br>Properties of metals and alloys: explanation in terms of the distortion of the layers of atoms. | | |
| Practical development | Investigate the melting points of tin, lead and solder**.**<br>Investigate the hardness of different alloys or steels. | | | |
| 10. Polymers | Polymers are made from small molecules called monomers joined together in very long chains.<br>The uses of polymers are related to their properties.<br><br>Polymers are not biodegradable (not broken down by microbes) and there are problems with the disposal of polymers. | 5.2.2.5<br>Polymers – recognition of polymers from diagrams showing bonding and structure. | | 5.2.2.6<br>Giant covalent structures |
| 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 |
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| 1. Acids and metal reactions | Acids react with some metals to produce hydrogen.<br>Hydrochloric acid produces chlorides.<br>Sulfuric acid produces sulfates.<br>Write word equations for the reactions when given the names of the reactants.<br>Describe and carry out the test for hydrogen. | 5.4.1.2 The reactivity series: Reactions of Group 1 and transition metals with water and dilute acid; formation of ions; construction of a reactivity series including hydrogen and carbon; displacement.<br><br>5.8.2.1 Test for Hydrogen | | 5.3 Quantitative chemistry |
| Practical development | Investigate the reactions of magnesium, zinc and iron with hydrochloric and sulfuric acids.<br><br>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.<br>An acid is neutralised by a carbonate to produce a | 5.4.2.2 Neutralisation of acids and salt production: Addition of nitric acid; ions, formulae and symbol equations. | 5.4.2.4 The pH scale and neutralisation | 5.3 Quantitative chemistry |

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| | salt, water and carbon dioxide.<br><br>Write word equations for the reactions when given the names of the reactants.<br>Describe and carry out the limewater test for carbon dioxide. | 5.4.2.3 Soluble salts: details of salt production.<br><br>5.8.2.3 Test for carbon dioxide | | 5.8.2.2 Test for oxygen<br>5.8.2.4 Test for chlorine |
| Practical development | Investigate the neutralisation of acids by bases, alkalis and carbonates.<br>Produce solid salt crystals by evaporation of a salt solution. | Required practical 8: Preparation of a pure, dry sample or a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution. | | |
| 3. Energy and rate of reaction | Describe reactions that transfer energy to the surroundings so that temperature increases.<br><br>Describe reactions that take in energy from the surroundings so the temperature decreases. | 5.5.1.1 Energy transfers during exothermic and endothermic Reactions: definitions. | | 5.5.1.2 Reaction profiles and activation energy |
| Practical development | Investigate the temperature changes that take place in combustion, oxidation and neutralisation reactions. | Required practical 10: Investigate the variables that affect temperature changes in reacting solutions such as eg acid plus metals, acid plus carbonates, neutralisations, displacements of metals. | | |

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| | Investigate the temperature changes when eg 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 the:<br>• temperature<br>• concentration of reactants<br>• surface area of reactants<br>**or** by adding a catalyst.<br><br>Measure and record the:<br>• time for a reactant to be used up.<br>• volume of gas produced<br>• time for a solution to change colour/clarity. | 5.6.1.2<br>Factors which affect the rates of chemical reactions.<br><br>5.6.1.4 Catalysts: much more detail regarding how catalysts work. | 5.6.1.1<br>Calculating rates of reaction including use of graphs.<br><br>5.6.1.3<br>Collision theory and activation energy | 5.6.2<br>Reversible reactions and dynamic equilibrium. |
| Practical development | Investigate how to make a chemical reaction go faster. | Required practical 11: Investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produces and a method involving change in colour or turbidity. | | |
| 5. Changes in Earth's atmosphere | Development of the Earth's current atmosphere.<br><br>Photosynthesis and | 5.9.1.2 The Earth's early atmosphere: additional detail.<br><br>5.9.1.3 How oxygen increased: | | |

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| | changes in the early atmosphere. | Symbol equation for photosynthesis. | | |
| 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.<br><br>The present composition of the Earth's atmosphere. | 5.9.1.4<br>How carbon dioxide decreased: Additional detail.<br><br>5.9.1.1 The proportions of different gases in the 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.<br><br>Fractional distillation to produce useful fuels, such as petrol and diesel. | 5.7.1.1<br>Crude oil, hydrocarbons and alkanes: structural formulae; names of first four alkanes.<br>5.7.1.2<br>Fractional distillation and petrochemicals: additional details of the process and the families of compounds.<br>5.7.1.3<br>Properties of hydrocarbons: additional details relating to trends, properties and molecule size. | 5.7.1.4<br>Cracking and alkenes | |

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| Practical development | Compare prepared samples of fractions from crude oil/ demonstration of fractional distillation of prepared crude oil sample. | | | |
| 8. Burning fuels | The products of total combustion of a fuel are carbon dioxide, water vapour and oxides of nitrogen.<br>Some fuels produce sulfur dioxide when burned.<br><br>Partial combustion due to a limited air supply results in the production of carbon monoxide and, often, soot particles.<br><br>Potential harm to the environment by burning fossil fuels:<br>• oxides of sulfur and nitrogen ($N_{OX}$) cause acid rain and may harm human health.<br>• carbon monoxide can cause death.<br>• solid particles can cause global dimming and harm human health. | 5.7.1.3<br>Properties of hydrocarbons: balanced equation for combustion of hydrocarbons.<br><br>5.9.3.1<br>Atmospheric pollutants from fuels: predict products of combustion from given data.<br><br>5.9.3.2<br>Properties and effects of atmospheric pollutants. | | |

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| Practical development | Investigate the products of combustion.<br><br>Compare 'roaring' and 'safety' Bunsen burner flames.<br><br>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). | | | |
| 9. Human influences on the atmosphere | Carbon dioxide is produced by burning fossil fuels.<br><br>Methane is produced from landfills and farming.<br><br>The effects of increased carbon dioxide and methane on the temperature of the atmosphere. | 5.9.2.2<br>Human activities which contribute to an increase in greenhouse gases in the atmosphere: modelling change; evaluating evidence about global climate change. | 5.9.2.1 Greenhouse gases.<br>5.9.2.3 Global climate change.<br>5.9.2.4 The carbon footprint and its reduction | |
| 10. Water for drinking | Safe drinking water has few dissolved substances and low levels of microbes.<br><br>Safe drinking water is produced by filtration and sterilisation. | 5.10.1.2 Potable water: additional detail. | 5.10.1.1<br>Using the Earth's resources and sustainable development.<br>5.10.1.3<br>Waste water treatment. | 5.10.2.1<br>Life cycle assessment.<br>5.10.2.2<br>Ways of reducing the use of resources. |

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| Practical development | Distil a salt water solution to produce fresh water.<br><br>Investigate the amount of dissolved solids in water from different locations by evaporating samples and weighing residues. | Required practical 13: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation,<br>(*cf* ELC Biology Component 2 Outcome 7) |