# Combined Science
# Learning Journey – C4 Chemical Changes

| What have I done previously in my learning journey? | |
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| **Previously….** | **You have learnt previously about chemical reactions. This has involved learning about:**<br>• chemical reactions as the rearrangement of atoms<br>• representing chemical reactions using formulae and using equations<br>• combustion, thermal decomposition, oxidation and displacement reactions<br>• defining acids and alkalis in terms of neutralisation reactions<br>• the pH scale for measuring acidity/alkalinity; and indicators<br>• reactions of acids with metals to produce a salt plus hydrogen<br>• reactions of acids with alkalis to produce a salt plus water<br>• what catalysts do |
| **In this topic…** | You will learn that the understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organizing their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes. |

| **We will develop our learning by studying the following each lesson:** | **RAG** | **Skills in Science checklist** |
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| **C4.01 Metal Oxides**<br>• Describe how metals react with oxygen<br>• State the compounds that metals form when they react with oxygen<br>• Define oxidation and reduction | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.02 The Reactivity Series**<br>• Describe the arrangement of metals in the reactivity series, including carbon and hydrogen<br>• Use the reactivity series to predict the outcome of displacement reactions<br>• Recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids<br>• Relate the reactivity of metals to its tendency to form positive ions and be able to deduce an order of reactivity of metals based on experimental results | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.03 Extraction of Metals and Reduction**<br>• Recall what native metals are.<br>• Explain how metals can be extracted from the compounds in which they are found in nature by reduction with carbon.<br>• Evaluate specific metal extraction processes when given appropriate information and identify which species are oxidised or reduced | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.04 Reactions of Acids and Metals**<br>• Describe oxidation and reduction in terms of loss and gain of electrons.<br>• Write ionic equations for displacement reactions, and identify which species are oxidised and reduced from a symbol or half equation.<br>• Explain in terms of gain or loss of electrons that the reactions between acids and some metals are redox reactions, and identify which species are oxidised and which are reduced | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.05 Neutralisation of Acids and Salt Production**<br>• Explain that acids can be neutralised by alkalis, bases and metal carbonates and list the products of each of these reactions.<br>• Predict the salt produced in a neutralisation reaction based on the acid used and the positive ions in the base, alkali or carbonate.<br>• Use the formulae of common ions to deduce the formulae of the salt.<br>• Describe how soluble salts can be made from acids and how pure, dry samples of salts can be obtained.<br>• ***Required practical 1:*** *preparation of a pure, dry sample of 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* | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.06 The pH Scale and Neutralisation**<br>• Recall what the pH scale measures and describe the scale used to identify acidic, neutral or alkaline solutions | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application |

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| • Define the terms acid and alkali in terms of production of hydrogen ions or hydroxide ions (in solution), define the term base<br>• Describe the use of universal indicator to measure the approximate pH of a solution<br>• Use the pH scale to identify acidic or alkaline solutions | | ☐ Communication |
| **C4.07 Strong and Weak Acids**<br>• Use and explain the terms dilute and concentrated (in terms of amount of substance) and weak and strong (in terms of the degree of ionisation) in relation to acids<br>• Explain how the concentration of an aqueous solution and the strength of an acid affects the pH of the solution and how pH is related to the hydrogen ion concentration of a solution | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.08 Electrolysis of Molten Ionic Solutions**<br>• Describe how ionic compounds can conduct electricity when dissolved in water and describe these solutions as electrolytes<br>• Describe the process of electrolysis<br>• Describe the electrolysis of molten ionic compounds and predict the products at each electrode of the electrolysis of binary ionic compounds | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.09 Using Electrolysis to Extract Metals**<br>• Explain how metals are extracted from molten compounds using electrolysis and use the reactivity series to explain why some metals are extracted with electrolysis instead of carbon | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |
| **C4.10 Electrolysis of Aqueous Solutions**<br>• Describe the electrolysis of aqueous solutions and predict the products of the electrolysis of aqueous solutions containing single ionic compounds<br>• ***Required practical 3:*** *investigate what happens when aqueous solutions are electrolysed using inert electrodes*<br>• Describe the reactions at the electrodes during electrolysis as oxidation and reduction reactions and write balanced half equations for these reactions | | ☐ Scientific Methods<br>☐ Practical<br>☐ Number Skills<br>☐ Application<br>☐ Communication |

**Key Vocabulary**

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| **Oxidation** | **Reduction** | **Reactivity series** | **Displacement reaction** | **Native metal** | **Ionic equation** | **Redox reaction** | **Neutralisation** | **pH scale** |
| **Hydrogen ion** | **Hydroxide ion** | **Universal indicator** | **Titration** | **Strong acid** | **Weak acid** | **Eelctrolysis** | **Molten** | **Electrode** |
| **Aqueous** | | | | | | | | |

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| **Future Learning** | In AS and A Level Chemistry you will build on what you have learnt in this topic and study:<br>Energetics - The enthalpy change in a chemical reaction can be measured accurately. It is important to know this value for chemical reactions that are used as a source of heat energy in applications such as domestic boilers and internal combustion engines.<br>Kinetics - The study of kinetics enables chemists to determine how a change in conditions affects the speed of a chemical reaction. Whilst the reactivity of chemicals is a significant factor in how fast chemical reactions proceed, there are variables that can be manipulated in order to speed them up or slow them down.<br>Oxidation, reduction and redox equations - Redox reactions involve a transfer of electrons from the reducing agent to the oxidising agent. The change in the oxidation state of an element in a compound or ion is used to identify the element that has been oxidised or reduced in a given reaction. Separate half-equations are written for the oxidation or reduction processes. These half-equations can then be combined to give an overall equation for any redox reaction. |
| **In careers** | Knowing about different chemical changes has helped biochemists to understand the complex reactions that take place in living organisms. The extraction of important resources from the earth makes use of the way that some elements and compounds react with each other and how easily they can be 'pulled apart'. |