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**Knowledge Rich Curriculum Plan**

SCIENCE- Chemistry Year 10

Topic: Chemical Changes

| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** |
| --- | --- | --- | --- | --- |
| **Lesson:** **Acids** | * Students will know that acids produce H+ ions in aqueous solutions
* Students will know that aqueous solutions of alkalis contain hydroxide ions (OH-)
* Students will know that the pH scale goes from 0 to 14, and is a measure of the acidity or alkalinity of a solution
* Students will know that the pH of a solution can be determined through using universal indicator or a pH probe
* Students will know that a solution with a pH of 7 is neutral
* Students will know that acids have a pH less than 7
* Students will know that alkalis have a pH above 7
* Students will know the following 3 common acids, along with their formula:
* Hydrochloric acid - HCl
* Sulfuric acid - H2SO4

Nitric acid - HNO3 | ***Students need to already know that universal indicator works by changing colour in acidic/ alkaline conditions*** |  | Tier 2Tier 3*Alkalis: substances which have a pH above 7 and contain hydroxide ions (OH-)* *Acids: substances which have a pH below 7 and contain hydrogen ions (H+)**pH scale: A measure of how many hydrogen ions there are in a solution.*  |
| **Lesson:** **Strong and Weak Acids (Higher tier)** | * Students will know that acids ionise (split into their ions) in aqueous solution
* Students will know that strong acids completely ionise in aqueous solution
* Students will know that hydrochloric acid, nitric acid and sulfuric acid are examples of strong acids
* Students will know that weak acids only partially ionise in aqueous solution
* Students will know that examples of weak acids include ethanoic acid, citric acid and carbonic acids
* Students will know that for a given concentration of aqueous solutions, the stronger an acid, the lower the pH
* Students will know that as the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10
* Students will know how to use the terms dilute, concentrated, weak and strong correctly

Students will know how to describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH | ***Students need to already know that the acidity of a substance is linked to the amount of H+ ions*** |  |  |
| **Lesson:** **Neutralisation** | * Students will know that neutralisation reactions are reactions where an acid is neutralised, producing salt and water only
* Students will know that in neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water
* Students will know that acids can be neutralised by metal oxides or metal hydroxides
* Students will know that the ionic equation for neutralisation is:
* H+ + OH- --> H2O
* Students will know how to describe the use of indicator to measure the approximate pH of a solution
* Students will know how to use the pH scale to identify acidic or alkaline solutions
* Students will know that the name of salt produced in neutralisation depends on the acid and alkali used.
* Students will know that the suffix of the salt depends on the acid as follows:
* hydrochloric acid - chloride
* sulfuric acid - sulphate
* nitric acid - nitrate

Students will know how to write equations to represent neutralisation | ***Students need to already know the colours associated with universal indicators*** |  | Tier 2Tier 3*Neutralisation: the reaction of an acid with an alkali/ basic substance that produces water and salt only* |
| **Lesson:** **Titration (TRIPLE ONLY)** | * Students will know that the volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator
* Students will know how to carry out titrations using strong acids and strong alkalis

Students will know how to calculate the chemical quantities in titrations involving concentrations in mol/dm3 and g/dm3 | ***Students need to already know how to calculate concentration in mol/dm3 and g/dm3*** |  |  |
| **Lesson:** **Soluble Salts (Required Practical)** | * Students will know that soluble salts can be produced from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxide or carbonates.
* Students will know that the solid is added to the acid until no more reacts, and that the excess solid is filtered off to produce a solution of the salt
* Students will know that salt solutions can be crystallised to produce solid salts

Students will know how to describe the method used to make pure, dry samples of names soluble salts from information provided | ***Students need to already know how to name salts produced*** |  | Tier 2Tier 3*Solute: The solid dissolved in solution**Solvent: The liquid that the solute is dissolved into* *Solution: When a solute dissolves in a solvent* |
| **Lesson:** **Metals and Acids** | * Students will know that when acids and metals react together the products are salt and hydrogen
* Students will know that the reactions between metals and acids can be represented with symbol and ionic equations
* Students will know how to describe the reactions as redox reactions
* Students will know how to determine which species has been oxidised (lost electrons) or reduced (gained electrons)

Students will know how to represent the reactions of magnesium, zinc and iron with hydrochloric and sulfuric acid using symbol and ionic equations | * ***Students need to already know how to name salts***

***Students need to already know how to balance symbol equations*** |  |  |
| **Lesson:** **Metal Oxides** | * Students will know that metals react with oxygen to produce metal oxides.
* Students will know that these reactions are oxidation reactions because the metal gains oxygen

Students will know how to explain reduction and oxidation in terms of loss or gain of oxygen (reduction is loss of oxygen, oxidation is gain of oxygen) | ***Students need to already know how to represent chemical reactions using equations*** |  |  |
| **Lesson:** **Oxidation and Reduction (Higher Tier)** | * Students will know that oxidation is the loss of electrons and reduction is the gain of electrons
* Students will know how to write ionic equations for displacement reactions

Students will know how to identify which species have been oxidised or reduced when looking at an equation | ***Students need to already know how to write ionic equations*** |  |  |
| **Lesson:** **The Reactivity series** | * Students will know that when metals react with other substances they form positive ions
* Students will know that the reactivity of a metal is related to its tendency to form positive ions.
* Students will know that the order of reactivity of metals (from highest to lowest) is: potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper
* Students will know that the reactivity series of metals was determined through observations made of the metal’s reactivity with water and dilute acids
* Students will know that more reactive metals can displace less reactive metals from a compound
* Students will know that when reacting with water, the following observations are made:
* potassium - violent reaction
* sodium - very quick reaction
* lithium - quick reaction
* calcium - slow reaction
* Students will know that when reacting with dilute acid, the following observations are made:
* calcium - very quick reaction
* magnesium - quick reaction
* zinc - slow reaction
* iron - slower reaction than zinc
* copper - very slow reaction

Students will know how to deduce an order of reactivity of metals based on experimental results. | ***Students need to already know signs a chemical reaction is taking place*** |  | Tier 2Tier 3Reactivity: measure of how much a substance reacts |
| **Lesson:** **Extraction of Metals** | * Students will know that unreactive metals, such as gold, are found in the Earth as the metal itself but most metals are found as compounds that require chemical reaction to be extract the metal
* Students will know that metals less reactive than carbon can be extracted from their oxides by reduction
* Students will know that an ore is a metal containing compound that contains enough metal for it to be economically viable to extract
* Students will know how to evaluate a specific metal extraction process when given appropriate information

Students will know how to identify substances which are oxidised or reduced | ***Students need to already know that oxidation is the gain of oxygen and reduction is the loss of oxygen.*** |  | Tier 2Tier 3*Ore: a rock that contains enough metal to extract and make money from**Reduction: a reaction that removes oxygen* |
| **Lesson:** **Electrolysis of Molten Compounds** | * Students will know that liquids and solutions that are able to conduct electricity are known as electrolytes
* Students will know that passing an electric current through electrolytes causes the ions to move to the electrodes
* Students will know that positively charged ions move to the negative electrode (the cathode)
* Students will know that negatively charged ions move to the positive electrode (the anode).
* Students will know that ions are discharged at the electrodes, producing elements. This process is known as electrolysis.
* Students will know that carbon is used as electrodes as it can conduct electricity (as graphite) and is chemically inert
* Students will know that when molten ionic compounds are electrolysed, the metal is produced at the cathode and the non-metal is produced at the anode.
* Students will know how to predict the products of electrolysis of binary ionic compounds in the molten state
* Students will know how to represent the electrolysis as ionic half equations

Students will know how to identify what has been oxidised or reduced. | * ***Students need to already know that an ionic compound is made of ions***
* ***Students need to already know that ionic compounds can conduct electricity when molten or dissolved in water***

***Students need to already know how to write ionic equations*** |  | Tier 2Tier 3Electrolysis: The splitting of a compound using electric current |
| **Lesson:** **Electrolysis and Extracting Metals** | * Students will know that metals can be extracted from molten compounds using electrolysis
* Students will know that electrolysis is used to extract a metal if it is more reactive than carbon.
* Students will know that extraction of metals using electrolysis requires a large amount of energy.
* Students will know that aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite.
* Students will know that aluminium oxide is mixed with cryolite to reduce the temperature needed to melt the mixture
* Students will know that carbon is used as the anode.
* Students will know that the positive electrode needs to be replaced as the oxygen that is produced there reacts with the carbon to form carbon dioxide.
* Students will know how to explain why a mixture is used as the electrolyte

Students will know how to explain why the positive electrode must be continually replaced. | * ***Students need to already know that the anode is the positive electrode***
* ***Students need to already know that metals are ranked by their reactivity in the reactivity series***

***Students need to already know that some metals can't be extracted by heating with carbon as they are more reactive than carbon.*** |  | Tier 2Tier 3*Aqueous: when a solid has been dissolved in water**Molten: liquified by heat* |
| **Lesson: Electrolysis of aqueous solutions** | * Students will know that when a current is applied across an aqueous solution the water molecules can also be split into its ions (H+ and OH-)
* Students will know that when an aqueous solution is electrolysed the ions that are discharged at the electrodes depends on the relative reactivity of the elements involved.
* Students will know that if the metal is more reactive than hydrogen, then hydrogen gas is produced at the cathode
* Students will know that oxygen is produced at the anode, unless the solution contains halide ions (where the halogen is produced instead)
* Students will know how to predict the products of the electrolysis of aqueous solutions
* Students will know how to carry out electrolysis of aqueous solutions
* Students will know that when hydrogen is released at the cathode, the half equation is:
* 2H+ + 2e- --> H2
* This represents reduction as the hydrogen ions are gaining electrons
* Students will know that when oxygen is released at the anode (in aqueous solutions), the half equation is:
* 4OH- --> O2 + 2H2O + 4e-

This represents oxidation as the OH- ion has lost electrons | * ***Students need to already know that aqueous means dissolved in water***
* ***Students need to already know that reactivity of a metal is linked to its tendency to form ions***

***Students need to already know that the cathode is the negative electrode and the anode is the positive electrode*** |  | Tier 2Tier 3*Aqueous: when a solid has been dissolved in water* |