Science Year 11 – Chemistry Rotation

	What? **When?** **Why?**		
	Chemistry Chemical Change	**Chemistry** Groups, Rates and Energy Changes	**Chemistry** Fuels; Earth and Atmospheric Sciences
Lesson 1 Learning intentions	**Electrolysis** Recall that electrolytes are ionic compounds in the molten state or dissolved in water Describe electrolysis as a process in which electrical energy, from a direct current supply, decomposes electrolytes. Explain the movement of ions during electrolysis, in which: a) positively charged cations migrate to the negatively charged cathode b) negatively charged anions migrate to the positively charged anode. **Write half equations for reactions occurring at the anode and cathode in electrolysis** **Explain oxidation and reduction in terms of loss or gain of electrons** **Recall that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions**	**Group 1** Explain why some elements can be classified as alkali metals (group 1), halogens (group 7), or noble gases (group 0), based on their position in the periodic table. Recall that alkali metals: a) are soft b) have relatively low melting points. Describe the reactions of lithium, sodium and potassium with water. Describe the pattern in reactivity of the alkali metals, lithium, sodium and potassium, with water; and use this pattern to predict the reactivity of other alkali metals. Explain this pattern in reactivity in terms of electronic configurations.	**Hydrocarbons in Crude Oil and Natural Gas** Recall that hydrocarbons are compounds that contain carbon and hydrogen only Describe crude oil as: a) a complex mixture of hydrocarbons b) containing molecules in which carbon atoms are in chains or rings (names, formulae and structures of specific ring molecules not required) c) an important source of useful substances (fuels and feedstock for the petrochemical industry) d) a finite resource Recall that petrol, kerosene and diesel oil are non-renewable fossil fuels obtained from crude oil and methane is a non-renewable fossil fuel found in natural gas.
Lesson 2 Learning intentions	**Core Practical** Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes	**Group 7** Recall the colours and physical states of chlorine, bromine and iodine at room temperature. Describe the pattern in the physical properties of the halogens, chlorine, bromine and iodine, and use this pattern to predict the physical properties of other halogens.	**Fractional Distillation of Crude Oil** Describe and explain the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation Recall the names and uses of the following fractions:

		Describe the chemical test for chlorine. Describe the reactions of the halogens, chlorine, bromine and iodine, with metals to form metal halides, and use this pattern to predict the reactions of other halogens. Recall that the halogens, chlorine, bromine and iodine, form hydrogen halides which dissolve in water to form acidic solutions, and use this pattern to predict the reactions of other halogens.	a) gases, used in domestic heating and cooking b) petrol, used as fuel for cars c) kerosene, used as fuel for aircraft d) diesel oil, used as fuel for some cars and trains e) fuel oil, used as fuel for large ships and in some power stations f) bitumen, used to surface roads and roofs Explain how hydrocarbons in different fractions differ from each other in: a) the number of carbon and hydrogen atoms their molecules contain b) boiling points c) ease of ignition d) viscosity
Lesson 3 Learning intentions	**<u>Products of Electrolysis</u>** Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes. Predict the products of electrolysis of other binary, ionic compounds in the molten state. Explain formation of the products in the electrolysis of copper sulfate solution, using copper electrodes, and how this electrolysis can be used to purify copper	**<u>Halogen Reactivity</u>** Describe the relative reactivity of the halogens chlorine, bromine and iodine, as shown by their displacement reactions with halide ions in aqueous solution, and use this pattern to predict the reactions of astatine. **Explain why these displacement reactions are redox reactions in terms of gain and loss of electrons, identifying which of these are oxidised and which are reduced.** Explain the relative reactivity of the halogens in terms of electronic configurations.	**<u>The Alkane Homologous Series</u>** Explain how hydrocarbons … are mostly members of the alkane homologous series Explain an homologous series as a series of compounds which: a) have the same general formula b) differ by CH_2 in molecular formulae from neighbouring compounds c) show a gradual variation in physical properties, as exemplified by their boiling points d) have similar chemical properties
Lesson 4 Learning intentions	**<u>Reactivity</u>** Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions.	**<u>Group 0</u>** Explain why the noble gases are chemically inert, compared with the other elements, in terms of their electronic configurations.	**<u>Complete Combustion</u>** Describe the complete combustion of hydrocarbon fuels as a reaction in which: a) carbon dioxide and water are produced b) energy is given out

	Explain displacement reactions as redox reactions, in terms of gain or loss of electrons. Explain the reactivity series of metals (potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations	Explain how the uses of noble gases depend on their inertness, low density and/or non-flammability. Describe the pattern in the physical properties of some noble gases and use this pattern to predict the physical properties of other noble gases.	
Lesson 5 Learning intentions	**<u>Ores</u>** Recall that: a) most metals are extracted from ores found in the Earth's crust b) unreactive metals are found in the Earth's crust as the uncombined elements. Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by a) heating with carbon (including iron) b) electrolysis (including aluminium) (knowledge of the blast furnace is not required) **Evaluate alternative biological methods of metal extraction (bacterial and phytoextraction)**	**<u>Rates of Reaction</u>** Suggest practical methods for determining the rate of a given reaction. Interpret graphs of mass, volume or concentration of reactant or product against time	**<u>Incomplete Combustion</u>** Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide Explain how carbon monoxide behaves as a toxic gas Describe the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels
Lesson 6 Learning intentions	**<u>Oxidation and Reduction</u>** **Explain displacement reactions as redox reactions, in terms of gain or loss of electrons.** Explain oxidation as the gain of oxygen and reduction as the loss of oxygen. Recall that the extraction of metals involves reduction of ores.	**<u>Factors Affecting Reaction Rate</u>** Explain how reactions occur when particles collide and that rates of reaction are increased when the frequency and/or energy of collisions is increased. Explain the effects on rates of reaction of changes in temperature, concentration, surface area to volume ratio of a solid, and	**<u>Combustible Fuels and Pollution</u>** Explain how impurities in some hydrocarbon fuels result in the production of sulfur dioxide. Explain some problems associated with acid rain caused when sulfur dioxide dissolves in rain water

	Explain how a metal's relative resistance to oxidation is related to its position in the reactivity series	pressure (on reactions involving gases) in terms of frequency and/or energy of collisions between particles.	Explain why, when fuels are burned in engines, oxygen and nitrogen can react together at high temperatures to produce oxides of nitrogen, which are pollutants
Lesson 7 Learning intentions	**<u>Recycling</u>** Evaluate the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the supply of valuable raw materials. Describe that a life time assessment for a product involves consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful. Evaluate data from a life cycle assessment of a product.	**<u>Core Practical</u>** Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by: a) measuring the production of a gas (in the reaction between hydrochloric acid and marble chips)	**<u>Breaking Down Hydrocarbons</u>** Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars Explain how cracking involves the breaking down of larger, saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes) Explain why cracking is necessary
Lesson 8 Learning intentions	**<u>Dynamic Equilibria</u>** Recall that chemical reactions are reversible and the use of the symbol ⇌ in equations and that the direction of some reversible reactions can be altered by changing the reaction conditions. Explain what is meant by dynamic equilibrium Describe the formation of ammonia as a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) and that it can reach a dynamic equilibrium. Recall the conditions for the Haber process as: a) temperature 450°C b) pressure 200 atmospheres c) iron catalyst **Predict how the position of a dynamic equilibrium is affected by changes in:**	**<u>Core Practical</u>** Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by: b) observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid)	**<u>The Early Atmosphere</u>** Recall that the gases produced by volcanic activity formed the Earth's early atmosphere Describe that the Earth's early atmosphere was thought to contain: a) little or no oxygen b) a large amount of carbon dioxide c) water vapour d) small amounts of other gases and interpret evidence relating to this Explain how condensation of water vapour formed oceans

	a) temperature **b) pressure** **c) concentration**		
Lesson 9 Learning intentions		**<u>Catalysts and Activation Energy</u>** Describe a catalyst as a substance that speeds up the rate of a reaction without altering the products of the reaction, being itself unchanged chemically and in mass at the end of the reaction. Explain how the addition of a catalyst increases the rate of a reaction in terms of activation energy. Recall that enzymes are biological catalysts and that enzymes are used in the production of alcoholic drinks	**<u>A Changing Atmosphere</u>** Explain how the amount of carbon dioxide in the atmosphere was decreased when carbon dioxide dissolved as the oceans formed Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased Describe the chemical test for oxygen
Lesson 10 Learning intentions		**<u>Exothermic and Endothermic Reactions</u>** Recall that changes in heat energy accompany the following changes: a) salts dissolving in water b) neutralisation reactions c) displacement reactions d) precipitation reactions and that, when these reactions take place in solution, temperature changes can be measured to reflect the heat changes. Describe an exothermic change or reaction as one in which heat energy is given out. Describe an endothermic change or reaction as one in which heat energy is taken in.	**<u>The Atmosphere</u>** Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm: this is known as the greenhouse effect Evaluate the evidence for human activity causing climate change, considering: a) the correlation between the change in atmospheric carbon dioxide concentration, the consumption of fossil fuels and temperature change b) the uncertainties caused by the location where these measurements are taken and historical accuracy
Lesson 11 Learning intentions		**<u>Energy Changes in Reactions</u>**	**<u>Climate Change</u>** Describe: a) the potential effects on the climate of increased levels of carbon dioxide and

		Recall that the breaking of bonds is endothermic and the making of bonds is exothermic Recall that the overall heat energy change for a reaction is: a) exothermic if more heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants b) endothermic if less heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants **Calculate the energy change in a reaction given the energies of bonds (in kJ mol^{-1})** Explain the term activation energy Draw and label reaction profiles for endothermic and exothermic reactions, identifying activation energy	methane generated by human activity, including burning fossil fuels and livestock farming b) that these effects may be mitigated: consider scale, risk and environmental implications