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	Assessment	Support
Lesson: Reactions of Metals	• 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: The Reactivity series PRACTICAL Water + (Potassium, sodium, lithium, calcium) Dilute acid + (Calcium, magnesium, zinc, iron and copper)	• 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 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		Reactivity: measure of how much a substance reacts		

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Lesson: Metal Oxides **Practical (Mg + O2)**	• 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: Displacement reaction **PRACTICAL**	• Students will know that more reactive metals can displace less reactive metals from a compound • Students will know how to analyse displacement reactions based on tabulated data.			*Displacement reaction: When the more reactive element replaces the less reactive element in a compound*		https://www.youtube.com/watch?v=I-2aTLhmEyE – Displacement of halogens https://www.youtube.com/watch?v=tkPJdV2fLqU&t=137s – Displacement and redox reactions
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: 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.		*Ore: a rock that contains enough metal to extract and make money from* *Reduction: a reaction that removes oxygen*		https://www.youtube.com/watch?v=Au0WJ34RkA8 – What is an ore?

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	Assessment	Support
Lesson: HT Alternative Methods of Extracting Metals- Phytomining and Bioleaching	• Students will know that Earth's resources of metal ores are limited • Students will know that copper ores are becoming scarce and new ways of extracting copper from low-grade ores including Phyto mining and bioleaching. • Students will know that Phyto mining uses plants to absorb metal compounds. • Students will know that once plants have absorbed metal compounds they are burned to produce ash that contains metal compounds • Students will know that bioleaching uses bacteria to produce leachate solutions that contain metal compounds. • Students will know that the metal compounds that are produced during bioleaching are processed to obtain the metal. • Students will know how to evaluate alternative biological methods of metal extraction • Students will already know that metals are extracted from ores.			Phytomining: using plants to extract metals from low grade ores Bioleaching: using bacteria to extract metals from their ores or waste		https://www.youtube.com/watch?v=xTUoNxKZlS4 - Phytomining https://www.youtube.com/watch?v=8d9VtG2osiE – Kay Science pros and cons of bioleaching and Phytomining
TRIPLE Lesson: Preventing corrosion	• Students will know the definition of corrosion to be the gradual deterioration of materials by chemical or electrochemical reaction with their environment. • Students will know the definition of sacrificial protection to be a method of corrosion prevention where a more reactive metal is used to protect a less reactive one. • Students will know that irons rusts due to reactions with water and oxygen to form hydrated iron (III) oxide. • Students will know how to write the equations involved in rusting to be; $4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$ • Students will know that corrosion can be prevented by; 1. Removing the substances that causes rust. Oxygen can be removed by storing			Corrosion to be the gradual deterioration of materials by chemical or electrochemical reaction with their environment. Sacrificial protection to be a method of corrosion prevention where a more reactive metal is used to protect a less reactive one.		

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	Assessment	Support
	the metal in an atmosphere of unreactive nitrogen and argon. 2. Placing a physical barrier to oxygen and water by using paint, oiling/greasing, coating with plastic. This includes galvanising, when zinc coats the iron. 3. Iron can be protected from rusting by using a more reactive metal such as zinc. This means that the more reactive metal becomes oxidised.					

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	Assessment	Support
Lesson: States and State symbols	• *Students will know that intermolecular forces are forces that act between molecules* • *Students will know that the changes of states are known as:* *1) Melting (solid to liquid)* *2) Boiling (liquid to gas)* *3) Condensing (gas to liquid)* *4) Freezing (liquid to solid)* *5) subliming (solid to gas)* *6) Deposition (gas to solid)* • *Students will know that for changes of state to take place energy is needed to overcome intermolecular forces between the particles* • *Students will know that the stronger the intermolecular forces, the more difficult it is to overcome them* • *Students will know limitations of the particle model include that there are no forces represented, that all particles are represented with spheres and that the spheres are solid.* • *Students will know that state symbols can be used to represent the states of different substances in a symbol equation* • *Students will know that the state symbols are:* *(s) - solid* *(l) - liquid* *(g) - gas* *(aq) - aqueous (dissolved in water)* • *Students will know how to use data to identify the state of substances in certain conditions* 1. *Students will know how to explain the limitations of the particle model*	• *Students need to already know that the three states of matter are solids, liquids and gases* • *Students need to already know how to draw particle models of solids, liquids and gases*		*Aqueous- An aqueous solution is a solution in which the solvent is water.* *Subliming- solid to gas* *Deposition- gas to solid*	*State the key word that describes the change of state from a solid to a liquid.* *Melting* *What word is used to describe water into water vapour.* *Evaporation* *What might be the limitations of using the particle model to show changes of state?* *What might cause a substance to have a high melting point?*	
Lesson: Electronic configuration and Forming Ions	• *Students will know that atoms are more stable if they have a full outer shell of electrons* • *Students will know that atoms can either gain or lose electrons to gain a full outer shell* • *Students will know that metals lose their outer electrons to get a full outer shell* • *Students will know that metals form positive ions* • *Students will know that non-metals gain electrons to get a full outer shell*	*Students need to already know that ions are charged atoms*		*Ion: A charged atom, formed by losing or gaining electrons*	*What ions are formed when metals lose electrons* *Why might metals lose electrons rather than gain electrons* *Why might non-metals gain electrons*	

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	Assessment	Support
	• *Students will know that non-metals form negative ions*				*rather than gain electrons.*	
Lesson: Metallic Bonding	• *Students will know that metals consist of giant structures of atoms arranged in a regular pattern* • *Students will know that the outer shell electrons in a metal are delocalised, and are free to move around the structure* • *Students will know that metallic bonds are strong electrostatic forces of attraction between metal ions and delocalised electrons* • *Students will know the difference between pure metals and an alloy to be a mixture of one metal with a small amount of another element (metal or non-metal)*	*Students need to already know that metal ions are positively charged.*		*Tier 2* *Property: an attribute, quality, or characteristic of something* *Tier 3* *Lattice: A series of particles arranged in a distinct pattern.* *Delocalised: free moving* *Malleable: able to bend into different shapes* *Longevity: long existence or service*	*Lesson: Metallic Bonding*	
TRIPLE: Use of alloys	• *Students will know that the difference between a pure metal (one type of metal) and an alloy (another additional element).* • *Students will know that the elements in steel to be; iron (99%) and carbon (1%). Bronze to be; copper (88%) and tin (12%).* • *Students will be able to list examples of alloys and their uses;* *Brass- copper and zinc – coins, musical instruments* *Bronze – copper and tin- ship propellers and bells* *Solder – tin and lead – joining copper pipe and electrical components* • *Students will know that pure metals have a regular lattice structure and when a force is applied to a metal the layers of atoms can move past each other. Adding another type of atom that is a different size distorts the layers so they cannot slide over each other so easily. This makes the alloys stronger than pure metals.*			*Carat- the measure of the purity of a gold alloy*		https://www.youtube.com/watch?v=QRDctnk7sF4 - *Alloys*

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	• *Students will know that iron and carbon form steel, there are three categories of steel; low carbon steel, medium carbon steel and high carbon steel. The higher the carbon content the harder the resulting material and therefore harder to work. For this reason, low steel is more commonly used.* • *Define the term 'carat to be the measure of the purity of a gold alloy.* • *Students will be able to use data on properties of unfamiliar alloys to explain a suitable alloy for a given purpose.* • *Students will be able to evaluate an alloy it terms of its properties and uses*					
Lesson: *Ionic Bonds*	• *Students will know that ionic bonds form between metals and non-metals* • *Students will know that electrons are transferred from the outer shell of the metal atom* • *Students will know that metals lose electrons from their outer shell to form positive ions* • *Students will know that non-metal atoms gain electrons to form negative ions* • *Students will know that ions formed from group 1 elements have a +1 charge* • *Students will know that ions formed from group 2 elements have a +2 charge* • *Students will know that ions formed from group 6 elements have a -2 charge* • *Students will know that ions formed from group 7 elements have a -1 charge* • *Students will know that ions formed by group 1, group 2, group 6 and group 7 elements have the same electronic structure as noble gases* • *Students will know that an ionic bond is an electrostatic attraction between oppositely charged ions* • *Students will know how to represent ionic compounds using dot and cross diagrams* • *Students will know how to determine the charge on an ion*	• *Students need to already know that ions are charged atoms* • *Students need to already know how to draw electronic structures*		*Tier 2* *Imbalance: A lack of balance* *Tier 3* *Electrostatic attraction: attraction between charged objects* *Ionic bond: The electrostatic attraction between two oppositely charged ions*	*What atoms form ionic bonds?* *What ions do metals form?* *What metals do non-metals form?* *What ion will (name element from group2)* *Why does an element from group 6 form a -2 Ion?*	

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	Assessment	Support
Lesson: Ionic Compounds	• *Students will know that an ionic compound is a giant structure made from ions* • *Students will know that ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions* • *Students will know that a lattice is a repeating 3D shape of ions* • *Students will know that the electrostatic attractions in an ionic compound are felt in all directions* • *Students will know that a limitation of dot and cross diagrams is that it shows electrons as being different in different atoms, whereas electrons are the same* • *Students will know that ionic compounds have high melting and boiling points as the strong electrostatic forces of attraction require a lot of energy to overcome* • *Students will know that solid ionic compounds are electrical insulators as there are no charged particles that are free to move* • *Students will know that melted or dissolved ionic compounds are able to conduct electricity as the ions are free to move and carry a charge* • *Students will know how to deduce the formula of an ionic compound based on the charges of the ions* *Students will know how to deduce the formula of an ionic compound based on a diagram of the lattice*	*Students need to already know that ionic compounds form between metals and non-metals*		*Tier 2* *Tier 3* *Lattice: a regular repeated three-dimensional arrangement of atoms, ions, or molecules in a metal or other crystalline solid.* *Aqueous: Dissolved in water*	*Explain why ionic compounds have high melting points* *Why might using dot and cross diagrams not be accurate in showing ionic bonding.* *Why do ionic compounds need to be molten or dissolved to conduct electricity*	Ionic jigsaw in Prep room 1
Lesson: Simple Covalent Molecules	• *Students will know that a covalent bond is between two non-metal atoms* • *Students will know that a covalent bond occurs when a pair of electrons is shared between two atoms* • *Students will know how to represent the covalent bonds in water, hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, ammonia and methane using dot and cross diagrams*	*Students need to already know how to draw electronic configurations*		*Tier 2* *Limitation: Weakness* *Tier 3* *Covalent: chemical bond formed by the sharing of a pair of electrons between atoms*	*What do covalent bonds occur between?* *What is the structure of a water molecule. Describe how we might represent the bonds.*	Molymod 2D molymod Both in prep room 1

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	Assessment	Support
Lesson: Properties of Simple Covalent Molecules & Polymers	• *Students will know that most substances that contain covalent bonds are simple covalent molecules* • *Students will know that to melt or boil a simple covalent molecule enough energy is needed to overcome weak intermolecular forces* • *Students will know that simple covalent molecules have low melting and boiling points as not a lot of energy is needed to overcome the intermolecular forces* • *Students will know that simple covalent molecules are poor electrical conductors as they don't have any charged particles that are free to move.* • *Students will know how to explain the properties of simple covalent substances.* •	*Students need to already know that intermolecular forces are forces that occur between molecules*		*Tier 2* *Tier 3* *Intermolecular forces: forces acting in between molecules*	*Explain why simple covalent molecules have low boiling points?* *Why might simple covalent molecules be poor conductors of electricity.*	*Molymods and elastic bands – elastic band to represent intermolecular forces.* Also 2D molymod
Lesson: Giant Covalent Structures and Polymers	• *Students will know that some substances that contain covalent bonds are very large molecules called polymers* • *Students will know that some covalently bonded substances have giant structures, such as silicon dioxide, diamond and graphite* • *Students will know that since polymers are large molecules, the intermolecular forces between them are relatively large* • *Students will know that polymers tend to be solids at room temperature* • *Students will know that giant covalent structures have very high melting and boiling points* • *Students will know that to melt a giant covalent structure a lot of energy is required to break strong covalent bonds* *Students will know how to represent polymers*	*Students need to already know that the melting point is the temperature needed to reach to melt a substance*		*Tier 2* *Compare: estimate, measure, or note the similarity or dissimilarity between* *Tier 3* *Polymer: A long chain of repeating units* *Polymerisation: is a process of reacting monomer molecules together in a chemical reaction to form polymer chains* *Macromolecule: is defined as a molecule with a very large number of atoms* *Allotropes: each of two or more different physical forms in which an element can exist*	*Explain why most polymers are solid at room temperature?* *Why do giant covalent structures have high melting and boiling points?* *How do we represent polymers.*	Polymer beads in prep room 1

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	Assessment	Support
Lesson: Diamond and Graphite	• *Students will know that diamond and graphite are both forms of carbon* • *Students will know that in diamond each carbon atom is covalently bonded to 4 other carbon atoms* • *Students will know that diamond is very hard due to its repeating structure of each carbon atom being covalently bonded to 4 other carbon atoms* • *Students will know that diamond has a very high melting point as a lot of energy is required to overcome the strong covalent bonds between the carbon atoms* • *Students will know that in graphite each carbon atom is covalently bonded to 3 other carbon atoms, leaving one electron per carbon atom delocalised* • *Students will know that the structure of graphite consists of layers of repeating hexagonal rings of carbon atoms* *Students will know that graphite is able to conduct electricity as the delocalised electrons are free to move and carry charge*	*Students need to already know that delocalised electrons are electrons that are free to move*			*Describe the difference in structure between diamond and graphite?* *Why can graphite conduct electricity?*	Giant ionic lattice of diamond and carbon in AG16
Lesson: Graphene and Fullerenes	• *Students will know that graphene is a single layer of graphite* • *Students will know that graphene consists of a single layer of carbon atoms, each covalently bonded to 3 other carbon atoms* • *Students will know that graphene can conduct electricity due to having delocalised electrons* • *Students will know that graphene is useful in electronics and composites* • *Students will know that a composite is a material that is made up of at least 2 different parts* • *Students will know that fullerenes are molecules of carbon atoms that have a hollow shape* • *Students will know that the structure of fullerenes is based on rings of carbon atoms, where the rings can consist of either 5 or 7 carbon atoms* • *Students will know that the first fullerene to be discovered was buckminsterfullerene, which consisted of 60 carbon atoms in a spherical shape*	*Students need to already know that delocalised electrons are electrons that are free to move*		*Tier 2* *Tier 3* *Composite: A material that is made up of at least two different parts*	*Why can graphene conduct electricity* *What is a composite* *What are the benefits of using a composite* *Describe the shape of Buckminster fullerenes.*	

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	• *Students will know that nanotubes are cylindrical fullerenes.* *Students will know how to recognise graphene and fullerenes*					
Lesson: Nanotechnology (Triple only)	• *Students will know that 1 nm is 1 x 10^-9 m* • *Students will know that nanoscience refers to structures that are 1 - 100 nm in size* • *Students will know that fine particles have diameters in the range of 100 - 250 nm* • *Students will know that coarse particles have diameters between 1 x 10^-5 and 2.5 x 10^-6 m* • *Students will know that coarse particles are often referred to as dust* • *Students will know that as the side of a cube decreases by a factor of 10, the surface area : volume ratio increases by a factor of 10* • *Students will know that nanoparticles have different properties to the same material in bulk due to their high surface area : volume ratio* • *Students will know that only small amounts of nanoparticles are needed to be as effective as the same material in bulk* • *Students will know that nanoparticles are used in medicine, electronics, cosmetics, deodorants, sun cream and as catalysts* *Students will know how to evaluate the use of nanoparticles for a specific purpose*		*Estimations using relative sizes*	*Tier 2* *Bulk: in large quantities* *Tier 3* *Nanoscience: the study of structures that are in the range of 1-100 nm* *Fine particles: Particles with a diameter in the range of 100 – 250 nm* *Coarse particles (also known as dust): Particles with a diameter in the range of 1 x 10^{-5} m to 2.5 x 10^{-6} m*	*What might be the application of nanotechnology.* *What are the advantages and disadvantages of nanotechnology*	
Lesson: Nanotechnology (Triple only)	• *Students will know that 1 nm is 1 x 10^-9 m* • *Students will know that nanoscience refers to structures that are 1 - 100 nm in size* • *Students will know that fine particles have diameters in the range of 100 - 250 nm* • *Students will know that coarse particles have diameters between 1 x 10^-5 and 2.5 x 10^-6 m* • *Students will know that coarse particles are often referred to as dust* • *Students will know that as the side of a cube decreases by a factor of 10, the surface area : volume ratio increases by a factor of 10*		*Estimations using relative sizes*	*Tier 2* *Bulk: in large quantities* *Tier 3* *Nanoscience: the study of structures that are in the range of 1-100 nm* *Fine particles: Particles with a diameter in the*	*What might be the application of nanotechnology.* *What are the advantages and disadvantages of nanotechnology*	

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	Assessment	Support
	• *Students will know that nanoparticles have different properties to the same material in bulk due to their high surface area : volume ratio* • *Students will know that only small amounts of nanoparticles are needed to be as effective as the same material in bulk* • *Students will know that nanoparticles are used in medicine, electronics, cosmetics, deodorants, sun cream and as catalysts* *Students will know how to evaluate the use of nanoparticles for a specific purpose*			*range of 100 – 250 nm* *Coarse particles (also known as dust): Particles with a diameter in the range of 1 x 10^{-5} m to 2.5 x 10^{-6} m*		
Lesson: Nanotechnology (Triple only)	• *Students will know that 1 nm is 1 x 10^-9 m* • *Students will know that nanoscience refers to structures that are 1 - 100 nm in size* • *Students will know that fine particles have diameters in the range of 100 - 250 nm* • *Students will know that coarse particles have diameters between 1 x 10^-5 and 2.5 x 10^-6 m* • *Students will know that coarse particles are often referred to as dust* • *Students will know that as the side of a cube decreases by a factor of 10, the surface area : volume ratio increases by a factor of 10* • *Students will know that nanoparticles have different properties to the same material in bulk due to their high surface area : volume ratio* • *Students will know that only small amounts of nanoparticles are needed to be as effective as the same material in bulk* • *Students will know that nanoparticles are used in medicine, electronics, cosmetics, deodorants, sun cream and as catalysts* *Students will know how to evaluate the use of nanoparticles for a specific purpose*		*Estimations using relative sizes*	*Tier 2* *Bulk: in large quantities* *Tier 3* *Nanoscience: the study of structures that are in the range of 1-100 nm* *Fine particles: Particles with a diameter in the range of 100 – 250 nm* *Coarse particles (also known as dust): Particles with a diameter in the range of 1 x 10^{-5} m to 2.5 x 10^{-6} m*	*What might be the application of nanotechnology.* *What are the advantages and disadvantages of nanotechnology*	

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Lesson 1: *Group 0*	• *Students will know that elements found in group 0 are known as the "noble gases"* • *Students will know that the noble gases are unreactive (chemically inert)* • *Students will know that the noble gases are chemically inert as they have a full outer shell of electrons* • *Students will know that all noble gases have 8 electrons in their outer shell, except for helium which has 2 electrons in its outer shell* • *Students will know that the boiling point of noble gases increases as you go down the group (with increasing relative atomic mass)*	*Students need to already know that chemical properties are related to the number of electrons in the outer shell*		*Tier 2* *Scrupulous: Careful, thorough and extremely attentive to detail* *Property: a distinctive attribute of a material or substance* *Tier 3* *Chemically Inert: Unreactive* *Octet: Eight electrons in outer shell* *Monatomic: Substance made from one atom*		Periodic tables left over from exams are in a box in the workroom to save on printing
Lesson 2 & 3: Group 1 *PRACTICAL*	• Students will know that elements found in group 1 of the periodic table are known as the "alkali metals" • Students will know that alkali metals are relatively soft when compared to other metals (can be cut by a knife), and the melting points of the alkali metals are relatively low • Students will know that the alkali metals are very reactive, and this is due to the fact they have one electron in the outer shell • Students will know that the reactivity of group 1 metals increases as you go down the group • Students will know that when the alkali metals react with water they produce hydrogen gas and a metal hydroxide • Students will know that when lithium reacts with water fizzing is observed • Students will know that when sodium reacts with water it reacts violently, forming a ball and moving around the surface of the water	*Students need to already know that chemical properties are related to the number of electrons in the outer shell*	*Making accurate observations*	*Tier 2* *Density: A measure of mass per unit volume* *Relative: In relation or proportion to something else* *Tier 3* *Alkali: A base dissolved in water. pH is above 7* *Electrostatic attraction: Attraction between a positive and negative charge*		

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	Assessment	Support
	• Students will know that when potassium reacts with water a lilac flame is observed • Students will know that at room temperature alkali metals will react with oxygen to form metal oxides • Students will know that alkali metals burn vigorously with water. • Students will know that alkali metals react vigorously with chlorine gas, and the products are chlorides • Students will know that when a group 1 metal reacts it loses its outer electron • Students will know that reactivity is linked to how easy it is for the atom to lose the outer shell electron. • Students will know that the further down the group you go, the easier it is to remove the electron from the outer shell. • Students will know that when we go down a group: • 1) The atoms get bigger • 2) The bigger the atoms the further away the electrons are from the nucleus • 3) The further the electrons are from the nucleus the smaller the attraction to the nucleus • 4) The smaller the attraction the easier it is for the electron to be removed • Students will know how to represent the reactions of alkali metals with word and balanced symbol equations					
Lesson 4&5 Group 7	• Students will know that elements found in group 7 are referred to as the "halogens" • Students will know that the halogens have similar chemical properties as they all have 7 electrons in their outer shell • Students will know that halogens are non-metals, and exist as diatomic molecules (molecules made up of 2 atoms) • Students will know that the boiling points of halogens increases as you go down the group • Students will know that when halogens react they gain an electron for their outer shell	*Students need to already know that chemical properties are related to the number of electrons in the outer*		Tier 2 Tier 3 *Salt: A product formed when a metal reacts with a halogen* *Diatomic: Molecule made of 2 atoms* *Displacement: When a more reactive element takes the place of a less*		Periodic tables left over from exams are in a box in the workroom to save on printing

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	Assessment	Support
	• Students will know that when halogens react with metals they form compounds known as salts • Students will know that the reactivity of the halogens decreases as you go down the group • Students will know that a displacement reaction is a reaction where a more reactive element will take the place of a less reactive element in a compound • Students will know that more reactive halogens can displace less reactive halogens in compounds. • Students will know that when halogens react with hydrogens they form hydrogen halides • Students will know that when the hydrogen halides are dissolved in water they form an acidic solution. • Students will know that as you go down the group it is harder to gain an electron, this is because: • 1) The atoms get bigger • 2) the outer shell gets further away from the nucleus • 3) There is less attraction between the outer shell and the nucleus, so harder to attract other electrons • Students will know how to represent the reactions of the halogens with word and balanced symbol equations			*reactive element in a compound*		
Lesson 6: Transition Metals (TRIPLE ONLY)	• *Students will know that transition metals all have similar properties* • *Students will know that the middle block of atoms in the periodic table are the transition metals* • *Students will know that compared to the group 1 metals, transition metals have higher melting points and larger densities* • *Students will know that transition metals can form ions with different charges* • *Students will know that transition metals form coloured compounds, and can be used in catalysts*	• *Students need to already know that chemical properties are related to the number of electrons in the outer shell* • *Students need to already know that the majority of elements in the periodic table are metals*				

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	Assessment	Support
Lesson: Conservation of Mass	• *Students will know that the law of conservation of mass states that no atoms are lost or made during a chemical reaction* • *Students will know that the mass of the products equals the mass of the reactants* • *Students will know that the law of conservation of mass means that symbol equations must be balanced* • *Students will know that the mass of a reaction can be observed to increase. This is due to one of the reactants being a gas, and not being measured in the initial mass measurement* • *Students will know that the mass of a reaction can be observed to decrease. This is due to one of the products being a gas, and escaping the reaction vessel.* • *Students will know how to explain any observed changes in mass during a chemical reaction* • *Students will know that there are uncertainties linked with any chemical measurements.* • *Students will know how to balance equations* *Students will know how to use the range of a set of measurements about the mean as a measure of uncertainty.*	*Students need to already know how to work out the number of atoms in a molecule*		*Tier 2* *Conservation – the total value remains constant* *Tier 3* *Open system- Can exchange matter with its surroundings.* *Closed system- a system that is completely isolated from its environment, nothing can enter or leave.* *Vessel- container*		
Lesson: Relative Formula Mass	• *Students will know that the symbol for relative formula mass is Mr* • *Students will know that the relative formula mass of a compound is the sum of the relative atomic masses of the atoms in the numbers shown by the formula* • *Students will know that in a balanced equation the sum of the relative formula masses of the reactants is equal to the sum of the relative formulas masses of the products in the quantities shown* • *Students will know how to calculate the relative formula mass of a compound given the formula* *Students will know how to calculate the percentage by mass in a compound given relative formulas masses and relative atomic masses*	*Students need to already know how to use a periodic table to determine the relative atomic mass of an atom*		*Tier 2* *Tier 3* *Relative formula mass (M_r): The sum of all the relative atomic masses of the atoms in the numbers shown in the formula*		

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	Assessment	Support
Lesson: *Moles (Higher Tier)*	• *Students will know that chemical amounts are measured in moles.* • *Students will know that the symbol for moles is mol.* • *Students will know that the mass of one mole of a substance in grams is equal to its relative formula mass* • *Students will know that one mole of a substance contains the same number of particles as one mole of any other substance.* • *Students will know that the number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant (6.02 x 10^23)* • *Students will know that to calculate the number of moles you use the equation:* • *moles = mass ÷ relative formula mass* *Students will know how to use the equation to calculate the number of moles, the mass or the relative formula mass*	• *Students already need to know how to use the periodic table to find atomic mass* *Students already need to know how to calculate relative formula mass*		*Tier 2* *Tier 3* *Mole (mol): A unit of substance.* *Relative: in relation or proportion to something else*		
Lesson: *(Higher Tier) Calculating Moles using Masses*	• *Students will know that the masses of reactants and products can be calculated from balanced symbol equations* • *Students will know that balanced equations show the relative number of moles of the reactants and products taking part* • *Students will know how to calculate the masses of substances shown in a balanced equation* • *Students will know how to calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant.*	• *Students need to already know how to calculate relative formula mass* *Students already need to know how to calculate number of moles*		*Tier 2* *Excess: Exceeding something else in amount* *Exceeding: greater than* *Tier 3*		
Lesson: *Using Moles to Balance Equations*	• *Students will know that the balancing numbers in a symbol equation can be calculated from the masses of reactants and products by converting the masses into moles and converting the number of moles into simple whole number ratios* • *Students will know how to balance an equation given the masses of reactants and products.*	• *Students need to already know how to calculate number of moles* • *Students need to already know how to change the subject of a mathematical equation*				

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	Assessment	Support
Lesson: Limiting Reactants (Higher tier)	• *Students will know that a limiting reactant is a reactant that is completely used up in a chemical reaction* • *Students will know that when a reactant is used in excess more of the reactant is used than necessary* • *Students will know how to explain the effect of a limiting reactant on the number of products it is possible to obtain* *Students will know how to determine the limiting reactant when given information on masses of reactants*	• *Students already need to know how to calculate number of moles* *Students already need to know how to balance symbol equations*		*Tier 2* *Tier 3* *Limiting Reactant: reactant that is completely used up in a chemical reaction*		
Lesson: Concentration of Solutions	• *Students will know that most chemical reactions take place in solutions* • *Students will know that the concentration of a solution can be measured in mass per given volume e.g. g/dm3* • *Students will know the equation for calculating concentration is:* • *concentration = mass ÷ volume* • *Students will know that to convert from cm3 to dm3 you need to divide by 1000* • *Students will know how to calculate concentration from mass of a solute* *Students will know how to explain how mass of a solute and volume of a solution are related to the concentration of the solution*	*Students need to already know that grams is a unit of mass*		*Tier 2* *Convert: change the form, character, or function of something.* *Tier 3* *Concentration: The amount of a substance in a certain volume of a solution.* *Solution: When a solute dissolves in a solvent*		
Lesson: Concentration (TRIPLE ONLY)	• *Students will know that concentration of a solution can be measured in mol/dm3* • *Students will know that the equation for calculating concentration in mol/dm3 is:* • *concentration = moles/ volume* • *Students will know how to calculate concentration, moles and volume using the equation above* • *Students will know how to calculate the concentration of an unknown solution using the volume and concentration of a solution it reacts with* *Students will know how to interchange between mol/dm3 and g/dm3*	*Students need to already know how to convert between cm3 and dm3*				

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	Assessment	Support
Lesson: Percentage Yield (TRIPLE ONLY)	• *Students will know that it is not always possible to obtain the calculated amount of a product.* • *Students will know the reasons why it's not possible to obtain the calculate amount of a product include:* • *The reaction may not go to completion due to being reversible* • *Some of the products will be lost when separated from the reaction mixture* • *Some of the reactants may react in ways different to the expected reaction* • *Students will know that the product obtained is known as the yield* • *Students will know that percentage yield can be calculated by using the equation:* • *% yield = (actual yield÷theoretical yield) x 100* • *Students will know how to calculate the percentage yield of a product from the actual yield of a reaction* *Students will know how to calculate the theoretical mass of a product from a given mass of reactant and the balanced equation*	• *Students already need to know how to calculate number of moles* *Students already need to know how to calculate percentages*		*Tier 2* *Theoretical: based on or calculated through theory rather than experience or practice* *Tier 3* *Yield: Amount produced*		
Lesson: Atom Economy (TRIPLE ONLY)	• *Students will know that the atom economy is a measure of the amount of starting materials that end up as useful products.* • *Students will know that it is important for sustainable development and economic reasons to use reactions that have high atom economy* • *Students will know that atom economy is calculated with the equation:* • *(relative formula mass of desired product from the equation ÷ Total relative formula masses of all reactants from the equation) x 100* • *Students will know how to calculate the atom economy of a reaction* *Students will know how to explain why a particular reaction is chosen to produce a specified product*	• *Students already need to know how to calculate number of moles* *Students already need to know how to calculate percentages*		*Tier 2* *Economy: careful management of available resources* *Tier 3* *Atom Economy: The percentage of the reactant that is turned into the desired product*		

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	Assessment	Support
Lesson: *Molar Gases*	• *Students will know that equal amounts in moles of gases occupy the same volume under the same temperature and pressure* • *Students will know that one mole of any gas at room temperature and pressure occupies 24 dm3* • *Students will know that room temperature is 20 degrees Celsius* • *Students will know that room atmosphere is 1 atmosphere pressure* • *Students will know that the volumes of gaseous reactants and products can be calculated from the balanced equation for the reaction* • *Students will know how to calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass* • *Students will know how to calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product*	• *Students need to already know how to calculate number of moles* • *Students need to already know how to balance equations* *Students need to already know how to change the subject of a mathematical equation*				

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	Assessment	Support
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: 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 2* *Tier 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: Soluble Salts (Required Practical)***
Lesson: Soluble Salts (Required Practical)	• *Students will know that soluble salts can be produced from a metal carbonate or an alkali with a dilute acid.* • *Students will write the equations for the reactions of a metal carbonate + acid → salt + water + carbon dioxide* • *Students will know how to test for the presence of carbon dioxide using limewater. If carbon dioxide is present, the limewater will turn from colourless to cloudy.*					
Lesson: Acids and alkalis	• *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 need to already know that universal indicator works by changing colour in acidic/ alkaline conditions***		*Tier 2* *Tier 3* *Alkalis: substances which have a pH above 7 and contain hydroxide ions (OH-)*		

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	Assessment	Support
	• *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*			*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 need to already know the colours associated with universal indicators***		*Tier 2* *Tier 3* *Neutralisation: the reaction of an acid with an alkali/ basic substance that*		

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	Assessment	Support
	• *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*			*produces water and salt only*		
Lesson: Titration REQUIRED PRACTICLAL (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: Concentration of Solutions	• *Students will know that most chemical reactions take place in solutions* • *Students will know that the concentration of a solution can be measured in mass per given volume e.g. g/dm3* • *Students will know the equation for calculating concentration is:* • *concentration = mass ÷ volume* • *Students will know that to convert from cm3 to dm3 you need to divide by 1000* • *Students will know how to calculate concentration from mass of a solute* • *Students will know how to explain how mass of a solute and volume of a solution are related to the concentration of the solution*	***Students need to already know that grams is a unit of mass***		*Tier 2* *Convert: change the form, character, or function of something.* *Tier 3* *Concentration: The amount of a substance in a certain volume of a solution.* *Solution: When a solute dissolves in a solvent*		

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	Assessment	Support
Lesson: Production and uses of NPK Fertilisers (TRIPLE ONLY)	• *Students will know that fertilisers used to improve agricultural productivity often contain compounds of nitrogen, phosphorus and potassium* • *Students will know that NPK fertilisers contain compounds that contain all three of nitrogen, phosphorus and potassium* • *Students will know that NPK fertilisers are formulations* • *Students will know that ammonia can be used to manufacture ammonium salts and nitric acid, which are compounds that contain nitrogen* • *Students will know that potassium chloride, potassium sulfate and phosphate rock are obtained by mining* • *Students will know that phosphate rock can't be used directly as a fertiliser, so needs to be treated with nitric acid or sulfuric acid to produce soluble salts.* • *Students will know how to compare the production of fertilisers in industry and in laboratories.*	• ***Students need to already know how to name salts*** • ***Students need to already know that a formulation is a mixture of substances that have been carefully mixed to have certain properties.***		*Tier 2* *Fertiliser: a chemical or natural substance added to soil or land to increase its fertility* *Agricultural productivity: the science or practice of farming, including cultivation of the soil for the growing of crops* *Tier 3*		

The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Chemistry Year 10

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	Assessment	Support
Lesson: Exothermic and Endothermic Reactions	• Students will know that energy is conserved in chemical reactions • Students will know that if a reaction transfers energy to the surroundings the product molecules must have less energy than the reactants • Students will know that an exothermic reaction is one that transfers energy to the surroundings so the temperature of the surroundings increases • Students will know that examples of exothermic reactions include combustion, many oxidation reactions and neutralisation • Students will know every day uses of exothermic reactions include self-heating cans and hand warmers • Students will know that an endothermic reaction is one that takes in energy from the surroundings so the temperature of the surroundings decreases • Students will know that examples of endothermic reactions include thermal decompositions and the reaction of citric acid and sodium hydrogen carbonate • Students will know that everyday uses of endothermic reactions include some sports injury packs • Students will know how to distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings • Students will know how to evaluate uses of exothermic and endothermic reactions Students will know how to practically determine whether a reaction is exothermic or endothermic.	***Students need to already know that heat change is a sign of a chemical reaction***		*Exothermic reaction is one that transfers energy to the surroundings so the temperature of the surroundings increases* *Endothermic reaction is one that takes in energy from the surroundings so the temperature of the surroundings decreases* *Activation energy- The minimum energy required to start a reaction*	*Cold call questions:* *1. How might we distinguish between an endothermic and exothermic reaction?* *"Exothermic reactions feel hotter, endothermic reactions will feel colder"* *2. Photosynthesis is and endothermic reaction, how might you explain this?* *"Photosynthesis absorbs light energy from the sun, endothermic reactions absorb energy"* *Cold call questions:* *1. How might catalysts influence the*	

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	Assessment	Support
					temperature change in an exothermic reaction? *"The catalyst makes the reaction happen quicker therefor the temperature would increase faster"*	
Lesson: Reaction Profiles	• Students will know that chemical reactions can only occur when reacting particles collide with each other with sufficient energy • Students will know that the minimum amount of energy that particles must have to react is called the activation energy • Students will know that reaction profiles are diagrams that can be used to show the relative energies of reactants and products, the activation energy and the overall energy change of a reaction. • Students will know that in an exothermic reaction the products have less energy than the reactants • Students will know that in an endothermic reaction the products have more energy than the reactants • Students will know how to draw simple reaction profiles for exothermic and endothermic reactions Students will know how to use reaction profiles to identify reactions as exothermic or endothermic	• *Students need to already know that exothermic reactions transfer energy to the surroundings* *Students need to already know that endothermic reactions take in energy from the surroundings*		*Reaction profiles: Diagrams that can be used to show the relative energies of the reactants and products, activation energy and overall energy change.*	How might a reaction profile change if a catalyst I added? - A catalyst lowers the activation energy therefor the energy difference between the reactants and top of the peak will be less. If the energy of the products is less than that of the reactants on a reaction profile, what type of reaction is represented? -Exothermic because energy has exited to the surroundings.	

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	Assessment	Support
Lesson: Energy change of reactions (Higher tier)	• Students will know that during a chemical reaction energy must be supplied to break bonds in the reactants • Students will know that during a chemical reaction energy is released when bonds in the products are formed • Students will know that the energy needed to break the bonds and the energy released when bonds are formed can be calculated from bond energies • Students will know that the difference between the sum of the energy needed to break bonds in the reactants and the sum of the energy released when bonds in the products are formed is the overall energy change of the reaction • Students will know that in an exothermic reaction the energy released from forming new bonds is greater than the energy needed to break existing bonds. This means that the calculated energy change will be negative • Students will know that in an endothermic reaction the energy needed to break existing bonds is greater than the energy released from forming new bonds. This means that the calculated energy change will be positive Students will know how to calculate the energy transferred in chemical reactions using bond energies supplied.	• *Students need to already know that exothermic reactions transfer energy to the surroundings* • *Students need to already know that endothermic reactions take in energy from the surroundings* *Students need to already know how to perform addition and subtraction using brackets*		Bond- a lasting attraction between atoms, ions or molecules that enables the formation of chemical compounds. Overall- taking everything into account.	Cold call questions: 1. How might the overall energy change value help to distinguish between an exo and endothermic reaction? "Positive energy changes represent an endothermic reaction because energy is entering the system" "Negative energy changes represent an exothermic reaction because energy is being lost from the system"	
Lesson: Cells and Batteries (triple only)	• Students will know that cells contain chemicals which react to produce electricity • Students will know that the voltage produced by a cell is dependent upon a number of factors, including type of electrode and electrolyte • Students will know that a simple cell can be made by connecting two different metals in contact with an electrolyte	• *Students need to already know that an electrolyte is a liquid (either molten or solution) that is capable of conducting electricity.* *Students need to already know that metals can conduct electricity*		Cell,: unit structure used to generate an electrical current by some means Battery: a container consisting of one or more cells	How might a greater voltage be achieved? -Create a battery, which is 2 or more cells connected together in series. Why will a non-rechargable battery eventually stop	Making cells using tinfoil, cardboard, coins and salt water

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	Assessment	Support
	• Students will know that batteries consist of two or more cells connected together in series to provide a greater voltage • Students will know that in non-rechargeable cells and batteries the chemical reactions stop when one of the reactants has been used up. An example of non-rechargeable batteries includes alkaline batteries. • Students will know that rechargeable batteries can be recharged because the chemical reactions are reversed when an external electrical current is supplied • Students will know that advantage of alkaline batteries is that they are cheap to manufacture. Disadvantages are that they can end up in landfill when discharged and that it is expensive to recycle them Students will know that advantage of rechargeable cells are that they can be recharged many times which reduces the use of resources. The disadvantage is that they are more expensive to manufacture than alkaline cells.			Electrode: an electrical conductor that makes contact with the non-metallic circuit parts of a circuit electrolyte: a substance that conducts electricity when molten or dissolved in water	producing electricity? -When one of the reactants have been completely used up. Explain why might a non-rechargeable batteries still be favoured over the use of rechargeable batteries? -Alkaline batteries are cheap to manufacture. Why might a re-chargeable battery be considered better for the environment? -They can be recharged and used over again because the chemical reactions can be reversed. This reduces the need for more natural resources to be used and fewer batteries will end up in landfill sites.	
Lesson: Fuel Cells (Triple only)	• Students will know that fuel cells are supplied by an external source of fuel (e.g. hydrogen) and oxygen or air. • Students will know that the fuel is oxidised electrochemically within the fuel cell to produce a potential difference. • Students will know that the overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water.	• *Students need to already know that the cathode is the negative electrode* • *Students need to already know that the anode is the positive electrode.*		External-the outward features of something. Channelled- a path along which information (such as data or music) in the form of an electrical signal passes.	What is the balanced chemical equation for the reaction that takes place in a hydrogen fuel cell. Explain why might a company manufacturing electric cars consider using hydrogen fuel cells to power the vehicle?	

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	Assessment	Support
	• Students will know that hydrogen fuel cells offer a potential alternative to rechargeable cells and batteries. • Students will know that the half equation at the cathode in a hydrogen fuel cell is: • $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$ • Students will know that the half equation at the anode in a hydrogen fuel cell is: • $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ • Students will know advantages of hydrogen fuel cells include that they're easy to maintain, they are small in size and water is the only product. The disadvantages of hydrogen fuel cells is that they're very expensive to manufacture and they need a constant supply of hydrogen, which is a flammable gas • Students will know how to evaluate the use of hydrogen fuel cells			Oxidation- Loss of electrons Reduction- Gain of electrons	-Hydrogen fuel cells are easily maintained and small in size. They only produce water, therefore do not pollute the environment by releasing harmful greenhouse gases. Explain why a car manufacturer may choose to continue to make cars with petrol engines instead of hydrogen fuel cells? -Hydrogen fuel cells are expensive and it is difficult to store hydrogen gas because it is highly flammable.	

The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Chemistry Year 11

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	Assessment	Support
Lesson: Using Resources	• Students will know humans use the Earth's resources to provide warmth, shelter, food and transport • Students will know that natural resources, supplemented by agriculture, provide food, timber, clothing and fuels. • Students will know that finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials. • Students will know that sustainable development is development that meets the needs of current generations without compromising the ability of future generations to meet their own needs • Students will know that chemistry plays an important role in improving agricultural and industrial processes to provide new products and in sustainable development. Students need to know how to distinguish between finite and renewable resources given appropriate information.	• ***Students need to already know that finite resources are resources that will eventually run out*** ***Students need to already know that renewable resources are resources that will naturally replenish faster than they are being used***		Tier 2 Agriculture: the practice of farming Tier 3 *Natural resources- These are resources formed without any human input.* *Synthetic resources- These are resources formed with human input (man made).* *Finite resources- These aren't formed fast enough to be considered replaceable (being used up faster than they are being made).* *Renewable resources- These form at a similar rate, or faster, than they are used so they can be replaced before they are used up.* *Ore-a naturally occurring solid material from which a metal or valuable mineral can be extracted profitably.*		
Lesson: Potable Water	• Students will know that water of appropriate quality is essential for life • Students will know that potable water is water that is safe for drinking.	• ***Students will already know that sea water contains salt*** ***Students will already know that filtering removes solid particles from a liquid***	Required practical: producing potable water	Tier 2 *Sterilisation- Any process that removes, kills, or deactivates all forms of life.*		

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	Assessment	Support
	• Students will know that drinking water should have sufficiently low levels of dissolved salts and microbes. • Students will know that the methods used to produce potable water depends on available supplies of water and local conditions. • Students will know that in the UK rain provides water with low levels of dissolved salts (fresh water) that collects in the ground and in lakes and rivers. • Students will know that most potable water is produced by: -choosing an appropriate source of fresh water -passing the water through filter beds -sterilising • Students will know that water is sterilised by using chlorine, ozone and ultraviolet light. • Students will know that if fresh water supplies are limited then desalination of sea water or salty water. • Students will know that desalination is carried out through either distillation or by reverse osmosis. • Students will know that distillation and reverse osmosis require large amounts of energy • Students will know how to distinguish between potable water and pure water • Students will know how to analyse water samples			Tier 3 *Potable water - treated to levels that that meet state and federal standards for consumption (safe to drink).* *Desalination: Removal of salt from sea water*		

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	Assessment	Support
	Students will know how to purify water samples					
Lesson: Waste Water Treatment	• Students will know that urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released to the environment. • Students will know that sewage and agricultural waste water require removal of organic matter and harmful microbes. • Students will know that industrial waste water may require removal of organic matter and harmful chemicals. • Students will know that treatment of sewage includes: -screening and grit removal -sedimentation to produce sewage sludge and effluent -anaerobic digestion of sewage sludge -aerobic biological treatment of effluent	• ***Students will already know that filtration is used to remove solids***		Tier 2 *Effluent: liquid waste or sewage discharged into a river or the sea* Tier 3 *Organic Matter: Waste that has come from a living organism.* *Microbes: A microorganism, especially a bacterium causing disease or fermentation*		
Lesson: Alternative Methods of Extracting Metals	• Students will know that Earth's resources of metal ores are limited • Students will know that copper ores are becoming scarce and new ways of extracting copper from low-grade ores including Phyto mining and bioleaching. • Students will know that Phyto mining uses plants to absorb metal compounds. • Students will know that once plants have absorbed metal compounds			Tier 2 Tier 3 Phytomining: using plants to extract metals from low grade ores Bioleaching: using bacteria to extract metals from their ores or waste		

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	they are burned to produce ash that contains metal compounds • Students will know that bioleaching uses bacteria to produce leachate solutions that contain metal compounds. • Students will know that the metal compounds that are produced during bioleaching are processed to obtain the metal. Students will know how to evaluate alternative biological methods of metal extraction Students will already know that metals are extracted from ores.					
Lesson: Life Cycle Assessment	• Students will know that life cycle assessments are carried out to assess the environmental impact of products • Students will know that the stages of life cycle assessments are: -extracting and processing raw materials -manufacturing and packaging -use and operation during its lifetime -disposal at the end of its useful life, including transport and distribution at each stage • Students will know that some things are easily quantified, such as the use of water, resources, energy sources and production of some wastes. • Students will know how that pollutant effects are difficult to quantitatively measure Students will know how to carry out simple comparative LCAs for shopping bags made from plastic and paper	*Students need to already know that energy production can release pollutants into the atmosphere*		Tier 2 Raw Material: The basic material from which a product is made Disposal: Getting rid of something Tier 3		

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Lesson: Reducing the Use of Resources	• Students will know that metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. • Students will know that much of the energy from processes comes from limited resources. • Students will know that obtaining raw materials from the Earth by quarrying and mining causes environmental impacts. • Students will know that some products can be reused. • Students will know that some products can be recycled. • Students will know that metals can be recycled by melting and recasting or reforming into different products. • Students will know that the amount of separation required for recycling depends on the material and the properties required of the final product. Students will know how to evaluate ways of reducing the use of limited resources.	***Students will already know that recycling is the process of converting waste into reusable material.***		Tier 2 *Recycling: the action or process of converting waste into reusable material.* *Advantage: put in a favourable or superior position* Tier 3		
Lesson: Corrosion and its Prevention (TRIPLE ONLY)	• Students will know that corrosion is the destruction of materials by chemical reactions with substance in the environment. • Students will know that rusting is an example of corrosion. • Students will know that rusting only occurs in iron • Students will know that air and water are necessary for iron to rust • Students will know that corrosion can be prevented by applying a coating that acts as a barrier, such	***Students will already know that metals have different reactivity.***				

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	as greasing, painting or electroplating. • Students will know that aluminium has an oxide coating that protects the metal from further corrosion. • Students will know that some coatings are reactive and contain a more reactive metal to provide sacrificial protection • Students will know how to describe experiments to show that air and water are necessary for rusting Students will know how to explain sacrificial protection in terms of relative reactivity.					
Lesson: Alloys (TRIPLE ONLY)	• Students will know that alloys are mixtures of metals. • Students will know that bronze is an alloy of copper and tin. • Students will know that brass is an alloy of copper and zinc • Students will know that the gold that is used in jewellery is usually an alloy with silver, copper and zinc. • Students will know that the proportion of gold in the alloy is measured in carats. • Students will know that 24 carats are pure gold and 18 carats is 75% gold. • Students will know that steels are alloys of iron that contain specific amounts of carbon and other metals. • Students will know that high carbon steel is strong but brittle. • Students will know that low carbon steel is softer and more easily shaped. • Students will know that steels containing chromium and nickel	*Students will know that mixtures contain 2 or more substances not bonded together.*				

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	(stainless steels) are hard and resistant to corrosion. Students will know how to interpret and evaluate composition and uses of alloys					
Lesson: Ceramics, Polymers and Composites (TRIPLE ONLY)	• Students will know that soda-lime glass is made by heating a mixture of sand, sodium carbonate and limestone. • Students will know that borosilicate glass is made from sand and boron trioxide • Students will know that borosilicate glass melts at a higher temperature than soda-lime glass • Students will know that pottery and bricks are examples of clay ceramics • Students will know that clay ceramics are made by shaping wet clay and then heating in a furnace • Students will know that the properties of polymers depend on what monomers they are made from and the conditions they are made in. • Students will know that thermosoftening polymers melt when they are heated • Students will know that thermosetting polymers do not melt when they are heated • Students will know that low density poly(ethene) and high-density poly(ethene) are formed from the same monomer (ethene) • Students will know that low density poly(ethene) has a structure where the polymer chains are branched,	• *Students need to already know that polymers are made up of many monomers joined together* • *Students need to already know that covalent bonds are strong* *Students need to already know that the melting point is the temperature a substance melts at.*		Tier 2 *Property: is how something behaves or what it looks like.* *Materials: a substance or mixture of substances that make up an object.* Tier 3 *Composite: A material that is made from different materials and has properties in common with each that it is made from.* Polymer- A large molecule composed of many repeating subunits. Monomer-small molecules that can join with other similar molecules to form very large molecules. Subunit-A distinct component of something. Polymerisation – The joining of monomers to form a polymer. Plasticiser- A plasticiser is a substance that is		

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	which means that the molecules are arranged randomly. • Students will know that high density poly(ethene) has less branching in its structure, so the molecules are able to line up closely • Students will know that thermosoftening polymers don't have covalent bonds between neighbouring polymer molecules, so the molecules can move over each other when heated • Students will know that most composite materials have two components, the reinforcement (which makes the material stronger) and the matrix (which binds the reinforcement together) • Students will know how to quantitatively compare the physical properties of glass and clay ceramics, polymers and composites • Students will know how to explain the properties of materials, and relate the properties of materials to their uses. • Students will know that thermosetting polymers have covalent bonds between neighbouring polymer molecules, which means that the molecules are unable to move Students will know that a composite material consists of two or more materials with different properties.			added to a material to make it softer and more flexible Intermolecular bonds- Weak forces of attraction between DIFFERENT molecules.		

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Lesson: **The Haber Process**	• Students will know that ammonia is NH3 • Students will know that ammonia is manufactured through the Haber process • Students will know that ammonia is used to produce nitrogen-based fertilisers • Students will know that the raw materials for the Haber process are nitrogen (obtained from air) and hydrogen (from natural gas) • Students will know that the reaction to produce ammonia from nitrogen and hydrogen is reversible: • N2 + 3H2 ⇌ 2NH3 • Students will know that during the Haber process the gases are passed over a catalyst of iron at a temperature of 450 degrees Celsius and a pressure of 200 atm • Students will know that liquid ammonia is removed from the reaction vessel after cooling, and the remaining hydrogen and nitrogen is recycled • Students will know how to apply ideas of dynamic equilibria to the conditions used in the Haber Process • Students will know how to explain the trade-off between rate of production and position of the equilibrium Students will know how to interpret graphs of reaction conditions vs reaction rate	• ***Students need to already know that some reactions are reversible*** • ***Students need to already know that when a dynamic equilibrium is reached the position of the equilibrium will shift to counteract any changes in conditions.*** ***Students need to already know that the conditions that can lead to a shift in equilibrium include temperature, pressure and concentration***		Tier 2 *Yield: produce or provide* *Compressed: squeezed or pressed together* Tier 3		

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Lesson: Production and uses of NPK Fertilisers (TRIPLE ONLY)	• Students will know that fertilisers used to improve agricultural productivity often contain compounds of nitrogen, phosphorus and potassium • Students will know that NPK fertilisers contain compounds that contain all three of nitrogen, phosphorus and potassium • Students will know that NPK fertilisers are formulations • Students will know that ammonia can be used to manufacture ammonium salts and nitric acid, which are compounds that contain nitrogen • Students will know that potassium chloride, potassium sulfate and phosphate rock are obtained by mining • Students will know that phosphate rock can't be used directly as a fertiliser, so needs to be treated with nitric acid or sulfuric acid to produce soluble salts. Students will know how to compare the production of fertilisers in industry and in laboratories.	• ***Students need to already know how to name salts*** ***Students need to already know that a formulation is a mixture of substances that have been carefully mixed to have certain properties.***		Tier 2 *Fertiliser: a chemical or natural substance added to soil or land to increase its fertility* *Agricultural productivity: the science or practice of farming, including cultivation of the soil for the growing of crops* Tier 3		