OCR Gateway GCSE Chemistry

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C1: Carbon Chemistry	C1a: Cooking	Describe reasons why some foods must be cooked before they are eaten: - the high temperature kills microbes - improve the texture - improve the taste - improve the flavour - easier to digest.			
		Explain that cooking food is a chemical change because a new substance is formed and the process cannot be reversed. State that eggs or meat are good sources of proteins. State that protein molecules in eggs and meat change shape when they are cooked. State that potatoes are a good source of carbohydrates. ***Explain the changes that occur to an egg or meat when it is cooked:*** - ***shape of protein molecules change*** - ***the process is irreversible*** - ***the process is called denaturing.*** ***Explain the changes that happen to a potato when it is cooked in terms of changes to the cell wall and how this makes the potato easier to digest.***	**Food Chemistry**		
		State that baking powder contains sodium hydrogencarbonate. Describe that sodium hydrogencarbonate breaks down when heated (decomposes) to make sodium carbonate, carbon dioxide and water. Write the balanced word equation for the decomposition of baking powder: Sodium hydrogencarbonate → sodium carbonate + carbon dioxide + water Describe the chemical test for carbon dioxide. ***Write the balanced symbol equation for the decomposition of sodium hydrogencarbonate*** $2NaHCO_3 \rightarrow Na_2CO3 + H_2O + CO_2$	**Food Chemistry**	**Chemical Reactions**	

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C1: Carbon Chemistry	C1b: Food Additives	Interpret given information about food additives and E numbers (no recall is expected). Explain why a particular food additive is added to a food, given details about the food.	**Food Chemistry**		
		State two examples of foods containing added antioxidants. Describe two examples of how active or intelligent packaging is used to improve the quality or safety of food: - cans which will heat or cool contents - removal of water inside the pack Interpret information on intelligent packaging given relevant data. ***Explain how and why active packaging is used in food packaging:*** - ***active packaging involves the material controlling or reacting to things which are taking place inside the package to improve the quality or safety of the products*** - ***removal of water will make it more difficult for bacteria or mould to grow.***	**Designer Materials**		
		Describe emulsifiers as molecules that have a water loving part (hydrophilic) and an oil or fat loving (hydrophobic) part. State examples of foods that contain emulsifiers e.g. mayonnaise. ***Describe how an emulsifier helps to keep oil and water from separating:*** - ***hydrophilic end bonds to water molecules*** - ***hydrophobic end bonds with oil molecules.***	**Food Chemistry**		

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		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C1: Carbon Chemistry	C1c: Smells	State that alcohols react with acids to make an ester and water. Describe how to carry out a simple experiment to make an ester. State that esters are used as perfumes.			**Carboxylic Acids and Esters**
		Explain why a perfume needs certain properties: - easily evaporates so that the perfume particles can easily reach the nose - non-toxic so it does not poison you - does not react with water because otherwise the perfume would react with perspiration - does not irritate the skin otherwise the perfume could not be put directly on the skin - insoluble in water so it cannot be washed off easily. ***Explain the volatility (ease of evaporation) of perfumes in terms of kinetic theory:*** - ***particles with lots of energy can escape the attraction to other molecules in the liquid*** - ***only weak attraction between particles in the liquid perfume so easy to overcome this attraction.***			
		State that esters can be used as solvents. State that a solution is a mixture of solvent and solute that does not separate out. Interpret information on the effectiveness of solvents (no recall expected). ***Explain why water will not dissolve nail varnish colours:*** - ***attraction between water molecules is stronger than attraction between water molecules and particles in nail varnish*** - ***attraction between particles in nail varnish is stronger than attraction between water molecules and particles in nail varnish.***			**Soap and Water**
		Explain why new cosmetic products need to be thoroughly tested before they are permitted to be used. Describe one advantage and one disadvantage of testing cosmetics on animals.			

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C1: Carbon Chemistry	C1d: Making Crude Oil Useful	Explain why fossil fuels are finite resources and are non-renewable. Describe crude oil as a mixture of many hydrocarbons.	**Making Oil** **Useful Fractions from Oil**		
		Label a diagram of a crude oil fractional distillation column to show the main fractions and the temperature gradient. Describe the fractional distillation of crude oil into fractions: - crude oil is heated - use of a fractionating column which has a temperature gradient (cold to hot from top to bottom) - fractions contain mixtures of hydrocarbons with similar boiling points - fractions with low boiling points 'exit' from the top of the fractionating column - fractions with high boiling points 'exit' at the bottom of the fractionating column. ***Explain why crude oil can be separated by fractional distillation:*** - ***covalent bonds between carbon and hydrogen atoms within a hydrocarbon molecule are stronger than the intermolecular forces between hydrocarbon molecules*** - ***during boiling intermolecular forces are broken*** - ***intermolecular forces between large hydrocarbon molecules are stronger than those between smaller hydrocarbon molecules*** - ***hydrocarbons with large molecules have a higher boiling temperature than those with smaller molecules.***	**Making Oil** **Useful Fractions from Oil**		
		Explain some of the environmental problems involved in the exploitation of crude oil. ***Discuss in simple terms the political problems associated with the exploitation of crude oil.***	**Making Oil** **Useful** **Earth's Atmosphere** **Climate Change**		
		Describe cracking as a process that: - converts large alkane molecules into smaller alkane and alkene molecules - makes useful alkene molecules because they can be used to make polymers - interpret data about the supply and demand of crude oil fractions (no recall expected). ***Explain how cracking helps an oil refinery match its supply of useful products such as petrol with the demand for them.***	**Making Oil** **Useful** **Making Polymers**		

		Chemistry			
		Syllabus point	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C1: Carbon Chemistry	C1e: Making Polymers	Recognise the displayed formula for a polymer. ***Construct the displayed formula of an addition polymer given the displayed formula of its monomer*** ***Construct the displayed formula of a monomer given the displayed formula of an addition polymer.***	Making Polymers		
		Describe polymerisation as a process in which many monomer molecules react together to give a polymer which requires high pressure and a catalyst. ***Explain that addition polymerisation involves the reaction of many unsaturated monomer molecules (alkenes) to form a saturated polymer.***	Making Polymers		
		Describe a hydrocarbon as a compound formed between carbon atoms and hydrogen atoms only. Explain why a compound is a hydrocarbon given its molecular or displayed formula. ***Describe a saturated compound as one which contains only single covalent bonds between carbon atoms.*** ***Describe an unsaturated compound as one which contains at least one double covalent bond between carbon atoms.***	Making Oil Useful Making Polymers		
		Describe alkanes as hydrocarbons which contain single covalent bonds only. Interpret information on displayed formula of alkanes. ***Interpret information on displayed formula of a saturated hydrocarbon.*** ***Explain that hydrogen atoms and carbon atoms share an electron pair to form a covalent bond.***	Making Oil Useful Making Polymers	Covalent Bonding	
		Describe alkenes as hydrocarbons which contain one or more double covalent bond(s) between carbon atoms. Interpret information on displayed formulae of alkenes. ***Interpret information on displayed formula of an unsaturated hydrocarbon.*** ***Describe how the reaction with bromine can be used to test for unsaturation.***	Making Oil Useful Making Polymers Food Chemistry		

		Chemistry			
		Syllabus point	Boardworks Presentations		
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C1: Carbon Chemistry	C1f: Designer Polymers	Suggest the properties a polymer (plastic) should have in order to be used for a particular purpose. Explain why a polymer (plastic) is suitable for a particular use given the properties of the polymer. ***Describe that the atoms in plastics are held together by strong covalent bonds.*** ***Relate the properties of plastics to simple models of their structure:*** - ***plastics that have weak intermolecular forces between polymer molecules have low melting points and can be stretched easily as the polymer molecules can slide over one another*** - ***plastics that have strong forces between the polymer molecules (covalent bonds or cross-linking bridges) have high melting points, cannot be stretched and are rigid.***	**Making Polymers**		
		Compare the properties of nylon and Gore-Tex®: - nylon is tough, lightweight, keeps water out, keeps UV light out but does not let water vapour through it which means that sweat condenses - Gore-Tex® has all of the properties of nylon but is also breathable. Explain why the discovery of Gore-Tex® type materials has been of great help to active outdoor people to cope with perspiration wetness. ***Describe the construction of Gore-Tex® type materials explaining why they make clothing waterproof and yet breathable:*** - ***nylon laminated with PTFE/polyurethane membrane*** - ***holes in PTFE are too small for water to pass through but are big enough for water vapour to pass through*** - ***PTFE laminate is too fragile on its own and so is combined with nylon.***	**Designer Materials**		
		Explain why chemists are developing addition polymers that are biodegradable. Explain some of the environmental and economic issues related to the use of polymers: - landfill sites get filled quickly wasting valuable land - burning waste plastics makes toxic gases - disposal by burning or land-fill sites wastes a valuable resource - difficult to sort out different polymers so recycling is difficult.	**Making Polymers**		

C1: Carbon Chemistry	Chemistry				
		Syllabus point	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
	C1g: Using Carbon Fuels	List factors that need to be considered in a given use of a fossil fuel: - energy value - availability - storage - cost - toxicity - pollution e.g. acid rain / greenhouse effect - ease of use. Interpret data about fuels in order to choose the best fuel for a particular purpose (no recall expected). ***Evaluate the use (no recall expected) of different fossil fuels:*** - ***energy value*** - ***availability*** - ***storage*** - ***toxicity*** - ***pollution e.g. acid rain / greenhouse effect*** - ***ease of use.*** ***Explain why the amount of fossil fuels being burnt is increasing.***	**Making Oil Useful Fractions from Oil Earth's Atmosphere Climate Change**		
		Describe a fuel as a substance that reacts with oxygen to release useful energy. Describe an experiment to show that combustion of a hydrocarbon in a plentiful supply of air produces carbon dioxide and water. Write word equations to show the incomplete or complete combustion of a hydrocarbon fuel. ***Construct the balanced symbol equation for the complete combustion of a simple hydrocarbon fuel given its molecular formula.***	**Combustion and Alternative Fuels**		
		Explain that a blue flame releases more energy than a yellow flame because it involves complete combustion rather than incomplete combustion. Describe the advantages of complete combustion over incomplete combustion of hydrocarbon fuels: • less soot made • more heat released • poisonous carbon monoxide not produced. Explain the importance of regularly servicing gas appliances. ***Construct the balanced symbol equation for the incomplete combustion of a simple hydrocarbon fuel given its molecular formula.***	**Combustion and Alternative Fuels**		

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			GCSE Science	Additional Science	Separate Sciences
C1: Carbon Chemistry	C1h: Energy	Describe an exothermic reaction as one in which energy is transferred into the surroundings (releases energy). Describe an endothermic reaction as one in which energy is taken in from the surroundings (absorbs energy). Recognise exothermic and endothermic reactions using temperature changes. ***Describe bond making as an exothermic process.*** ***Describe bond breaking as an endothermic process.*** ***Explain why a reaction is exothermic or endothermic using the energy changes that occur during bond breaking and bond making.***		Energy Transfer	
		Describe, using a diagram, a simple calorimetric method for comparing the energy transferred in combustion reactions: - use of spirit burner or a bottled gas burner - heating water in a copper calorimeter - measuring the temperature change - fair tests. Interpret and use data from simple calorimetric experiments related to the combustion of fuel to compare which fuel releases the most energy. ***Describe a simple calorimetric method for comparing the energy transferred per gram of fuel combusted:*** - ***use of spirit burner or a bottled gas burner*** - ***heating water in a copper calorimeter*** - ***measuring mass of fuel burnt*** - ***measuring temperature change*** - ***fair and reliable tests.*** ***Calculate the energy transferred by recalling and using the formula:*** ***Energy transferred (in J) = mass of water heated (in g) x temperature 4.2 (in °C)*** ***Calculate the energy output of a fuel in J/g by recalling and using the formula:*** ***energy per gram = energy supplied ÷ mass of fuel burnt***			Food and Fuels

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C2: Rocks and Metals	C2a: Paints and Pigments	Describe paint as a colloid where the particles are mixed and dispersed with particles of a liquid but are not dissolved. ***Explain that the components of a colloid will not separate because the particles are scattered or dispersed throughout the mixture and are sufficiently small they will not settle at the bottom.***			
		Describe that many paints are applied as a thin surface which dries when the solvent evaporates. Describe emulsion paints as water based paints. ***Explain that the drying of oil paints involves oxidation of the oil by atmospheric oxygen.*** ***Interpret the uses and properties of different paints given relevant information.***			
		Explain that the use of synthetic dyes has increased the number of colours available to colour fabrics.			
		Describe some uses of thermochromic pigments: - warming of a hot cup - use in electric kettles. ***Describe and explain how thermochromic pigments can be added to acrylic paints to give even more colour changes.***	**Designer Materials**		
		Phosphorescent pigments absorb and store energy and release it as light over a period of time. ***Explain that phosphorescent pigments are much safer than the alternative radioactive substances e.g. in use of 'glow in the dark' watches.***			

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C2: Rocks and Metals	C2b: Construction Materials	State that some construction materials are manufactured from rocks in the Earth's crust: - aluminium and iron from ores - brick from clay - glass from sand.	Building Materials and Rocks		
		Describe that marble is much harder than limestone. Describe that granite is harder than marble. ***Explain why granite, marble and limestone have different hardness:*** - ***limestone is a sedimentary rock*** - ***marble is a metamorphic rock made by the action of high pressures and temperatures on limestone*** - ***granite is an igneous rock.***	Building Materials and Rocks		
		State that the word equation for the decomposition of limestone is: calcium carbonate → calcium oxide + carbon dioxide Describe thermal decomposition as a reaction in which when heated one substance is chemically changed into at least two new substances. ***State that the balanced symbol equation for the decomposition of limestone is:*** $CaCO_3 \rightarrow CaO + CO_2$	Building Materials and Rocks	Chemical Reactions	
		Describe that cement is made when limestone and clay are heated together.	Building Materials and Rocks		
		Describe reinforced concrete as a composite material containing concrete and a solid steel support. ***Explain why reinforced concrete is a better construction material that non-reinforced concrete:*** - ***hardness of the concrete*** - ***flexibility and strength of the steel.***	Building Materials and Rocks		

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C2: Rocks and Metals	C2c: Does the Earth Move?	Describe the outer layer of the Earth (lithosphere) as oceanic plates under oceans and continental plates forming continents. Describe the lithosphere as the (relatively) cold rigid outer part of the Earth that includes the crust and the outer part of the mantle. Explain that tectonic plates are found on top of the mantle because they are less dense than the mantle. Explain the problems of studying the structure of the Earth. ***Describe the mantle as the zone between the crust and the core and that it is relatively cold and rigid just below the crust but hot and non-rigid and so able to flow at greater depths.*** ***Describe the theory of plate tectonics:*** - ***energy transfer involving convection currents in the largely solid mantle causing the plates to move slowly*** - ***oceanic plates are more dense than continental plates*** - ***collision between oceanic and continental plate leads to subduction and partial remelting (oceanic goes underneath continental).*** ***Describe in simple terms the development of the theory of plate tectonics.***	**Earth's Structure**		
		Explain that magma from the mantle must have a density less than that of the crust in order to rise through it.	**Earth's Structure**		
		Explain how the size of crystals in an igneous rock is related to the rate of cooling of molten rock: - iron-rich basalt and its coarse equivalent gabbro - silica-rich rhyolite and its coarse equivalent granite. ***State that magma can have different compositions and that this affects the rock that forms and the type of eruption, limited to:*** - ***iron-rich basalt (runny and fairly 'safe')*** - ***explosive silica-rich rhyolite (producing pumice and volcanic ash and bombs, sometimes with graded bedding).***	**Earth's Structure**		
		Describe that geologists study volcanoes to be able to predict future eruptions and to reveal information about the structure of the Earth. ***Describe that geologists are now able to better predict volcanic eruptions but not with 100% certainty.***	**Earth's Structure**		

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C2: Rock and Metals	C2d: Metals and Alloys	Label the apparatus needed to purify copper by electrolysis. Describe some of the problems of recycling copper. ***Describe the use of electrolysis in the purification of copper:*** - ***impure copper as anode*** - ***pure copper as cathode*** - ***copper(II) sulfate as electrolyte.***	**Extracting Metals**	**Electro-chemistry**	
		State the main metals in each of the following alloys: - amalgam: mercury - brass: copper and zinc - solder: lead and tin.	**Metals and Alloys**		
		Describe that alloys often have properties that are different from the metals they are made from and that these properties may make the alloy more useful than the pure metal. Suggest properties needed by a metal or alloy for a particular given use. ***Explain why metals, including alloys are suited to a given use given appropriate data (no recall expected).*** ***Explain how the use of 'smart alloys' such as those with a shape memory property have increased the number of applications of alloys e.g. nitinol (nickel and titanium).***	**Metals and Alloys** **Designer Materials**		

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C2: Rocks and Metals	C2e: Cars for Scrap	State that salt water and acid rain accelerate rusting. Explain that aluminium does not corrode in moist conditions because it has a protective layer of aluminium oxide which does not flake off the surface. Interpret data about the rate of corrosion of different metals in different conditions (no recall is expected). ***Describe rusting as an oxidation reaction where iron reacts with water and oxygen to form hydrated iron(III) oxide.*** ***State the word equation for rusting:*** ***iron + oxygen + water → hydrated iron(III) oxide***	**Metals and Alloys**		**Further Electro-chemistry**
		Describe that alloys often have properties that are different from the metals they are made from and that these properties may make the alloy more useful than the pure metal. For example, steel is harder, stronger and less likely to corrode than iron. Describe advantages and disadvantages of building car bodies from aluminium or from steel. A car of aluminium would be lighter and would corrode less than one of steel but would be more expensive. ***Explain advantages and disadvantages of building car bodies from aluminium or from steel. A car of aluminium would be lighter and so would have better fuel economy. An aluminium car that corrodes less may have a longer lifetime.***	**Metals and Alloys**		
		Suggest properties needed by a material for a particular use in a car. Explain why a material used in a car is suited to a given use given appropriate data (no recall expected).			
		Explain the advantages and disadvantages of recycling the materials used to make cars. Explain that new laws will soon specify that a minimum percentage of all materials used to manufacture cars must be recyclable. ***Evaluate information on materials used to manufacture cars (no recall expected).***	**Metals and Alloys**		

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C2: Rocks and Metals	C2f: Clean Air	State the percentage composition by volume of clean air: - 21% oxygen - 78% nitrogen - 0.035% carbon dioxide. Describe a simple carbon cycle involving photosynthesis, respiration and combustion. Describe how the present day atmosphere evolved: - original atmosphere came from the gases escaping the interior of the Earth - photosynthesis by plants increased the percentage of oxygen to today's levels. ***Evaluate the effects of human influences on the composition of air:*** - ***deforestation*** - ***increased energy consumption (burning fossil fuels)*** - ***population.*** ***Describe one possible theory for how the atmosphere evolved:*** - ***degassing from Earth's crust*** - ***initial atmosphere of ammonia and carbon dioxide*** - ***formation of water*** - ***development of photosynthetic organisms*** - ***increase in oxygen and nitrogen levels*** - ***lack of reactivity with nitrogen.***	**Earth's Atmosphere** **Climate Change**		
		Describe the origin of the following atmospheric pollutants: - carbon monoxide: incomplete combustion of petrol or diesel in car engine - oxides of nitrogen: formed in the internal combustion engine - sulfur dioxide: formed when sulfur impurities in fossil fuels burn. Interpret data about the effects of atmospheric pollutants.	**Earth's Atmosphere**		
		Explain why it is important that atmospheric pollution is controlled. State that a catalytic converter changes carbon monoxide into carbon dioxide. ***Describe the use of a catalytic converter in removing carbon monoxide from exhaust fumes by converting it to carbon dioxide:*** $2CO + 2NO \rightarrow N_2 + 2CO_2$	**Earth's Atmosphere**		

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C2: Rocks and Metals	C2g: Faster or Slower (I)	Explain that the more collisions between particles, the faster the reaction. ***Explain that the rate of reaction depends on the:*** - ***collision frequency of reacting particles*** - ***energy transferred during the collision (whether the collision is successful or effective)***		Rates of Reaction	
		Explain that a temperature increase makes particles move faster so they have more energy, and that this gives an increased rate of reaction (and vice versa). ***Explain that an increase in temperature results in more effective, successful or energetic collisions (and vice versa).***		Rates of Reaction	
		Explain that increasing the concentration (or pressure) increases the rate of a reaction because the particles are more crowded (and vice versa). ***Explain that increasing the concentration (or pressure) increases the rate of a reaction by increasing the frequency of collisions between particles (and vice versa).***		Rates of Reaction	
		Interpret data in table, graphical and written form involving the effect of concentration and temperature on the rate of reaction e.g. - deciding when a reaction has finished - comparing the rate of reaction during a reaction - deciding when the rate of reaction is the greatest. Explain that the amount of product formed depends on the amount of reactant used. Draw sketch graphs to show the effect of changing temperature or concentration on: - the rate of reaction - amount of product formed in a reaction. ***Interpret data from table, graphical and written form involving temperature and concentration on the rate of reaction e.g:*** - ***calculating the rate of reaction from the slope of an appropriate graph*** - ***extrapolation*** - ***interpolation.***		Rates of Reaction	

Chemistry					
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			GCSE Science	Additional Science	Separate Sciences
C2: Rocks and Metals	C2h: Faster or Slower (II)	Describe a catalyst as a substance which changes the rate of reaction and is unchanged at the end of the reaction. State that only a small amount of a catalyst is needed to catalyse large amounts of reactants. ***Recognise that a catalyst is specific to a particular reaction.***		Rates of Reaction	The Chemical Industry
		Explain that a powder has a larger surface area than a lump and so reacts faster because there are more collisions. ***Explain that an increase in surface area increases the frequency of collisions.***		Rates of Reaction	
		Describe an explosion as a very fast reaction which releases a large volume of gaseous products. Explain the dangers of fine combustible powders in factories (e.g. custard powder, flour or sulfur).		Rates of Reaction	
		Interpret data in table, graphical and written form involving the effect of surface area and the addition of a catalyst on the rate of reaction: - decide when a reaction has finished - comparing the rate of reaction during a reaction - deciding when the rate of reaction is the greatest. Draw sketch graphs to show the effect of changing surface area and the addition of a catalyst on the: - rate of reaction - amount of product formed in a reaction. ***Interpret data from table, graphical and written form involving surface area and the addition of a catalyst on the rate of reaction:*** - ***calculating the rate of reaction from the slope of an appropriate graph*** - ***extrapolation*** - ***interpolation.***		Rates of Reaction	

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C3: The Periodic Table	C3a: What are Atoms Like?	State that the nucleus is made up of protons and neutrons. State the relative charge and relative mass of an electron, a proton and a neutron: - electron: charge -1 and mass 0.0005 (zero) - proton: charge +1 and mass 1 - neutron: no charge and mass 1. ***Explain that an atom is neutral because it has the same number of electrons as protons.***		Atomic Structure	
		Describe atomic (proton) number as the number of protons in an atom. Describe mass (nucleon) number as the total number of protons and neutrons in an atom. Describe isotopes as varieties of an element that have the same atomic number but different mass numbers. ***Deduce the number of protons, electrons and neutrons in a particle given its atomic number, mass number and the charge on the particle by using data in a table and using the conventional symbolism.*** ***Identify isotopes from data about the number of electrons, protons and neutrons in particles.***		Atomic Structure Patterns in the Periodic Table	
		State that the elements in the periodic table are arranged in ascending atomic number.		Atomic Structure Patterns in the Periodic Table	
		Describe that electrons occupy the space around the nucleus. State that electrons occupy shells. ***Deduce the electronic structure of the first 20 elements in the periodic table e.g. calcium is 2.8.8.2.***		Atomic Structure Patterns in the Periodic Table	

	Chemistry				
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C3: The Periodic Table	C3b: How Atoms Combine – Ionic Bonding	Describe the formation of positive ions by the loss of electrons from atoms e.g. 2^+ ions form by the loss of 2 electrons. Describe the formation of negative ions by the gain of electrons by atoms e.g. 2^- ion formed by the gain of 2 electrons. Explain that a metal and non-metal combine by transferring electrons to form positive ions and negative ions which then attract one another. ***Describe, using the 'dot and cross' model, the ionic bonding in the following:*** - ***sodium chloride*** - ***magnesium oxide*** - ***sodium oxide*** - ***magnesium chloride.*** ***Explain that atoms gain or lose electrons to get a complete outer shell (a stable octet).*** ***Deduce the formula of an ionic compound from the formula of the positive and negative ion.***		Ionic Bonding	
		State that sodium chloride solution conducts electricity. State that magnesium oxide and sodium chloride conduct electricity when molten. ***Describe the structure of sodium chloride or magnesium oxide as a giant ionic lattice in which positive ions are electrostatically attracted to negative ions.*** ***Explain some of the physical properties of sodium chloride and magnesium oxide:*** - ***strong attraction between positive and negative ions so have high melting points*** - ***ions cannot move in a solid so do not conduct electricity*** - ***ions can move in solution or in a molten liquid so do conduct electricity.***		Ionic Bonding Electro-chemistry	

Chemistry

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C3: The Periodic Table	C3c: Covalent Bonding and the Structure of the Periodic Table	State that non-metals combine together by sharing electrons and this is called covalent bonding. ***Describe the formation of simple molecules containing single and double covalent bonds by the 'dot and cross' model limited to the molecules:*** - H_2 - Cl_2 - CH_4 - CO_2 - H_2O		Covalent Bonding	
		State that carbon dioxide and water do not conduct electricity. ***Describe carbon dioxide and water as simple molecules with weak intermolecular forces between molecules.*** ***Relate the properties of carbon dioxide and water to their structure:*** - ***weak intermolecular forces so low melting points*** - ***no free electrons so do not conduct electricity.***		Covalent Bonding	
		Recognise that the group number is the same as the number of electrons in the outer shell. That group 1 elements have 1 electron in the outer shell, group 7 elements have 7 electrons in the outer shell and group 8 elements have 8. ***Deduce the group to which an element belongs from its electronic structure (limited to the first 20 elements).***		Atomic Structure Patterns in the Periodic Table	
		Recognise that the period to which the element belongs corresponds to the number of occupied shells in the electronic structure. ***Deduce the period to which the element belongs from its electronic structure.***		Patterns in the Periodic Table	

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C3: The Periodic Table	C3d: The Group 1 Elements	Describe the reaction of lithium, sodium and potassium with water: State the word equation for the reaction of an alkali metal with water. - hydrogen is formed - an alkali is formed which is the hydroxide of the metal - the reactivity with water increases down Group 1 - potassium gives a lilac flame. ***State the balanced symbol equation for the reaction of an alkali metal with water e.g.*** $2Na + 2H_2O \rightarrow 2NaOH + H_2$ ***Predict the properties of alkali metals e.g. properties of caesium or rubidium given information about other alkali metals.***		**The Alkali Metals**	
		State that the Group 1 metals have one electron in the outer shell. Explain that Group 1 metals have similar properties because they have one electron in their outer shell. ***Explain that alkali metals have similar properties because when they react, an atom loses one electron to form a positive ion with a stable electronic structure.*** ***Write an equation to show the formation of an ion of a Group 1 metal from its atom.*** ***Explain that the more reactive the alkali metal the easier it is for an atom to lose one electron.*** ***Describe the loss of electrons as oxidation.*** ***Explain why a process is oxidation from its ionic equation.***		**The Alkali Metals Electro-chemistry**	
		Describe how to carry out a flame test to test for the presence of lithium, sodium and potassium compounds: - use of moistened flame test wire - flame test wire dipped into solid sample - flame test wire put into blue Bunsen flame.		**The Alkali Metals**	**Chemical Analysis – Chemical Techniques**

		Chemistry			
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C3: The Periodic Table	C3e: The Group 7 Elements	Describe the physical appearance of the halogens at room temperature: - chlorine is a green gas - bromine is an orange liquid - iodine is a grey solid.		The Halogens	
		Describe the reaction between alkali metals and halogens to give metal halides. Identify the metal halide formed when a halogen reacts with an alkali metal. Construct the word equation for the reaction between an alkali metal and a halogen. ***Construct the balanced symbol equation for the reaction of an alkali metal with a halogen.***		The Halogens	Chemical Analysis – Chemical Techniques
		State that the reactivity of the halogens decreases down the group. Describe the displacement reactions of halogens with solutions of metal halides: - chlorine displaces bromides and iodides - bromine displaces iodides. Construct the word equation for the reaction between a halogen and a metal halide. ***Predict the properties of fluorine or astatine given the properties of the other halogens e.g:*** - ***physical properties*** - ***melting point*** - ***boiling point*** - ***displacement reactions.*** ***Construct the balanced symbol equation for the reaction between halogens and metal halides.***		The Halogens	
		Explain that Group 7 elements have similar properties because they have seven electrons in their outer shell. ***Explain that halogens have similar properties because when they react, an atom gains one electron to form a negative ion with a stable electronic structure.*** ***Write an equation to show the formation of a halide ion from a halogen molecule.*** ***Explain that the more reactive the halogen, the easier it is for an atom to gain one electron.*** ***Describe the gain of electrons as reduction.*** ***Explain why a process is reduction from its ionic equation.***		The Halogens Electro-chemistry	

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C3: The Periodic Table	C3f: Electrolysis	Describe the key features of the electrolysis of dilute sulfuric acid: - hydrogen made at the cathode - oxygen made at the anode. ***State the electrode reactions in the electrolysis of sodium chloride:*** - ***cathode:*** $2H^+ + 2e^- \rightarrow H_2$ - ***anode:*** $4OH^- - 4e^- \rightarrow 2H_2O + O_2$		Electro-chemistry	
		Describe the key features of the electrolytic decomposition involved in the production of aluminium: - use of molten aluminium oxide - oxygen is formed at the graphite anode - the anodes are gradually worn away by oxidation - aluminium is formed at the graphite cathode - process has a high electrical requirement. Write the word equation for the decomposition of aluminium oxide. ***State the electrode reactions in the electrolytic extraction of aluminium:*** - ***cathode:*** $Al^{3+} + 3e^- \rightarrow Al$ - ***anode:*** $2O^{2-} \rightarrow O_2 + 4e^-$ ***Explain that cryolite is used to lower the melting point of the aluminium oxide.*** ***Explain that aluminium is expensive because its extraction uses large amounts of electricity.***		Electro-chemistry	

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C3: The Periodic Table	C3g: Transition Elements	State that compounds of transition elements are often coloured: - copper compounds are blue - iron(II) compounds are light green - iron(III) compounds are orange/brown. State that transition elements and their compounds are often catalysts: - iron in the Haber process - nickel in the manufacture of margarine.		**The Transition Metals** **Rates of Reaction**	
		Describe the thermal decomposition of transition metal carbonates illustrated by $FeCO_3$, $CuCO_3$, $MnCO_3$ and $ZnCO_3$: - metal oxide and carbon dioxide formed - word equations - colour change occurs (colour not needed). ***Construct the balanced symbol equation for the thermal decomposition of:*** - ***$FeCO_3$*** - ***$CuCO_3$*** - ***$MnCO_3$*** - ***$ZnCO_3$***		**Chemical Reactions** **The Transition Metals**	
		Describe the use of sodium hydroxide solution to identify the presence of transition metal ions in solution: - Cu^{2+} gives a blue solid - Fe^{2+} gives a grey/green solid - Fe^{3+} gives an orange/brown solid - the solids are called precipitates. ***Construct the symbol equation for the reaction between Cu^{2+}, Fe^{2+} and Fe^{3+} and OH^- (without state symbols) given the formulae of the ions.***		**Chemical Reactions** **The Transition Metals**	**Chemical Analysis – Chemical Techniques**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C3: The Periodic Table	C3h: Metal Structure and Properties	Suggest properties needed by a metal for a particular given use e.g. saucepan bases need to be good conductors of heat. Explain why metals are suited to a given use (data may or may not be provided). Describe that metals have high melting points and boiling points because of strong metallic bonds. ***Explain why metals are suited to a given use (data may or may not be provided).*** ***Describe metallic bonding as the strong electrostatic attraction between a sea of delocalised electrons and close packed positive metal ions.*** ***Explain that metals often have high melting points and boiling points because of the strong attraction between the delocalised electrons and the positive metal ions that needs to be overcome.***	**Metals and Alloys**		
		Describe that when metals conduct electricity electrons move. Describe that superconductors are materials that conduct electricity with little or no resistance. Describe the potential benefits of superconductors: - loss-free power transmission - super-fast electronic circuits - powerful electromagnets. ***Explain that metals conduct electricity because the delocalised electrons can move easily.*** ***Explain the drawbacks of superconductors:*** - ***only work at very low temperatures*** - ***the need to develop superconductors that will work at 20^{o}C.***	**Metals and Alloys**		

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4a: Acids and Bases	Describe how universal indicator can be used to estimate the pH of a solution.		Chemical Reactions	
		Describe an alkali as a soluble base. State that in neutralization: acid + base → salt + water Explain the change in pH when an acid is neutralized by an acid, or vice versa. ***State that acids in solution contain hydrogen ions.*** ***State that alkalis in solution contain hydroxide ions.*** ***Describe neutralization using the ionic equation:*** $H^+ + OH^- \rightarrow H_2O$		Chemical Reactions	Understanding Acids and Alkalis
		Recall that metal oxides and metal hydroxides neutralize acids because they are bases. Recall that carbonates neutralize acids to give water, a salt and carbon dioxide. Predict the name of the salt produced when a named base or carbonate is neutralized by a laboratory acid: - sulfuric acid - nitric acid - hydrochloric acid. ***Construct word equations to show the neutralization of acids by bases and carbonates (without being given the names of the products).*** ***Construct balanced symbol equations for the neutralization of acids by bases and carbonates limited to:*** - ***sulfuric acid, nitric acid and hydrochloric acid*** - ***ammonia, potassium hydroxide, sodium hydroxide and copper oxide*** - ***sodium carbonate and calcium carbonate.***		Chemical Reactions	Chemical Analysis – Chemical Techniques

Chemistry					
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4b: Reacting Masses	Calculate the relative formula mass of a substance from its formula (with brackets) given appropriate relative atomic masses.		Quantitative Chemistry	
		Use simple ratios to calculate reacting masses and product masses given the mass of a reactant and a product. ***Explain why mass is conserved in chemical reactions.*** ***Interpret chemical equations quantitatively.*** ***Calculate masses of products or reactants from equations using relative formula masses.***		Quantitative Chemistry	
		State the formula: $\text{percentage yield} = \frac{\text{actual yield}}{\text{predicted yield}} \times 100$ Calculate percentage yield given 'actual yield' and 'predicted yield'.		Quantitative Chemistry	The Chemical Industry

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4c: Fertilizers and Crop Yield	Explain that fertilizers must first dissolve in water before they can be absorbed by plants. State that fertilizers increase crop yield. ***Explain how the use of fertilizers increase crop yield:*** - ***replaces essential elements used by a previous crop or provides extra essential elements*** - ***more nitrogen gets incorporated into plant protein so increased growth.*** ***Describe the process of eutrophication:*** - ***run-off of fertilizer*** - ***increase of nitrate or phosphate in river water*** - ***algal bloom*** - ***blocks off sunlight to other plants which die*** - ***aerobic bacteria use up oxygen*** - ***most living organisms die.***		**Plant Growth (Biology)**	
		Calculate the relative formula mass of a fertilizer given its formula and the appropriate relative atomic masses. ***Calculate the percentage by mass of each essential element of a fertilizer given its formula and the appropriate relative atomic masses.***		**Quantitative Chemistry**	
		State the name of the acid and the alkali needed to make each of the following fertilizers: - ammonium nitrate - ammonium phosphate - ammonium sulphate - potassium nitrate. ***Describe the preparation of a named synthetic fertilizer by the reaction of an acid and an alkali:*** - ***names of reactants*** - ***experimental method*** - ***how a neutral solution is obtained*** - ***how solid fertilizer is obtained.***		**Chemical Reactions**	

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4d: Making Ammonia – Haber Process and Costs	Describe how ammonia is made in the Haber process: - nitrogen + hydrogen → ammonia - iron catalyst - high pressure - temperature in the region of 450°C - unreacted nitrogen and hydrogen are recycled. ***Explain the use of the conditions used in the Haber process:*** - ***high pressure increases the percentage yield of ammonia*** - ***high temperature decreases the percentage yield of ammonia*** - ***high temperature gives a high rate of reaction*** - ***450°C is an optimum temperature to give a fast reaction with a high percentage yield*** - ***catalyst increases the rate of reaction but does not change the percentage yield.*** ***State the balanced equation for the manufacture of ammonia in the Haber process.***		Reversible Reactions	
		Describe how different factors affect the cost of making a new substance: - the higher the pressure, the higher the plant cost - the higher the temperature, the higher the energy cost - catalysts reduce costs by increasing the rate of reaction - when unreacted starting materials are recycled, costs are reduced - automation reduces the wages bill. ***Explain that economic considerations determine the conditions used in the manufacture of chemicals:*** - ***rate must be high enough to give a sufficient daily yield of product*** - ***percentage yield must be high enough to give a sufficient daily yield of product*** - ***a low percentage yield can be accepted if the reaction can be repeated many times with recycled started materials*** - ***optimum conditions used that give the lowest cost rather than the fastest reaction or highest percentage yield.***		Reversible Reactions	The Chemical Industry
		Interpret data in tabular and graphical form relating to percentage yield in reversible reactions and changes in conditions. (No recall required). ***Interpret data about rate, percentage yield and costs for alternative industrial processes. (No recall required).***		Reversible Reactions	
		Recognise the importance of ammonia in relation to world food production.			

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4e: Detergents	Explain the advantages of using low temperature washes in terms of energy saving and the type of clothes that can be washed.			**Soap and Water**
		Describe the chemical nature of a detergent and how detergents work: - ***hydrophilic head*** - ***hydrophobic tail.***			**Soap and Water**
		Describe dry cleaning as a process used to clean clothes that does not involve water: - solvent that is not water - stain will not dissolve in water.			
		Explain in terms of intermolecular forces, how a dry cleaning solvent removes stains.			
		Describe that many detergents are made by the neutralization of acids with alkalis.			**Carboxylic Acids and Esters, Soap and Water**
		Interpret data from experiments on the effectiveness of washing up liquids and washing powders.			
		Interpret data from experiments on the effectiveness of washing up liquids and washing powders.			

Chemistry					
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4f: Batch or Continuous?	Compare the relatively small scale production of pharmaceutical drugs to the large scale industrial manufacture of ammonia. ***Evaluate the advantages and disadvantages of batch and continuous manufacturing process given relevant data and information.***			
		Describe the factors contributing to the high costs involved in making and developing a new medicine or pharmaceutical drug: - often more labour intensive - less automation possible - research and testing may take many years - raw materials likely to be rare and / or involve expensive extraction from plants - legislative demands. ***Explain how economic considerations determine the development of new drugs in relation to:*** - ***research and development time and associated labour costs*** - ***time required to meet legal requirements including timescale for testing and human trials*** - ***anticipated demand for new product*** - ***length of payback time for initial investment.***			**The Chemical Industry**
		Describe how chemicals are extracted from plant sources: - crushing - dissolving in suitable solvent - chromatography.			**Chemical Analysis – Instrumental Techniques**

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4g: Nanochemistry	Recognise the structures of diamond, graphite and Buckminster fullerene. ***Explain that diamond, graphite and fullerenes are all allotropes of carbon.***		Nano-technology	
		Explain that diamond is used in cutting tools because it is very hard and has a high melting point. Explain that diamond is used in jewellery because it is lustrous and colourless. ***Explain the properties of diamond in terms of its structure:*** - ***does not conduct electricity since it has no free electrons*** - ***hard and has a high melting point because of the presence of many strong covalent bonds.***		Covalent Bonding	
		Explain that graphite is used in pencil leads because it is slippery and black. Explain that graphite is used in lubricants because it is slippery. Explain that graphite is used as an electrode in electrolysis because it conducts electricity and has a high melting point. ***Explain the properties of graphite in terms of its structure:*** - ***conducts electricity because it has delocalised electrons that can move*** - ***slippery because layers of carbon atoms are weakly held together and can slide easily over each other*** - ***high melting point because there are many strong covalent bonds to break.***		Covalent Bonding	
		State that Buckminster fullerene has the formula C_{60} Describe some uses of nanotubes: - semiconductors in electrical circuits - industrial catalysts. ***Describe the use of fullerenes to 'cage' other molecules.*** ***Describe the use of 'caged molecules' in new drug delivery systems.*** ***Explain the use of nanotubes as catalysts:*** - ***catalyst attached to nanotubes*** - ***large surface area available.***	Designer Materials	Nano-technology	
		Describe that nanoparticles have different properties from the 'bulk' chemical. ***Describe molecular manufacturing in terms of molecule-by-molecule building of a product, using positional chemistry or by starting with a bigger structure and then removing matter to produce nanoscale features.***		Nano-technology	

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C4: Chemical Economics	C4h: How Pure is our Water?	Interpret data about water resources in the United Kingdom (no recall is expected). Explain why it is important to conserve water.			**Soap and Water**
		Recall the source of pollutants in water: - nitrate from fertilizer run off - lead compounds from lead pipes - pesticides from spraying near to water resources.			**Aquatic Ecology (Biology)**
		Describe the water purification process to include filtration, sedimentation and chlorination. ***Explain the processes involved in water purification.*** ***Explain that some soluble substances are not removed from water during purification and that these may be poisonous.*** ***Explain the disadvantages of using distillation of sea water to make large quantities of fresh water.***			**Soap and Water**
		Interpret data about the testing of water with aqueous silver nitrate and barium chloride solutions. Write word equations for the reactions of barium chloride with sulphates and silver nitrate with halides. Recall that the reaction of barium chloride with sulphates and silver nitrate with halides are examples of precipitation reactions. ***Write balanced symbol equations for the reaction of barium chloride with sulphates and silver nitrate with chlorides given the appropriate formulae.***			**Chemical Analysis – Chemical Techniques**
		Explain the importance of clean water for people in the developing nations.			

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5a: Moles and Empirical Formulae	Calculate the molar mass of a substance from its formula (with brackets) using the appropriate relative atomic masses. ***Recall and use the relationship between molar mass, number of moles and mass:*** ***Number of moles = mass ÷ molar mass.*** ***Determine the number of moles of an element from the mass of that element.*** ***Determine the number of moles of a compound from its mass.*** ***Determine the masses of different elements present in a given number of moles of a compound.*** ***State that the RAM of an element is the average mass of an atom of the element compared to the mass of 1/12th of an atom of carbon-12.***		Quantitative Chemistry	Further Quantitative Chemistry
		Given a set of reacting masses, calculate further reacting amounts by simple ratio. ***Calculate mass of products and / or reactants using the mole concept from a given balanced equation and the appropriate relative atomic masses.***		Quantitative Chemistry	Further Quantitative Chemistry
		Recall that an empirical formula gives the simplest whole number ratio of each type of atom in a compound. Deduce the empirical formula of a compound given its chemical formula. ***Calculate empirical formula of a compound from: percentage mass by composition; mass of each element in a sample of the compound.***			Further Quantitative Chemistry

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5b: Electrolysis	State the products of the electrolytic decomposition of the following: - K_2SO_4(aq) – hydrogen and oxygen - KNO_3(aq) – hydrogen and oxygen. Describe electrolysis in terms of flow of charge and discharge of ions. ***Explain in the electrolysis of aqueous solutions it may be easier to discharge ions from the water rather than from the solute.*** ***Write half equations for the electrode processes that happen during the electrolysis of each of the following, given the formula of the ions present in the electrolyte: K_2SO_4(aq) and KNO_3(aq).***		Electro-chemistry	Further Electro-chemistry
		Describe the changes in mass of the copper electrodes used in the electrolysis of copper(II)sulphate solution: - negative electrode gains mass - positive electrode loses mass - the gain and losses of mass are equal. Describe the factors that affect the amount of substance produced during electroysis – amount made increases as time increases and as current increases. ***Write the half equations for electrode processes that happen during the electrolysis of CuSO4(aq)*** - ***positive electrode: $Cu - 2e^- \rightarrow Cu^{2+}$*** - ***negative electrode: Cu2+ + 2e- → Cu*** ***Recall the relationship between charge transfer, current and time: Q = It*** ***Perform simple calculations based on current, charge and the amount of substance produced in electrolysis.***	Extracting Metals	Electro-chemistry	Further Electro-chemistry
		Recall that ionic substances contain ions which are in fixed positions in the solid but can move in solution or when melted. ***Write the half equations for the electrode processes that happen during the electrolysis of each of the following molten substances, given the formula of the ions present in the electrolyte:*** - ***Al_2O_3(l)*** - ***$PbBr_2$(l)*** - ***PbI_2(l)*** - ***KCl(l)***		Ionic Bonding Electro-chemistry	Further Electro-chemistry

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5c: Quantitative Analysis	Recall that the more concentrated a solution, the more crowded the solute particles. Convert volume in cm^3 into dm^3 (or vice versa). ***Convert concentration in g/dm^3 into mol/dm^3 (or vice versa).*** ***Calculate the concentration of a solution given appropriate information about the mass or number of moles of solute in a particular volume of solution.*** ***Perform simple calculations involving concentration, number of moles and volume of solution.***		**Rates of Reaction**	**Titration**
		Perform calculations involving concentration for simple dilutions of solutions e.g. how to dilute a 1.0mol/dm^3 solution into a 0.1mol/dm^3 solution.			**Titration**
		Interpret information on food packaging about recommended daily allowances. ***Interpret more complex food packaging information and its limitations:*** - ***convert amounts of sodium to amounts of salt*** - ***understand that an ion may come from several sources so this conversion will be inaccurate.***			

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5d: Titrations	Recall that there is a sudden change in pH at the endpoint of a titration. Explain why pH changes during the reaction of an acid with an alkali: - neutralization - acid + alkali → salt + water. Interpret a simple pH curve: - determine the volume of acid or alkali at neutralization - determine the pH when a particular volume is added (and vice versa). ***Sketch a pH titration curve for the titration of an acid or an alkali.***		**Chemical Reactions**	**Understanding Acids and Alkalis** **Titrations**
		Explain the need for several consistent titre readings in titrations. ***Calculate the concentration of an acid or alkali from titration results, limited to examples involving a one-to-one molar ratio (acid:alkali).*** ***State and use the relationship between number of moles, concentration and volume:*** - ***moles = concentration × volume in dm^3*** - ***concentration = moles ÷ volume in dm^3*** - ***volume in dm^3 = moles ÷ concentration***			**Titrations**
		Describe that a single indicator such as litmus produces a sudden colour change during titration whereas a mixed indicator such as universal indicator produces a continuous colour change. ***Explain why an acid-base titration should use a single indicator rather than a mixed indicator.***			**Titrations**

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5e: Gas Volumes	Describe an experimental method to measure the volume of gas produced in a reaction given appropriate details about the reaction.			**Further Quantitative Chemistry**
		Describe an experimental method to measure the mass of gas produced in a reaction given appropriate details about the reaction.			**Further Quantitative Chemistry**
		State that the limiting reactant is the one that is used up first of all. Explain why a reaction stops in terms of the limiting reactant present, given appropriate qualitative information. Describe that the amount of gas produced is directly proportional to the amount of the limiting reactant present. ***Given the knowledge that one mole of gas molecules occupy 24dm^3 at room temperature and pressure, use it to calculate the volumes of samples of gases.*** ***Perform calculations involving gas volumes and number of moles.***			**Further Quantitative Chemistry**
		Interpret graphs and tables of data about the volume of gas produced during the course of a reaction (not major gridlines): - deduce total volume of gas produced - deduce when the reaction has stopped - deduce volume of gas at particular time (and vice versa) - deduce the volume of gas produced with different amounts of limiting reactant. ***Sketch a graph to show how the volume of gas produced during the course of a reaction changes, given appropriate details:*** - ***change in the rate of reactions*** - ***total volume of gas collected*** - ***when the reaction stops.***			**Further Quantitative Chemistry**

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5f: Equilibria	Describe that some reversible reactions may reach an equilibrium where the rate of the forward reaction equals the rate of the backward reaction and the concentrations of the reactants and the products do not change. State that when the position of equilibrium is on the right, the concentration of product is greater than the concentration of reactant. State that when the position of equilibrium is on the left, the concentration of reactant is greater than the concentration of product. ***Explain why a reversible reaction may reach an equilibrium:*** - ***importance of a closed system*** - ***initially rate of forward reaction decreases*** - ***initially rate of backward reaction increases*** - ***eventually rate of forward equals rate of backward reaction.***		**Reversible Reactions**	
		Describe that a change in temperature, pressure or concentration of reactant or product may change the position of equilibrium. Interpret data in the form of tables or graphs about the equilibrium composition including composition at particular temperatures and pressures and the effect of temperature and pressure on composition. ***Explain in simple qualitative terms, factors that affect the position of equilibrium:*** - ***removing a product moves the position of equilibrium to the right (or vice versa)*** - ***adding extra reactant moves the position of equilibrium to the right (or vice versa)*** - ***increasing the pressure moves the position of the equilibrium to the side with the least number of moles of gas molecules.***		**Reversible Reactions**	
		State the conditions used in the Contact Process: V_2O_5 catalyst, around 450°C, atmospheric pressure. Recall that the sulfur dioxide needed for the Contact Process often comes from burning sulfur: sulfur + oxygen → sulfur dioxide ***Recall the symbol equations for the three stages in the manufacture of sulfuric acid by the Contact Process:*** - $S + O_2 \rightarrow SO_2$ - $2SO_2 + O_2 \rightarrow 2SO_3$ - $SO_3 + H_2O \rightarrow H_2SO_4$ ***Explain the conditions used in the Contact Process:*** - ***high temperature decreases yield and increases rate of reaction so an optimum is used*** - ***catalyst increases rate but doesn't change position of equilibrium*** - ***position of equilibrium is already on right so high pressure is expensive and not needed.***			**Understanding Acids and Alkalis**

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5g: Strong and Weak Acids	State that an acid ionises in water to produce H^+ ions. State that a strong acid completely ionises in water. State that the ionisation of a weak acid is an example of a reversible reaction. State that the ionisation of a weak acid produces an equilibrium mixture. ***Explain why the pH of a weak acid is much higher than the pH of a strong acid of the same concentration.*** ***Explain the difference between acid strength and acid concentration:*** - ***acid strength (strong or weak) is a measure of the degree of ionisation of the acid*** - ***concentration of an acid is a measure of how many moles of acid in one dm^3.*** ***Write equations for the ionisation of weak and strong acids given the formula of the acid limited to:*** ***CH_3COOH $CH_3COO^- + H^+$*** ***$HCl \rightarrow H^+ + Cl^-$***		Chemical Reactions	Understanding Acids and Alkalis
		Describe that ethanoic acid reacts slower than hydrochloric acid because there are fewer hydrogen ions and so fewer collisions with hydrogen ions. ***Explain that ethanoic acid reacts slower than hydrochloric acid of the same concentration because:*** - ***ethanoic acid is weak and hydrochloric acid is strong*** - ***greater concentration of hydrogen ions*** - ***greater collision frequency with hydrogen ions.***		Rates of Reactions	Understanding Acids and Alkalis
		Explain that the volume of hydrogen formed is determined by the amounts of reactants, present not the acid strength.		Chemical Reaction	
		Describe that ethanoic acid is less conductive than hydrochloric acid of the same concentration because there are fewer hydrogen ions available to move. Explain why hydrogen is produced during the electrolysis of ethanoic acid and of hydrochloric acid. ***Explain that ethanoic acid is less conductive than hydrochloric acid of the same concentration because:*** - ***ethanoic acid is weak and hydrochloric acid is strong*** - ***greater concentration of hydrogen ions to carry the charge.***			Understanding Acids and Alkalis
		Explain why strong acids are inappropriate as descaling agents. ***Explain why a weak acid may be more useful than the more dilute strong acid.***			Soap and Water Carboxylic Acids and Esters

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C5: How Much?	C5h: Ionic Equations	Describe that ionic substances contain ions which are in fixed positions in the solid but can move in solution or when melted. Describe that ions must collide with other ions if they are to react. ***Describe that most precipitation reactions are extremely fast reactions between ions.***		**Ionic Bonding** **Rates of Reaction**	**Chemical Analysis – Chemical Techniques**
		Construct word equations for simple precipitation reactions e.g. for the reaction between solutions of barium chloride and sodium sulfate. ***Convert balanced equations into ionic equations, given the ions present.*** ***Construct ionic equations for simple precipitation reactions, given the ions present and the identity of the products.*** ***Explain the concept of 'spectator ions'.***		**Chemical Reactions**	**Chemical Analysis – Chemical Techniques**
		Construct balanced ionic equations, with state symbols, given relevant information and the formulae of the ions present.			**Chemical Analysis – Chemical Techniques**
		Describe the stages involved in the preparation of a dry sample of an insoluble compound by precipitation given the names of the reactants: - mix solutions of reactants - filtration - wash and dry residue.			**Chemical Analysis – Chemical Techniques**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6a: Energy Transfers – Fuel Cells	State that the reaction between hydrogen and oxygen is exothermic. ***Draw and interpret an energy level diagram for the reaction of hydrogen and oxygen.***			**Food and Fuels**
		Describe a fuel cell as one which is supplied with fuel and oxygen and uses the energy from the reaction between them to create a potential difference. State the word equation for the overall reaction in a hydrogen-oxygen fuel cell: hydrogen + oxygen → water	**Combustion and Alternative Fuels**		**Food and Fuels**
		Write a balanced symbol equation for the overall reaction in a hydrogen-oxygen fuel cell: $2H_2 + O_2 \rightarrow 2H_2O$ ***Explain the changes that take place at each electrode in a hydrogen-oxygen fuel cell including electrode reactions and redox reactions.***			**Food and Fuels**
		Describe some advantages of using a fuel cell to provide electrical power in a spacecraft. Explain why the car industry is developing fuel cells. ***Explain the advantages of a hydrogen-oxygen fuel cell over conventional methods of generating electricity:*** - ***more efficient*** - ***fewer stages*** - ***direct energy transfer*** - ***less pollution.***			**Food and Fuels**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6b: Redox Reactions	State that rusting of iron is a redox reaction. State the word equation for the rusting of iron: iron + oxygen + water → hydrated iron(III)oxide. ***Explain why rusting is a redox reaction:*** - ***iron loses electrons*** - ***oxygen gains electrons.***	**Metals and Alloys**		**Further Electro-chemistry**
		Explain that oil, grease and paint prevent iron from rusting because they stop oxygen or water reaching the surface of the iron. ***Explain the following methods of preventing rust:*** - ***galvanising – zinc acts as a barrier and also as a sacrificial metal*** - ***sacrificial protection – use of a metal such as magnesium which will lose electrons in preference to iron*** - ***tinning – acts as a barrier but when scratched the iron will lose electrons in preference to tin.***			**Further Electro-chemistry**
		Construct word equations for displacement reactions between metals and metal salt solutions. ***Write symbol equations for displacement reactions between metals and metal salt solutions.***			**Chemical Analysis – Chemical Techniques**

		Chemistry			
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6c: Alcohols	State the molecular formula and displayed formula of ethanol. ***State the general formula of an alcohol and use it to write the molecular formula of an alcohol with up to five carbon atoms.*** ***Draw the displayed formulae of alcohols containing up to five carbon atoms.***			**CFCs and Alcohols**
		State the word equation for fermentation: glucose → carbon dioxide + ethanol Describe how ethanol can be made by fermentation: - glucose solution and yeast - optimum temperature for the yeast - distillation to get the ethanol. ***State the balanced symbol equation for fermentation:*** $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$ ***Explain the conditions used in fermentation:*** - ***temperature too low – yeast inactive*** - ***temperature too high – enzymes denatured*** - ***absence of air prevents formation of ethanoic acid.***			**CFCs and Alcohols**
		Describe how ethanol is produced for industrial use by passing ethene and steam over a heated phosphoric acid catalyst. State the word equation for the hydration of ethene: ethene + water → ethanol ***Evaluate the merits of the two methods of making ethanol (fermentation and hydration).*** ***State the balanced symbol equation for the hydration of ethane:*** $C_2H_4 + H_2O \rightarrow C_2H_5OH$			**CFCs and Alcohols**
		Describe how ethanol can be dehydrated to ethene by passing its vapour over a heated aluminium oxide catalyst: State the word equation for the dehydration of ethanol: ethanol → ethene + water ***State the balanced symbol equation for the hydration of ethane:*** $C_2H_5OH \rightarrow C_2H_4 + H_2O$			**CFCs and Alcohols**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6d: Chemistry of Sodium Chloride	Describe how it can be mined as rock salt and by solution mining in Cheshire. Explain that mining for salt can lead to subsidence.			
		Describe the key features of the electrolysis of concentrated sodium chloride solution (brine): - hydrogen made at the cathode - chlorine made at the anode - sodium hydroxide is also made - use of inert electrodes. ***Explain how the electrolysis of sodium chloride solution (brine) produces sodium hydroxide, hydrogen and chlorine:*** - ***cathode*** $2H^+ + 2e^- \rightarrow H_2$ - ***anode*** $2Cl^- - 2e^- \rightarrow Cl_2$ - ***ions not discharged to make NaOH.*** ***Explain that electrolysis of concentrated sodium chloride solution produces chlorine at the anode but dilute sodium chloride solution produces oxygen.***	**Building Materials and Rocks**	**Electro-chemistry**	
		Recall the electrode reactions that occur during the electrolysis of molten sodium chloride.		**Electro-chemistry**	
		Describe that household bleach is made from reacting sodium hydroxide and chlorine.			

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6e: Depletion of the Ozone Layer	Explain why the use of CFCs has been banned in the UK. ***Describe how scientists' attitude to CFCs has changed:*** - ***initial enthusiasm for use of CFCs based upon their inertness*** - ***later discovery of ozone depletion and link to presence of CFCs*** - ***acceptance by scientists and the rest of the world that the use of CFCs should be banned.*** ***Discuss the ban on use of CFCs in some countries but not in others related to the global problem of depletion of the ozone layer.***			**CFCs and Alcohols**
		Describe that the action of ultraviolet light on CFCs leads to the formation of chlorine atoms. Chlorine atoms in the stratosphere leads to the depletion of the ozone layer. State that a chlorine free radical is a chlorine atom. Describe that CFCs are only removed slowly from the stratosphere. ***Explain how a covalent bond can break unevenly to form ions or evenly to form highly reactive free radicals.*** ***Describe that only a small number of chlorine atoms are required because a chain reaction is set up.*** ***Write symbol equations for the reactions that take place when chlorine atoms and ozone react.*** ***Explain why CFCs will continue to deplete ozone a long time after their use has been banned.***			**CFCs and Alcohols**
		Describe how depletion of the ozone layer allows more ultraviolet light to reach the surface of the Earth. ***Explain how ozone absorbs ultraviolet light in the stratosphere.***	**Earth's Atmosphere**		**CFCs and Alcohols**
		Describe that CFCs can be replaced with alkanes or HFCs and that these will not damage the ozone layer.			**CFCs and Alcohols**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6f: Hardness of Water	Describe that dissolved carbon dioxide causes water to be slightly acidic. Describe how common forms of calcium carbonate (chalk, limestone and marble) react with water and carbon dioxide to form soluble calcium hydrogencarbonate in water. State the word equation for the reaction between calcium carbonate, water and carbon dioxide. ***Explain how common forms of calcium carbonate (chalk, limestone and marble) react with water and carbon dioxide to form soluble calcium hydrogencarbonate in water.*** ***Write a balanced symbol equation for the reaction between calcium carbonate, water and carbon dioxide.***			**Soap and Water**
		Recall that temporary hardness is caused by dissolved calcium hydrogencarbonate and that permanent hardness is caused by dissolved calcium sulfate.			**Soap and Water**
		Describe how boiling removes temporary hardness but not permanent hardness: decomposition of calcium hydrocarbonate to give insoluble calcium carbonate, water and carbon dioxide. Describe how an ion-exchange resin can soften water. ***State the symbol equation for the decomposition of calcium hydrogencarbonate occurring when water containing temporary hardness is boiled.*** ***Explain how ion exchange can be used to soften hard water.*** ***Explain how washing soda (sodium carbonate) can soften hard water.***		**Chemical Reactions**	**Soap and Water**
		Interpret data about water hardness. Describe an experiment to compare the hardness in samples of different sources of water.			**Soap and Water**
		Explain how a weak acid can be used as a limescale remover. ***Construct a symbol equation for the action of an acid on limescale.***			**Soap and Water Carboxylic Acids and Esters**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6g: Natural Fats and Oils	State that animal and vegetable fats and oils are esters. Describe that all the carbon-carbon bonds in a saturated fat or oil are single bonds. Describe that an unsaturated fat or oil has at least one carbon-carbon double bond. Describe how unsaturation in fats and oils can be shown using bromine water. Describe how margarine is manufactured from vegetable oils. ***State that animal fats and oils are often saturated and vegetable oils and fats are often unsaturated.*** ***Explain why unsaturated fats are healthier.*** ***Explain how unsaturation in fats and oils can be shown by using bromine water.***	**Food Chemistry**		
		Describe that a vegetable oil and water are immiscible liquids and they can be made to mix as an emulsion. Describe an oil-in-water emulsion and a water-in-oil emulsion.	**Food Chemistry**		
		Describe how natural fats and oils can be split up by hot sodium hydroxide solution to produce soap and glycerol. State that this process of splitting up natural fats and oils using sodium hydroxide solution is called saponification. ***Explain that the saponification of fats and oils is a hydrolysis reaction.*** ***fat + sodium hydroxide → soap + glycerol***			**Soap and Water**

	Chemistry				
		Syllabus point (text abridged)	Boardworks Presentations		
			GCSE Science	Additional Science	Separate Sciences
C6: Chemistry Out There	C6h: Analgesics	Explain that chemicals required for making analgesics must be very pure. Describe that a drug is an externally administered substance which modifies or affects chemical reactions in the body. Interpret the displayed formulae of aspirin, paracetamol and ibuprofen, e.g. be able to work out the molecular formula. ***Interpret the displayed formulae of aspirin, paracetamol and ibuprofen and be able to find similarities and differences in the structures.***			**The Chemical Industry**
		Describe some advantages of using soluble aspirin. Describe the dangers of overdoses of aspirin and paracetamol. ***Describe and explain differences in solubility between aspirin and soluble aspirin in terms of structure and effect.*** ***Describe problems caused to some patients using aspirin.***			
		Describe how aspirin is manufactured from salicylic acid.			**The Chemical Industry**