GCSE
SCIENCE A, SCIENCE B, CHEMISTRY
UNIT C1 – Example 1
4461, 4462, 4421

Scheme of Work

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334.
Registered address AQA, Devas Street, Manchester M15 6EX. *Dr Michael Cresswell Director General.*

Introduction

This Outline Scheme of Work is one of a number of schemes prepared by practising teachers for the new AQA GCSE Sciences suite. It is hoped that other teachers will find them helpful as the basis for the fully detailed schemes prepared for teaching from September 2006. Each outline scheme covers one unit (B1, B2, B3, C1, C2, C3, P1, P2, P3) and for some units more than one outline scheme is available. This is because there are different, equally valid ways of approaching the teaching of the specifications and a single scheme would not show the range of possible approaches.

The AQA specifications are designed to be used with a wide range of resources, so this scheme does not assume the availability of any particular printed or electronic publications, or any special equipment. Teachers are enabled to use existing resources, including their own, together with resources specially purchased for the new specifications.

The outline scheme is arranged under the section headings of the relevant specification, for example, *12.1/11.1 How do rocks provide building materials?* The content in the section is further subdivided with a brief statement given of the coverage of each subdivision, together with activities that relate to that content and an indication of the number of hours it is suggested are needed to deliver that part of the content.

Opportunities to deliver 'How Science Works' and to use ICT are highlighted using the same icons as used in the specifications.

This identifies parts of the content which lend themselves to extended investigative work of the type needed to explore Sections 10.3–10.7 of the specifications. These sections are about obtaining valid and reliable scientific evidence.

This identifies parts of the content which lend themselves to activities which allow Sections 10.2 and 10.8–10.9 to be considered. These sections are about using scientific evidence, for example, how scientific evidence can contribute to decision making and how scientific evidence is limited.

This identifies where there are opportunities to use ICT sources and tools in teaching the specifications.

UNIT 1			
Total hours: 15	**11.1/12.1 How do rocks provide building materials?**		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Usefulness of limestone and other building materials.		• Survey locally used building materials and famous buildings built from limestone. • Test properties of limestone, cement, concrete and glass: strength, resistance to acid, resistance to thermal changes. • Survey advantages and disadvantages of the respective materials, including cost/benefit.	Simple tests involving hammer, heat and quench and dilute acids.
Elements and the periodic table.		• Compare properties of a selection of elements, including appearance, electrical conductivity, magnetic properties. • Survey properties using periodic table, software or internet. Plot graphs of melting point against atomic number, density or atomic volume against atomic number.	Wide selection of metal and non-metal elements, solid, liquid and gas. Software for surveying the periodic table.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Atomic structure, elements and their reaction to form compounds.		• Brief explanation of size and structure of atoms and Geiger Marsden experiment, using snooker analogy. • Demonstration of reaction of hydrogen and oxygen to produce water, iron and sulphur to produce iron sulphide, iron and chlorine to produce iron chloride.	Electrolysis of water to generate hydrogen and oxygen. Gas jar of chlorine plus hot iron wool for iron chloride demonstration.
Representing chemical reactions.		• Use molymod or similar molecular models to construct models of molecules, introduce concept of reaction stoichiometry. Use this as a basis of exercises in balancing equations etc.	Molecular models.
Conservation of mass.		• Students carry out precipitation reaction and/or burning magnesium in air in a crucible with lid, weighing before and after.	Precipitation of a chloride with silver nitrate solution. Sensitive balance. Magnesium and crucibles with lids.
Thermal decomposition of metal carbonates.		• Students determine which metal carbonates of Groups 1 and 2 decompose on heating to produce carbon dioxide, testing for this using limewater.	Group 1 and 2 metal carbonates, delivery tube apparatus and limewater.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Limestone cycle		• Students heat calcium carbonate vigorously, note mass loss, add water to slaked lime. Divide product into two. Test one sample for pH, the other by blowing through it using straws.	Sensitive balance, marble chips, straws, universal indicator solution.
Uses of limestone		• Illustrate limekiln production of quicklime and slaked lime, uses of the same in producing glass, mortar and cement.	

Total hours: 12	11.2/12.2 How do rocks provide metals and how are metals used?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Metals, metal ores and recycling		• Students find out best ways of separating aluminium steel cans etc. • Research different metals in a variety of batteries, suggesting value of recovering each, both economic and environmental. • Students research the local level of recycling materials, including the economic cost/balance analysis by local authority, producing a report on progress made for local weekly newspaper.	Selection of cans. Magnets. Selection of batteries. Information on cost and toxicity of various metals.
Advantages of metals in construction		• London Eye versus Millennium bridge? Students act as advocates in debate and judges of these as structural icons of the new millennium.	
Structure and properties of alloys		• Students build models of metal atom packing. Then consider effect of adding a second, different metal atom into the structure. • Compare properties of alloys with pure metals by simple inspection.	Polystyrene balls of different sizes. Samples of metals and alloys.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Extracting metals		• Students challenged to isolate the most copper from malachite. Probably after lessons on 'metal reactivity and extraction'. • Students research the rise and decline of iron and steel making in Britain over the last 3000 years.	Calcium carbonate powder. Electrolysis apparatus, iron wool for displacement. Precise balance.
Metal reactivity and extraction		• Students investigate the ability of carbon powder to reduce a variety of metal oxides. • Relate this to the reactivity series. Speculate on why this method is not needed for unreactive metals. • Relate this to the production of iron, and describe properties of steels in terms of models of crystal lattice covered previously. • Discuss properties of alloys.	Lead oxide, copper oxide, iron oxide, zinc oxide, carbon powder. Polystyrene ball models of packing in metals.
Transition metals		• Use periodic table website to research properties of each of the transition elements. Answer question: what might this metal be useful for?	http://www.webelements.com/

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Copper		• Students carry out electrolytic extraction of copper. They then carry out extraction by ammoniacal precipitation/displacement using zinc, and compare the possible environmental impact of each process. • Discuss bacterial extraction of metals.	Copper oxide. Hydrochloric acid. Electrolysis apparatus. Sensitive balance. Ammonia solution. Sodium hydroxide. Vacuum filtration apparatus. Zinc dust. (Adapt Salter's Advanced Chemistry exercise M2.3)
Aluminium and titanium		• Describe method of extraction and usefulness of these materials, and students list environmental costs.	

Total hours: 8	11.3/12.3 How do we get fuels from crude oil?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Fuels for the future		• Students choose a novel fuel and provide a presentation illustrating its use, eg hydrogen, ethanol, LPG. Describe in context of the environmental impact of fossil fuels.	
Fractional distillation of crude oil		• Students carry out simple test tube/delivery tube fractional distillation of CLEAPSE formulated crude-oil substitute. Examine appearance mobility, volatility, combustibility of fractions. Discuss physical separation on basis of boiling point. Demonstrate larger scale fractional distillation using quickfit.	CLEAPSE crude oil. Delivery tubes. Thermometers. Crucibles for combustion. Quickfit apparatus.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Alkanes		• Students make models of alkanes using Molymod or similar, or computer software. Deduce the general formula. Draw graph of boiling points against number of carbon atoms.	
Polluting effects of fossil fuels		• Demonstrate burning sulfur generates acidic gases. Demonstrate use of scrubber to remove these. Students assess incomplete combustion in different fuels by burning different alcohols in spirit burners and look for sooty flames.	In fume cupboard, burn sulfur on deflagrating spoon in gas jar with indicator solution. Possibly pass product gases through U-tube containing calcium hydroxide solid, bubble exhaust through indicator solution. Spirit burners containing methanol, ethanol, propanol, butanol.
Crude oil as a raw material		• Students research and present information regarding which materials in modern life are derived from crude oil, or where would we be without crude oil? Extend to include the environmental and economic impact of using these materials, assessment of biodegradability etc.	
Useful molecules from alkanes		• Students carry out thermal decomposition (cracking) of an alkane and collect products: test unsaturated nature of gaseous alkene product with bromine water. Also test its flammability. Relate this to use as fuels.	Petroleum jelly soaked into mineral wool is a suitable alkane. Porous pot acts as a catalyst. Boiling tubes plus gas delivery tubes for the reaction. Care with suck back. Bromine water.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Structure of alkenes		• Students use molecular models to build alkenes, and deduce a general formula of alkenes. Students predict what might happen in a reaction with water. Explain unsaturation and addition reactions including polymerization.	Molymod models or similar. Molecular simulation software.

Total hours: 3	11.4/12.4 How are polymers and ethanol made from oil?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Making polymers		• Demonstrate properties of polymers: demo making nylon, polyurethane. Students make slime from polyethenol and borax, investigating its properties and desirability.	
Uses of polymers		• Students observe properties and uses of as wide a variety of polymers as possible.	Circus of experiments testing strength, resistance to acid, solubility in water (use a water soluble polymer as one example, eg poly(ethanol), solubility in organic solvents, action of heat etc on a wide variety of polymers.

Total hours: 5	11.5/12.5 How can plant oils be used?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Vegetable oils in food		• Introduce various structures of vegetable oils and putative effects on health. Students survey diet of own family in the light of this. Propose and debate advantages and disadvantages of use of these substances as fuels.	
Sources of vegetable oils		• Students distil avocado pear soft tissue to yield oil. Assess water content of this by shaking and observing emulsion. Dry with anhydrous calcium sulphate. Ignite the product and assess energy storage.	Avocadoes. Simple distillation apparatus. Anhydrous calcium sulphate.
Properties of vegetable oils		• Pupils investigate miscibility of water of a variety of vegetable oils. Discuss properties of emulsions. Then assess unsaturation by shaking with bromine water. Introduce the hydrogenation reaction using molecular models.	Corn oil, olive oil, sunflower oil, rapeseed oil.
Additives and processed foods		• Use a variety of food labels to introduce additives and the reasons for including them in food. Students carry out paper chromatography of food colourings to illustrate this technique.	

Total hours: 4	11.6/12.6 What are the changes in the earth and the atmosphere?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Structure of the Earth		• Outline basic structure of the Earth. Use canon ball in wooden box to explain evidence for dense core. Use shrunken apple or orange to illustrate original theory for structure on crust as a reasonable deduction.	Old desiccated apple or orange, or photograph of same.
Tectonic plates		• Students build a map of the world illustrating earthquake activity/active volcanoes to show plate boundaries. Use models made of fabric or sculpted from polystyrene to demonstrate abrupt movement of plates against each other. Illustrate evidence for this. Discuss convection currents as driving force for plate movement.	BBC 'Earth Story' programmes are excellent for illustrating all aspects of this section of the specification.
Gases of the atmosphere		• Students construct pie chart of atmospheric composition. Note surprisingly low proportion of carbon dioxide. Use periodic table website to investigate properties of noble gases.	www.webelements.com
Evolution of Earth's atmosphere		• Students construct timeline to illustrate the changes that have occured. Students blow through limewater to illustrate sequestration of carbon dioxide as carbonates.	