

## IGCSE Co-ordinated Sciences 0654

### Unit 15: C14 Fuels & C15 Batteries

#### Recommended Prior Knowledge

Students should have some appreciation of the reactivity series of metals.

#### Context

The knowledge for this Unit is linked with topics C3 and C6.

#### Outline

Consideration of factors affecting the combustion of materials, and the energy released, lead to a consideration of pollution caused by emissions. Electrical cells are related to the reactivity series of metals, and different types of cells compared.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
ABC	Understand burning in terms of the fire triangle and know that carbon dioxide and water are among the products of burning hydrocarbon fuels.	Students could investigate the products formed when fuels burn. From the burning of a candle, water can be condensed and tested, and carbon dioxide can be identified by reaction with lime water. Ideas can be extended to other hydrocarbon fuels.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 13. Teaching and Assessing Practical Skills in Science by Dave Hayward.
A	Be aware of the use of oxygen in welding and in medicine.	Students can research local uses of oxygen.	
AB	Understand what is meant by the term <i>fossil fuel</i> .	Fossil fuels should be listed and a brief explanation of their formation given.  Students could practice the skill of interpreting information presented in the form of graphs and tables, including those related to world and local fuel reserves. Data from the web sites can be used.	World fuel reserves: <a href="http://www.kcpc.usyd.edu.au/discovery/9.2.2/9.2.2_OilReserves.html">http://www.kcpc.usyd.edu.au/discovery/9.2.2/9.2.2_OilReserves.html</a> <a href="http://www.eia.doe.gov/oiaf/ieo/nat_gas.html">http://www.eia.doe.gov/oiaf/ieo/nat_gas.html</a>

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AB	Know that some finely powdered substances may explode when ignited because their high surface area causes very high reaction rate.	An explosion caused when flour is mixed with air can be demonstrated using a can with a tightly fitting lid and containing a lit candle and a syringe leading to a pile of flour. The idea can be related to explosions in flour mills and coal mines.	
ABC	Know some examples of solid, liquid and gaseous fuels and be able to give examples of their use.	Students can measure the energy transferred when fuels burn, using a suitable calorimeter. They can then be given the opportunity to comment critically on the apparatus used.  Students can make a comparison of the properties of fuels. This should bring out the criteria for judging a fuel, including its cost.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 13. Teaching and Assessing Practical Skills in Science by Dave Hayward
AB	Know that methane obtained by decay of waste materials may be used as a fuel.	Students can use the web sites to prepare a written or oral presentation about the use of methane as a biofuel.	Biofuels: <a href="http://www.habmigern2003.info/biogas/biofuels.html">http://www.habmigern2003.info/biogas/biofuels.html</a> <a href="http://www.green-trust.org/methane.htm">http://www.green-trust.org/methane.htm</a>
A	Know the terms <i>exothermic reaction</i> and <i>endothermic reaction</i> .	The terms exothermic and endothermic can be linked back to reactions in topic 9 Acids and Alkalis.	
AB	Know that the oxides of some non-metals such as sulphur and nitrogen are acidic and may cause pollution.	Sulphur can be burned in a gas jar and the products dissolved in water and tested with Universal indicator.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 10.
A	Know that carbon monoxide and lead compounds are also atmospheric pollutants.	Pollution caused by burning fuels should be discussed using local examples wherever possible.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 10.
AB	Know some of the environmental issues that arise from the use of	Students can gather information on the effects of air pollution from the web sites, including global	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 10. Oxides of nitrogen:

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AO	fossil fuels such as the adverse effect on buildings, trees and health.	warming, for written or oral presentation. Newspaper articles can be used as a source of local information on air pollution.	<a href="http://www.doh.gov.uk/hef/airpol/airpol5.htm">http://www.doh.gov.uk/hef/airpol/airpol5.htm</a> Sulphur dioxide: <a href="http://www.doh.gov.uk/hef/airpol/airpol3.htm">http://www.doh.gov.uk/hef/airpol/airpol3.htm</a> Carbon monoxide: <a href="http://www.doh.gov.uk/comeap/carmonox.htm">http://www.doh.gov.uk/comeap/carmonox.htm</a>  Lead in petrol: <a href="http://www.mcl.tulane.edu/ECME/leadhome/sources.html">http://www.mcl.tulane.edu/ECME/leadhome/sources.html</a> <a href="http://www.tnrcc.state.tx.us/air/monops/lessons/leadinfo.html">http://www.tnrcc.state.tx.us/air/monops/lessons/leadinfo.html</a>
AB	Appreciate that there are ways of reducing the emission of pollutants.	A brain storming session can be used to lead to suggestions for ways to reduce the emission of pollutants.	
AB	Understand that pollutants in the exhaust gas from vehicles may be cut down by the use of catalytic converters.	The reactions that take place in a catalytic converter can be studied using word or symbol equations. Students can extract information from the web site.	<a href="http://www.krioma.net/articles/Catalytic%20Converter/Catalytic%20Converter.htm">http://www.krioma.net/articles/Catalytic%20Converter/Catalytic%20Converter.htm</a>
ABC	Know that metals can be placed in order of their reactivity by reference to reaction with water/steam or dilute acid.	Students may plan and carry out investigations on the reactivity of metals with acids and the displacement of metals from their salts. To their data additional information from demonstrated reactions of metals with water and steam can be added. Students should arrive at an order of reactivity for the metals tested.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9 & 13.  Teaching and Assessing Practical Skills in Science by Dave Hayward
ABC	Know that a cell consists of two different electrodes dipping into an electrolyte solution.  Know that changing the electrodes changes the cell voltage.	Students could measure the voltage between electrodes of different metals dipping into electrolytes such as sulphuric acid or metal salts.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9 & 13.  Teaching and Assessing Practical Skills in Science by Dave Hayward
AB	Know that the reactivity of metals is	Ionic equations may be written for electrode	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9 &

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	related to the ease with which they form ions.	reactions. This can then lead to ideas of ease of loss of electrons, which can be related to the voltages observed above.	13.
ABC	Know that the voltage of a cell with two metal electrodes can be related to the position of the metals in the activity series.	Students should look at the results of the experiments they have carried out to find this relationship.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9 & 13.  Teaching and Assessing Practical Skills in Science by Dave Hayward
ABC	Understand that there is a limit to the life of a simple cell because one or more of the reactants is eventually used up.	Students should plan and carry out investigations using suitable cells. This will provide students with a practical opportunity to use voltmeters and set up circuits. Students could design a suitable cell for themselves and take into account factors such as cost, convenience etc.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 13.  Teaching and Assessing Practical Skills in Science by Dave Hayward
AB	Appreciate some of the cost and convenience factors which dictate the choice of cells for particular purposes.	Students can gather information about the local cost of different types of cells and relate this information to their uses. They may use the web site to access information about different types of battery.	Battery questions and answers: <a href="http://www.powerstream.com/BatteryFAQ.html">http://www.powerstream.com/BatteryFAQ.html</a>
AB	Understand, in principle, the differences between simple cells, rechargeable cells and fuel cells.	Students can gather relevant information for written or oral presentation.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 13.
ABC	Know that rusting involves a reaction of iron with air and water.	The involvement of air and water may be demonstrated using a series of experiments to see under which conditions iron nails rust.  The web site gives a lesson plan for rusting experiments.	IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9.  Teaching and Assessing Practical Skills in Science by Dave Hayward  <a href="http://www.cmu.edu/gipse/materials/pdf-2003/8-9/rust-A_Chase.pdf">http://www.cmu.edu/gipse/materials/pdf-2003/8-9/rust-A_Chase.pdf</a>

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ABC	Be able to give an account of methods of rust prevention and appreciate the advantages and disadvantages of alternative methods of rust prevention	<p>Students could plan and carry out investigations into rusting and suggested methods of preventing corrosion. This requires accurate observations of the changes in corrosion indicators.</p> <p>Anodizing of aluminium could be used as an example of preventing corrosion of this metal.</p> <p>Students can use the web site to list and describe methods of rust prevention.</p>	<p>IGCSE Chemistry by B Earl and LCR Wilford, Chapter 9.</p> <p>Teaching and Assessing Practical Skills in Science by Dave Hayward</p> <p><a href="http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/m0010149.html">http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/m0010149.html</a></p>