

**Chemistry: Periodic Table 1**

**Whole Unit Overview**

(Please note: (S) denotes material in the Supplement (Extended syllabus) only)

Learning Outcomes		Suggested Teaching Activities	Resources
6.1	Describe the meaning of exothermic and endothermic reactions.	<p>This can be seen as a rise or fall in temperature of many often chemical reactions used in the syllabus.</p> <p><i>This concept can be taught across the syllabus, rather than as a discrete lesson.</i></p> <p><i>Suggested experiments:</i></p> <ul style="list-style-type: none"> <li>• <i>neutralisation reactions of acids and alkalis (see Unit 3 Acids - section 8.1)</i></li> <li>• <i>metal displacement reactions (see section 10.2 below)</i></li> <li>• <i>dissolving salts, including ammonium salts</i></li> <li>• <i>if data loggers are available, temperature probes could be used.</i></li> </ul>	

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9	Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements.	<p>Elements to be classified as metals and non-metals. Their states should be mentioned.</p> <p>Properties limited to quantitative idea of melting/boiling point.</p> <p><i>Suggested activities:</i></p> <ul style="list-style-type: none"> <li>• <i>students make observations from photographic version of periodic table.</i></li> <li>• <i>a database of properties and states for element of periods 1, 2 and 3 could be set up. Students could be asked to design queries to find the metals, non metal, solids and liquids and enter the results on a blank copy of the periodic table.</i></li> </ul>	<p>Interactive periodic tables:  <a href="http://www.cs.ubc.ca/cgi-bin/nph-pertab/tab/periodic-table">http://www.cs.ubc.ca/cgi-bin/nph-pertab/tab/periodic-table</a>  <a href="http://www.webelements.com/">http://www.webelements.com/</a>  <a href="http://chemlab.pc.maricopa.edu/periodic/periodic.html">http://chemlab.pc.maricopa.edu/periodic/periodic.html</a>  <a href="http://www.dayah.com/periodic/">http://www.dayah.com/periodic/</a>  <a href="http://www.chemicool.com/">http://www.chemicool.com/</a>  <a href="http://www.chemsoc.org/viselements/">http://www.chemsoc.org/viselements/</a></p> <p>Periodic table teaching site:  <a href="http://www.genesismission.org/educate/scimodule/cosmic/ptable.html">http://www.genesismission.org/educate/scimodule/cosmic/ptable.html</a></p>
9.1	Describe the change from metallic to non-metallic character across a Period.	Emphasize the metal/non metal boundary.	
9.1(S)	Describe the relationship between Group number, number of valency electrons and metallic/non-metallic character.	Emphasize number of valency electrons = group number.	
10.1	Describe the general physical and chemical properties of metals.	<p>Physical properties such as appearance, melting/boiling point, conduction of heat and electricity, malleability and ductility.</p> <p>Chemical properties such as reactions with water, steam and dilute mineral acids.</p>	

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10.1	Explain why metals are often used in the form of alloys.	Relate to improvement in corrosion resistance and mechanical properties such as strength.  <i>Link to production of steel (section 10.3a below) and brass.</i>	
9.2	Describe lithium, sodium and potassium in Group 1 as a collection of relatively soft metals showing a trend in melting point, density, in reaction with water.	Demonstration <i>or video</i> only of reactions with water due to highly exothermic nature. Focus on the observations here.	
9.2	Predict the properties of other elements in the Group, given data, where appropriate.	Include reactions of Rubidium and Caesium and physical properties such as melting and boiling points. Trends can be obtained from suitable data bases.	
10.2	Place in order of reactivity: calcium; copper, (hydrogen), iron, magnesium, potassium, sodium and zinc by reference to the reactions, if any, of the metals with  Water or steam  Dilute hydrochloric acid  And the reduction of their oxides with carbon.	Experiments possible include :  Potassium, Sodium with water (as demonstration only)  Calcium, Magnesium with water  Magnesium, Zinc with steam  Magnesium, Zinc, Iron with dilute hydrochloric acid.  For advanced candidates this could be extended to (aluminium), lead, nickel, tin and silver to provide a more detailed list of reactivities. (note that aluminium is less reactive than expected in test tube experiments)	

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10.2 (S)	Describe the reactivity series as related to the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with  The aqueous ions,  The oxides, of the other listed metals.	Experiments possible include :  Reaction of the metals magnesium, zinc, iron and copper with aqueous solution of their ions.  (again (aluminium), lead, nickel, tin and silver could be added to the list to expand the experiment)  Aluminium and iron(III) oxide (Thermit reaction) as a demonstration of the reactions of metals and oxides.	
10.2 (S)	Account for the apparent unreactivity of aluminium in terms of the oxide layer which adheres to the metal.	Do not confuse with rusting of iron.	
10.3(b)	Name the uses of aluminium: in the manufacture of aircraft because of its strength and low density and in food containers because of its resistance to corrosion.	<i>Relate to the uses of aluminium e.g. aluminium is toxic, but oxide layer enables its use for drinks cans.</i>	
10.2	Deduce an order of reactivity from a given set of experimental results.	Reactions of metals with water, steam and dilute hydrochloric or sulphuric acid ( <i>for advanced candidates also with other aqueous metal ions</i> ).	

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10.3 (a)	Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series.	<p>Electrolysis, carbon + metal oxide and mining of native metal as the different methods.</p> <p>Relate these three methods to the position of the metal in the reactivity series.</p> <p><i>Possible issues to discuss include</i></p> <ul style="list-style-type: none"><li>• <i>the economic and environmental cost of the high energy required in metal extraction processes.</i></li><li>• <i>the large input of non renewable fossil fuel resources into electrolysis and carbon reduction.</i></li><li>• <i>the importance of recycling metals.</i></li></ul>	
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10.3(a)	Describe the essential reactions in the extraction of iron from haematite.	<p>Key points : use of blast furnace, coke, hot air, limestone and iron ore and the formation of slag and molten iron.</p> <p><i>Possible issues to discuss include</i></p> <ul style="list-style-type: none"> <li>• <i>local environmental effect of large scale mining of haematite</i></li> <li>• <i>the economic and environmental cost of the high energy demand of blast furnace.</i></li> <li>• <i>the large input of non renewable fossil fuel resources into carbon reduction.</i></li> <li>• <i>the need to collect waste toxic carbon monoxide, which can be used as a fuel to reduce energy cost of plant</i></li> <li>• <i>the environmental effect of disposing of slag, and economic issues of searching for a potential use for the waste material</i></li> <li>• <i>the need to recycle iron.</i></li> </ul>	<p>Iron and steel manufacture:  <a href="http://www.ohiosteel.org/">http://www.ohiosteel.org/</a></p>
10.3(a)	Describe the conversion of iron into steel.	Use of basic oxygen process (O <sub>2</sub> lance) <i>limited to the removal of carbon excess carbon (good example of redox chemistry to illustrate syllabus section 7.3).</i>	

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10.3 (b)	Describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys.	Use of other elements (often transition elements) and changing carbon content to alter properties such as strength and hardness.  <i>Opportunity for data analysis activities to link steel specifications to use.</i>	
10.3(b)	Name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery).	Relate to greater resistance to chemical attack on stainless steel	
10.3(a) (S)	Describe in outline, the extraction of zinc from zinc blende.	Key points : roasting in air of sulphide to produce oxide and then similar process to iron manufacture (except there is no limestone and zinc vaporizes and condenses in pans high in the furnace).  <i>Possible issues to discuss</i> <ul style="list-style-type: none"> <li>• <i>high energy demand of process and input of non renewable fossil fuel</i></li> <li>• <i>polluting effects of waste sulphur dioxide and resultant legislative control of roasting in many countries</i></li> <li>• <i>the need to recycle zinc.</i></li> </ul>	History of the production of zinc: <a href="http://www.zincworld.org/">http://www.zincworld.org/</a>
10.3(b) (S)	Name the uses of zinc for galvanising and for making brass.	Can be expanded to include coinage and musical instruments.	

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<p>10.3(b) (S)</p>	<p>Name the uses of copper related to its properties; electrical wiring and in cooking utensils.</p>	<p>Properties such as electrical conductivity, melting point and general low chemical reactivity.</p> <p>Uses can be expanded to include coinage</p> <p><i>Link to Unit 8 (Electrochemistry) regarding the purification of copper.</i></p> <p><i>Issues of the need and economic difficulties of recycling of metals could be discussed here.</i></p>	
<p>9.3</p>	<p>Describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts.</p>	<p>Relevant elements for colours include iron (valency of 2 and 3), manganese (in potassium manganate(VII)), chromium (in potassium dichromate(VI)) and copper(II).</p> <p>Catalysts to include nickel for hydrogenation of alkenes/fats, platinum in car catalytic converters and iron in the Haber process (also vanadium(V) oxide in the Contact process).</p> <p><i>Possible issues to discuss include the importance of catalysts in lowering the energy demand of industrial processes and hence conserving fossil fuel and increasing profitability.</i></p>	