AQA Chemistry GCSE Student Progress

Unit 4.10 - Using Resources

4.10.1. Using the Earth's Resources and Obtaining Potable Water

4.10.1.1. Using the Earth's Resources and Sustainable Development

a	I know that humans use the Earth's resources to provide warmth, shelter, food and transport.			
b	I know that natural resources, supplemented by agriculture, provide food, timber, clothing and fuels and I can state examples of natural products that are supplemented or replaced by agricultural and synthetic products.			
c	I can describe how finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials.			
d	I know that sustainable development is development that meets the needs of current generations without compromising the ability of future generations to meet their own needs.			
e	I can describe the role of chemistry in improving agricultural and industrial processes to provide new products and in sustainable development.			
f	I can distinguish between finite and renewable resources (given appropriate information).			
g	I can extract and interpret information about resources from charts, graphs and tables.			

4.10.1.2. Potable Water

a	I know that water of appropriate quality is essential for life and that water that is safe to drink is called potable water.			
b	I know that, for humans, potable drinking water should have sufficiently low levels of dissolved salts and microbes.			
c	I know that potable water is not pure water in the chemical sense because it contains dissolved substances.			
d	I know that, in the United Kingdom (UK), rain provides water with low levels of dissolved substances (fresh water) that collects in the ground and in lakes and rivers.			
e	I know that the methods used to produce potable water depend on available supplies of water and local conditions.			
f	I know that most potable water is produced by: • choosing an appropriate source of fresh water; • passing the water through filter beds; • sterilising.			
g	I know that sterilising agents used for potable water include chlorine, ozone or ultraviolet light.			
h	I know that, if supplies of fresh water are limited, desalination of salty water or sea water may be required.			
i	I know that desalination can be done by distillation or by processes that use membranes such as reverse osmosis and that these processes require large amounts of energy.			
j	I can give reasons for the steps used to produce potable water.			

4.10.1.3. Waste Water Treatment

a	I know that urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released into the environment.			
b	I know that sewage and agricultural waste water require removal of organic matter and harmful microbes and that industrial waste water may require removal of organic matter and harmful chemicals.			
c	I know that sewage treatment includes: • screening and grit removal; • sedimentation to produce sewage sludge and effluent; • anaerobic digestion of sewage sludge; • aerobic biological treatment of effluent.			
d	I can comment on the relative ease of obtaining potable water from waste, ground and salt water.			

4.10.1.4. Alternative Methods of Extracting Metals (HT Only)

a	I know that the Earth's resources of metal ores are limited.			
b	I know that copper ores are becoming scarce and new ways of extracting copper from low-grade ores include phytomining, and bioleaching and that these methods avoid traditional mining methods of digging, moving and disposing of large amounts of rock.			
c	I know that phytomining uses plants to absorb metal compounds from the soil as they grow and that the plants are then harvested and burned to produce ash that contains metal compounds.			
d	I know that bioleaching uses bacteria to produce leachate solutions that contain metal compounds.			
e	I know that the metal compounds obtained from phytomining and bioleaching can be processed to obtain the metal e.g. copper can be obtained from solutions of copper compounds by displacement using scrap iron or by electrolysis.			
f	I can evaluate alternative biological methods of metal extraction (given appropriate information).			

4.10.2. Life Cycle Assessment and Recycling

4.10.2.1 Life Cycle Assessment

a	I know that life cycle assessments (LCAs) are carried out to assess the environmental impact of products in each of these stages: • extracting and processing raw materials; • manufacturing and packaging; • use and operation during its lifetime; • disposal at the end of its useful life, including transport and distribution at each stage.			
b	I know that use of water, resources, energy sources and production of some wastes can be fairly easily quantified, however, allocating numerical values to pollutant effects is less straightforward and requires value judgements, so LCA is not a purely objective process.			
c	I know that selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, eg in support of claims for advertising purposes.			
d	I can carry out simple comparative LCAs for shopping bags made from plastic and paper.			
e	I can interpret LCAs of materials or products (given appropriate information).			

4.10.2.2 Ways of Reducing the Use of Resources

a	I can describe how, the reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, use of energy sources, waste and environmental impacts.			
b	I know that metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials and that much of the energy for the processes comes from limited resources.			
c	I know that obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.			
d	I can describe how some products, such as glass bottles, can be reused or can be crushed and melted to make different glass products but that other products cannot be reused and so are recycled for a different use.			
e	I know that metals can be recycled by melting and recasting or reforming into different products.			
f	I know that the amount of separation required for recycling depends on the material and the properties required of the final product e.g. some scrap steel can be added to iron from a blast furnace to reduce the amount of iron that needs to be extracted from iron ore.			
g	I can evaluate ways of reducing the use of limited resources (given appropriate information).			

4.10.3. Using Materials (Chemistry Only)

4.10.3.1 Corrosion and its Prevention (Chemistry Only)

a	I know that corrosion is the destruction of materials by chemical reactions with substances in the environment and that rusting is an example of corrosion.			
b	I know that both air and water are necessary for iron to rust.			
c	I can describe an experiment and interpret results to show that both air and water are necessary for rusting.			
d	I know that corrosion can be prevented by applying a coating that acts as a barrier, such as greasing, painting or electroplating and that aluminium has an oxide coating that protects the metal from further corrosion.			
e	I know that some coatings are reactive and contain a more reactive metal to provide sacrificial protection, e.g. zinc is used to galvanise iron.			
f	I can explain sacrificial protection in terms of relative reactivity.			

4.10.3.2 Alloys as Useful Materials (Chemistry Only)

a	I know that most metals in everyday use are alloys e.g. bronze is an alloy of copper and tin, brass is an alloy of copper and zinc and gold used as jewellery is usually an alloy with silver, copper and zinc.			
b	I know that the proportion of gold in the alloy is measured in carats with 24 carat being 100% (pure gold), and 18 carat being 75% gold.			
c	I know that steels are alloys of iron that contain specific amounts of carbon and other metals.			
d	I know that high carbon steel is strong but brittle and low carbon steel is softer and more easily shaped.			
e	I know that steels containing chromium and nickel (stainless steels) are hard and resistant to corrosion.			
f	I know that aluminium alloys are low density.			
g	I can recall a use of each of the alloys specified.			
h	I can interpret and evaluate the composition and uses of alloys other than those specified given appropriate information.			

4.10.3.3 Ceramics, Polymers and Composites (Chemistry Only)

a	I know that most of the glass we use is soda-lime glass, made by heating a mixture of sand, sodium carbonate and limestone.			
b	I know that borosilicate glass, made from sand and boron trioxide, melts at higher temperatures than soda-lime glass.			
c	I know that clay ceramics, including pottery and bricks, are made by shaping wet clay and then heating in a furnace.			
d	I know that the properties of polymers depend on what monomers they are made from and the conditions under which they are made e.g. low density (LD) and high density (HD) poly(ethene) are produced from ethene.			
e	I can explain how low density and high density poly(ethene) are both produced from ethene.			
f	I know that thermosoftening polymers melt when they are heated, whilst thermosetting polymers do not melt when they are heated.			
g	I can explain the difference between thermosoftening and thermosetting polymers in terms of their structures.			
h	I can compare the properties of thermosetting and thermosoftening polymers.			
i	I know that most composites are made of two materials, a matrix or binder surrounding and binding together fibres or fragments of the other material, which is called the reinforcement.			
j	I can recall some examples of composites.			
k	I can compare quantitatively, the physical properties of glass and clay ceramics, polymers, composites and metals.			
l	I can explain how the properties of materials are related to their uses and select appropriate materials.			

4.10.4. The Haber Process and the Use of NPK Fertilisers (Chemistry Only)

4.10.4.1 The Haber Process (Chemistry Only)

a	I know that the Haber process is used to manufacture ammonia, which can be used to produce nitrogen-based fertilisers.			
b	I know that the raw materials for the Haber process are nitrogen and hydrogen.			
c	I can recall a source for the nitrogen and a source for the hydrogen used in the Haber process.			
d	I know that the purified gases (nitrogen and hydrogen) are passed over a catalyst of iron at a high temperature (about 450°C) and a high pressure (about 200 atmospheres) and that some of the hydrogen and nitrogen reacts to form ammonia.			
e	I know that on cooling, the ammonia liquefies and is removed. The remaining hydrogen and nitrogen are recycled.			
f	I know that the reaction is reversible so some of the ammonia produced breaks down into nitrogen and hydrogen.			
g	I can interpret graphs of reaction conditions versus rate.			
h	I can apply the principles of dynamic equilibrium to the Haber process.			
i	I can explain the trade-off between rate of production and position of equilibrium.			
j	I can explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate.			

4.10.4.2 Production and Uses of NPK Fertilisers (Chemistry Only)

a	I know that compounds of nitrogen, phosphorus and potassium are used as fertilisers to improve agricultural productivity and that NPK fertilisers contain compounds of all three elements.			
b	I know that NPK fertilisers are formulations of various salts containing appropriate percentages of the elements.			
c	I know that industrial production of NPK fertilisers can be achieved using a variety of raw materials in several integrated processes.			
d	I know that ammonia can be used to manufacture ammonium salts and nitric acid.			
e	I know that potassium chloride, potassium sulphate and phosphate rock are obtained by mining, but phosphate rock cannot be used directly as a fertiliser.			
f	I know that phosphate rock is treated with nitric acid or sulphuric acid to produce soluble salts that can be used as fertilisers.			
g	I can recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid.			
h	I can compare the industrial production of fertilisers with laboratory preparations of the same compounds, given appropriate information.			