4.10 Using resources - Knowledge Organiser

4.10.1	Using the Earth's resources and obtaining potable water
4.10.11 Using the Earth's resources and sustainable development	Humans use the Earth's resources to provide **warmth**, **shelter**, **food** and **transport**. Natural resources, supplemented by agriculture, provide food, clothing and fuels. **Finite** resources (will run out) from the Earth, oceans and atmosphere are processed to provide energy and materials. Chemistry plays an important role in improving agricultural and industrial processes to provide new products and in **sustainable development**, which is development that meets the needs of current generations without compromising the ability of future generations to meet their own needs ie the world isn't destroyed to provide our needs
4.10.1.2 **Potable water**	Water of appropriate quality is essential for life. For humans, drinking water should have sufficiently low levels of dissolved salts and microbes. **Water that is safe to drink** is called **potable water**. Potable water is not pure water in the chemical sense because it contains dissolved substances. The methods used to produce potable water depend on available supplies of water and local conditions. 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, and most **potable water** is produced by: • choosing an appropriate **source** of fresh water • passing the water through **filter beds** to remove insoluble substances • **sterilising to** kill microbes **Sterilising agents** used for potable water include **chlorine, ozone** or **ultraviolet light**. If supplies of fresh water are limited, **desalination** of **salty water** or sea water may be required. Desalination can be done by **distillation** or by processes that use **membranes** such as **reverse osmosis**. These processes require **large amounts of energy.** **Required practical 8:** analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.
4.10.1.3 **Waste water treatment**	Urban lifestyles and industrial processes produce large amounts of **waste water** that require treatment before being released into the . **Sewage** and **agricultural waste water** require **removal of organic matter** and **harmful microbes.** Industrial waste water may require removal of organic matter and harmful chemicals. **Sewage treatment** includes: · **screening and grit removal** · **sedimentation** to produce sewage sludge and effluent – chemicals added to clump insoluble particles together · **anaerobic digestion** of sewage sludge · **aerobic biological** treatment of **effluent.**
4.10.1.4 **Alternative methods of extracting metals (HT only)**	The Earth's resources of metal ores are limited. Ores are becoming scarce and new ways of **extracting copper** from **low-grade ores** include **phytomining**, and **bioleaching**. These methods avoid mining methods of digging, moving and **disposing of large amounts of rock.** **Phytomining** uses **plants** to absorb metal compounds. The plants are harvested and then **burned** to produce **ash** that contains metal compounds. **Bioleaching** uses **bacteri**a to produce **leachate** sol**utions** that contain metal compounds.The metal compounds can be processed to obtain the metal. For example, copper can be obtained from solutions of copper compounds by **displacement using scrap iron** or by **electrolysis.**

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4.10.2	Life cycle assessment and recycling
4.10.2.1 **Life cycle assessment**	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. Use of water, resources, energy sources and production of some wastes can be fairly easily quantified. Allocating numerical values to pollutant effects is less straightforward and requires **value judgements**, so LCA is not a purely objective process. Beware of **bias**
4.10.2.2 **Ways of reducing the use of resources**	The reduction in use, the reuse and recycling of materials by end users reduces the use of limited resources, use of energy sources, waste and environmental impacts. Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. Much of the energy for theprocesses comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts. Some products, such as glass bottles, can be reused. Glass bottles can be crushed and melted to make different glass products. Other products cannot be reused and so are recycled for a different use. Metals can be **recycled** by **melting** and **recasting** or reforming into different products. The amount of separation required for recycling depends on the material and the properties required of the final product. For example, 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.
4.10.3	Using materials (chemistry only)
4.10.3.1 **Corrosion and its prevention**	Corrosion is the destruction of materials by chemical reactions with substances in the environment. **Rusting** is an example of **corrosion**. Both **air** and **water** are necessary for iron to rust. It can be prevented by applying a **coating** that acts **as a barrier**, such as **greasing**, **painting** or **electroplating**. Aluminium has an oxide coating that protects the metal from further corrosion. **Some coatings** are **reactive** and contain a more reactive metal to provide **sacrificial protection**, eg **zinc** is used to **galvanise iron**.
4.10.3.2 **Alloys as useful materials**	Most metals in everyday use are alloys. **Bronze** is an alloy of **copper** and **tin**. **Brass** is an alloy of **copper** and **zinc**. Gold used as jewellery is usually an alloy with silver, copper and zinc. The proportion of gold in the alloy is **measured in carats**. **carat** being **100% (pure gold**), and 18 carat being 75% gold. **Steels** are alloys of **iron** that contain specific amounts of **carbon** and **other metals**. **High carbon steel** is **strong** but **brittle**. **Low carbon steel** is **softer** and more easily shaped. Steels containing **chromium** and **nickel** (**stainless steels)** are hard and resistant to corrosion. **Aluminium alloys** are **low density.**
4.10.3.3	Most of the **glass** we use is **soda-lime glass**, made by heating a mixture of **sand, sodium carbonate** and **limestone**. **Borosilicate glass**, made from **sand** and **boron trioxide**, melts at **higher temperatures** than soda-lime glass.

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Ceramics, polymers and composites	**Clay ceramics**, including **pottery** and **bricks**, are made by shaping **wet clay** and then heating in a **furnace**. The properties of **polymers** depend on what **monomers** they are made from and the **conditions** under which they are made. **Low density (LD)** and **high density (HD) poly(ethene**) are produced from **ethane (a monomer)** using **different catalysts and temperatures.** **Thermosoftening** polymers **melt** when they are heated. **Thermosetting** polymers **do not melt** when they are heated. They have **cross links** preventing the polymer molecules separating. 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.
4.10.4	**The Haber process and the use of NPK fertilisers (Chemistry only)**
4.10.4.1 The Haber process	The **Haber process** is used to manufacture **ammonia**, which can be used to produce **nitrogen**-based fertilisers. The raw materials for the Haber process are **nitrogen** (from air) and **hydrogen (**water or natural gas**)** The purified gases are passed over a **catalyst of iron** at a **high** m**temperature (about 450°C**) and a high **pressure (about 200** atmospheres). Some of the hydrogen and nitrogen reacts to form **ammonia**. The **reaction is reversible** *nitrogen + hydrogen* ← → *ammonia* On **cooling**, the **ammonia liquefies** and is **removed**. The remaininghydrogen and nitrogen are recycled. (HT only) Students should be able to: • interpret graphs of reaction conditions versus rate • 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	**Compounds** of **nitrogen**, **phosphorus** and **potassium** are used as **fertilisers** to improve agricultural productivity. **NPK fertilisers** contain compounds of all three elements. Industrial production of NPK fertilisers can be achieved using a variety of raw materials in several integrated processes. NPK fertilisers are formulations of various salts containing appropriate percentages of the elements. Ammonia can be used to manufacture ammonium salts and nitric acid. Potassium chloride, potassium sulfate and phosphate rock are obtained by mining, but phosphate rock cannot be used directly as a fertiliser. Phosphate rock is treated with nitric acid or sulfuric acid to produce soluble salts that can be used as fertilisers. Students should be able to: • recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid • compare the industrial production of fertilisers with laboratory preparations of the same compounds, given appropriate information.

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