C10 Using Resources

What's the science story?

Industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists' study how human activity has affected the Earth's natural cycles, and how damaging effects can be minimised.

Previous knowledge:

KS3 - pH testing and separation techniques

Next steps…

N/A

Keywords

Natural	Reuse	Desalination
Synthetic	Recycle	Distillation
Finite	Potable	Purify
Renewable	Pure	Bioleaching
Non-renewable	Sterilisation	Phytomining

Working scientifically skills:

WS2 - Draw/Interpret diagrams
WS3 - Make predictions - Make prediction using a model
WS4 - Ethical arguments - Rights and wrongs of technology
WS5 - Risk perception - Hazards of new technology

Assessments:

End of unit test (summative)
Exit tickets x 1 (formative)

- **Exam Q's on water cycle & water treatment**

AQA GCSE Combined Science Trilogy (8464)

Lesson No. and Title	Learning objectives	AQA Specification	Practical equipment
1. Using Resources	4 – State examples of natural products that are supplemented or replaced by agricultural and synthetic products. 5 – Distinguish between finite and renewable resources, reuse and recycle. 6 – Extract and interpret information about resources from graphs.	**5.10.1.1 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, timber, clothing and fuels. Finite resources 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. Students should be able to: • state examples of natural products that are supplemented or replaced by agricultural and synthetic products • distinguish between finite and renewable resources given appropriate information. Students should be able to: • extract and interpret information about resources from charts, graphs and tables • use orders of magnitude to evaluate the significance of data **5.10.2.2 Ways of reducing the use of resources** 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. Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. Much of the energy for the processes 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. Students should be able to evaluate ways of reducing the use of limited resources, given appropriate information.	

2. Potable Water	4 - To describe the difference between potable water and pure water. 5 – To describe the differences in treatment of ground water, salt water and sewage. 6 – To give reasons for each of the steps in producing potable water.	**5.10.1.2 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 • sterilising. 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. Students should be able to: • distinguish between potable water and pure water • describe the differences in treatment of ground water and salty water • give reasons for the steps used to produce potable water. **5.10.1.3 Waste water treatment** Urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released into the environment. 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 • anaerobic digestion of sewage sludge • aerobic biological treatment of effluent. Students should be able to comment on the relative ease of	

		obtaining potable water from waste, ground and salt water.	
3. Required practical – analysing and purifying water	Carry out practical safely and using appropriate equipment. Obtain results that will allow for a conclusion to be made.	Required practical activity 13: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.	**Method 1** - X3 samples of water to identify, universal indicator paper, balances, measuring cylinders, beakers, evaporating basins In labs - Tripods, heat mats, gauzes and Bunsens. **Method 2** – Conical flasks, delivery tubes, test tubes, beakers. In labs - Tripods, heat mats, gauzes and Bunsens.
4. Life Cycle Assessment	5 – To describe the four stages in carrying out a life cycle assessment (LCA) of a material or product. 6 – To evaluate the advantages and disadvantages of recycling a material or product.	**5.10.2.1 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.	

		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. Students should be able to carry out simple comparative LCAs for shopping bags made from plastic and paper.	
5. HT - Extracting metals	5 – To describe the methods of extracting metals (AO1). 6 – To evaluate the use of bioleaching, phytomining and traditional mining (AO3).	**5.10.1.4 Alternative methods of extracting metals (HT only)** The Earth's resources of metal ores are limited. Copper ores are becoming scarce and new ways of extracting copper from low-grade ores include phytomining, and bioleaching. These methods avoid traditional 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 bacteria to produce leachate solutions 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. Students should be able to evaluate alternative biological methods of metal extraction, given appropriate information.	