# Scheme of work

## Combined Science: Trilogy - Foundation

## Chemistry – Using resources

This resource provides guidance for teaching the Using resources topic from our new GCSE Combined Science: Trilogy specification (8464). It has been updated from the draft version to reflect the changes made in the accredited specification. These changes are also reflected in the learning outcomes, opportunities to develop skills with some additions to the resources.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 5.10 Using resources

#### 5.10.1 Using the Earth's resources and obtaining potable water

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes** *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment****Opportunities and resources***Reference to past questions that indicate success*  |
| --- | --- | --- | --- | --- | --- | --- |
| 5.10.1.1 | 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. It’s also important 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. | State examples of natural products that are supplemented or replaced by agricultural and synthetic products.Distinguish between finite and renewable resources given appropriate information.Extract and interpret information about resources from charts, graphs and tables.Use orders of magnitude to evaluate the significance of data.WS 3.2MS 2c, 2h, 4a | 2 | Define finite and renewable resources and describe the differences using suitable examples.Define sustainable development.Give examples of natural products that are supplemented or replaced by agricultural and synthetic products, such as strawberries or cotton.Compare the production of strawberries from different locations: [Sustainable Strawberries – Understanding Sustainability](http://www.sustainability-ed.org.uk/support_materials/LCA%20strawberries.pdf)  | Investigate whether cotton or polyester would be better for making an outdoor coat, ie:* toughness by rubbing with sandpaper
* heaviness by weighing wet and dry
* waterproofness by inverting a measuring cylinder of water
* easiest to clean.

  | [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |
| 5.10.1.2 | 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 UK, rain provides water with low levels of dissolved substances (fresh water) that collects in the ground, 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 ultra-violet 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. | 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.WS 2.3, 2.4, 2.5, 2.6, 2.7 | 2 | Define potable and pure water, and describe the differences between them.Recall the water cycle.Research where local water is sourced from (ie ground water or reservoirs). Draw a flow diagram to describe the stages in producing potable water in the UK, focusing on the locality.Discuss the advantages and disadvantages of using chlorine to sterilise swimming pools.Describe the process of desalination as a diagram, highlighting the places in the world where it is used. | **Required practical 13:**Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.AT skills covered by this practical activity: 2, 3 and 4.  | Video clipYouTube:[UTEC – Potable Water Generator](https://www.youtube.com/watch?v=35yeVwigQcc) Resources for schools - [Thames Water Tools for Schools](http://www.thameswater.co.uk/about-us/3494.htm)[Simple Distillation](https://www.youtube.com/watch?v=x-Bnq6UPdZo) |
| 5.10.1.3 | 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.
 | Comment on the relative ease of obtaining potable water from waste, ground and salt water. | 1 | Draw a flow diagram to illustrate the stages in a water treatment works.Compare the methods of obtaining potable water from waste, ground and salt water, giving advantages and disadvantages for each. | Set up a model sewage treatment works eg: [Waterwise – Making a model of a wastewater treatment works](http://www.waterwise.co.za/export/sites/water-wise/education/activities/wastewater-cleaned/downloads/Making_a_Model_of_a_Wastewater_Treatment_Works.pdf)  | Several water companies provide resources for schools regarding sewage treatment, for example:[Anglian Water](http://www.anglianwater.co.uk)Video clipYouTube:[Water and You: The Water Treatment Process](https://www.youtube.com/watch?v=tuYB8nMFxQA) |

#### 5.10.2 Life cycle assessment and recycling

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes** *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment****Opportunities and resources***Reference to past questions that indicate success*  |
| --- | --- | --- | --- | --- | --- | --- |
| 5.10.2.1 | 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. | Carry out simple comparative LCAs for shopping bags made from plastic and paperWS 1.3, 1.4, 1.5MS 1a, 1c, 1d, 2a, 4a | 1 | Describe what a LCA is using: [Sustainability Ed – Life cycle of a cup of coffee](http://www.sustainability-ed.org.uk/pages/look4-1.htm) .Describe the LCA of bottling lemonade: small cans made of aluminium vs single serving glass bottles vs 2 l polythene bottle and the problems with deciding which system to use. Link this to how caution is needed when using LCAs compared to other sustainability models.[Sustainability Ed – Measuring sustainable development](http://www.sustainability-ed.org.uk/pages/look1-1.htm) . | Use the internet to carry out simple comparative LCAs for shopping bags made from plastic and paper:[Sustainability Ed – What goes into an LCA](http://www.sustainability-ed.org.uk/pages/look4-2.htm) |  |
| 5.10.2.2 | The reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, energy consumption, waste and environmental impacts.Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. Much of the energy used in 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. | Evaluate ways of reducing the use of limited resources, given appropriate information. | 2 | Describe the environmental impacts of obtaining raw materials from the Earth. Students can research methods of producing metal, glass, building materials, clay ceramics, plastics and how much energy is used in each case. Use local area maps to identify sites of raw material extraction (if any): [Minerals UK – Statistics](https://www.bgs.ac.uk/mineralsuk/statistics/UKStatistics.html) Research the major global sites for extracting different resources and raw materials considered critical: [Minerals UK – Critical Raw Materials](http://www.bgs.ac.uk/mineralsuk/statistics/criticalRawMaterials.html) Compare the energy used in making new glass with recycling glass.Research how metal is recycled and alternatives for use of scrap metals including adding steel to a blast furnace:[EEF UK Steel – The electric arc furnace](http://www.eef.org.uk/uksteel/About-the-industry/How-steel-is-made/step-by-step/The-electric-arc-furnace.htm) Another example of recycling is here: [The Atlantic – Turn your Christmas tree lights into slippers](http://www.theatlantic.com/international/archive/2011/12/the-chinese-town-that-turns-your-old-christmas-tree-lights-into-slippers/250190/)  | Demonstrate the different materials. Students can make recycled paper using newspaper (liaise with Art departments to check cross-curricular links).Liaise with Art department for links with ceramics.Students can make glass: [RSC – Making Glass](http://www.rsc.org/learn-chemistry/resource/res00000687/making-glass)Students can compare the properties – colour, clarity, pliability of different plastics, ie:* milk bottle (HDPE)
* bleach bottle (PVC)
* bin bag (LDPE)
* yoghurt container (PP)
* clear plastic cups (PS)
* lemonade bottle (PET).

 Students can extract copper: [Nuffield Foundation – Extracting metals from rocks](http://www.nuffieldfoundation.org/practical-chemistry/extracting-metals-rocks) [Nuffield Foundation – Extracting metals with charcoal](http://www.nuffieldfoundation.org/practical-chemistry/extracting-metals-charcoal)  | Video clipYouTube:[Recycling Plastics](http://www.youtube.com/watch?v=s5p6Nk3SzcU) |