Categorising and describing resources:

Resources are categorised as renewable (or sustainable). These are often natural items that can be grown. Finite resources are limited so will run out.

Humans need food and shelter to survive	Mostly natural resources like plants to eat, trees for timber, rocks for building, cotton for fabrics.
Humans use energy for warmth and transport	Mostly finite resources like fossil fuels to burn and metals to build.

Finite resource: one being used up faster than it can be replaced. To make sure that food is not being used up faster than it can be replaced, we use fertilisers to increase food production. To make sure we have enough energy we improve efficiency. Chemists are vitally important to these advances.

Sustainable development: development that meets the needs of current generations without compromising the ability of future generations to meet their own needs.

Some natural resources are under threat or can only be grown in a specific place or there is not enough of it to meet demand. We can replace these with synthetic products – ones that are made by chemists, these include:

Natural resource	Useful product	Synthetic alternative
Wool (from sheep)	Carpets and clothing	Polymer (polyester)
Rubber (from tree)	Car tyres, tap washers	Polymer

Order of magnitude

You will be expected to calculate the difference between large numbers using "order of magnitude". The difference between a 10 gram mouse, a 100 gram bird and 1000 gram cat is one order of magnitude between the mouse and bird (x10 difference), and two orders of magnitude between the mouse and the cat (x100 difference). You may also be given numbers that require rounding:

Multiplication value	Order of magnitude
x10	1
x100	2
x1000	3
x10,000	4

Potable water: Water that is safe to drink

Most water needs to be processed and treated to make sure it is safe to drink. Where you get the water from depends on how it gets treated:

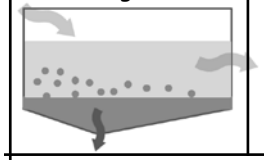
Fresh water: rivers and lakes	Salt water: inland seas and oceans
Part 1: **filter** out debris, let large dirt **settle** to the bottom. Part 2: **sterilise** (kill off bacteria) with chlorine or ozone or UV light	Step 1: filter out large objects. Step 2: **desalinate** (remove salt) by either high temperature **distillation** or high pressure **reverse osmosis**.
Benefits: Cheaper method, less energy used, quicker to process.	Drawbacks: more expensive because high temperature and pressure use lots of energy, slower to produce

Because desalination is so much more expensive, it is used when there is no fresh water available, so countries in dry and desert areas use this method more.

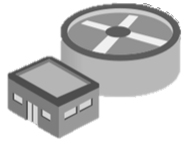
Sewage water: water from human and animal waste must also be treated…

Filter out paper leaves and debris

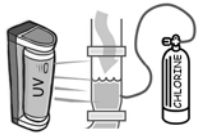
Sedimentation of the sludge



Aerobic digestion



Sterilisation



Anaerobic treatment of the **solid** waste removed

Clean water

Required Practical: Analysing and purifying water

Reproducibility and reliable results are essential. So if asked to "devise a fair test on a 100 cm^3 sample of water" you must:

1. Divide the sample into smaller volumes so you can see if your results are reproducible. Divide the sample into 10 smaller samples (e.g. 10 cm^3)
2. Always record the mass of any crucibles **before and after** to calculate the difference and find out the mass of the reside from the water sample.
3. Always use clean, dry equipment.

Type of analysis: A high pH (3-6) means acid rain, or distilled water. Low pH (8-10) means carbonate rocks and minerals dissolved in water. A boiling point of exactly 100 °C means pure water, the more impurities the lower the b.p. becomes. A freezing point of exactly 0 °C means pure water, the more impurities the lower the freezing point (this is why sea water is not frozen even at -10 °C.)

Trilogy C14 – The Earth's Resources Page 2 **Life Cycle Assessment: evaluating the impact on the environment of a product at all stages of its life**

You must be able to compare and evaluate two products that are made from two different types of resource that are made for the same purpose, for example a paper bag and a plastic bag. You must consider the following steps:

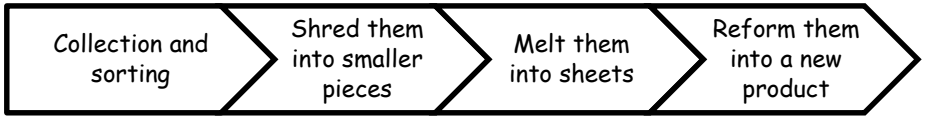
Stage:	Possible consequences:
Extracting and processing raw material.	Does it use lots of land, does it need lots of energy, does it pollute, is it dangerous?
Manufacturing and packaging	Does it use lots of energy, does it produce large amounts of waste?
Use and operating over the life time of the product	Can it be used many times over, does it need electricity or fossil fuels?
Disposal of the product	Can it be recycled easily, does it take a long time to decompose, is it natural?
Transport of the product throughout each stage	Heavy items (wood and metal) cost more to move than light (plastic).

Some of these processes may have numerical data that can be compared, you must always state the difference in the values and say which one is better. Some of these processes have no data and will be based more on judgement. Reasons you may decide that impact the environment might be:

Paper: *Negatives* requires forests with only one species of tree (reduces biodiversity), huge amounts of land required, huge amounts of water used to produce paper, paper products are heavy and have little strength and no resistance to water. *Positives* growing trees takes in carbon dioxide from atmosphere, trees are renewable, cutting down trees has a low likelihood of cause a huge environmental catastrophe, easily recycled or used as biomass.
Plastic: *Negatives* made from oil, a fossil fuel and a finite resource, if an oil spill occurs it has a devastating environmental impact, obtaining and processing the oil uses a lot of energy and produces lots of CO_2. *Positives* plastic is lightweight, it can be used many times, it is made very efficiently, most plastics can be recycled, plastic items are durable.

Reduce, reuse, recycle

Items that are finite resources are the most important to recycle – such as metals (aluminium, iron and copper). The main benefits of recycling are the large **reduction in energy** (which means less pollution from burning fossil fuels) and the **protect for wildlife** as metals are mined from the ground. Glass and plastic can also be recycled. The stages of recycling are similar for all products:



Extracting metals (Higher Tier): compare methods to obtain copper metal

High Grade Ores: An ore is a rock that contains enough metal to make it economically worth extracting. High grade means it has a high proportion of metal in the rock. The rock is heated until the metal becomes a liquid and is poured off. This requires lots of heat and so uses lots of energy. Involves mining- digging, moving and disposing of lots of rock.
Low Grade Ores: Very little metal present, so heating them too expensive. Instead we use either **bioleaching** where bacteria eat copper ore and release the copper as leachate solution; and **phytomining**, where a plant grows on land that contains copper, it absorbs the metal and stores it in the plants leaves and shoots, then the plant is harvested and burned to leave ash and metal compounds which are easily separated. The negative is both of these methods require a long time.

Purifying the metal: It is also important to purify the metal, either if the copper from any of these methods is impure, or if recycled copper contains other impurities, this can be done in one of two ways; a **displacement reaction** where the copper oxide (impure) is mixed with waste iron (more reactive metal that is cheaper) to produce iron oxide and pure copper; and **electrolysis** where the positive electrode has impure copper which travels to the negative electrode to make pure copper and the impurities fall off into solution.