The Earth's Resources Mastery Booklet

We use the Earth's natural resources to provide warmth, shelter, food and transport. If we do not alter them in any way (e.g. fruit for eating) then the resource is referred to as natural. If we have changed or made a new resource, it is referred to as "synthetic" (e.g. plastics).

All resources can be either finite (will run out) or renewable (will not run out). Crude oil can be used to manufacture fuel, but it will one day run out so is finite. We can also grow crops to turn into fuel but we can always grow more crops, so they are renewable. Most of the resources we use day-to-day are finite.

Where natural resources are running out it is down to scientists to design alternatives that are sustainable. Sustainable development is where we can meet the needs of current generations without compromising future generations.

1. How do finite and renewable resources differ?
2. Give two examples of finite resources
3. Give two examples of renewable resources
4. Car tires are made of synthetic rubber. Suggest an advantage of using synthetic rubber instead of natural rubber
5. Suggest a disadvantage of synthetic rubber
6. Poly(ethene) is made from ethene which comes from crude oil.
    a. What is crude oil?
    b. What is the formula for ethene?
    c. What type of material is poly(ethene)
    d. How are alkenes made from alkanes?
    e. When ethene reacts with oxygen it produces carbon dioxide and water. Write a symbol equation for this reaction.
    f. What are the potential negative consequences of releasing carbon dioxide into the atmosphere?
7. Coal is a fossil fuel that can be combusted
    a. In a combustion reaction the temperature of the surroundings increases. What type of reaction is this?
    b. Is coal a renewable or finite resource?
    c. Explain your answer
    d. The owner of a coal power plant wants to replace coal with wood chippings. Explain why such action is more sustainable than continuing to use coal.
8. Iron can be extracted from iron (III) oxide through reacting it with carbon. Carbon dioxide is a waste product.
    a. Write a word equation for this reaction
    b. Write a symbol equation for this reaction
    c. What name is given to this type of reaction?
    d. Why is electrolysis not necessary to extract iron?
    e. Is iron oxide a renewable resource?

Water safe to drink

The Earth's water originally condensed as rain as the Earth cooled. Now, it is collected in rivers, lakes, oceans and underground. This water is often not safe to drink as it can contain high levels of dissolved salts and dangerous microbes.

Water that is safe to drink is called **potable water**. This is water with safe levels of dissolved salts and no dangerous microbes. It is not **pure** because it is still a mixture of water and other substances, but the other substances are safe.

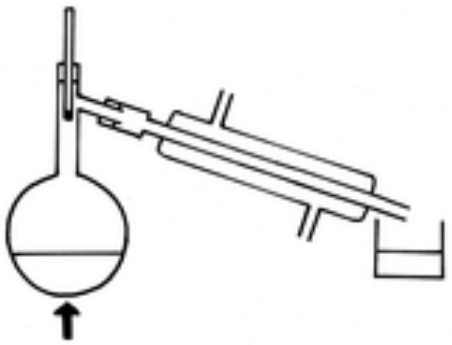
To obtain potable water we first choose an appropriate source of water, then we filter it to remove undissolved substances and then it is **sterilised**. Sterilisation is where harmful micro-organisms are killed. We use chlorine, ozone or ultraviolet let to sterilise water.

9. Why is it important to not drink from "naturally occurring" sources of water?
10. Why is it important to only drink water that has been sterilised?
11. Why is tap water not chemically pure, even though it is potable?
12. What is the difference between pure water and potable water?
13. If water is clear, looks clean and does not smell is it safe to drink?
14. Which is more pure, rainwater or river water?
15. Challenge 1: Is water a renewable or finite resource?
16. Challenge 2: anhydrous copper sulphate turns blue in the presence of water. Why can it not be used as a test for the purity of water?

Desalination

Sea water contains high levels of sodium chloride and cannot be drunk safely. Desalination is the process of removing sodium chloride from water and can be conducted through distillation or "reverse osmosis" using membranes. These processes require a lot of energy so are typically only conducted by wealthy countries in areas where there is no other water source.

17. Desalination can be carried out through distillation. Label the diagram below with the following labels
    a. Condenser
    b. Thermometer
    c. Salty water is boiled
    d. 100°C
    e. Vapours condense
    f. Flask
    g. Distilled water
    h. Beaker
    i. Salty water
    j. Steam leaves the flask



18. Why is desalination only carried out in wealthy countries?
19. Why does the United Kingdom not obtain drinking water by desalination?
20. What are the two ways of carrying out desalination?

21. Why is sea water not potable water?
22. Explain why bottled water sold at the canteen should not be labelled as "pure water"
23. Water obtained through distillation does not need sterilisation
    a. What is sterilisation?
    b. Why is it normally important?
    c. In what three ways do we normally sterilise water?
    d. Why does distilled water not need to be sterilised?
24. Challenge: Is desalination a **sustainable** process?

Treating Waste Water

Waste water is either sewage from human or animal excrement, agricultural waste or industrial waste. Sewage and agricultural waste water can have

- Organic matter
- Harmful microbes

Industrial waste can have

- Organic matter
- Harmful chemicals

In order to treat waste water a number of steps are followed:

i. Screening and grit removal
ii. Sedimentation to produce sewage sludge and effluent
iii. Anaerobic digestion of sewage sludge
    a. Biogas produced
    b. Remaining sludge can be used as fuel
iv. Aerobic biological treatment of effluent
    a. Effluent can now be discharged back into rivers

Questions:

25. Screening uses a large metal grate. What common items can be separated from the waste by the screen?
26. Effluent is water from the waste with no solids in it. At what stages are solids separated from the effluent?
27. Why is it important to separate solids from the effluent?
28. Why is it important to have two stages of separating solids?
29. What is anaerobic respiration?
30. What is sewage sludge?
31. What is biogas?
32. Draw a basic flowchart to illustrate how waste is treated.
33. In terms of sustainability, why is it important to treat waste water?
34. Summary water questions:
    a. There are three sources for obtaining potable water: waste water, ground water (underground, rivers and lakes) and salt water. For each of the three briefly describe how potable water is obtained
    b. How do they vary in terms of the ease of obtaining potable water?

Life Cycle Assessment (LCA)

An LCA is a process of looking at the entire life cycle of a product looking at cost and sustainability. The main stages of assessment are:

Extracting and processing raw materials
Manufacturing and packaging
Use and operation during its lifetime
Disposal at the end of lifetime (including transport and distribution)

35. A manufacturer designs a new car with an electric battery. Follow the steps below to write a LCA for the new car.
    a. The car is made of aluminium which initially comes from an ore called bauxite. Define ore.
    b. How is aluminium extracted from bauxite? (check your notes on extraction of metals for help)
    c. Give three major costs involved in the extraction of aluminium from bauxite
    d. Why can aluminium not be extracted from its ore using reduction with carbon?
    e. The cars are to be sold in Europe. Aluminium ore is mined in Australia (10500 miles from Europe) and India (4600 mile from Europe). Where should the factory that builds the cars be located?
    f. The Indian mine uses fossil fuels but the Australian one relies on wind and solar plants. How does this impact the LCA?
    g. Is aluminium a renewable resource?
    h. The batteries for the cars are manufactured in China. What is the effect of this on the LCA of the car?
    i. A businessperson says he can manufacture batteries in Europe. What more information would you need in order to decide whether to change manufacturer?
    j. Aluminium can be recycled, but only in southern Spain. How does this affect the LCA?
    k. A scientist develops a new material that is slightly heavier than aluminium but can be recycled anywhere. Explain how this would affect all stages of the LCA.

Reduce, Reuse, Recycle

36. What steps has the British government taken to reduce the number of plastic bags used?
37. Why is it important to reduce the amount of plastic that is used?
38. From what type of chemical are plastics initially made from?
39. Different plastics have different properties. What properties would be required for:
    a. Water bottles
    b. Carbonated (fizzy) drink bottles
    a. Underground water pipes
    b. Packaging materials (like Styrofoam)
    c. Chopping boards
40. Based on your answer to 15 explain why it is important to separate plastics before recycling them
41. Steel and aluminium can be separated by the use of a magnet. Explain why.
42. Give three reasons why it is important to recycle materials like steel
43. What is paper made of?
44. Why is it important to reduce the amount of new paper being made?
45. What is the largest cost in recycling?

46. Glass can either be made from sand or recycled from used glass. Both materials need to be melted before they can be turned into new glass.
    a. Used glass has a lower melting point than sand. Explain why it is an advantage to recycle used glass rather than sand to make glass
    b. Used glass bottles need to be separated into different colours before they can be recycled. Explain why this is a disadvantage.
    c. Glass bottles can easily be separated from plastic ones. On what property can this be carried out?
    d. Glass is made of silicon dioxide. Describe the structure and bonding in silicon dioxide
    e. Explain why silicon dioxide has a high melting point

Metal extraction

47. What method of extraction is used for metals
    a. Less reactive than carbon
    b. More reactive than carbon
48. Define ore
49. Why is gold found naturally in the Earth's crust?
50. Why is it important to find alternative methods to extract metals?
51. State the main steps involved in phytomining
52. Phytomining is often said to be a "carbon neutral" process. Explain why.
53. Purification of copper after phytomining often involves electrolysis. Explain why this means the process is not carbon neutral.
54. State the main steps involved in bioleaching