3. Filter fun!

2 - 3 hours

A challenge to find the most efficient filter(s) to treat a sample of 'reservoir' water. Before use on the industrial site the water must first be treated. Children use filtration techniques to obtain cleaner water.

OBJECTIVES

- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.
- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

RESOURCES

(Per group of 4 children unless otherwise stated)

- 3-litre transparent plastic bottle
- Stopclock, watch, or egg-timer
- Funnel (or top of plastic bottle,with a smoothed or taped edge)
- Filters, e.g. colander, sieve, fishing net, tea-strainer, nylon tights, socks, muslin, paper towels, tissues, cotton-wool, filter paper
- 5-6 x samples of 'reservoir' water containing:
- 100 ml water' 1-2 leaves', 1-2 twigs/stones, 12 teaspoon each of gravel, commercial compost and sand
- Torch
- 2 x A4 card
- 10-20 sheets plain paper or tissue paper
- 5-6 transparent containers (e.g. mini pop bottles)
- Activity sheet 10 and 11

Safety note

Garden soil must not be used in this activity, as harmful microbes can grow in ths soil. Sterilised commercial compost provides a suitable alternative.

BACKGROUND INFORMATION

A filter is chosen according to the size of the solid particles to be separated. Filters will separate anything that has a larger particle size than the size of its holes. Whether a filter is 'good' or 'bad' at separating the solids depends on the particle size in relation to the filter-hole size. Therefore, a colander is suitable for separating stones and gravel, but not sand and fine soil. Filter paper has very small holes and so will separate the fine soil particles from the water.

Filtering the water used for cooling in industry is important to prevent the pipes from getting blocked or scaled-up, and to remove substances that can cause corrosion.

The water is not fit to drink after filtering, as there will be many other things in the water, including microbes and dissolved chemicals, which cannot be seen.

If a filter is blocked in industry there are several ways of dealing with this. When the flow of fluid through a pipe or vessel has stopped, the filter can be taken out and cleaned. Another method is to 'backflush' the filter by reversing the flow of water. This carries any debris out of the filter to a destination of the operator's choice. If the flow of the fluid is rarely stopped and the filter becomes blocked, the fluid is re-directed along another branch of the pipeline in which there is a fresh filter. The blocked filter is then cleaned or replaced ready for use when the water is re-directed again.

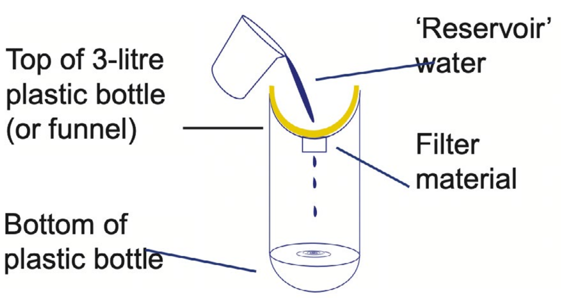
Filter mesh sizes vary from a few millimetres to a few micrometers (a micrometer is a thousand times smaller than a millimetre). Like flanges, filters have seals or gaskets to prevent leaks.

CARRYING OUT THE ACTIVITY

To introduce this activity the children brain-storm filtering or separating techniques that affect their daily lives. For example: tea-bags, coffee filters, vacuum cleaners, tumble driers, fishing or pond-dipping nets, strainers in plug-holes, etc.

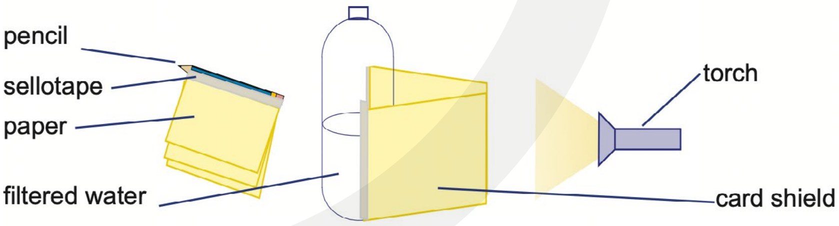
Activity sheet Sheet 10 presents the children with the problem of removing solids from a water sample, mixed to simulate water from a reservoir. They must obtain the clearest sample of water in the shortest possible time, thus creating an efficient filtration system. Each group chooses or is given 3-4 filtering materials with which to experiment.

One method of setting up the test equipment is shown opposite. The children begin to time the filtration as soon as they begin to pour the water sample. They decide when to stop timing, in order to make the test fair, i.e. when water is no longer dripping through the filter, or when the drips are a specific number of seconds apart. Timings are recorded on Activity sheet 11.



N.B. As filtration can take 40-60 minutes for some filters, it is advisable for children to be engaged in other tasks, such as recording the clarity of one water sample whilst another one is filtering.

One method of assessing the water clarity is to transfer the filtered water into a clean, transparent container. The children then shine a torch through the water sample, and gradually 'block out' the light with paper (tissue or writing paper, according to the brightness of the torch). The number of pieces of paper required is then recorded on Activity sheet 11. As a comparison, tap water and unfiltered water can also be assessed in this way. Each sample is then left for 15 minutes and the depth of sediment is measured and recorded. Alternatively, the children may simply rank the water samples using descriptive language, such as 'murky', 'dark brown', 'light brown', 'clear', etc.



DISCUSSION QUESTIONS

- Is the time taken or the clarity ('clearness') of the water most important? Why?
- Were any of the materials very good/bad filters? How?
- Is the water fit to drink after filtering? Why?
- Do any of the filters get blocked quickly?
- What might engineers do when the filters get blocked?
- How big do you think industrial filters will be?

EXTENSION ACTIVITY

Children test combinations of filters, e.g. a colander to remove coarse solids, followed by tights to remove fine solids. Children can also make their own filters by cutting holes of different sizes into card, using a hole punch, scissors (not the points) or a pin and making into a conical shape. Other 'mixtures' could be sorted using these filters, e.g. flour, rice, raisins, sesame seeds, etc.