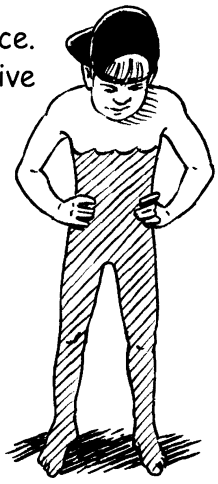
Science Pack

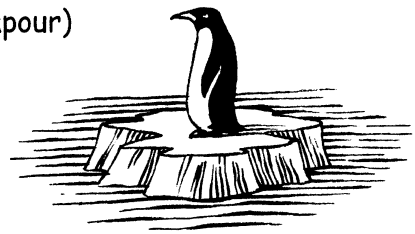
YorkshireWater

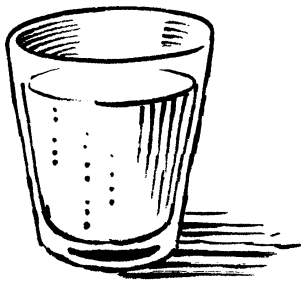
Water Facts

Water is a most important substance. We could not survive without it. 65% of our bodies are made up of water.



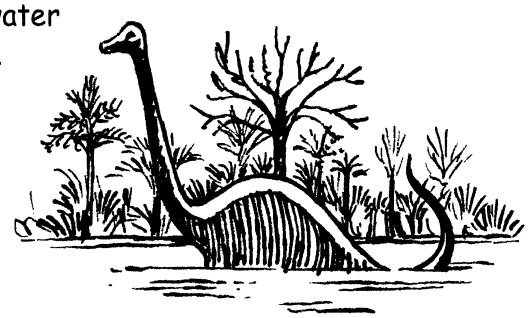
Water can be found as a solid (ice), gas (water vapour) and as a liquid.



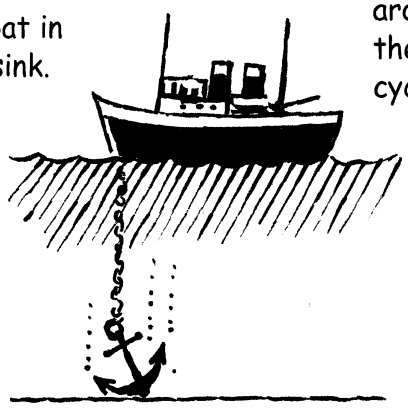


70% of all of the earth's surface is covered with water.

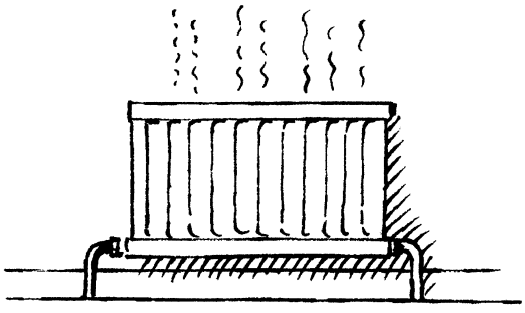
There is exactly the same amount of water on earth as there was millions of years ago. It just keeps on flowing around in the water cycle.



Some objects float in water and some sink. People and goods are ransported around the world on huge ships.



We use water to transfer heat and energy to other substances through cooking and in heating systems.



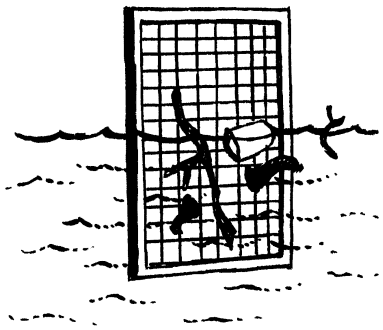
Water is used to produce electricity in hydro-electric generators.

The Activity Sheets

This series of work sheets has been designed to provide step-by-step activities to help pupils understand the importance of water treatment and distribution. The work sheets deal with...

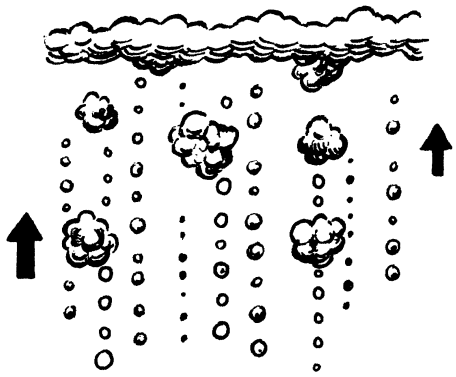
Activity 1

Collecting, settling and screening water



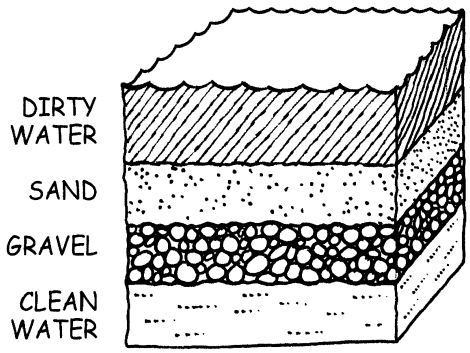
Activity 2

Flocculation and air flotation



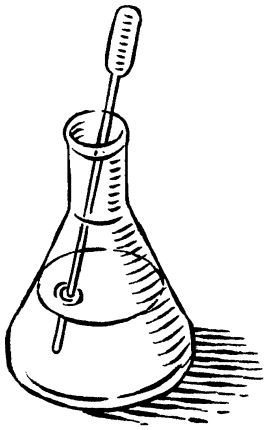
Activity 3

Filtering



Activity 4

Testing for acidity and alkalinity

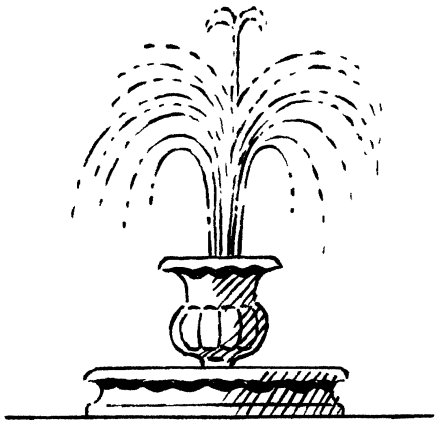


Activity 5

Germs and micro organisms

Activity 6

Moving water



1 Collection, settling and screening raw water

When it rains, water collects naturally in streams and lakes. From here the water is fed to reservoirs and then to water treatment works. This is **raw water** - but this water might not be fit to drink. Raw water can contain a number of creatures, objects or substances which can be unpleasant or harmful. The water treatment process is carefully designed to remove these objects and substances.

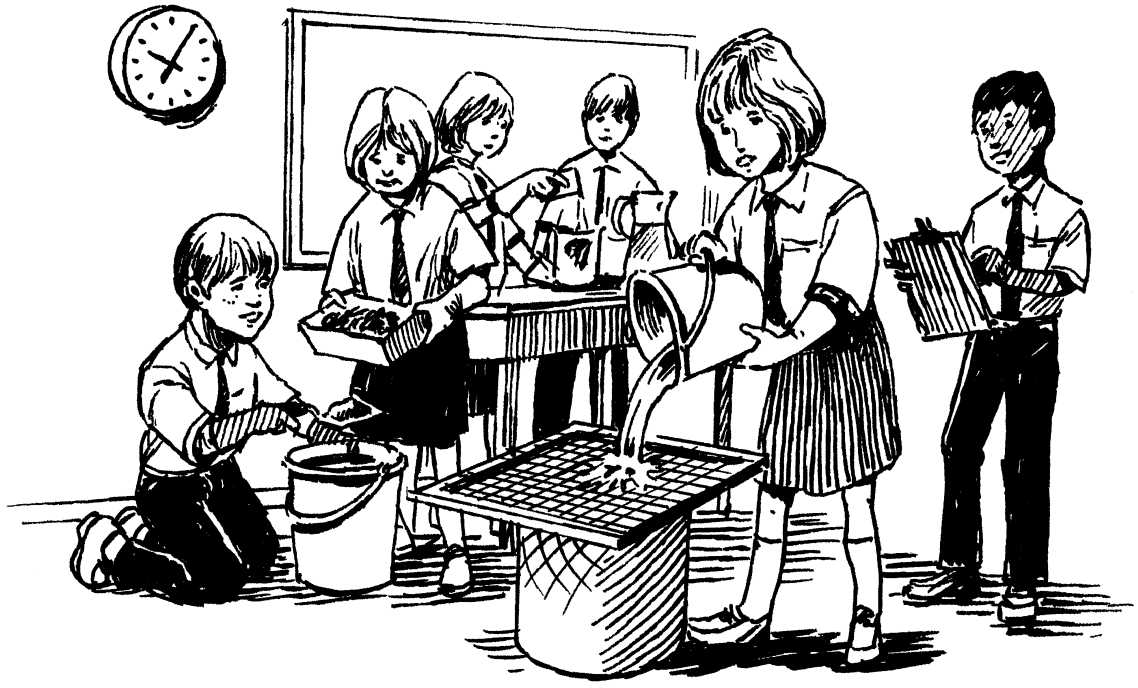
What sort of things might a water scientist have to remove from raw water?

Activity 1 **Make a sample of raw water from garden materials.**

Step by step

- Gather together a range of garden materials - soil/leaves/sand/twigs/gravel/ stones etc.
- Predict what you think will happen when the materials are mixed together in water.
- Mix the materials together with water in a large clear container.
- Observe what happens.
- Record what you see - immediately - after a few minutes - after an hour - after one day.

How could you separate the garden materials from the water?



Difficult words

Raw Water - is water in streams, ponds, pools and lakes that has not been made safe to drink through water treatment.
Reservoir - a reservoir is a place where large quantities of water are stored.

2 Flocculation and air flotation

After settling and screening only small particles remain in the raw water. A process called **flocculation** causes these small particles to clump together. Tiny air bubbles are made to rise through the water causing a **floc** to form on the surface of the treatment tank. The floc is removed by large paddles.

What sort of things might a water scientist have to remove from raw water?

Activity 2a **Making particles clump together.**

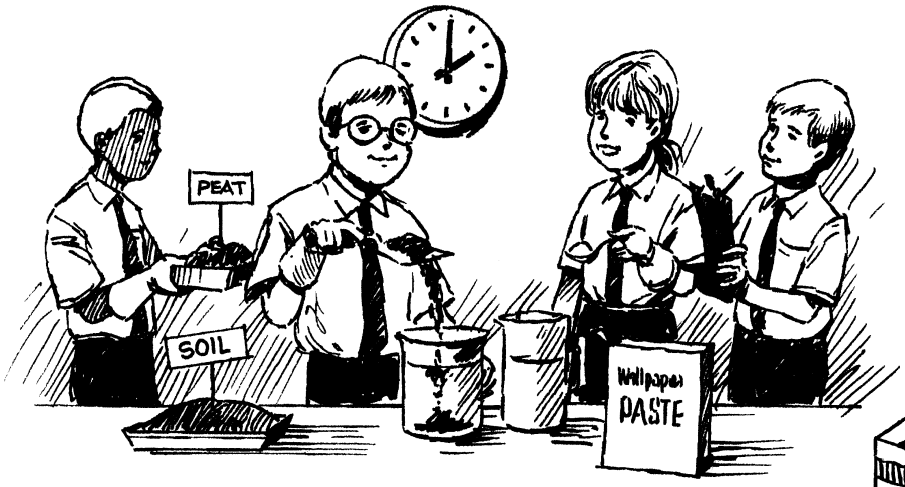
Step by step

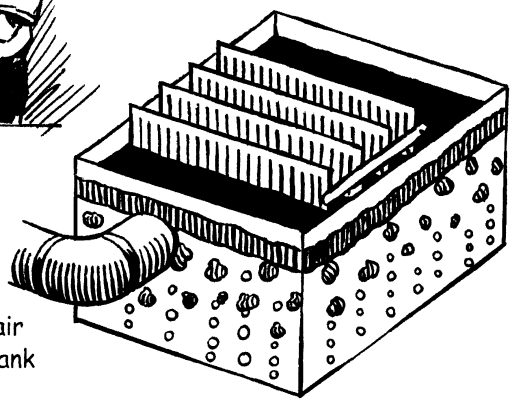
- Wall paper paste is one substance that can be used safely to make particles clump together.
- Mix together some water, fine soil and peat in a clear container.
- Add a small amount of wall paper paste to your mixture and stir. Does it make a difference?
- Now try using different amounts of wall paper paste.
- Observe and record what you see.

Activity 2b **Removing particles from water by flotation.**

Step by step

- You will need two identical transparent containers.
- Fill one with ordinary tap water and the other with fizzy lemonade or soda water.
- Drop a few raisins into each container.
- Observe and record what you see.





Dissolved air flotation tank

Difficult words **Floc** - is the name given to the scum that floats on the surface of the water treatment tank after flocculation.

Flotation - is the process in water treatment where tiny air bubbles rising through water causes the floc to rise to the surface so that it can be removed.

Ferric sulphate - is one of the special substances used in water treatment to cause flocculation to occur. If you are able to visit a water treatment plants you will be able to see the floc being removed from the water - 'Ferric makes floc' - is a little phrase that

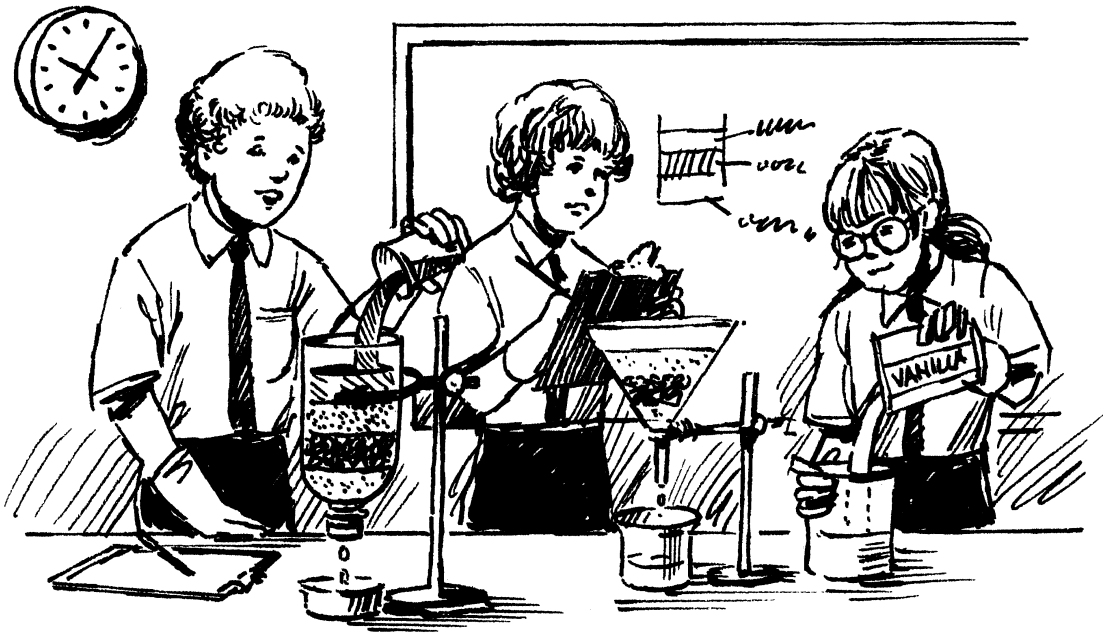
3 Filtering

After screening and flocculation most of the unwanted materials have been removed from the water, but there are still some very fine particles left. These are removed by passing the water through filter beds made of sand and gravel.

Activity 3 **Building a working filter bed.**

Step by step

- Mix together water and soil to create a raw water sample.
- Make a filter bed using sand and gravel in a funnel.
- Pour the raw water sample through the filter.
- Observe and record what you see.
- What else could you use to make a filter - charcoal - cotton wool - tissue paper? Can you make a filter that will remove very fine particles like chalk dust or flour mixed with water?
- See if it is possible to make a filter that will remove food colouring from water.
- Mix vanilla essence into the water sample and see if filters will remove the smell.



Difficult words **Vanilla essence** - is made from a plant. It has a special smell and is used to flavour ice cream.

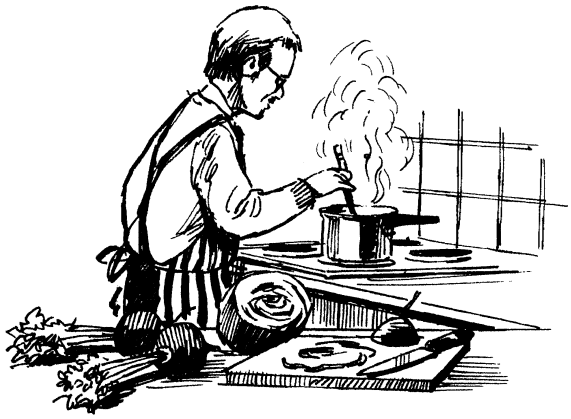
4 Testing for acidity and alkalinity

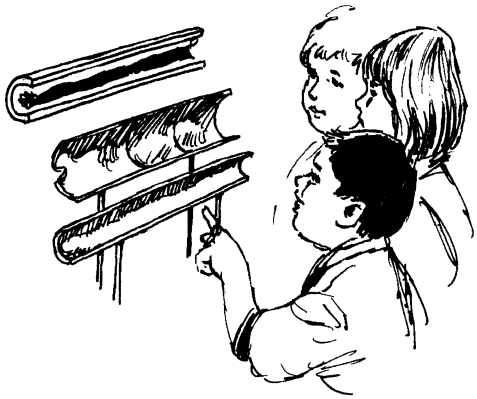
Before water is sent to our homes, it must have its acidity tested. Too much or too little and the water will damage the water pipes.

Activity 4 **Testing for acidity and alkalinity.**

Step by step

- For this activity you will need a special substance called an **indicator**. A liquid indicator can be made by boiling red cabbage or beetroot in a small amount of water. The indicator will change colour if it is mixed with an acid or alkali.
- Test a range of substances to see if they are acid or alkali - eg lemon juice, vinegar, soap, milk....
- Observe what happens.
- Draw a table of your results. What discoveries have you made?





Difficult words **Indicator** - An indicator is a special substance which will change colour if it is mixed with an acid or an alkali.

5 Germs and micro organisms

Germs and micro organisms are all around us and inside us - but they are too small for us to see. Some micro organisms are harmful and can make us ill. Some are beneficial - they help us digest our food - and they are part of the natural processes of decay.

Activity 5 **Finding out about germs and micro organisms.**

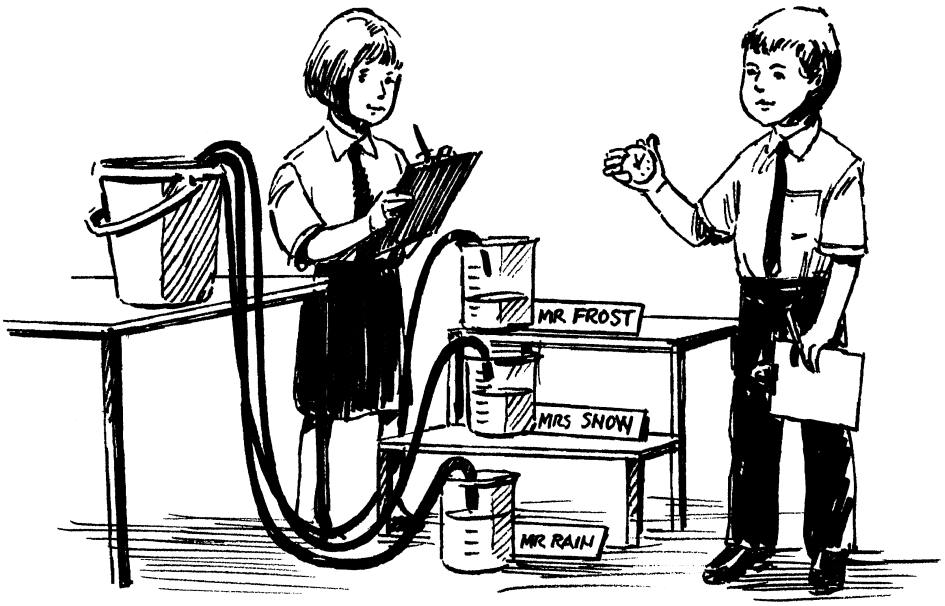
Step by step

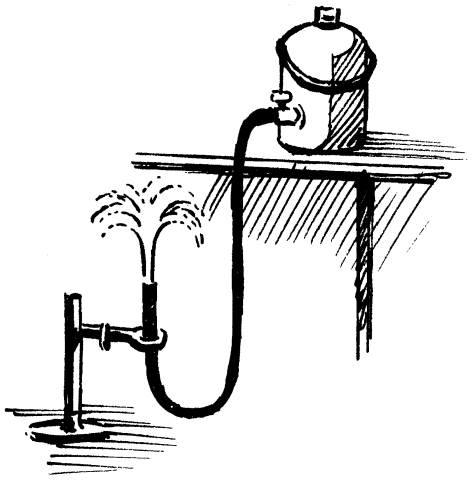
- Why do some people drink bottled water when they go on holidays to hot countries?.
- Plan some research to find out about micro organisms. How can micro organisms get into raw water?. Have you seen leaves and wood decaying in the garden or in a park? Compost heaps are full of decaying plant material.
- How might you present your research findings - in a small booklet - as a poster in a presentation...

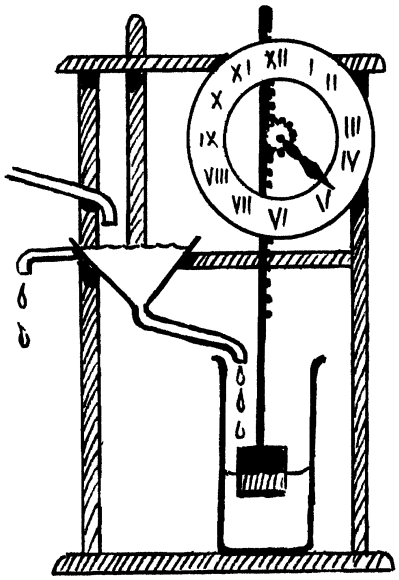
6 Moving water

In the picture, Mr Rain, Mrs Snow and Mr Frost, live on the side of a hill. They all receive their water supply from the reservoir. Can you devise an experiment to show how the water goes to each of their houses

In the park there is a fountain. Can you make a fountain? How would you do it?







Teachers notes

These activities are designed around the water treatment process. A visit to a water treatment plant can be an exciting and rewarding experience. The visit will make real and relevant the investigations suggested in this resource. A range of additional posters, booklets and background information are available from Yorkshire Water and these can provide a useful starting point for discussions and activities.

Prior Knowledge.

If the pupils have previously gained an understanding of the water cycle, these activities will be more easily understood.

Activity 1 Collecting, settling and screening water.

Do not collect and use samples of raw water from rivers, ponds etc. for use in school. Children should also avoid handling garden materials. Teachers should always remember that there is a small risk of harmful micro organisms being present. In this and other activities, remind all pupils to wash their hands after the investigations.

For this activity you will need a range of containers, mesh, sieves etc. Sweet jars and clear plastic pop bottles are good for water investigations. The activity can be extended to cover sinking and floating. Observation over time will clearly show the setting process that occurs naturally in reservoirs. Heavy objects sink. leaves and twigs float. Water is extracted from the mid point of reservoirs.

Activity 2 Flocculation and flotation.

Ferric sulphate and aluminium sulphate are used as flocculants in the water treatment process. These should not be used by pupils in the classroom without reference to health and safety documentation. Slaked lime can act as a flocculant but needs to be handled with care. Wallpaper paste will work. **You only need very small quantities.**

You will need a range of containers and small measuring beakers and cylinders for this activity. Follow-up work - What happens to the sludge that remains after water treatment?

In the flocculation process the floc containing particles clumped together needs to be removed. In a special tank, air is forced into water at five times normal pressure. This water, plus dissolved air, is then released into the water treatment tanks. Here the dissolved air forms tiny bubbles which rise through the water carrying with them the suspended floc. At the surface, the floc is removed by paddles. This process removes 80 - 90% of all suspended particles and most of the bacteria and micro organisms which are also in the raw water.

This process of flotation can be replicated in the classroom using a 'Sodastream' drinks maker. The bubbles rising through the water will cause a raisin to float. Fizzy lemonade poured from a bottle will give the same effect. You can discuss with the pupils how long it takes for the fizz to disappear and what is happening.

Activity 3 Filtering

For this investigation you will need a range of sands and gravel. A filter is easily made by blocking the end of a funnel with gravel and then adding finer sands. Charcoal will remove some smell and colour. Activated carbon is used in the water treatment process to remove pesticides and fertilisers. It will remove smells and odours. It is useful to look at the filtering process in fish tanks and coffee making. You can extend the filtering process using cloth, cotton wool and paper. Charcoal dust can be an irritant. Use goggles as necessary. Chalk dust or any powders need to be handled very carefully and can be a problem for asthma sufferers.

In the actual treatment process, the filter beds can become clogged after a while and are 'back washed' every 24 hours to remove the trapped fine particles. The filter beds also trap bacteria and micro organisms.

Activity 4 Testing for acidity and alkalinity

Before water is passed from a treatment plant to the household supply system it is tested for acidity/alkalinity. If water is too acid or alkali it will cause pipes to corrode - leading to leaks and water wastage - so it is essential that treated water is neutral - neither acid nor alkali. The water testing and safety system is automated and very sophisticated. Test processes work in triplicate and each of the readings is compared with what is considered normal. Alarms are automatically sounded if the test readings move outside of the set limits. Water is also tested to see if it is discoloured or cloudy.

The indicator made from beetroot or red cabbage needs to be made before the activity starts. An acid will turn the purple liquid to red or yellow and an alkali will turn the indicator blue or green. Only test using small quantities. Samples of water pipes - plastic, iron or lead - can provide a good discussion point.

Activity 5 Germs and micro organisms

This is a research task and will require a variety of resources to be provided in the classroom. It is reasonable to observe the processes of rotting and decay but any experiments in the classroom need to be done very carefully - in sealed containers which are then destroyed using an autoclave. It is useful to refer to sterilisation tablets used by campers and to the range of household disinfectants in use.

Germs and micro organisms are all around us and inside us - but they are too small for us to see. Some micro organisms are harmful and con make us ill. Some are beneficial - they help us digest our food - and they are part of the natural processes of decay. Some micro organisms can be harmful. It can be useful to mention tummy upsets with the children - and what causes them. We hear about food poisoning sometimes caused by Salmonella or the E.coli bacteria.

The water treatment process kills germs and micro organisms using chlorine. Chlorine is added to drinking water in very small amounts (approximately 8 parts per million) during the treatment process. It is a dangerous substance and is used in household bleach. This too is dangerous and should not be used in science investigations in schools. It is also added to swimming pools to kill germs and prevent the spread of infections.

Activity 6 Moving water

97% of all of the world's water is in the oceans. The other 3% can be considered to be moving through the water cycle. Only 1 % of water can actually be used. The water cycle has been running smoothly for about 500 million years.

Water rushes past from rain to stream and rivers and then back to the sea. An area such as Yorkshire requires 1 500 cubic metres of water every day - for drinking, cleaning and for business and industry. Moving and controlling water is very expensive.

Ours water supply is mainly gravity fed. Water runs quite naturally downhill - but in some areas there are some specially constructed water towers to provide a reasonable pressure of water for houses on higher ground.

We can simulate water flow using two fairly large transparent or semi transparent containers of equal size and some pipe. Fill one container almost to the top. Put only a small amount of water into the other container - approximately 5 centimetres deep. Put the length of pipe into the nearly full container and allow the pipe to fill completely with water. (Diagrams) Put your thumb over both ends of the pipe to keep out any air. Put the ends of the pipe below the water's surface - one end in the nearly full container and the other in the nearly empty container. Keep the ends of the pipe below the water's surface and allow to flow. The water will flow until the water levels in each of the containers are the same. This activity uses the principle of the siphon and needs a minimum of equipment.

If you have access to a range of large containers, pipes, clamps and taps you can devise a range of water demonstrations. The activity can be extended into building water clocks and fountains. A scale on the side of a water container will show that water escapes through an outlet at different rates of flow depending upon the amount of water in the container. (Diagram) Water storage containers with a stop tap used by campers and in caravans are ideal for water experiments. Be careful not to waste water in this and other activities.

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