Year 7 science[1]

How do we make water drinkable?

Australian Curriculum links: Year 7 Science

Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (ACSSU113)

In this lesson, students will predict how a mystery filter works and explore how separating techniques (filtering, decanting and flocculation) are used in water treatment systems.

The **Story of a river** is an effective demonstration to use prior to this activity to gain an understanding about the range of contaminants that can be found in rivers and dams.

Equipment

For the class

Mystery filter: 2 or 3 plastic or polystyrene cups

- filter materials (e.g. sand, gravel, cotton wool or pieces of paper towel)
- alfoil for wrapping
- clear plastic cup or jug to collect the filtered water
- soil, some tap water and another clear plastic cup

Filtering: Kitchen sieves with mesh of different sizes, colander

Flocculation: clear plastic cup, pea-sized piece of modelling clay

Preparation

Make the 'mystery filter' from two or three plastic cups with small holes in the bottom for drainage. Fill each cup with a small amount of a different filter material such as sand, gravel, cotton wool or pieces of paper towel. Use layers of filter material less than two centimetres thick so the water moves through the filter quickly. Place the cups on top of each other and cover them completely with alfoil so the students can't see how the filter works.

Activity steps

Mystery filter

1. Ask students to think about the kinds of contaminants that they might find in a local river or dam. Discuss their ideas and make a list on the board. Ideas could include:
    - branches, leaves, dead plant and animal matter (detritus)
    - dirt: sand, loam or clay
    - chemicals such as fertilisers

- bacteria or viruses.

2. The river water needs to be cleaned to make it safe to drink. Introduce the idea of cleaning water using the alfoil-covered ‘mystery filter’.

3. Show students some dirty water made by mixing soil with tap water in a clear container or jug. Ask students to predict what will happen when you pour the dirty water into the top of the mystery cup.

4. Hold the mystery filter over an empty cup and pour some of the dirty water into it. Students compare the water from the mystery filter with the original dirty water. Ask for suggestions about how the mystery filter might work and what might be inside. Ask: *What treatment techniques might be needed to separate the clean water from the other materials?* Some ideas might include:

    - scooping the mulch or detritus off the top with a sieve (filtering)
    - pouring the water off carefully to leave the heavier sand on the bottom of the cup (decanting).

Filtering

5. Unwrap the mystery filter and show students what is inside. Ask students to explain how the different filter media might work.

6. Display different kitchen sieves to show how different filter materials filter out particles of different sizes. Demonstrate why it is a good idea to start with the sieve with the biggest holes first (so that the fine filters don’t get clogged). Explain the terms filtrate and residue.

Coagulation and flocculation

7. Explain that clay particles form a suspension when mixed with water and are difficult to remove from water in the water treatment process because the particles are negatively charged and repel each other. The clay particles jiggle around in the mixture and remain suspended – hence the term ‘suspension’. The scientific term for the kind of suspension that doesn’t settle is a colloid.

    If there is clay in the raw water to be treated, a substance can be added to the clay suspension that helps clump the clay particles together to form larger clumps. The substance – usually alum or a special polymer – is positively charged and attracts the negatively charged clay particles. This step is called coagulation.

    Eventually these clumps become large enough to form a visible gel-like mass called a floc which becomes heavy enough to fall to the bottom of the tank as sediment. This step is called flocculation.

    Optional: you could demonstrate how this technique works by mixing a pea-sized piece of clay in a clear plastic cup of water; this could take some time. Add a small amount of alum and observe what happens. When using alum, make sure that you follow the prescribed safety procedures.

    If your class enjoys storybooks, read Adventure 1 of Whizzy’s new adventures in which Whizzy the waterdrop travels through a water treatment plant. Ask students to identify the different separating techniques shown in the book.

8. You could follow up this activity with the **Is clear water safe to drink?** activity in which students explore the types of dangerous ‘invisible’ contaminants that can be found in

crystal clear water. This activity also discusses the importance of providing safe drinking water and sanitation to developing countries.

Optional: Student groups compete in the **Clean water challenge** to see who can create a filter that produces the cleanest water in the shortest time by testing different filter media using a fair test.