What makes a water filter?

LESSON PLAN

Learning intention

To develop an understanding of the typical impurities present in untreated water, and the process involved in removing such contaminants. Consider how and why different filter media impede the movement of suspended material in water.

Time to complete

50 to 60 minutes

Class size

Any

Vocabulary

Filter, disinfectant, chlorine, contaminants, microorganisms, pesticides, herbicides

Levels

Years 4 to 8

Learning areas

English
The Humanities
- Civic and citizenship

Science
Technologies
- Design and technologies

Capabilities

Critical and creative thinking
Ethical
Intercultural
Personal and social
Literacy
Numeracy
Information and communications Technologies
Numeracy

Equipment required

1. 100mL of unfiltered 'river' water (tap water with half a handful of garden dirt).
2. 600mL clear plastic PET bottle (Cut the bottle in half and insert the top half upside-down into the bottom half. The funnel shaped top half will act as the body of the filter, whilst the bottom half will collect the filtered water as it drips through).
3. A collection of possible filter media:
   a. 1 x tissue
   b. 2 x cotton buds
   c. 1 x piece of sponge
   d. 1 x piece of absorbent cloth
   e. 1 x paper coffee filter
   f. 1 x small container of fine sand
   g. 1 x small container of gravel
   h. Any other material you want to try.
4. A result sheet (attached) to record your findings.

TEACHER NOTES

Students will be presented with a sample of 'river water' (tap water pre-mixed with dirt). A plastic PET bottle will act as the external body of the filter.

Each group is provided with six different materials: sand, gravel, coffee filter paper, cotton bud, sponge, absorbent cloth, and tissue paper.

In their groups, students are challenged to construct the internal layers of the filtration media using any three of the seven materials provided to them.

Introduction (10min)

Our drinking water goes on an incredible journey from catchment to tap. Before a typical glass full of water reaches your home, it has already travelled well over 150km.

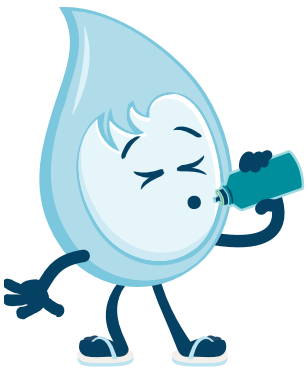
Originating in the Otway ranges, Geelong's water passes through pristine rainforest and along river beds, plunging down into the cold depths of our reservoirs, and travelling through a myriad of pipes, from large to small, before eventually seeing daylight again as it comes out of your kitchen tap.

The water that falls from our skies as rain is pure and safe to drink however, during its extended trip, water collects a variety of impurities in the form of natural minerals from vegetation and soil, bacteria and viruses from animal sources, and larger material picked up by surface run-off. All of these impurities are carried within the water, suspended within it.

Along this amazing journey, the water is cleaned at a Water Treatment Plant. It is the role of water corporations, like Barwon Water, to treat the water and remove all the impurities, making it safe for us to cook with, shower under, and of course, safe to drink.

An important step in the treatment process is filtration. This is where water is sent through a layered bed of fine particles (filtration media) that block the passage of contaminates, but allow the water molecules to pass. After filtration, the water is disinfected to kill off bacteria before being sent to businesses, homes and schools throughout the Barwon region.

Can you build a water filter from basic equipment that will remove dirt and clay from a 'river' water sample? What materials will make up your filter media, and in what order will you place them? Will your filtered water be safe to drink?



Activity (30 min)

1. After the introduction, students are asked to separate into groups of 2-3 per group.
2. Each group is provided with a sample of unfiltered 'river water'. They are asked to examine the water sample and identify the various components of contamination, and given a few minutes to record their findings.
3. **Class discussion**: Each group lists the contaminants they identified. At this point the teacher can assist the students in identifying any missed contaminants.
    - **The list should include: sand, clay, bark, plant material/organic matter, microorganisms (bacteria/germs/viruses), and natural minerals/salts.**
    - **The term 'dirt', should be expanded further, i.e. clay, sand, organic matter.**
    - **Other less obvious contaminants that may not be initially listed include: tannins/ colours, pesticides, herbicides, chemicals.**
4. Each group is provided with the PET filter body and a container of possible filter media. As a group, they select up to three materials to use as their filter media and nominate the order of placement in the filter. The groups should record their decision on the result sheet.
5. Each group now mixes their reservoir water sample, and slowly pours the entire contents onto the top layer of their filter. The water will slowly pass through the filter and collects in the holding tank. After a few minutes, the process should be complete.
6. The filtered water in the holding tank can now be examined.
7. Students examine the filtered water as well as the filter media and record their observations on the result sheet.
8. **Class discussion**: Each group provides feedback on how their water filter performed, and whether they believe the water is safe to drink.
9. **Teacher note:**
    - Has the filter removed all contaminants, i.e. bacteria?
    - What would need to happen to make the water safe to drink?
      Disinfection is required: That can be heat (boil), chemical (chlorine) or radiation (UV radiation) disinfection. Our water supply is disinfected with chlorine.
10. A representative from each group brings their filtered water to the front of the class to compare against the other groups and against a sample of tap water.
11. **Class discussion**: Is there a difference in the filtered water from each group? Which filter worked best and why?

Discussion (10min)

Short discussions should occur during the activity, focusing on each major learning point. However, answers recorded on the result sheet can be openly discussed at this point.

What makes a water filter: result sheet

Examine

1. Describe the unfiltered reservoir water sample, paying attention to colour, clarity, and layers. Draw a labeled diagram.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

2. List the various contaminants in the sample of reservoir water and describe their state within the water, i.e. **floating, suspended, dissolved, settled**.
(HINT: Some cannot be seen by the eye)

Contaminant	State
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Predict

3. What materials will you use in your water filter and why? Max of three materials can be used.
(Explain the reason why you chose each material for your filter)

_____
_____
_____
_____

4. In what order will you layer your filter media and why?

_____
_____
_____
_____

5. How many of your listed contaminants do you think your filter will remove?
(I.e. All of them, most of them, some of them, or none of them)

_____

6. What is your basis for this prediction?

_____
_____
_____
_____

7. What do you expect your filtered water will look like?

_____
_____
_____
_____

8. Draw a labeled diagram of your filter, showing each layer.

Observe

9. What does your filter media look like after the water sample has passed through it?

_____

_____

_____

_____

10. What does your filtered water look like? Describe it in comparison to the unfiltered water.

_____

_____

_____

_____

Explain

11. Did your filter work better, worse, or as you expected it to?
(compare what you expected your filtered water would look like, to what it actually looks like)

_____
_____
_____
_____

12. Explain how the filter removed, or why it did not remove, all the contaminants.

_____
_____
_____
_____

13. Is the water safe to drink? Explain.

_____
_____
_____
_____

14. Would you change any aspect of your filter?
(Filter media selection or order of layers)

_____
_____
_____
_____