

Teacher's notes: Cleaning water

Investigate the Coagulation Process

Coagulation is one of the steps involved in water purification that involves adding a coagulant to aid clumping of suspended solid material in the water. These clumps then settle and can be removed.

Two (or more) different coagulants could be used (aluminium sulphate and calcium hydroxide?) and their effectiveness compared. For some suggested methods:

Environmental Activities for the 21st Century – Drinking Water Treatment
<http://esa21.kennesaw.edu/activities/drink-water-trt/drink-water-trt.pdf>

Making Water Safe to Drink – Teacher's Guide
<http://www.safewaterscience.org/Downloads/Lesson4.pdf>

Investigate the Filtration Process

Groups could explore a sand / gravel filtration process and a membrane (filter paper) process – designing their own filtration system.

If the raw water has had food colour and / or food essence added groups could work to eliminate these factors given sand, gravel, charcoal (and activated charcoal?) to experiment with. This method could be compared with a membrane process using filter papers of varying porosity.

The Groundwater Foundation – Take the filter challenge
<http://www.groundwater.org/kids/popularactivities.html>

EPA Environmental Education – Water Filtration
<http://www.nwwater.com/images/documents/literature/forest.pdf>

Raw Water Analysis

After introducing the task and presenting the research 'brief' the class could be split into mixed ability 'research groups'. A 'pack' could then be issued to each group outlining their specific brief. Briefs could differ in location, population, quality of raw water etc.

Each group will then work to determine the quality of their raw water sample (probably safest to use lab synthesised 'raw' water) using a variety of analytical techniques.

It would be interesting to have the research groups analyse different raw water samples and if a scenario could be designed that would mean that groups would perhaps choose different treatment processes

Some suggested techniques are:

- BOD (Biological Oxygen Demand) levels – there are a variety of methods that could be used
 - Methylene blue – 10 -20 drops of methylene blue are added to distilled water and also to the ‘raw’ water. The more dissolved oxygen in the water the paler the colour of the methylene blue. This could be examined by eye and compared with standard solutions of known concentration. If a colorimeter is available, the absorbance of these samples could be measured and compared later with the ‘purified’ water.
 - Oxygen probe
 - The Winkler method
(http://serc.carleton.edu/microbelife/research_methods/environ_sampling/oxygen.html)
- pH
- total dissolved solids using conductivity (conductivity increases with increased dissolved solids)
- total turbidity
 - by comparing water samples with a turbidity chart
(<http://www.learnnc.org/lp/editions/mudcreek/6594>)
 - by evaporating a measured volume of ‘raw’ water and measuring the mass of the solids remaining
- bacterial content by streaking agar plates

As some of these techniques, concepts and skills may be entirely new to pupils it would be envisaged that considerable time may be spent learning these new concepts. For example if this is the first time pupils have met pH analysis then an entire lesson is likely to be spent on this – first discovering the pH scale and then using this knowledge to analysis their water sample.

UV purification

The raw water could be exposed to UV radiation to kill the bacteria. Groups may have to experiment with the optimum exposure time for this using a UV lamp.

An alternative method is given here:

Solar water disinfection

http://www.appropedia.org/Solar_water_disinfection

Analysis or ‘Clean’ Water

The now clean water could be analysed now for BOD, pH, dissolved solids, turbidity and bacterial growth.