GREEN SCIENCE

CLEAN WATER SCIENCE

A. OVERVIEW

Subject	Green Science
Age	6-10
Duration	60 Minutes
Content	Mixtures are made of components of various sizes. Water purification methods exploit the different sizes of the components to separate them.
Goals	Students will understand : 1. Particles have different sizes. 2. Definitions of mixture, solution, solvent and solute. 3. Differences between element, compound and mixture. 4. Mixtures can be separated using physical means e.g. a filter. 5. Filters, solar distillation and solar pasteurisation can be used as a water purification method.
Objectives	After completing this section, students will understand three methods water purification and relate to the separation of mixtures to their components.
Materials	Clean Water Science kit, Soil from a clean source (pot-plant/flower-bed), Cooking oil, A glass (any size), A transparent glass whose diameter is smaller than the round filter base, Glass of hot water, Ice cubes, Tea leaves, Small piece of transparent plastic sheet (e.g. kitchen wrap)
Introduction	Background reading/Classroom discussion – Elements, compounds, mixtures and water purification methods
Practical	Students will assemble filter columns, distillation kits and solar pasteurisation kits and demonstrate their use to produce 'clean' water.
Extensions	Open ended discussion/investigation

B. BACKGROUND READING

Set the background reading as a homework assignment the day before the planned filter column lesson. This lesson will cover particle size and mixtures. It will provide a springboard for discussion on purification or separation of mixtures into their component substances.

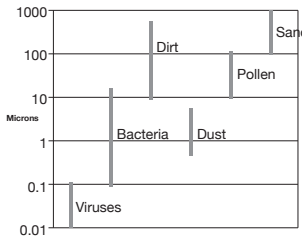
Review

Start the lesson by reviewing the reading.
Points to ensure are understood:

- Substances have particles of different sizes.
- Difference between mixtures and pure substances.
- Principles behind filters, distillation and pasteurisation.

Reading material

Particle size



Particles are defined as the very smallest amount of a substance. Particle size is different depending on the substance. Look at the following chart to compare the particle size of some substances.
A micron is one millionth of a meter (0.000001m)
A millimeter is one thousandth of a meter (0.001m)
1000 microns therefore is 1 millimeter

Pure substances

Pure substances can be either elements or compounds. They cannot be broken down by physical means. An element is a pure substance that cannot be broken down into any simpler substance by chemical methods. A compound is a pure substance made up of molecules, which is the product when two or more elements are chemically joined together.

Mixtures

Mixtures are made of a combination of elements and/or compounds and they can be separated by using a variety of physical means. Mixtures can be separated by using the properties of the substances from which they are made, e.g. particle size, density, magnetism, solubility or boiling point. Mixtures are not new pure substances as physical forces can still remove all the basic parts e.g. sugar in water – if you boil off the sugar you are left again with sugar.

Solutions

Solutions are groups of molecules that are mixed up in a completely even distribution - a homogenous system. Sugar in water forms a solution because the sugar dissolves in the water – evenly distributing itself throughout the water. Sand in water is a mixture as it is unable to dissolve.
Solute – substance dissolved – the sugar
Solvent – substance doing the dissolving – the water

Filters

Filters exploit the differences in the properties of the particles in a mixture to separate them. Mixtures contain particles of different size. If you pass the mixture through a substance with spaces between its particles only the particles in the mixture small enough pass through these spaces will travel through the substance.

This can be demonstrated with a kitchen sieve. When you boil rice or pasta in water before eating you need to separate the water from the rice or pasta. If you pour the mixture over a sieve the water passes through and you are left with the rice or pasta. This happens because the water molecules are small enough to flow through the holes of the sieve. The rice grains or pasta pieces are too big and so stay in the sieve.

Distillation
Water evaporates to form steam (water in gas form) when heated. Steam condenses to form water when cooled. Substances dissolved or mixed in with water that do not evaporate with the steam can, therefore, be separated from the water. They are left behind. The same principle can be used to separate any mixtures that contain substances that become gases at different temperatures.

Solar pasteurisation
What about substances that cannot be filtered because their particles are too tiny? Boiling and distilling water can use a lot of energy. Heating water can destroy micro-organisms that might make otherwise clean water dangerous. Water needs to be heated to 65 degrees Celsius (149 degrees Fahrenheit). This can be achieved using the free and freely available solar energy. Can you think when this might be useful?

C. CLASS DISCUSSION
Ask the class to label the following as an element, compound or mixture:

Concrete	Orange Juice	Paper	Diamonds	Sea waterGold	Sugar	Ink	Glass	Sand
Glue	Pure water	Oil	Iron	Salt Carbon	Sodium	Silicon	Silica	

Do they know what compounds the mixtures contain?
- e.g. orange juice – water, vitamin C, fibre, sugar etc.

Can they group the elements/compounds and mixtures together?
- Carbon, sugar, water, orange juice
- Water, sodium, chloride, salt, sea water
- Silicon, silica, sand, glass

Filters
What filters are in the home? What do they filter?
- e.g. vacuum cleaners (air filters), prisms (light filters), hair catcher in the shower drain (allows water to drain without other objects)

Distillation
Demonstrate the water cycle to the students.
- On the board, draw a body of water, a plant, a person, the sun and clouds/rain. You may wish to do this step-by-step with the questions to the class.
- Ask the class:

- What happens to the water when heated by the sun? It evaporates and rises into the atmosphere where it cools and forms clouds. Indicate this with arrows.
- What happens to the clouds? The make rain which falls to the earth. Indicate this with arrows.
- What do plants and people do with water? They take it in by through their roots and by drinking. Indicate this with arrows.
- How do plants/people lose water? Transpiration (plants). Sweat/urine (people).
- What happens to this water? Transpiration/sweat into the atmosphere. Urine into the body of water. Indicate with arrows.
- This is called the water cycle. Ensure the class understand the importance of the sun and a clean water supply to the Earth's health.

Pasteurisation
In what situations would solar pasteurisation be helpful?
- HINT – Encourage class to think about developing countries and disaster zones.

D. PRACTICAL
Each group of students requires 1 relevant kit and 1 instruction sheet. Select the relevant information from the instructions if necessary.
Filter column - Each group will need 1 filter column kit, 2 glasses (one with diameter smaller than the round filter base), some soil from a clean source and a little cooking oil.
Distillation – Each group will need 1 distillation kit, a glass o f hot water, ice cubes, tea leaves.
Solar pasteurisation – Each group will need 1 solar pasteurisation kit, a tall glass that will cover the whole of the black plastic cup, a small piece of transparent plastic e.g. kitchen wrap.
Go through the safety warnings advised in the instructions with the class.
Check each group's finished model and supervise the class' test runs.

E. EXTENSION
In the filter column the filters were placed in a specific order – gravel, sand, active carbon, filter paper.

Why this order?
Would it matter if they were re-arranged?
How does the active carbon work as a filter?
What other substances would make good filters?
In what other situations do we use filters?
HINT – what filters can you find around your home?

How are filters used in gold mining?
How is distillation used in oil refineries?
Can you make a model demonstrating the water cycle?
HINT – what other substances need to be purified?