STUDENT BOOKLET

ATSE STELR PROJECT

WATER IN THE 21ST CENTURY

NAME

CLASS

CONTENTS

How to approach a Scientific Challenge

In this water module, you will undertake a Scientific Challenge. This means in small teams you will **design**, **test**, **report** and **reflect** on your group's investigation. For guidance or help with your Scientific Challenge, look at the Scientific Challenge Report Planner and Challenge Checklist below.

Scientific Challenge Report Planner

- **Scientific Question**
  - ✓ State your challenge: What question are you going to find out the answer to?
  - ✓ Make a prediction: What do you think will happen?

- **Investigation**

  You need to decide:
  Will it be a fair test
  or an exploratory investigation ?


  If it is a fair test, how will you keep it fair?
  Consider the variables:
  - ✓ What will you change? (Independent variable)
  - ✓ What will you measure or observe? (Dependent variable)
  - ✓ What will you keep the same? (Controlled variables)

- **Method**
  How will you conduct the investigation?
  Write or draw the step-by-step instructions.
  Ensure you have included detailed measurements so that someone could repeat your investigation in EXACTLY the same way.

- **Observations and Results**
  What happened?
  How will you record what you find out?
  Consider using labelled diagrams, graphs, charts or tables.
  What did you find out from this investigation?
  Do you have data and evidence?

- **Evaluation**
  How would you improve your investigation if you did it again?

- **Reflection**
  What questions have arisen after doing this investigation?
  How has your thinking about the Big Science Idea been challenged, changed or supported, after this investigation?
  How does the big idea in this Scientific Challenge relate to your everyday life?

Challenge CheckList . . .	
✓	Have you read the Challenge?
✓	Have you read and completed the clipboard?
✓	Do you have all the equipment needed?
✓	Have you predicted and measured something?
✓	Are you working as a team?
✓	Have you included scientific language or terms?
✓	Is your team communicating throughout the investigation?
✓	Will others be able to follow and understand your report?

Unit 1: World Water
– planetary water and availability

The Big Science Idea

Despite the seeming abundance of water on Earth, fresh water availability is scarce.

Scientific Questions

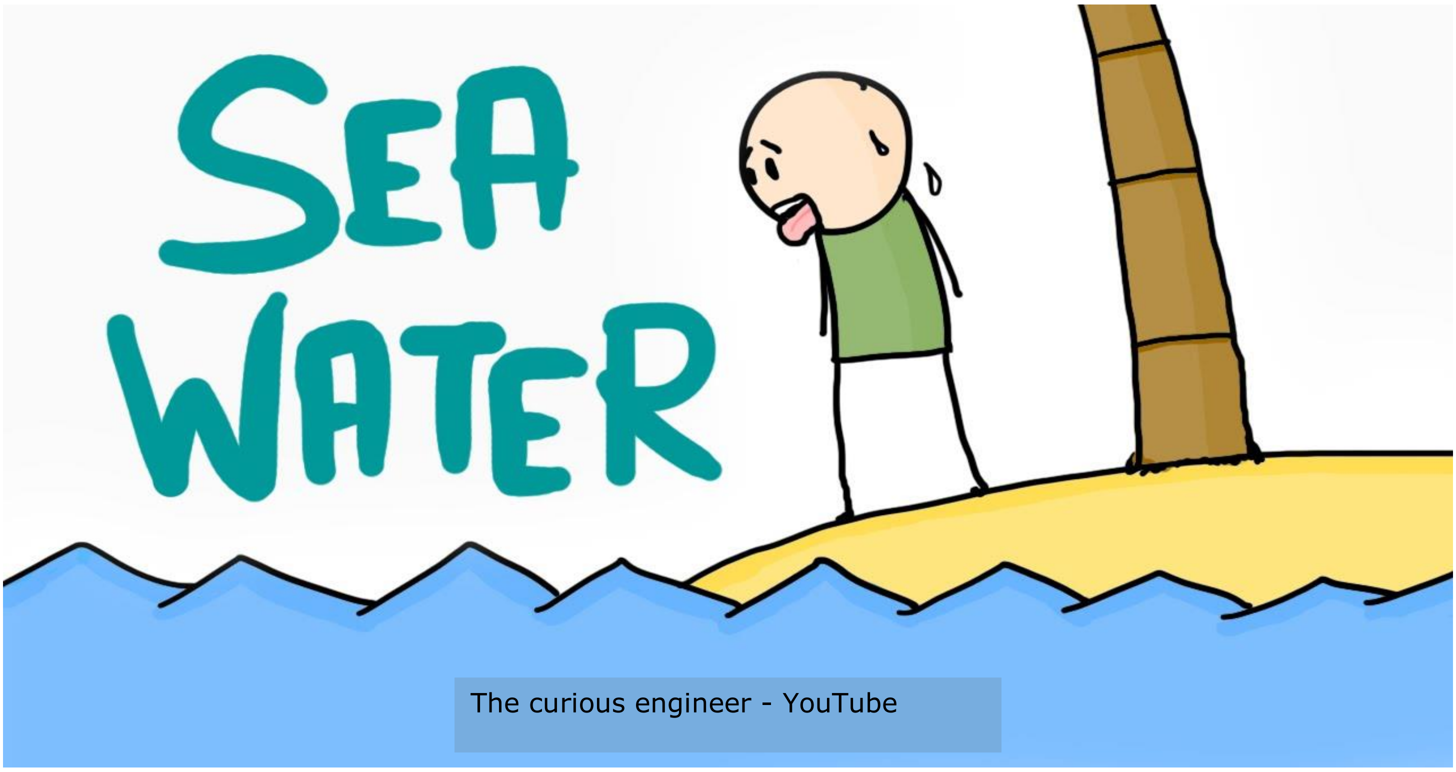
After reading this Big Science Idea, what questions do you have?

Scientific Glossary

This is the start of a keyword list. Define these terms and add your own as you work through this unit.

- Hydrosphere -
- Water scarcity -
- Groundwater -
- Potable water -

Image and questions to get you started!



The curious engineer - YouTube

We live on a blue planet but how much is available for us to drink?

Where can you find fresh water on planet Earth?

Is all fresh water suitable for drinking?

Scientific Challenge 1

Water is everywhere, how can we be scarce of drinking water?

The Challenge

Although there is an abundance of water in our world, the majority is salt water in the oceans. Very little is fresh water, with most of that locked up in glaciers, icecaps, atmosphere and soil. That leaves a relatively small amount available both on the surface and underground, for the world to use. On the surface, some of the places it can be found is in rivers, lakes, wetlands and dams. Underground, it is found in the cracks and spaces of soil, sand and rock.

The Equipment

- Flat tray
- 1 x small bottle
- 1 x large bottle
- Land: Material & foam blocks
- Fresh water: Petri dishes
- Syringe
- Big beaker 500ml
- Small beaker 25ml

- Salt
- Teaspoon
- Refractometer & pipette
- Distilled water for cleaning refractometer
- Scales

Create a simple model to demonstrate where water is found in our world.

Use only the water in the large bottle to fill the ocean areas of your model. Use only the water in the small bottle to fill the freshwater areas.

1. Make the ocean water salty.
2. Calculate the fresh/salty ratio of water available in our world. Represent your result as a fraction, decimal and percentage.
3. Test the salinity with the refractometer.

The Report

For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 2

Cloud to tap and back! How does fresh water move around our planet?

The Challenge

We all live in a catchment. When rain hits the ground, it either soaks into the ground or runs across the land. The surface water flows into drains, creeks and rivers, and eventually out to sea.

Build a functioning model of the water cycle including the surface and underground water in the catchment.

The Equipment

- Plastic box
- Small pebbles/rocks
- Trigger spray bottle
- Sponges
- Clear plastic sheeting
- Weed mat
- Foil
- Plastic sheets
- Scissors

The Report

For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 3

Is there water underground? What does this tell us about the local geology and human activities?

The Challenge

Some rain and river water soaks into the ground and drains down to the water table. It fills gaps in the rocks and soil and flows through the ground, a little like water flows through a sponge. As it infiltrates, minerals can leach into the water. Depending on the local geology and the human land uses, this will affect the colour, taste or salt levels and therefore influence its potential usage.

Watch this video to find out more about groundwater.
https://www.australiascience.tv/episode/seqwater-explains-ground-water-a-water-source-option/

Collect a sample of groundwater.
From the sample, find out:
1. The depth of the source,
2. The water quality and
3. What it is used for.

The Equipment

- Groundwater sample: this should not include silt or dirt so turbidity does not affect the results.
- Large beakers 500ml
- pH meter: acidity and alkalinity on scale 0-14.
- Electrical conductivity (EC) meter: *transfer of electricity.*
- Calcium ion meter: *hardness.*

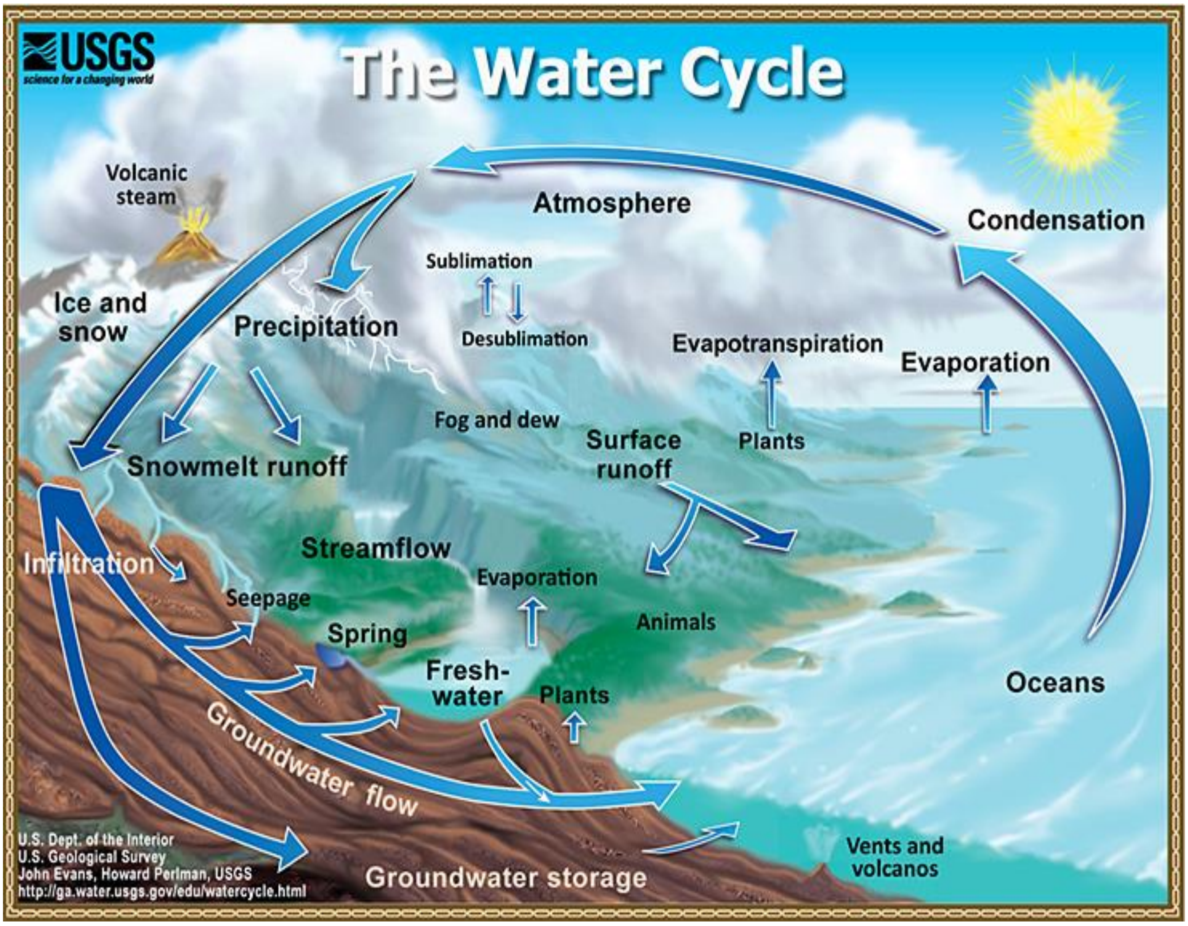
The Report

For a guide on how to write your report see page 3.

The Report continues

Unit 1 Science Information

We live on a blue planet that is comprised of about 70% oceans. However, despite this abundance of water on Earth, fresh water availability is scarce. Only 3% is fresh water. With 2% of that locked up in glaciers, icecaps, atmosphere and soil, this leaves only 1% available for the whole world's use. This is what is meant by water scarcity.

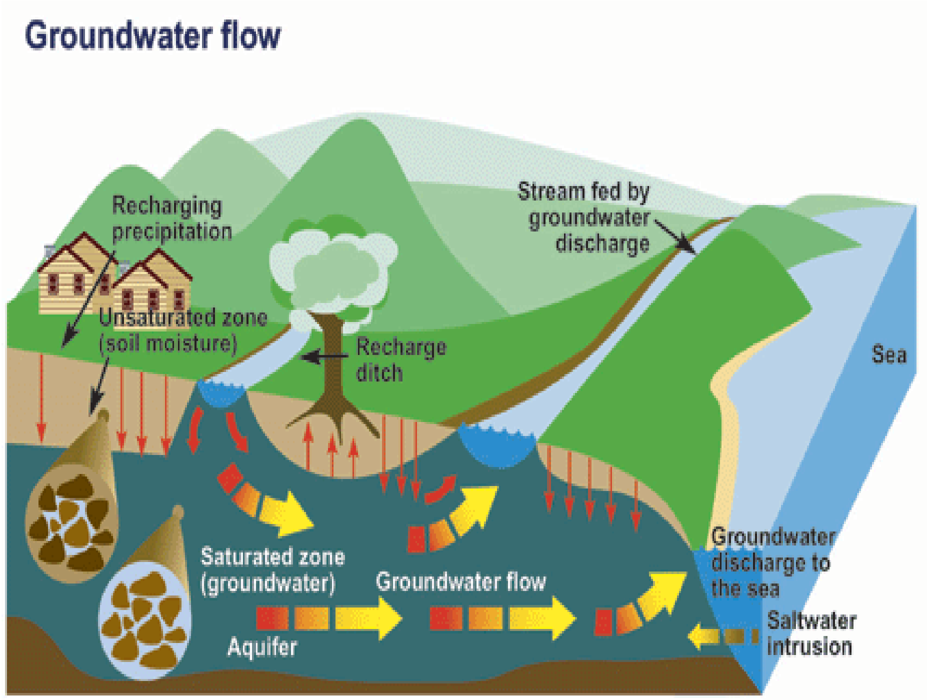


http://water.usgs.gov/edu/watercyclesummary.html

Different liquids contain different salt concentrations (the percentages shown in brackets in the following examples). Freshwater contains less than 1 gram per litre (0.1%) of total dissolved salts, seawater is about 35 grams per litre (3.5%) and our blood has 9 grams per litre (0.9%).

The fresh water in our world is found in three main places, on the surface, underground and in the atmosphere. Rivers, lakes, wetlands or dams are some of the places you find it on the surface of the land. Surface and atmospheric water seeps underground into cracks and spaces in soil, sand and rock and becomes groundwater. Water in the atmosphere will be seen as snow, rain, fog, mist or steam and is invisible as water vapour. When it rains the water moves through the catchment (the area of land that 'catches' the rain and drains it down to the lowest point). The water eventually flows into the ocean. The ocean, like other surface water, can be evaporated by the Sun's energy and the water returned to the atmosphere, entering the water cycle once more. The hydrosphere is all the water found on Earth in the water cycle including water on surface, in the atmosphere and underground.

Over time, water from rain and rivers infiltrates through the ground and is stored in spaces in soils and rocks, as groundwater. Rocks and soils that hold and transmit usable quantities of water are called aquifers. The top of the saturated portion of ground is known as the water table. There is about 60 times more groundwater than surface water but as it is out of sight, it is mostly out of mind. About 2 billion people worldwide depend on groundwater for their drinking water supply. Most of the time it is hidden but in some places it bubbles up naturally as springs or into rivers and wetlands. This can be a crucial factor in sustaining rivers, particularly through dry times and therefore many ecosystems depend on groundwater. Groundwater will become depleted if extraction rates exceed replenishment rates. Other groundwater management issues include contamination, salinity, saltwater intrusion and poor understanding of its connection to surface water and dependent ecosystems.



http://www.ec.gc.ca/eau-water

One type of groundwater is called transboundary water. This includes water that seeps into the ground in one country, runs under another and may resurface in a third. Another type of groundwater is called fossil water. This water has been cut off for millions of years. When it is pumped out, because it is not replenished, it is referred to as groundwater mining.

The water we have today is all the water we have ever had and will ever have. It just moves around through time and space in the water cycle. We are not going to get any more water but the world population growth is predicted to rise to more than 8 billion people by 2050 (from 7.4 billion in 2016). Humans are creating pressure on our fresh water resources through the growing population, over consumption, changes in evaporation and rain events due to climate change and poor land management practices that are contaminating some of the available fresh water supply.

Potable water is water that is safe enough to drink. It can be naturally potable or can be cleaned and treated to be safe for human use. However, water of different qualities can be used for different purposes. For example, using dam water for farming or in cities and towns, using rainwater from tanks for toilet flushing and clothes washing.

Unit 2: Just add water
– economy and equity

The Big Science Idea

The real cost of water considers everything involved in water consumption and production. This is often inequitable across the globe, particularly between majority and minority world countries.

Scientific Questions

After reading this Big Science idea, what questions do you have?

Scientific Glossary

This is the start of a keyword list. Define these terms and add your own as you work through this unit.

- Virtual water –
- Water footprint –
- Transboundary water –
- Sustainable Development Goals –

Image and questions to get you started!

What costs (environmental, economic and social) are there in ensuring you have clean and safe drinking water on tap at your home?

How is the production of your school shirt dependent on water?

The world's population is projected to grow from 7.4 billion people in 2016 to 8 billion in 2050, how will we have enough drinking water and will it be shared fairly across all countries?

Byron Bay Sewerage Treatment Plant

Scientific Challenge 4

What is the urban water cycle system? Show how it flows from raw water to wastewater.

The Challenge

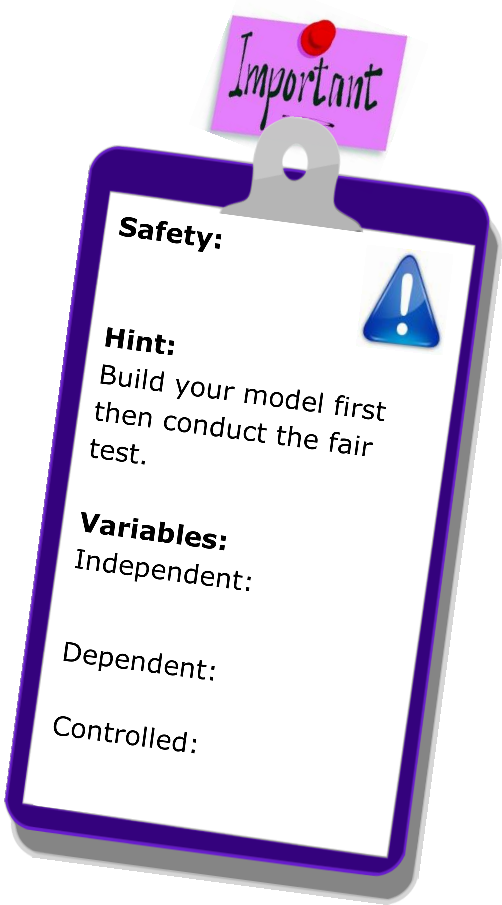
In urban regions, the main water source will often be a storage dam with a nearby water treatment plant to clean the water. Pipes distribute the potable (drinking quality) water throughout the region to town storage tanks called reservoirs. More pipes deliver this water to homes, businesses and industries. Consumption is measured with a water meter as it enters each property.

Design and build a functioning urban water distribution system, from the water storage dam to the house.

The Equipment

- Pipes and joiners
- Plastic boxes of various sizes (with holes)
- Spray bottle

1. Once your system is complete, draw a map of where the wastewater goes, including how it eventually makes it back to the water storage dam.
2. Label environmental, social or economic costs involved in this urban water supply system.



The Report

For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 5

What is the real cost of your daily water use?

The Challenge

In some majority world countries, access to freshwater is not as simple as turning on a tap. Most people live in remote, rural areas and have to travel large distances, spending hours walking to and from the water source each day. They carry the water to their homes using buckets or jerry cans.

If there was no water tap in your house, consider the distance, time, energy and physical ability needed to go to your closest water source and bring the water back again.

Using the information you have gathered and the team's knowledge of an average afterschool job wage, **calculate the real cost of collecting water.**

The Equipment

- Tape measure
- Water bottles 2L
- Activity tracking device

The Report

For a guide on how to write your report see page 3.

Important

Safety:
Maximum carrying capacity per person = 2L

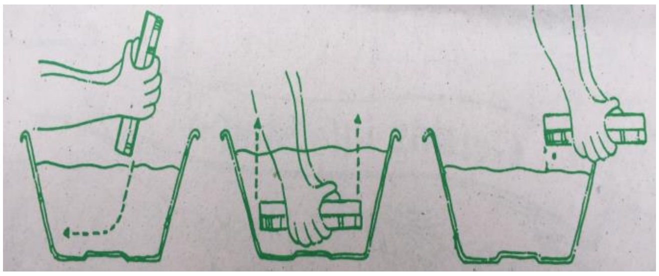
Hint:
Research the cost for your local area. For example, in the Lismore NSW region in 2017:

Average person's daily water use = **220L**.

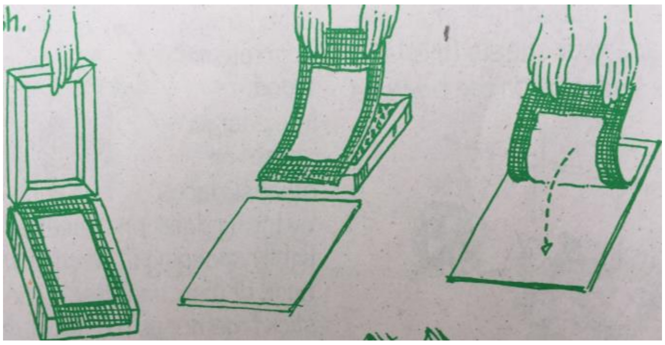
Water cost = **$3.60p/kL.**

1L water = 1kg

The Report continues



Holding frame tightly dip it into the tray, pausing at the bottom. Then take it out but hold on an angle to drip and remove excess water.



With drying board ready, peel the mesh off the screen. Then slowly lower the mesh down onto a drying board. Sponge the mesh and then peel the mesh off leaving the paper behind to dry.

Scientific Challenge 6

The water footprint is the clue to solve this investigation!

The Challenge

People use lots of water for drinking, cooking and washing but even more is used for growing our food and for making our clothing, cars or computers. The production of paper (including toilet paper, tissues, paper towel, cardboard etc.) requires water, whether it is made from wood pulp or recycled paper products. The amount of water to grow the trees to make non-recycled paper is called the green water footprint. The amount of water used during production is called the blue water footprint. The water that is used and discarded as wastewater is called grey water.

Calculate the water footprint of your student booklet using the data you collect.

The Equipment

- Scrap paper
- Blender
- Big flat tray
- Paper making frame and drying boards
- Kitchen strainer
- Sponge
- Large measuring jug 1L

Make recycled paper from used paper following the steps below.

How to make the paper:

1. Rip up enough used paper (postage stamp size) to pack full a 250ml beaker.
2. Put it into a tall jug, add 500ml water and blend to a mushy consistency.
3. Pour the pulp into a big flat tray and add 10 litres of water. Mix the pulp and water.
4. Put the three parts of the frame together. Start with draining screen, put fine mesh sheet over it and wooden frame on the top to hold it in place.
5. Use the frame to make the paper sheets, one per student – look at the pictures above.
6. Pour the remaining water and pulp through the sieve. Save the remaining pulp and estimate how many more sheets you could have made with that amount of pulp. Do not discard pulp down the drain.

The Report

For a guide on how to write your report see page 3.

Unit 2 Science Information

Everything we own, use, consume or buy has a <u>water footprint</u>. This is a measure of the amount of water used to produce these goods and services along the full production and supply chain.

Example 1: An orange!

Oranges are about 80% water. It takes about 50 litres of water to grow one orange! (*Source: www.waterfootprint.org*).

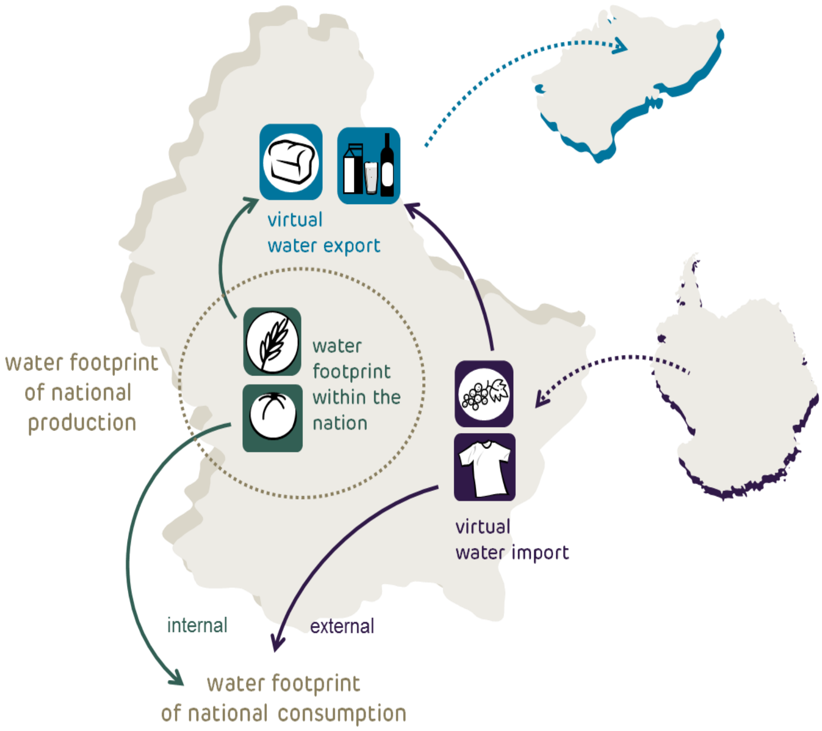
Spanish oranges will have been irrigated with water from a river or groundwater source in Spain.

After harvesting, the orchardist washed the oranges, resulting in wastewater.

They were then packed into boxes made from wood. The wooden boxes are included in the water footprint as they are a part of the production process.

The wood was sourced from Spanish or imported trees grown with rain or irrigation. Then ships and trucks transport the oranges to your supermarket. It is important we start thinking about all the <u>embedded or virtual water</u> in all our commodities or services; that includes the volume of water consumed or polluted.

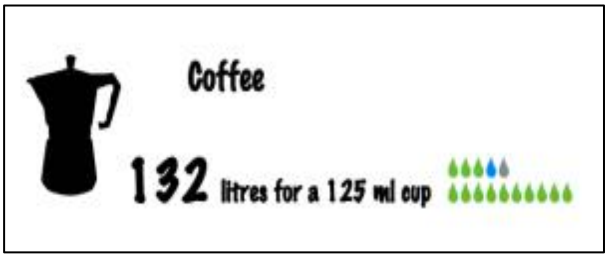
The virtual water is all the water used in production but may not be directly related to the manufacturing of the product. If a country imports/exports a product, it imports/exports water in its virtual form.



http://waterfootprint.org

Water footprints include the type of water being used to make a product e.g. your school shirt:

- **<u>Green water footprint</u>** – measures the amount of rainwater that is stored in the root zone of the soil and evaporated, transpired or incorporated by plants.
- **<u>Blue water footprint</u>** – measures the total amount of groundwater and surface water.
- **<u>Grey water footprint</u>** – measures the amount of freshwater required to dilute the wastewater pollutants to maintain water quality to an acceptable standard.



http://waterfootprint.org

Example 2: Paper production!

It has been estimated that on average one tree makes approximately 16.67 reams of copy paper or 8,333.3 sheets or 1 ream (500 sheets) requires 6% of a tree. This of course depends on the size and type of tree, paper quality and paper making process. Every tree requires 490 litres of water for growth (*it's blue and green water footprint*) and 189 litres for processing into paper (*it's blue and grey water footprint*). Making recycled paper uses less water and involves less energy consumption than virgin paper because most of the energy used in papermaking occurs when the tree are chipped. Recycled paper usually is bleached with oxygen instead of chlorine that reduces the by-product too. (*Source:* http://conservatree.org/learn/EnviroIssues/TreeStats.shtml).

In minority world countries, water management considers the water cycle as a whole and combining planning for all the elements of government water services i.e. drinking water, sewage, waterways, catchments, stormwater and groundwater. This integrated approach aims to provide more sustainable economic, social and environmental outcomes. However, the global dimension of water management is not always considered: that is, saving water by importing low virtual water products.

Access to safe water and sanitation is recognised as a human right. In 2015 at the United Nations Sustainable Development Summit, the 2030 Agenda for Sustainable Development was adopted. This includes a set of 17 Sustainable Development Goals (SDG). Goal number 6 states, "*Ensure availability and sustainable management of water and sanitation for all*". Yet 650 million people worldwide live without access to safe water (Source: http://www.wateraid.org). What is the real price paid by these communities for collecting their water; in wasted time and income, ill health, lost productivity and degraded ecosystems?

Unit 3: Water for Life
– human biology and ecosystems

The Big Science Idea

Water plays an essential role in our life: from cells, ecosystems to the biosphere.

Scientific Questions

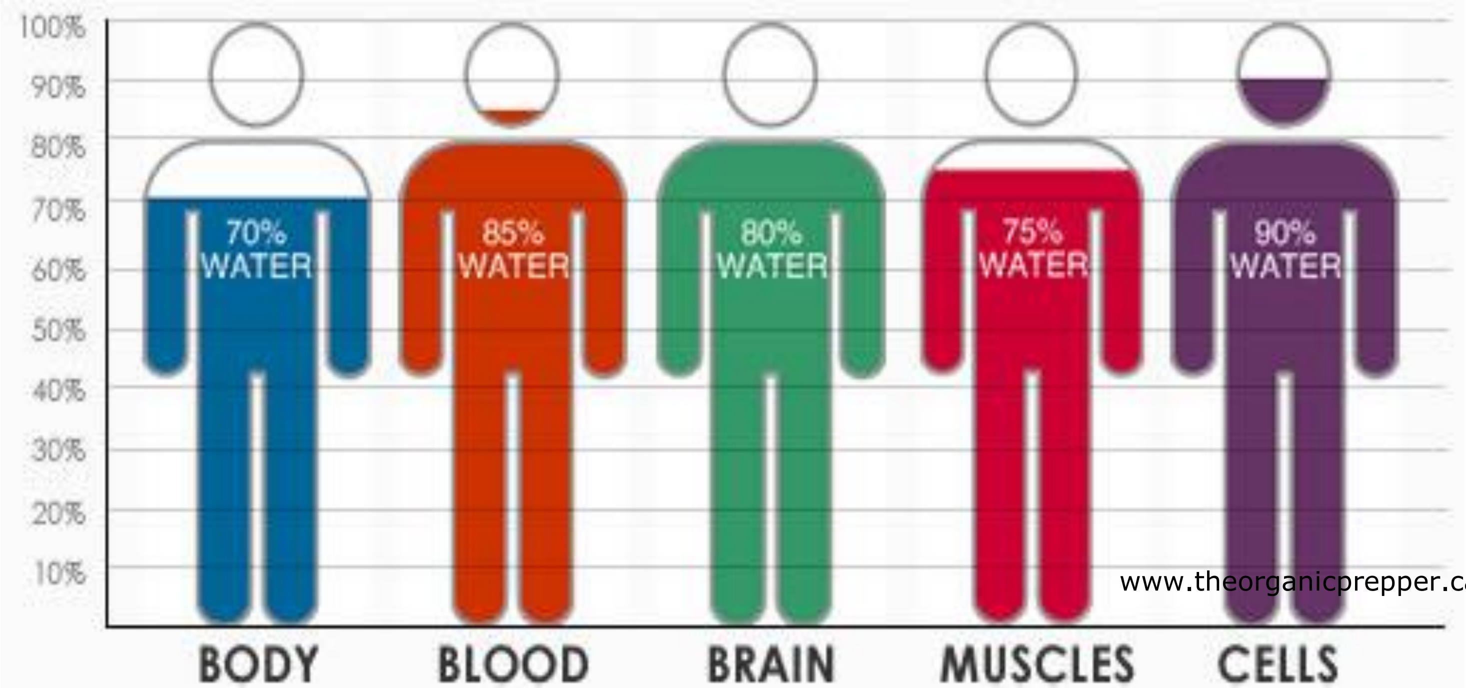
After reading this Big Science idea, what questions do you have?

Scientific Glossary

This is the start of a keyword list. Define these terms and add your own as you work through this unit.

- Osmosis -
- Ecosystems –
- Biosphere –
- Macroinvertebrate -

Image and questions to get you started!

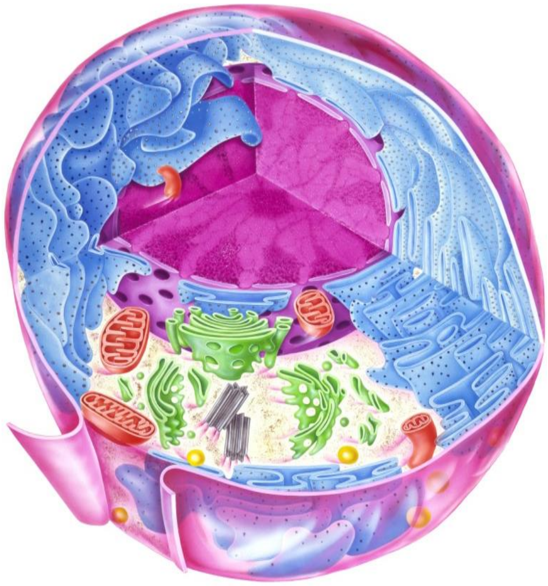


www.theorganicprepper.ca/

Why is water in our body vital for our survival?

Why is water in ecosystems vital for our survival?

The biosphere is the parts of earth where life exists: in the ground, on the land, in the water and air. Why is water in the biosphere vital for our survival?



Scientific Challenge 7

Why do cells need water?

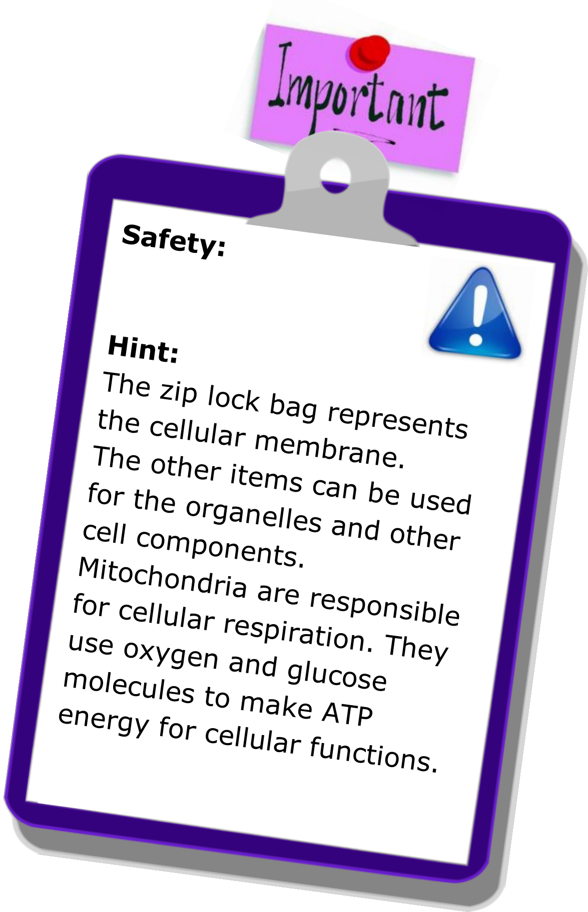
The Challenge

We are made of cells and about 70% of our total body weight is water. Water plays a vital role in the function of the cell.

Using the cell images as a guide, make a simple 3D model of a single human cell. To understand the function of water in a cell, add some organic molecules for the mitochondria to digest to produce energy for the cell.

The Equipment

- Laminated pictures of human cell
- Zip lock bag
- Bits to represent cell components: pipe cleaners, interlocking beads, polystyrene balls & other beads



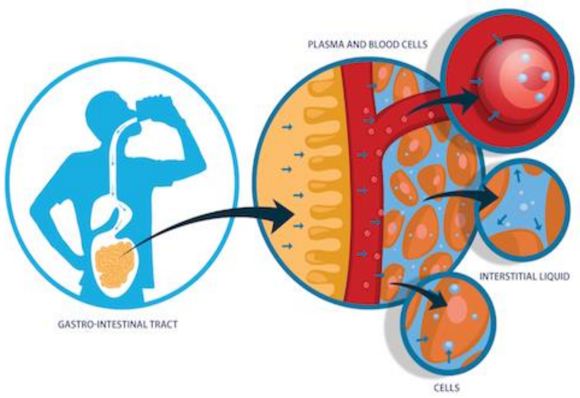
The Report

For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 8

Cell communication: no mobile phone required!



http://www.h4hinitiative.com

The Challenge

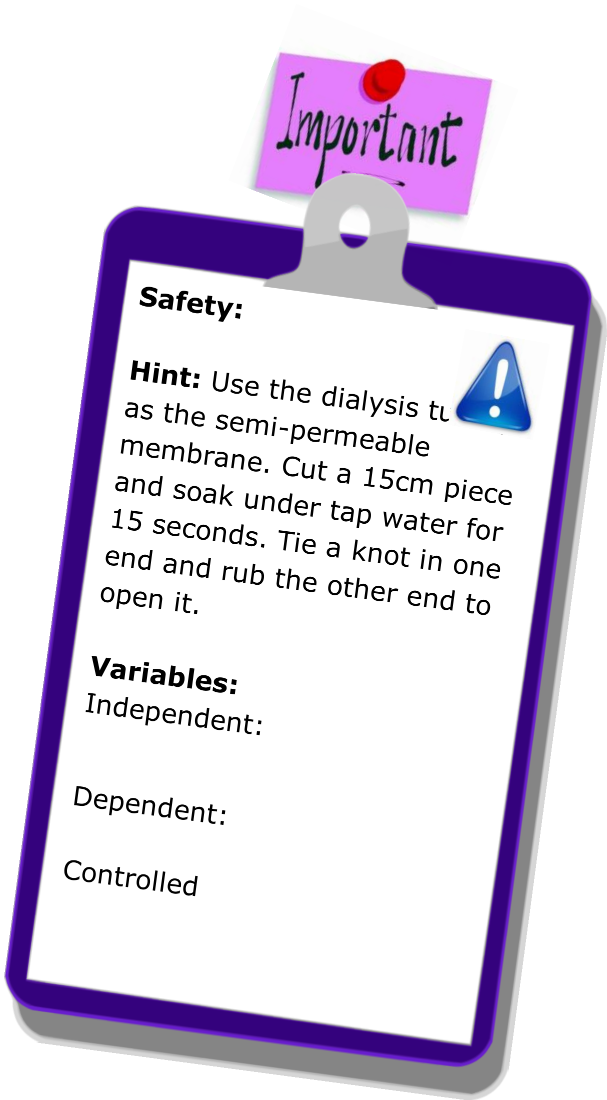
Even though cells do not talk as we do, they are constantly in communication with each other. Cells communicate through their cell membrane, which has a structure that allows nutrients to pass in and wastes to pass out.

Using a semi-permeable membrane, demonstrate the diffusion of water molecules (osmosis) into and out of cells.

Make enough salt solution to half fill a large beaker. Once prepared, add distilled water with a drop of food colouring to the dialysis tube. Close the top with a rubber band, rinse the outside of the dialysis tubing with tap water. Place it in the beaker.

The Equipment

- Dialysis tubing
- Elastic bands to tie off tubing
- Small funnel
- Large beakers 500ml
- Small beakers 25ml
- Distilled water
- Scissors
- Ruler
- Salt
- Food dye



The Report

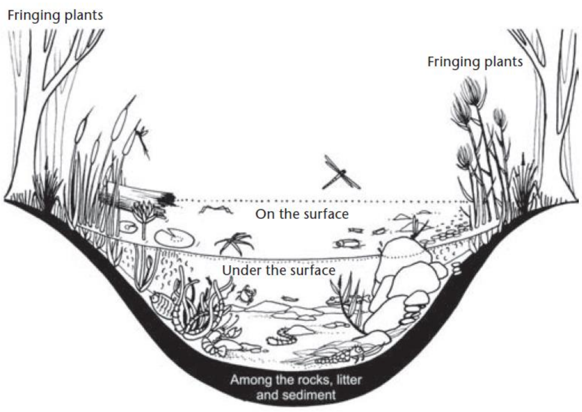
For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 9

Is this water from a healthy ecosystem?

The Challenge



http://www.streamwatch.org.au

You will be supplied with a bucket containing water and life from a local creek or waterway.

It was collected with a net from different parts of the water e.g. along the edge, in the reeds, under rocks and on the surface, to provide a sample of the aquatic habitat. To assist with environmental monitoring water beetles (macroinvertebrates) have been rated according to their sensitivity to pollution, as shown on the ID Chart.

Identify the macroinvertebrates with a magnifying glass and digital microscope. Use the classification chart to help you make your decision.

The Equipment

- Bucket of water with beetles, rocks & reeds from a creek or other waterway. Use a bucket with a lid and the net.
- Large low flat tray
- Digital Microscope (connected to Laptop)
- Wide tipped pipette
- Petri dishes
- Black rubber rings
- Magnifying glasses
- Water bug detective guide - ID chart
- Field record sheet

Important

Safety:

Hints:
These animals will be returned to their creek later, please look after them.

Place the rubber ring around the water beetle in a petri dish to limit their movement and aid viewing with the microscope.

Variables:

Independent:

Dependent:

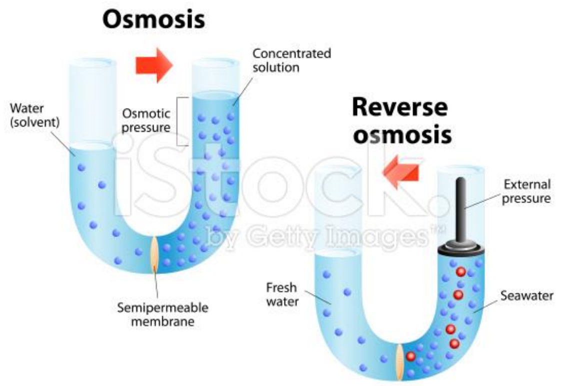
Controlled:

The Report

For a guide on how to write your report see page 3.

The Report continues

Unit 3 Science Information



About 70% of our body is water. It helps to regulate our internal body temperature; transport nutrients and oxygen in the bloodstream; remove bodily wastes; lubricate joints and acts as a shock absorber for our brain and spinal cord. About three-quarters of this water is in the cells and the rest is outside the cells, such as blood plasma, lymph and urine and other bodily fluids.

In our cells, the cytoplasm is the watery medium where the other cell components are suspended and where the work is carried out. All cells have a plasma or cell membrane that holds the cell together and controls nutrients passing into the cell and waste products passing out. The membrane is what controls this movement because it is semi-permeable. This means it allows small particles to move through it. Osmosis is the passive movement of water molecules, from a region of higher concentration to a lower concentration, through a semi-permeable membrane. A dilute solution contains a high concentration of water molecules, while a concentrated solution contains a low concentration of water molecules.

As water is found in cells, it makes sense that water is also the major constituent of most foods. It gives them their look, taste and structure. Even dry products such as cereals can contain up to 20% water, meat contains 60 to 75% and fruit and vegetables contain 80 to 90%. *Source: http://www.azaquar.com/en/doc/water-in-food*

Without water, there is no life. Water is found on the surface, in the ground and in the air, together this is the hydrosphere. The hydrosphere with the atmosphere and the lithosphere make up the biosphere, the home of all living things. The interconnected community of living and non-living things is called an ecosystem. Healthy natural ecosystems filter and replenish freshwater, this is one of the vital ecosystem services. Therefore, ecosystem stewardship is a key task for us all. This is about taking responsibility for looking after our natural resources. This is not only for our daily survival, but also for managing our water resources for an environmentally sustainable future.

Mosquito pupae float at the surface and use tubes to breath.

Healthy ecosystems mean healthy water for people, plants and animals.
Water quality indicators test the health of water and can be biological (e.g. macroinvertebrates), chemical (e.g. pH) and physical (e.g. turbidity). Macroinvertebrates or water bugs are animals without a backbone that can be seen with the naked eye, such as beetles, dragonflies, shrimp, worms and snails. They live all or part of their life in water, providing a food source for larger animals such as fish, platypus, frogs and birds. A system has been developed to score these organisms tolerance to "pollution" such as high levels of silt, nutrients or mineral salts and low levels of dissolved oxygen. The types, numbers and range of macroinvertebrates found in a creek or other waterway reveals a lot about the water quality and therefore health of the catchment and ecosystem. A Stream Pollution Index (SPI) value can be calculated and is seen as a significant indicator of water quality. An 'excellent' SPI score tells you that there is an abundance and diversity of water bugs. It also indicates that there is good water quality with a diversity of habitats in a very well managed site or protected natural bushland area of the catchment. The waterway will have low levels of pollution and high levels of dissolved oxygen; shade; logs and rocks for shelter; undisturbed and diverse native vegetation along and overhanging the banks; natural flow patterns; stable edges; no human structures; little human access; no stock access and no exotic water animals or plants.

Unit 4: Water Farming
– water quality and water recovery

The Big Science Idea

Water can be collected, harvested or recovered. Human behaviour and lifestyle choices will affect water quality and availability.

Scientific Questions

After reading this Big Science idea, what questions do you have?

____

____

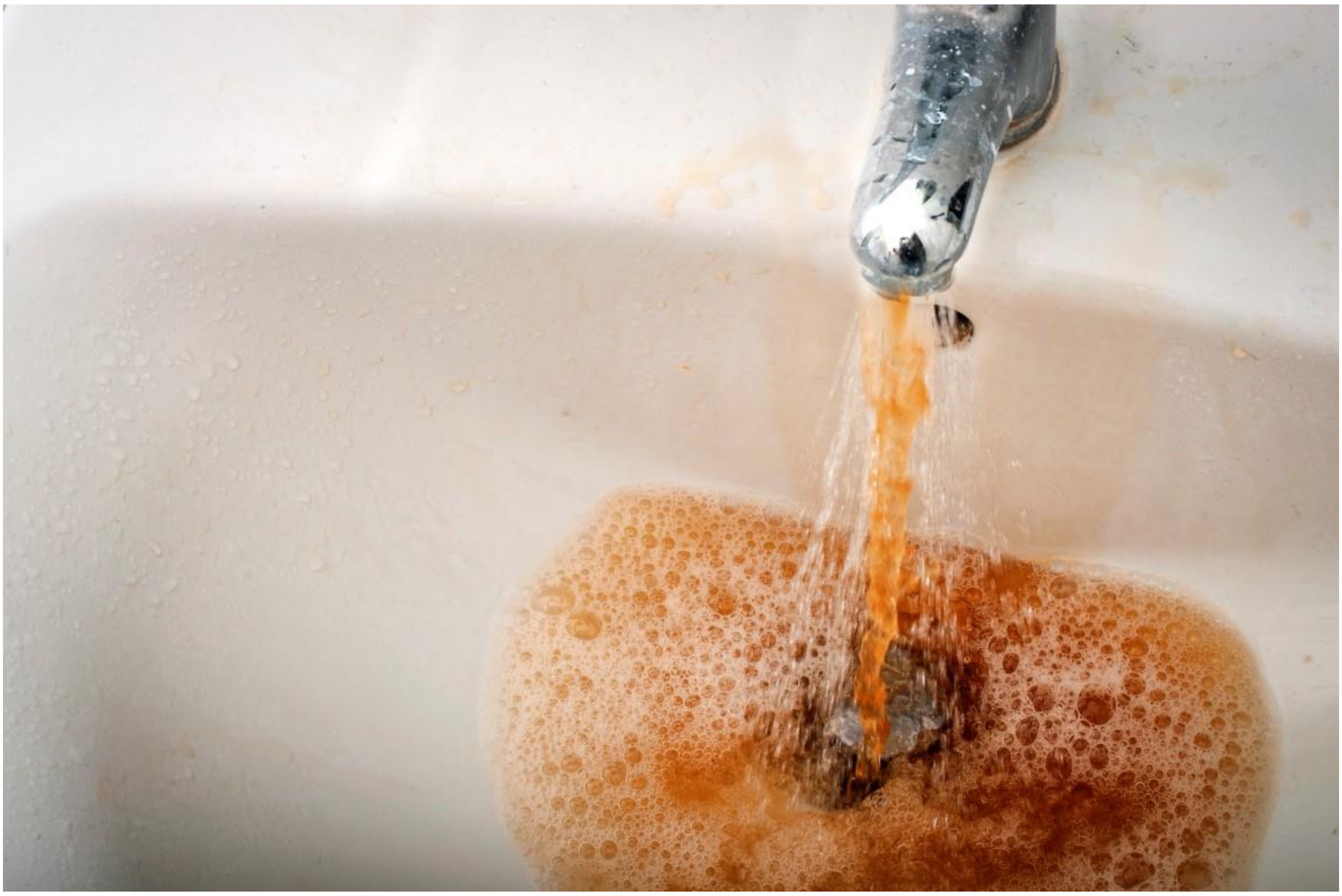
____

Scientific Glossary

This is the start of a keyword list. Define these terms and add your own as you work through this unit.

- Water harvesting and recovery –
- Water quality issues –
- Water treatment –
- Water fingerprinting –

Image and questions to get you started!



Where does your school tap water come from? Has it been cleaned and treated?

How would you reply if someone said to you, "*Why should I bother saving water?*"

The water authority in your local area is proposing to use recycled wastewater. What is your opinion about recycled water? Write an argument to justify a vote for or against!

http://www.nydailynews.com/news/world/world-driest-desert-chile-harvests-water-

Scientific Challenge 10

Invisible water – how can you harvest water from the air?

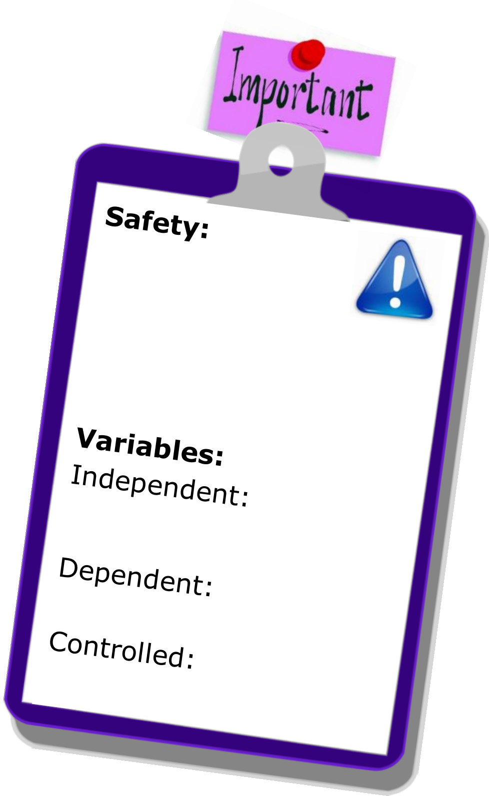
The Challenge

Using an example from Chile, where in the very high and very dry mountain region, there is no rain but regular fog. They catch the fog with giant mesh nets. It drips into pipes that both hold up the nets and act as gutters. A series of pipes and tanks distribute the water to farms.

Create a functioning model of this scenario to harvest water from the air!

The Equipment

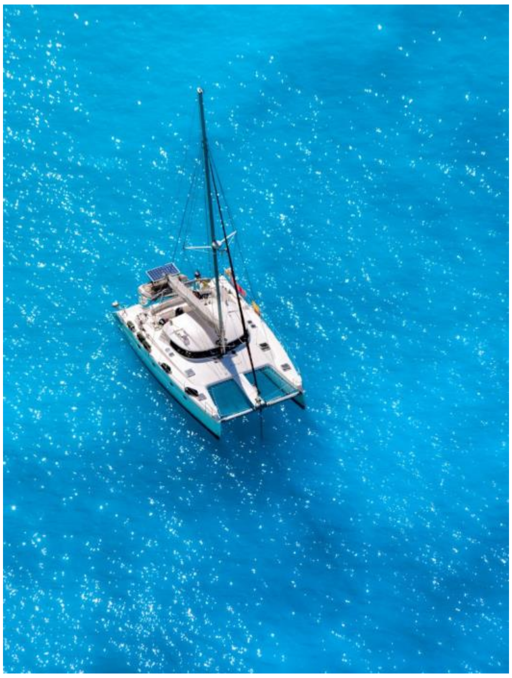
- Pipes and joiners
- Retort stand and clamps
- Spray bottle
- Shade cloth
- Plastic sheeting
- Weed mat
- Tape
- Scissors



The Report

For a guide on how to write your report see page 3.

The Report continues



Scientific Challenge 11

What would you do if you were out at sea and ran out of fresh drinking water?

The Challenge

Desalination is used to convert salty water to fresh in large water treatment plants for regions where rainfall is low or in small filters for boats.

Make a device for converting salty water into fresh liquid water for drinking.

1. Cut off the bottom of the plastic bottle and fold the edge up inside. Place this over a can of salty water.
2. Use the refractometer to measure the salinity

The Equipment

- Plastic bottles - empty
- Cans - empty
- Scissors
- Small beaker 25ml
- Refractometer & pipette
- Distilled water for cleaning refractometer
- Hot water as an alternative to direct sunlight
- Heat lamp as an alternative to direct sunlight
- Teaspoon
- Scales

The Report

For a guide on how to write your report see page 3.

The Report continues

Scientific Challenge 12

Dirty water, would you drink that?

The Challenge

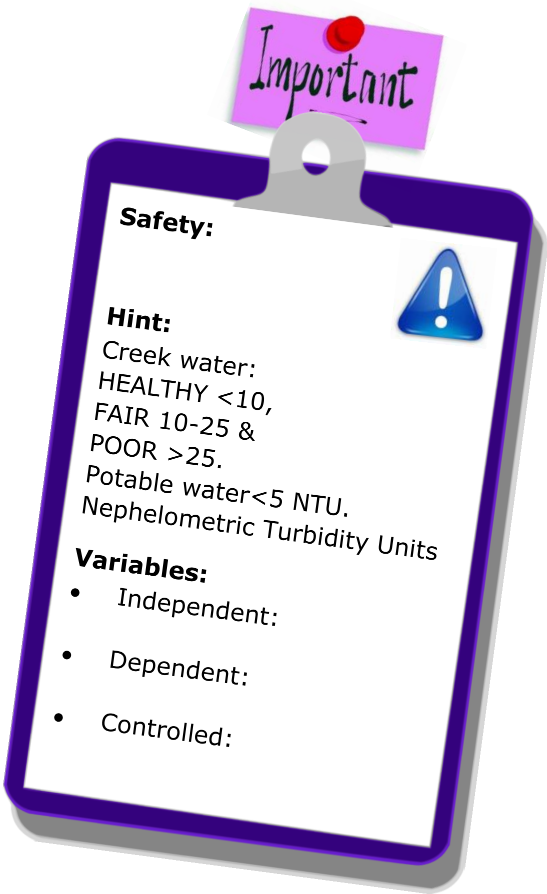
Our actions on the land can affect the water quality. Soils, oils, detergents, pesticides, animal faeces, rubbish and dust are some of the things that can wash or blow down drains and into the creeks and waterways. One indicator of poor water quality is murky (turbid) water. Removing the silt and other particles in the water also removes many of the unseen contaminants too. This is one of the main steps in water treatment plants. The turbidity meter measures the suspended particles.

Design and build your own water filter and compare your filter's effectiveness to that of the microfilters.

Would you drink your filtered water?
Make a list of other uses for which it would be suitable.

The Equipment

- Dirty water
- Large Beakers 500ml
- Katadyn microfilter
- SteriPEN - UV microfilter
- Turbidity meter and cleaning cloth
- Conical flask and powder funnel
- Filter making materials
  e.g. coffee filter papers, charcoal, rocks, wiping cloths, sand & cotton wool.



The Report

For a guide on how to write your report see page 3.

The Report continues

Unit 4 Science Information

Fresh water can be harvested and farmed from many sources e.g. ice, fog, rain, dams, creeks, rivers, springs and underground. It can be recovered from seawater and various wastewater sources such as sewerage systems and stormwater drains.

Many issues such as climate change and population growth affect fresh water availability. This has led to many innovations in water supply and management, both currently and historically. For example, in about 800 BC the Mayans, from the Mexican Yucatan Peninsula, lived in a limestone region. As limestone is a soluble rock it meant that there was almost no surface water. They developed a system of caves to reach the water table and used cisterns and reservoirs to keep the water flowing. A more modern example of an innovation in water supply is from Singapore, where a glass of drinking water will come from their '4 National Taps'. These are 1. A dam or channel; 2. Imported from Malaysia; 3. Desalinated seawater; or 4. Highly-purified recycled wastewater.

Mostly the level of water treatment dictates the water use. Recycled sewage is mostly treated to a level fit for watering public parks, sporting grounds or tree plantations and for household gardens, toilet flushing and laundry use. You can identify recycled water by purple pipes, purple taps, purple hoses and purple meters. It is treated to a drinkable level in some countries and even on the International Space Station. A NASA astronaut describes it as, "Yesterday's coffee turns into tomorrow's coffee." *Source: http://mars.nasa.gov*

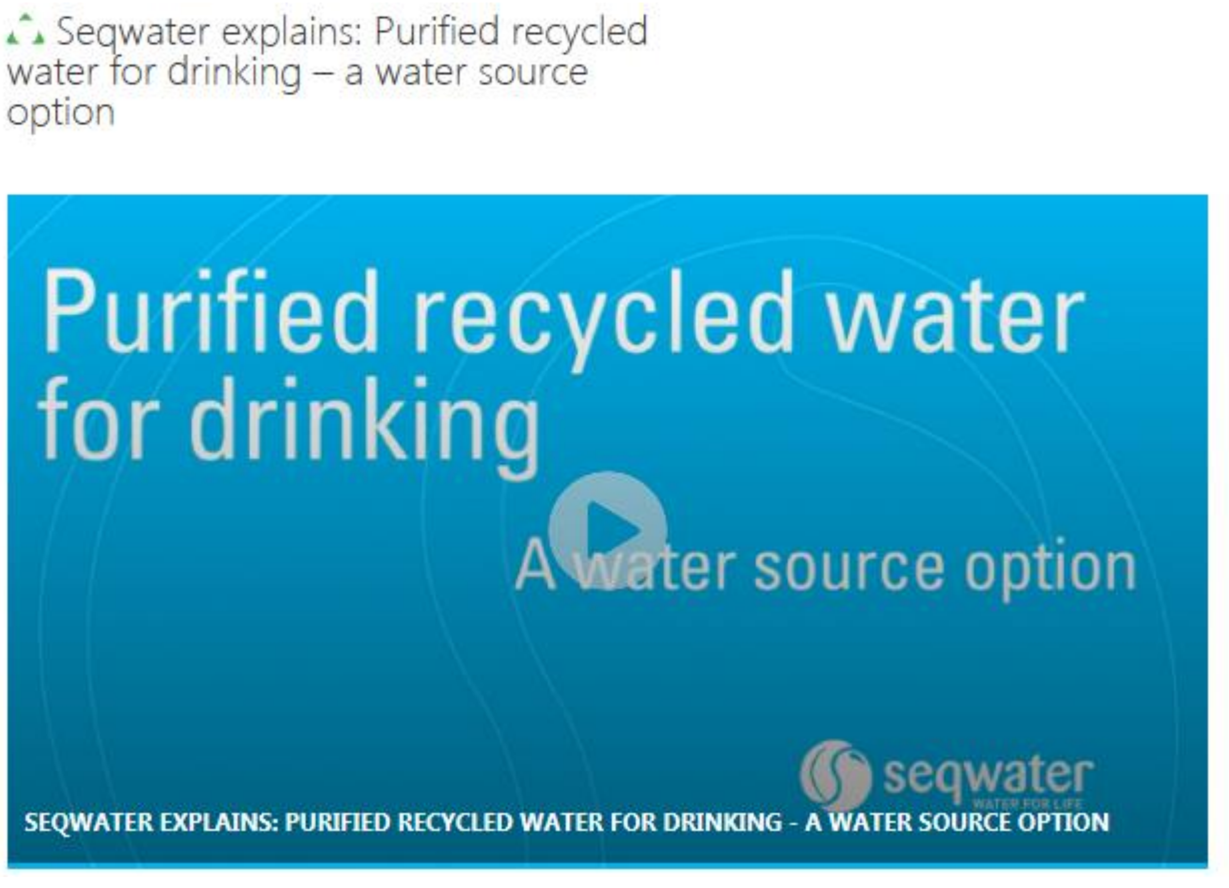
As water travels through time and space in the water cycle it is naturally cleaned. It is filtered through tree roots and sand; disinfected by UV rays; and aerated by aquatic plants, wind and waterfalls but there are also many opportunities for it to become contaminated too. Water is a solvent, which means that water-soluble wastes pollute water easily. As water flows down through the catchment it easily picks up substances left there by human activity e.g. oils, soil, detergents, pesticides, herbicides, fertilisers, rubbish, dust, smoke, human waste and animal faeces. This can wash down drains and into creeks, rivers and eventually out to sea. Inorganic or organic matter in the water can affect temperature, light, acidity, total dissolved salts, biologically dissolved oxygen and nutrient levels.

Water quality in our waterways is directly related to land management practices and human activities e.g. vegetation along the riverbank filters water, stabilises soil, reduces erosion and slows water flow. This leads to improved water quality and a healthier ecosystem as well as providing food, homes, shelter and a green corridor for safe movement of native wildlife.

<u>Turbidity</u> is a measure of the cloudiness of the water due to the silt, dirt and other particles in the water. It is caused by erosion from animals or people, stirring up by bottom feeders like carp, waste discharge, algae growth and urban runoff. Turbidity impacts ecosystems by increasing water temperature, reducing oxygen in the water, decreasing photosynthetic activity of plants and algae (which then lowers the oxygen concentration even more), fills in shallow lakes and clogs animal's gills, eggs or larvae. For drinking water it is essential to remove the turbidity to effectively clean it and you will also remove most of the pathogens, heavy metals or toxic organic compounds.

Water treatment plants process water to make it safe for human consumption. Water treatment plants remove pathogens like giardia, improve the appearance and smell of the water and prevent problems occurring in the pipe distribution system like corrosion. Nano technology is helping scientists to develop new treatment processes. NASA's International Space Station wastewater filtration device uses acoustics rather than pressure to drive water through small-diameter carbon nanotubes. <u>Water fingerprinting</u> is being done to find out the source of sediments, oil spills or contamination. It uses geochemistry and molecular or chemical isotope signatures. The human impact on the environment can also be monitored in groundwater e.g. environmental tracers can detect existing levels of CFCs, (chlorofluorocarbon gases that were used in refrigerants and aerosol propellants prior to 1989) and bombs pulses from the 1950s.

Watch this video:



https://www.australiascience.tv/episode/seqwater-explains-purified-recycled-water-for-drinking-a-water-source-option/

Unit 5: STEM at work

A career in water sustainability

Your task

In this activity you will be investigating the work of someone who works in the water industry and write a career profile for that person.

What to do

Select one of the following options. If possible, conduct an interview with the person you select. Alternatively, you may use the internet or other resources to find your information, including the STELR website.

Option 1

Research the career profile of someone who works in the water industry. Their job can involve any aspect of the industry, such as research, manufacture, engineering, management, installation, technical service and marketing.

Option 2

Research the career profile of an Australian scientist whose work focuses on water. Their job might involve research and development, researching the impact of the industry on the environment, and so on.

Your report

Select a suitable report format for your findings. The information you find out should include, if possible:

- Name of the organisation where the person works and brief description of what the organisation does
- Position in the organisation
- Subjects they studied at upper secondary school level
- Course(s) taken after leaving secondary school
- Duties involved in their job
- Why they chose this job
- The most enjoyable aspects of the job
- The challenges they face in the job
- How they think this job will change over the next decade
- Salary range of people working in this kind of job

Resources

Sustainable water careers video

https://www.australiascience.tv/season/sustainable-water-careers/

Bridget Walker is Water and Wastewater Manager for Ballina Shire Council and Thomas Lees is a Treatment Plant Process Engineer. They are part of the team of people who work and plan to ensure the delivery of drinking water, wastewater and recycled water services to the residents and businesses within the Ballina Shire Council in Northern New South Wales.

In this video, Bridget and Thomas discuss their work and why they chose to study and pursue a career in engineering.

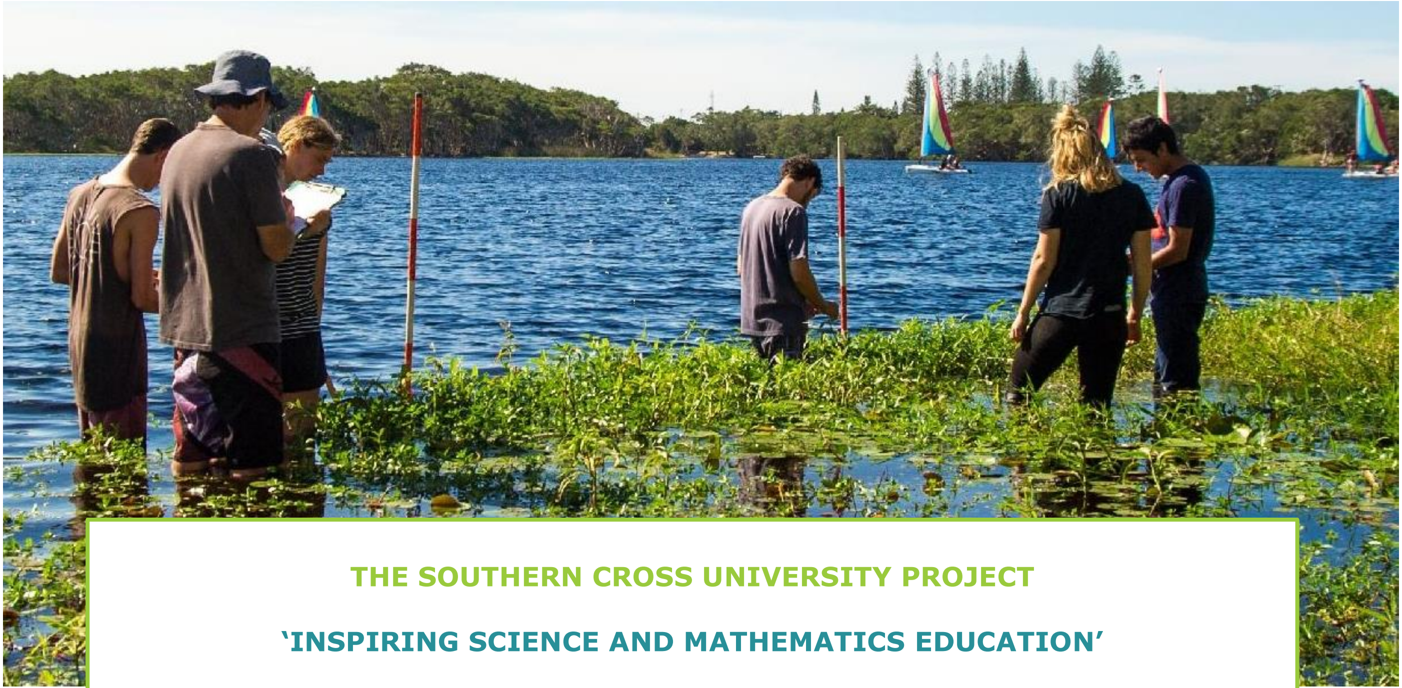
Southern Cross University produced this video along with the written material for the STELR Water in the 21st Century module.

OR

You can find sample career profiles of people working in the water industry on the ATSE STELR website at: http://www.stelr.org.au/career-profiles/

Glossary

Term	Meaning



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