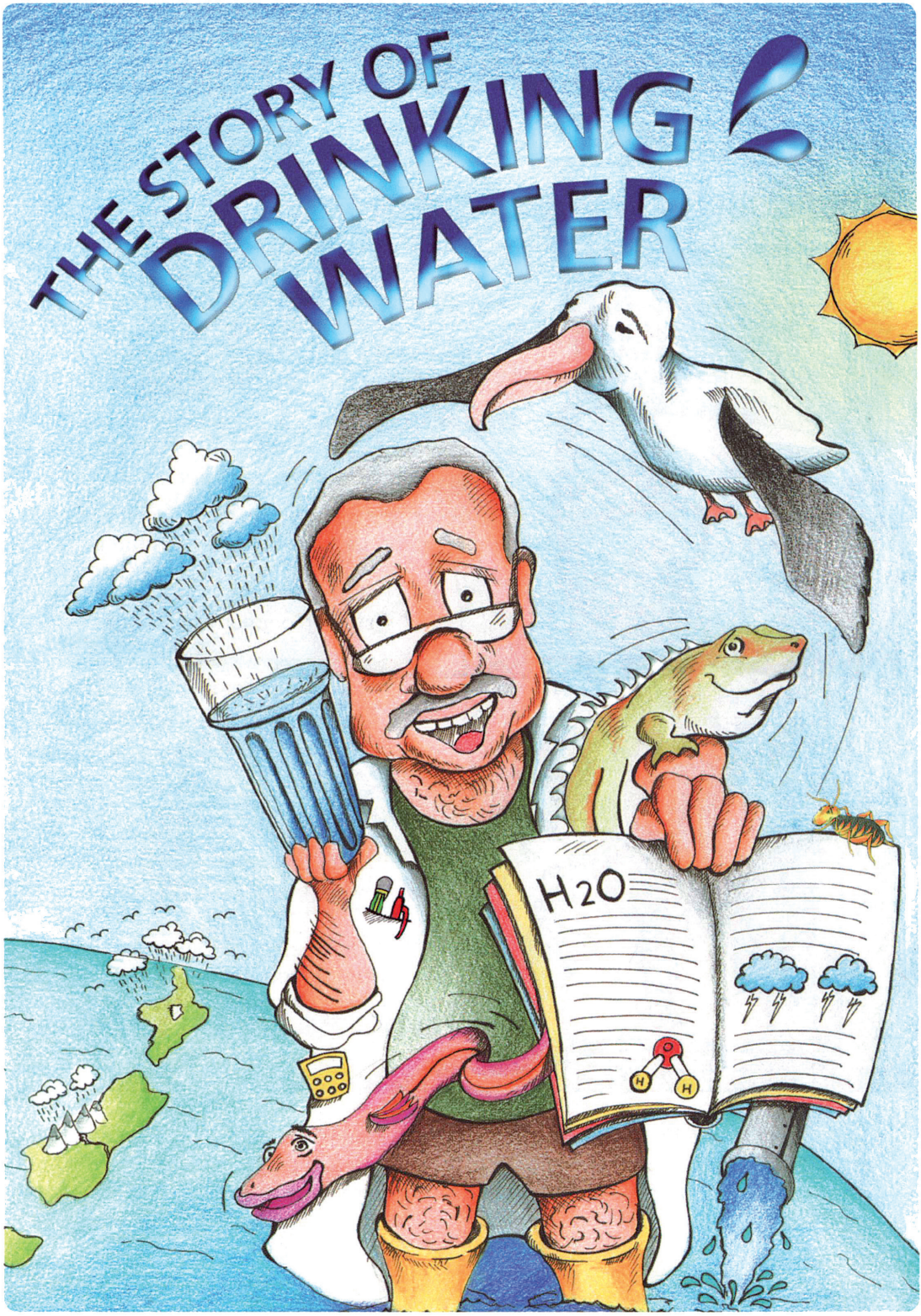
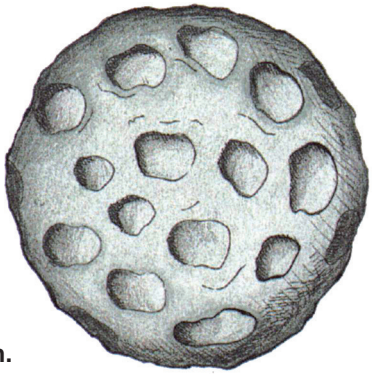

THE STORY OF
DRINKING
WATER
H2O

What do you know about water?



WHAT IF THERE WAS NO WATER ON EARTH?

There wouldn't be any trees... or animals... or humans. All living things need water to live. Next to the air we breathe, water is our most important need.

Without water the earth would look like the moon.

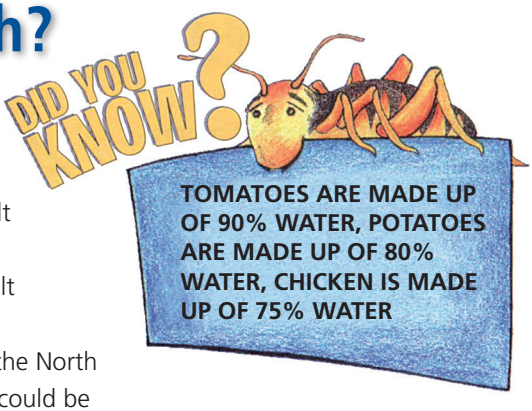
The human body is 70% water. Every system in our body uses water.

- Water makes up 83% of our blood.
- Water transports body wastes.
- Water lubricates our body's joints.
- Water keeps our body's temperature stable.
- Water is part of the cells that make up the human body.

Human beings can live several weeks without food, but only a few days without water. Drinking water or other liquids provide only half of the water we need. The other half comes from the foods we eat.

What do you know about water . . . on earth?

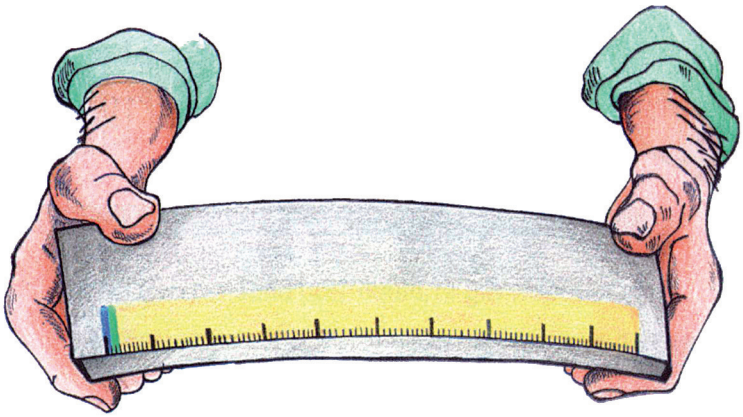
ALMOST 80% OF THE EARTH'S SURFACE IS COVERED WITH WATER



97% of the water on earth is salt water. Salt water is filled with salt and other minerals. Humans cannot drink this water. It is difficult and expensive to remove the salt.

2% of the water on earth is **glacier ice** at the North and South Poles. This ice is freshwater and could be melted down, but it is too far away from where people live to be usable.

Less than 1% of all the water on earth is **fresh water** that we can actually use. We use this small amount of water for drinking, transportation, heating and cooling, industry, and many other purposes.



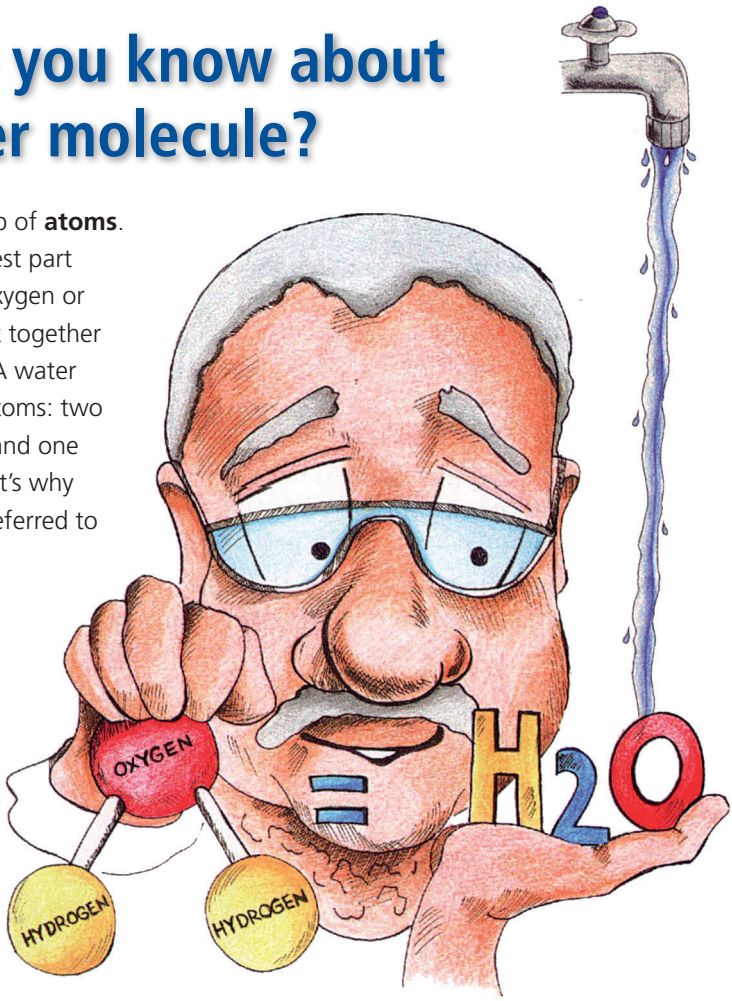
Water on the earth

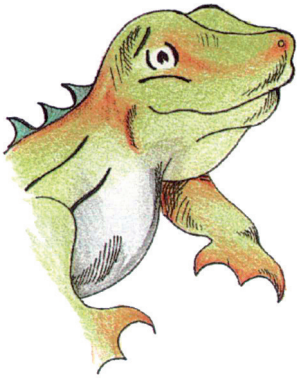
THIS RULER HAS 100 SPACES SHOWING 100% OF THE WATER ON EARTH

One space of **Blue** is 1% of the spaces on the ruler. This shows the fresh water that we can use. Two spaces of **Green** are 2% of the spaces on the ruler. This shows the water that is frozen in glaciers. Ninety-seven spaces of **Yellow** are 97% of the spaces on the ruler. This shows the amount of salt water that is on earth.

What do you know about the water molecule?

Everything is made up of **atoms**. An atom is the smallest part of an element, like oxygen or hydrogen. Atoms mix together to form **molecules**. A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (0) atom. That's why water is sometimes referred to as H_20.





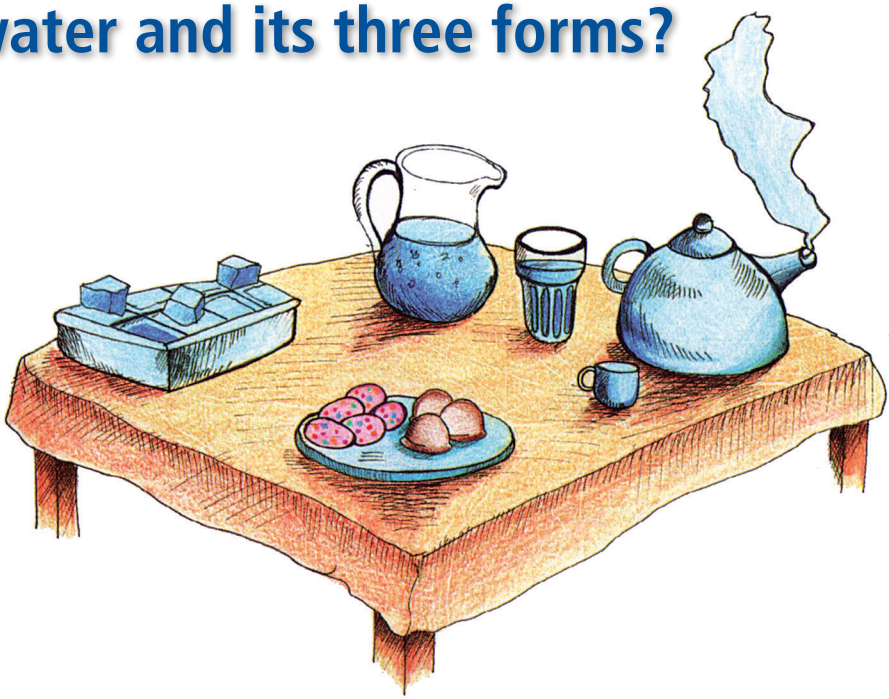
WHAT IS A SOLVENT?

A solvent is a material that can dissolve substances. Water is the most common solvent in nature. This is why many minerals are found in water.

We use water to dissolve many things.

Even when we cook, we use water as a solvent.

What do you know about water and its three forms?



WATER IS TASTELESS, ODOURLESS, AND COLOURLESS

Water can occur in three states: **solid** (ice), **liquid**, or **gas** (vapour).

Solid water - ice is frozen water. It floats because, as water freezes, it expands which makes it less dense and, therefore, lighter. Water freezes at 0 degrees Celsius.

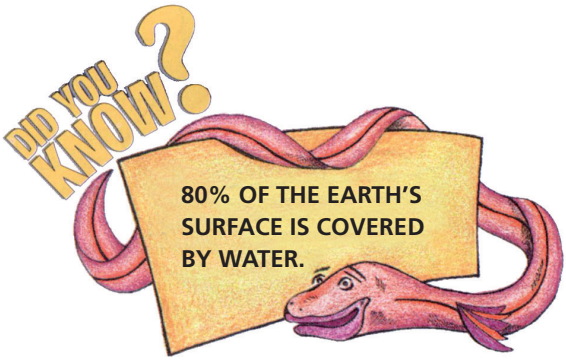
Liquid water is wet and fluid. This is the form of water that we are most familiar with. We wash with, drink, and use liquid water in many ways.

Water as a gas – vapour is always present in the air around us. You cannot always see it. When you boil water, it changes from a liquid to a gas. Some of the water vapour cools, and we see it as a small cloud called steam. This cloud of steam is a mini-version of the clouds we see in the sky. Steam is formed at 100 degrees Celsius.

The water vapour attaches to small bits of dust in the air. This forms raindrops in warm temperatures. In cold temperatures, snow or hail is formed.

What do you know about the water cycle?

WOULD YOU BELIEVE THAT YOUR LAST DRINK OF WATER COULD HAVE ONCE BEEN USED BY A DINOSAUR?

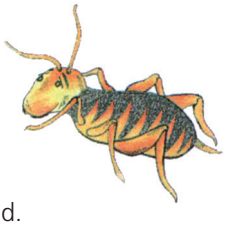


Water on earth today has been here for millions of years. Because of the **hydrologic cycle** (water cycle), water moves from the earth to the air and back to the earth again. It changes from solid to liquid to gas over and over again.

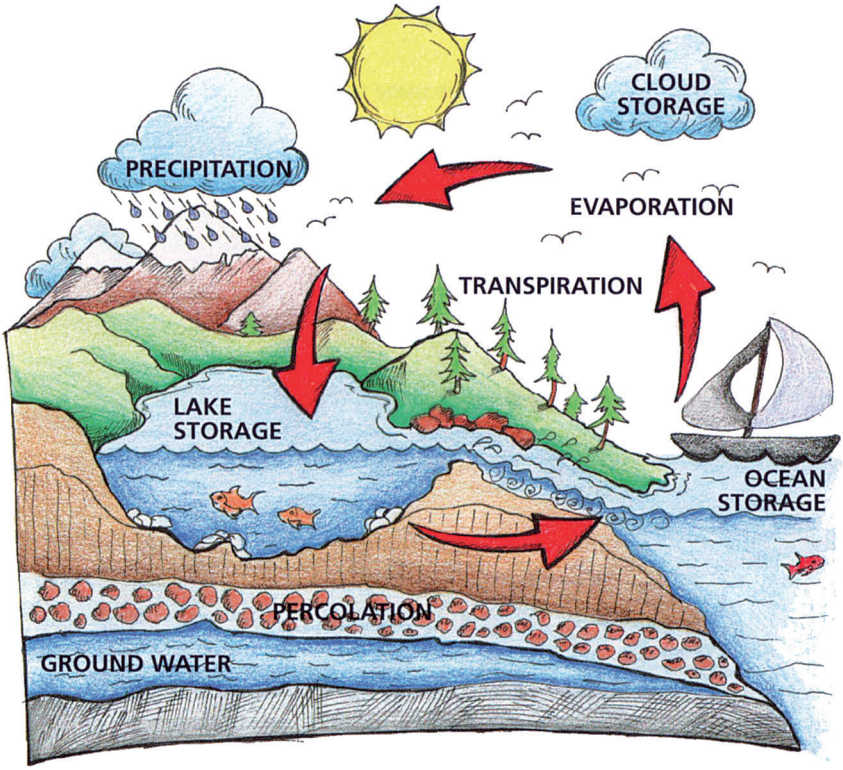
Hydrologic cycle (water cycle) vocabulary

Hydrologic – relating to water
Evaporation – liquid water becoming a gas
Water vapour – water as a gas in the air
Condensation – water vapour becoming a liquid
Surface runoff – water that runs along the soil and goes into lakes and rivers
Precipitation – rain, snow, sleet, or hail
Groundwater – water under the ground, as in a spring or well
Aquifer – a large water source under the ground
Percolation – water moving downward through openings in the soil

The hydrologic cycle (the water cycle)



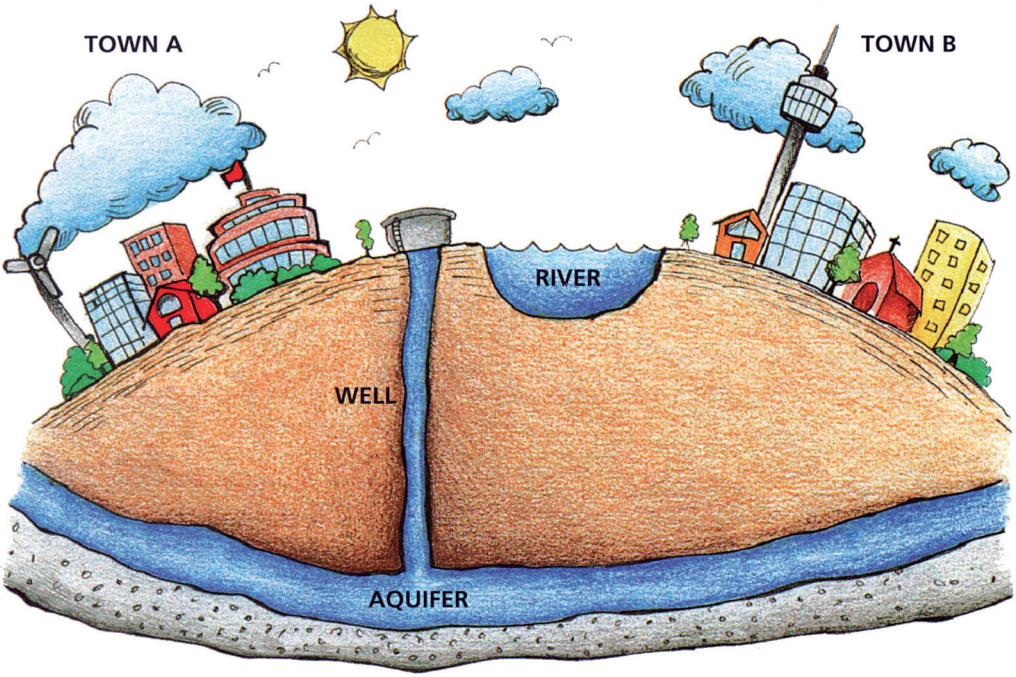
Water **evaporates**. It travels into the air, and becomes part of a cloud. It falls down to the earth as precipitation. Then it evaporates again. This repeats over and over again in a never-ending cycle. This **hydrologic cycle** never stops. Water keeps moving and changing from a solid to a liquid to a gas, over and over again.



Precipitation creates **runoff** that travels over the ground surface, and helps to fill lakes and rivers. It also **percolates** (moves downward) through openings in the soil to replenish **aquifers** under the ground. Some places receive more **precipitation** than others. These areas are usually close to oceans or large bodies of water that allow more water to **evaporate** and form clouds. Other areas receive less. Often these areas are far from water, or near mountains. As clouds move up and over mountains, the water vapour condenses to form precipitation, and freezes. Snow falls on the mountain peaks.

What do you know about water supply?

THERE ARE THREE PARTS TO WATER SUPPLY:
SOURCE, TREATMENT and DISTRIBUTION

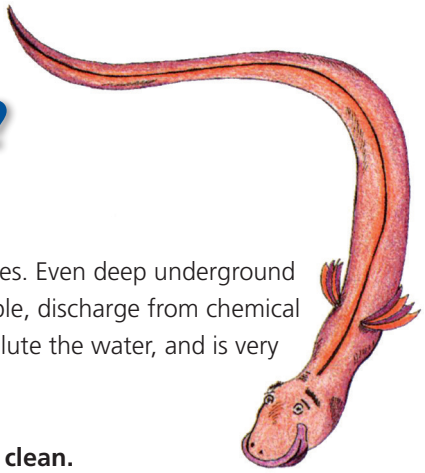


More than two billion people on the earth do not have a good water supply. This means that they are at risk of having nasty waste, like poo, enter their water supply. Drinking dirty water can make people very sick. There are also places where people spend most of each day carrying water great distances for their families to use.

Most people in New Zealand get their water from **local councils**. These councils get their water from a natural **source** (a river, lake, or aquifer). Many also **treat** (clean) the water to remove impurities. Councils then **distribute** (send) the water to people's homes and businesses to be used.

Some councils get water from **surface water sources** such as lakes and rivers. Other councils get water from **groundwater** sources. The underground rock, clay, sand, and gravel materials that store water are called **aquifers**. Some cities are fortunate enough to be near both a **surface water source** and a **groundwater aquifer**.

What do you know about water sources?



POLLUTION OF WATER SOURCES

Water can be polluted with human or chemical wastes. Even deep underground aquifers can be polluted from the surface. For example, discharge from chemical plants, freezing works, and farming activities can pollute the water, and is very hard to remove.

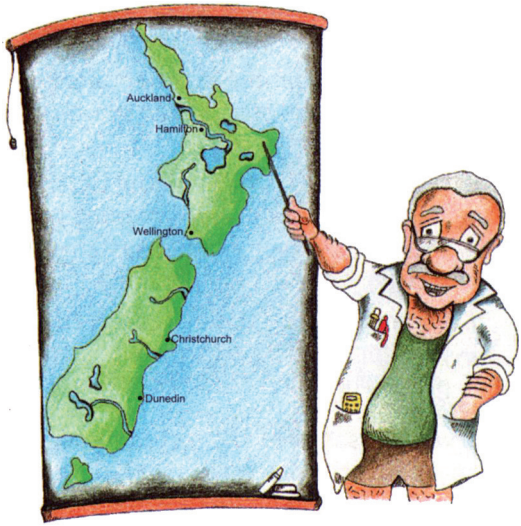
We must do our part to keep our water sources clean.

Councils must clean water very carefully. They test water and measure pollutants to make sure the water is safe. They can measure very small amounts of pollutants in bodies of water – parts per million, parts per billion, and even parts per trillion. The water that the water companies deliver to people must meet strict standards of quality.

It's hard to imagine but:

- One part per million would be equal to one drop in 38 litres, or 1 milligram per litre.
- One part per billion would be equal to one drop in 38,ooo litres, or 1 microgram per litre.
- One part per trillion would be equal to one drop in 3,8oo,ooo litres, or 1 nanogram per litre.

Water that councils deliver to customers must be safe for everyone to use.
After water is used, it goes down the drain. Then it goes through the sewer to a **wastewater treatment plant**. There it is treated (cleaned) again before the water is sent back to a natural water source. This protects everyone and everything that uses the water downstream.



What do you know about water treatment?

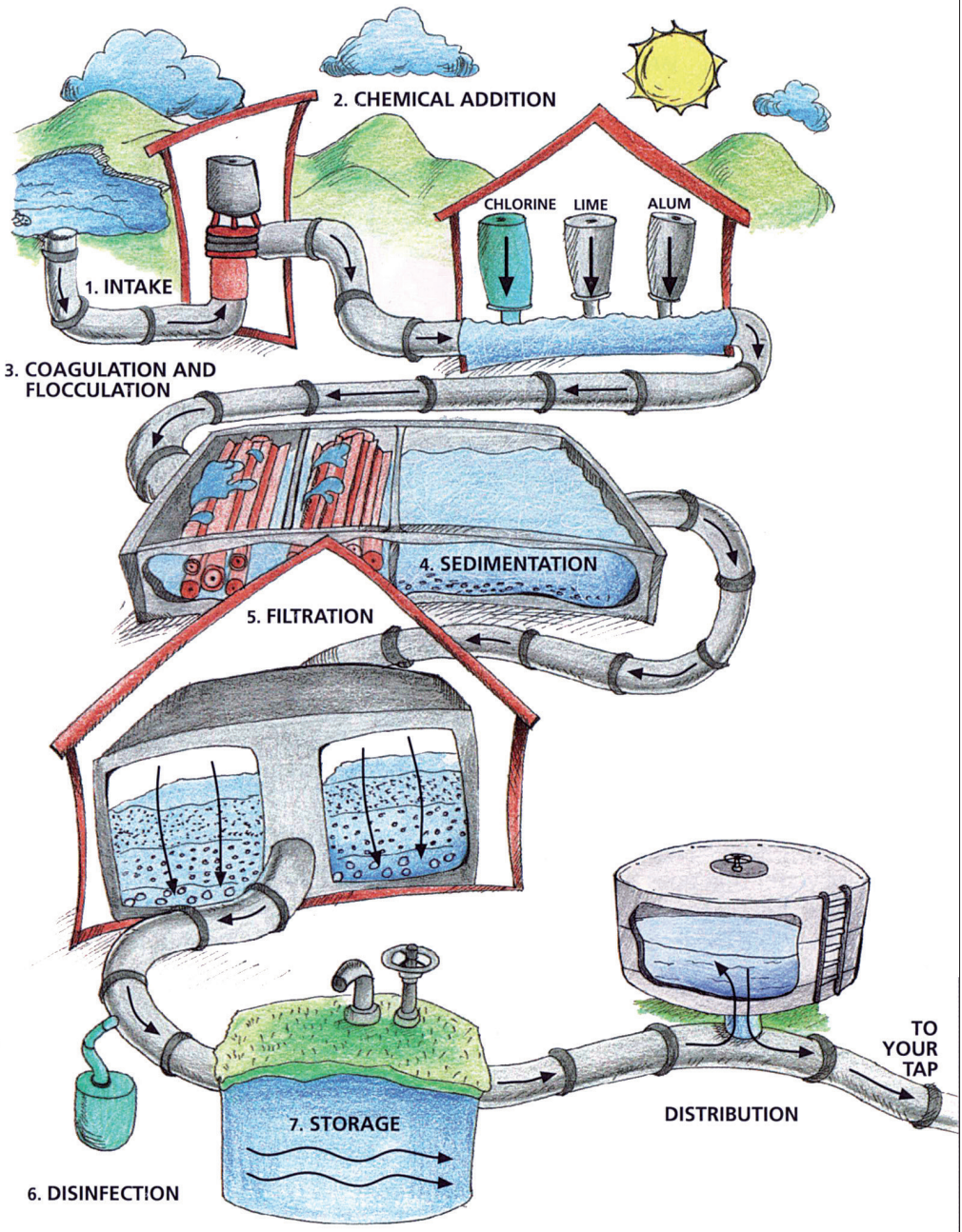
Water treatment is the process of cleaning the water. Treatment makes the water safe for people to drink. Because it is a good solvent, water picks up all sorts of natural pollutants. In nature, water is not always clean enough for people to drink. When the microscope was invented in the 1850s, germs could be seen in water for the first time. In 1902, Belgium was the first country to use chlorine to clean or treat water in a public water supply. Today, almost every large city in the world treats its drinking water. Treatment includes disinfection with chlorine or other chemicals to kill any germs in the water. Water treatment takes many forms in New Zealand. Below are a few examples.

A TREATMENT PLANT

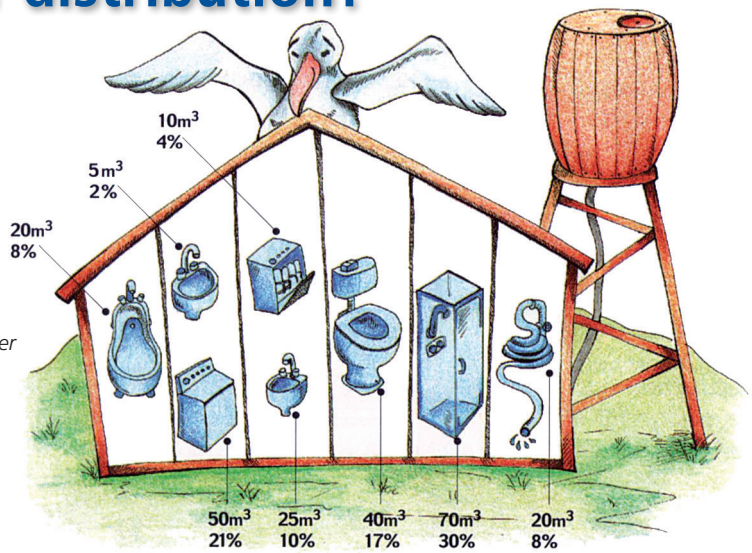
1. **Intake:** Water is taken from the source. Logs, fish, and plants are screened out at the intake and then the water is drawn into the treatment plant. If the source is groundwater, the "screening" is done by the soil as the water travels under the earth's surface. Sometimes very little treatment is required for groundwater.
2. **Chemical Addition:** Chlorine, aluminium sulphate (alum), and/or polymers are added to the water. These kill germs, improve taste and odour, and help settle solids still in the water. The water and these chemicals are then mixed together.
3. **Coagulation and Flocculation:** Here, the alum and other chemicals from the chemical addition step cling to substances in the water. This is called coagulation. It causes the particles to stick together and form larger particles called floc.
4. **Sedimentation:** The water and the floc particles flow into a sedimentation basin. Here the floc settles to the bottom, and is removed from the water.
5. **Filtration:** From the sedimentation basin, the water flows through filters. There are a variety of filter types, from layers of fine sand and gravel to modern membranes. The filters are used to remove any particles remaining in the water.
6. **Disinfection:** A small amount of chlorine or other disinfecting chemicals is added. This is used to kill any remaining germs, and to keep the water safe as it travels to the public. In some water systems, especially those with groundwater sources, this is the only treatment provided.
7. **Storage:** The water is placed in a closed tank or reservoir called a clear well. This allows time for the chlorine to mix throughout the water in order for disinfection to take place. The water then flows into the distribution system.

The water is sampled and tested throughout the treatment plant. Sampling is performed to make sure the processes are working, and that the water is safe before it leaves the plant. In New Zealand, standards are met for drinking water quality when it leaves the plant.

Water treatment



What do you know about water distribution?



A new dishwasher and washing machine can reduce usage by up to 30m³ or 12%.

The third part of a public water supply system is distribution. This is when water is sent from the treatment plant to homes and businesses. Each day, on average, 250 litres of clean drinking water is used by each person in New Zealand. Some of the water is stored in reservoirs or tanks ready for the public to use.

To save energy, treatment plants, reservoirs, and tanks are usually put on high ground so that gravity can move the water through the pipes to the customers. Pumps are used to pull the water up from aquifers. Pumps sometimes help water to move up hills or steep areas, but councils do all they can to save energy.

Water travels through large pipes called mains. In some cities, computers control the amount of water that goes through these mains. Large valves are also used to control the flow of water. They are just like giant taps. They can shut off water at important points. If the main breaks, or other problems occur, the water can be shut off until repairs are made.

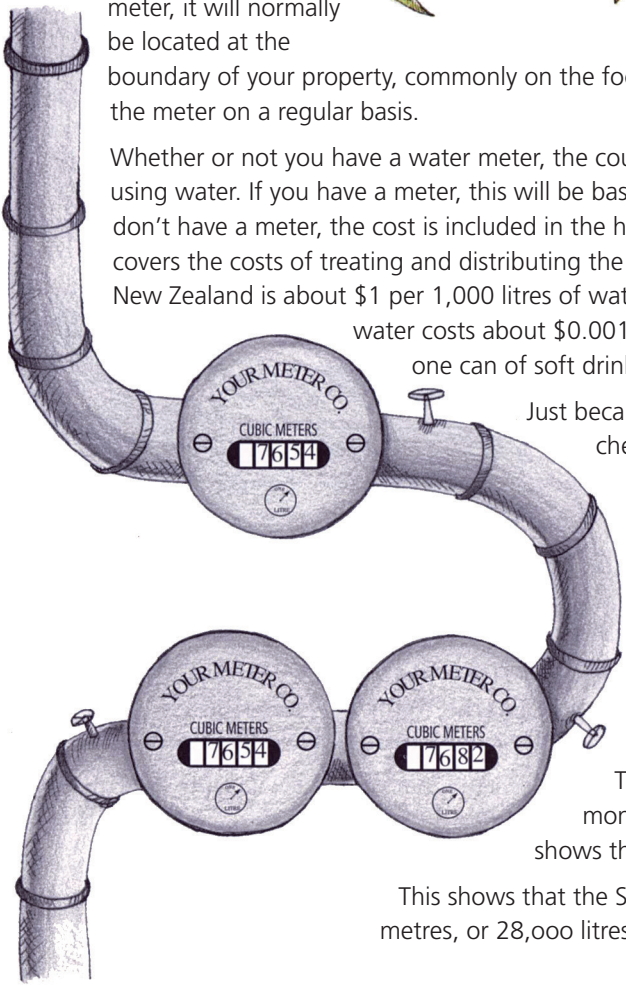
Councils also sample and test water throughout the distribution system to make sure the water reaching the customers is safe.

However, not all New Zealanders receive their water from these council water systems. About 10% of the New Zealand population (mostly in rural areas) are on their own individual water supply systems. These are either private water tanks or bores. Users of bore water and the like need to be cautious of the quality of water they are drinking and using. Rural users should have their water regularly tested in a lab to make sure it is of a safe standard!

What do you know about water costs?

A water meter measures the amount of water coming into your home or business. Not all New Zealand towns or cities have water meters. However, if your home does have a water meter, it will normally be located at the boundary of your property, commonly on the footpath. A meter reader reads the meter on a regular basis.

Whether or not you have a water meter, the council will send you a bill for using water. If you have a meter, this will be based on what you use. If you don't have a meter, the cost is included in the homeowner's rates bill. This covers the costs of treating and distributing the water. The cost of water in New Zealand is about $1 per 1,000 litres of water. At that price, a litre of water costs about $0.001. How does that compare with one can of soft drink?



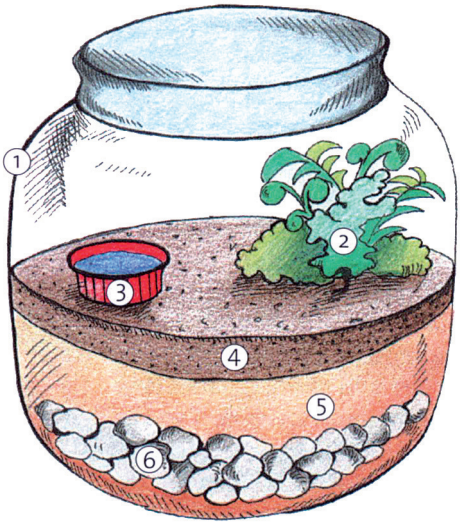
Just because clean drinking water is cheap does not mean that we can treat it like an unlimited resource – because it isn't!

The meter is read like a digital clock. Meters measure in cubic metres. One cubic metre is equal to 1,000 litres.

Let's say the readings to the left are for the Smith family. The first meter shows last month's reading. The second meter shows the reading for this month.

This shows that the Smith family used 28 cubic metres, or 28,000 litres, in the month.

You can have fun with water!



BUILD YOUR OWN WATER CYCLE

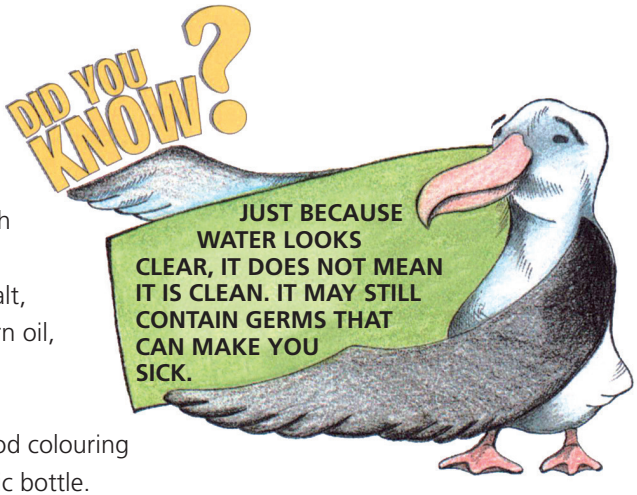
You will need:

1. Jar
2. Plants
3. Bottle cap or shell of water
4. Soil
5. Sand
6. Small rocks

Fill the jar first with small rocks, then sand, then soil. Add plants in the soil, and place your bottle cap or shell of water in the jar. Put the lid on, put the jar in a sunny place, and see how the water cycle works.

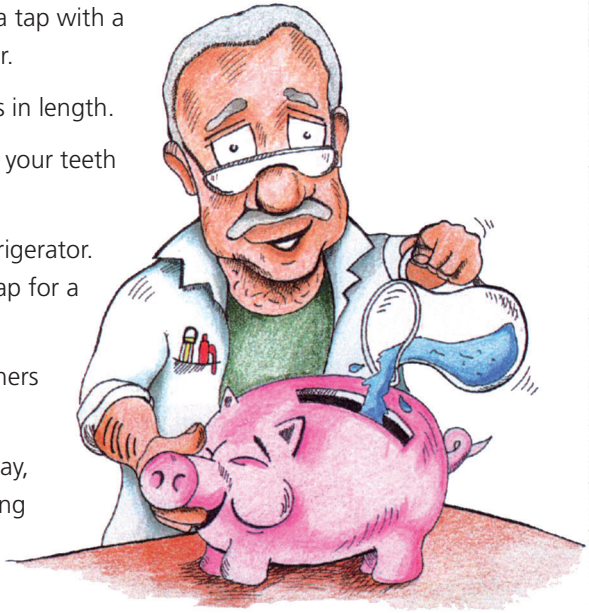
WATER ON THE EARTH

This activity demonstrates how much of the earth's water is fresh water.
Materials: 2 litre plastic bottle, salt, green food colouring, yellow corn oil, water.

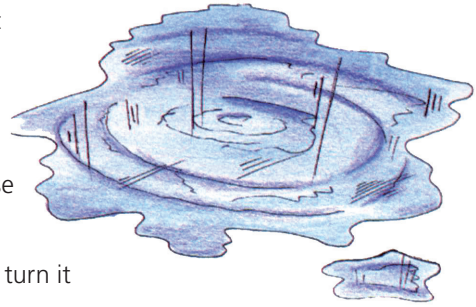


1. Put a few drops of green food colouring into the bottom of the plastic bottle.
2. Pour water into the container until just past the base of the neck.
3. Add 2-3 tsp. of salt to the green water. This water represents ocean water which is salty and cannot be used to drink or water plants.
4. Slowly pour 60mL of corn oil on top of the salt water in the 2 litre bottle. The corn oil represents 3% of the freshwater that is available on Earth. This is all the freshwater that is available for drinking, plant use, and all of our other fresh water needs.

What can you do to save water?



1. Check inside taps for leaks. Even a tap with a small drip can waste a lot of water.
2. Keep showers to 5 minutes or less in length.
3. Turn off the water while brushing your teeth or washing your hands.
4. Keep a pitcher of water in the refrigerator. Then you won't have to run the tap for a cold glass of water.
5. Use dishwashers and clothes washers for full loads only.
6. Use a broom to clean your driveway, garage, or sidewalk instead of using water.
7. Use a bucket of water to wash your bike or the family car. Do the rinsing quickly with the hose.
8. Be careful to water the lawn or garden, not the footpath or street.
9. Water your lawn or garden in the early morning hours to avoid evaporation. Water only when the lawn needs it, and give it a good soak to make the roots grow deeper into the ground. Most councils have bylaws stating when residents are allowed to use sprinklers.
10. Check outside hoses, taps, and automatic sprinklers for leaks.
11. Never throw oil or chemicals down the drain or onto the ground. Your local council can tell you how to get rid of these pollutants.
12. Use water only when you need it. Always turn it off when you are finished.



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water NEW ZEALAND
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A consistent approach across the 3 waters sector