Denise Pouleurs - Macarena Diaz

THE GREAT BOOK OF WATER

Australia & New Zealand

xylem watermark

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Index

26

Chapter 3

Urban water cycle

38

Chapter 4

Water in Australia & New Zealand

52

Chapter 5

Sustainability, the great challenge

66

Conclusion

Let's save water!

Encounter with water

I will never forget that summer. I was happy! Anytime I could, I joined letters and put together words from the signs on the streets, the ads on newspapers, my storybook. I had learned to read, and it was the beginning of my vacation!

After a whole day of travelling, with my sister and my parents in my uncle's car –a parrot green kombi– we arrived at a small town. We travelled the main street until the end, where we found a lake beach.

The afternoon sun created thousands of little stars over the rippling surface. It was the first time I saw that much water in the same place. It was the first time I saw a lake!

Years went by, and I never forgot that afternoon breeze and the sun reflected on that immensity.

That place became my favorite in the world. Anytime I can, I go back to visit it. And every time I go back, I learn something new: the importance of the lake for the forests living nearby, the rivers that flow into and from the lake, how everything moves around it, how everything is interconnected.

Years went by, and I kept studying—a lot. The visits to that lake inspired me to learn more about water and how to preserve it. I felt that I wanted to keep visiting that place for a long time and that future generations could see it too.

Today I am an engineer that works helping preserve the quality of water. Along with several colleagues, we prepared this book so that every boy and girl around the world can learn about the importance of water, the way the water cycle connects to our territory, the climate, and the ecosystems. Review why it is necessary to know the properties of water and how they help in the occurrence of wonderful phenomena in nature. Learn the course of water through the cities and, above all, how we, the people, can become aware and help protect this valuable resource.

We hope that you like *The Great Book of Water* as much as us and enjoy reading it and learning.

Denise Pouleurs

Chapter 1

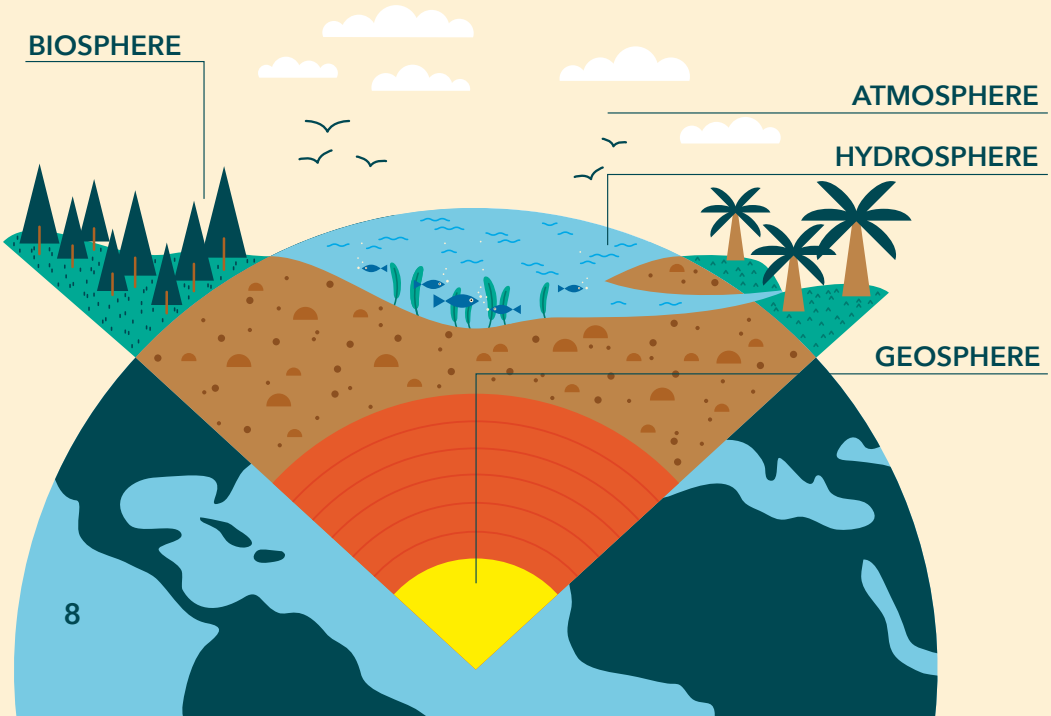
Planet Earth, planet water

We only have one planet Earth. Everything that happens on it is interconnected. Everything circulates, connects, and transforms as a part of a cycle where each element is related to what happened and what will happen, starting from a drop of water.

We invite you to learn how our planet is formed and where and how you can find water.

Layers of the Earth

The Earth is shaped as a sphere or ball, and it is composed of several layers of different materials that interconnect and create a system. These layers include the biosphere, atmosphere, hydrosphere, and geosphere.



ATMOSPHERE (AIR)
It is the gas layer that surrounds the Earth. It protects it from outer space, especially the harmful rays of the sun, and catches the heat that comes off the surface of the planet, helping regulate the temperature. Here you can find the oxygen we need to live.

GEOSPHERE (ROCKS AND MINERALS)
It encompasses the solid part of the Earth (land and rocks), and it is the one that provides support to the other layers. It extends from the surface to the centre of the planet, and it has three levels: crust, mantle, and core.

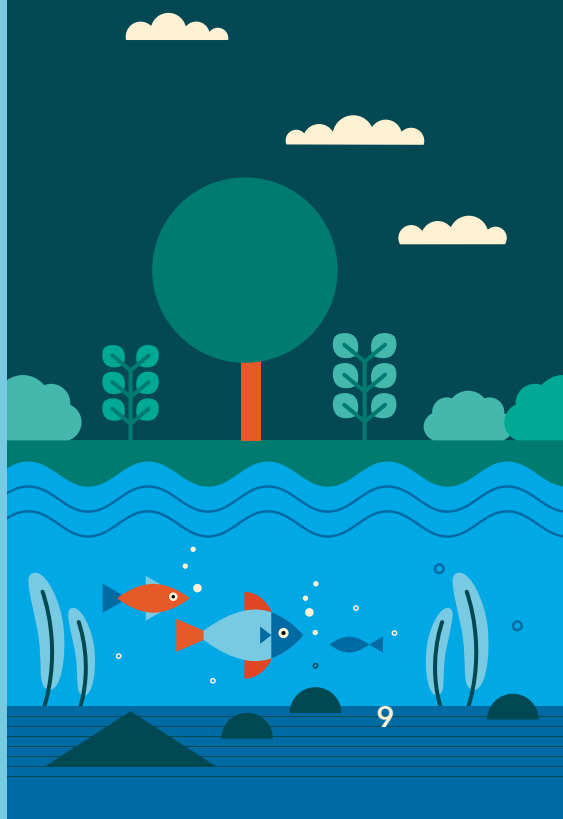
HYDROSPHERE (WATER)
It is all the water that exists on Earth, in its many forms, states, colors, and flavour. Here you can find the oceans, seas, rivers, lakes, groundwater currents, glaciers, and the water present in the atmosphere.

BIOSPHERE (LIVING BEINGS)
This layer includes living beings and the different ecosystems where they inhabit and interact, such as forests, rainforests, deserts, coral reef, tundra, etc. The biosphere also encompasses other layers, like the depths of the oceans or the closest part to the atmosphere, where fish and birds live

✳UNDERSTAND THE WORDS

A SYSTEM IS A MIXTURE OF SEVERAL ELEMENTS OR COMPONENTS INTERCONNECTED. EACH ONE PERFORMS A TASK THAT LINKS AND COMPLEMENTS THE OTHER COMPONENTS, SO THEY CANNOT WORK SEPARATELY.

AN ECOSYSTEM IS A SYSTEM FORMED IN A GEOGRAPHIC AREA CONSISTING OF ALL THE NATURAL ELEMENTS FOUND THERE, INCLUDED THE LIVING ORGANISMS AND THE PHYSICAL ENVIRONMENT. THESE ELEMENTS ARE CONNECTED IN HARMONY.



A liquid treasure

The water formed in the hydrosphere can be freshwater or saltwater.

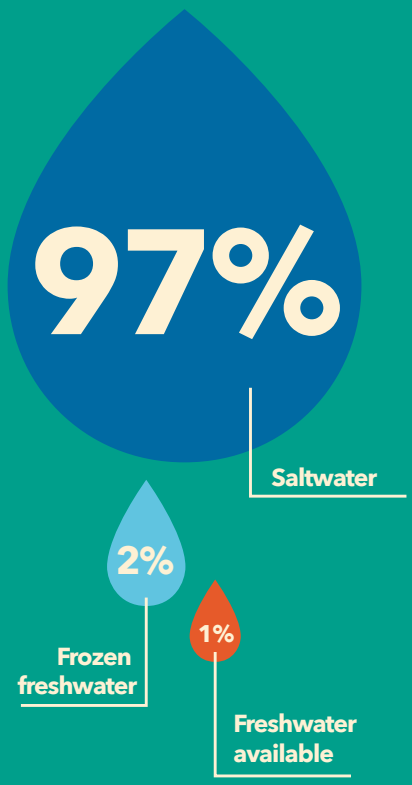
Saltwater contains an excess of dissolved minerals which gives it a salty flavour. That is the water you can find in oceans and seas.

Most living beings (except for the ones that live at sea) do not drink saltwater but freshwater. That is the water that gives life to plants, animals, and human beings.

The problem is that even if there is a lot of water on Earth, most of it is saltwater. Just a small part of it is freshwater and, besides, a great amount is frozen in the poles or high mountains.

This means that the water available in the form of rivers, lakes, ponds, and groundwater is even smaller and amounts to only 1% of the total water on the planet! In other words, for every hundred drops of water, only one of them is available freshwater.

With this 1%, all the necessary activities for life on this planet take place. It seems too little, right? Well, it is. And that is one of the main reasons why we should protect this liquid treasure.



WHY IS SEAWATER SALTY?

SEAWATER IS SALTY PRIMARILY DUE TO THE RIVERS THAT FLOW INTO THE SEAS AND OCEANS. AS RIVERS TRAVEL, THEY ERODE ROCKS, CARRYING MINERALS ALONG IN THEIR CURRENTS. ONE OF THE MOST COMMON MINERALS CARRIED BY RIVERS IS SODIUM CHLORIDE, ALSO KNOWN AS SALT. OVER MILLIONS OF YEARS, RIVERS HAVE TRANSPORTED SALT FROM THE EARTH'S SURFACE TO THE OCEANS, GRADUALLY INCREASING THEIR SALINITY.

70%

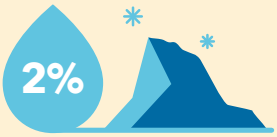
97% Saltwater

3% Freshwater

PLANET EARTH

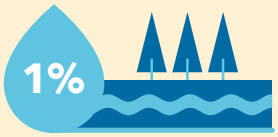
IS WATER-COVERED

TOTAL FRESHWATER IN THE WORLD



2%

GLACIERS, SNOW OR ICE



1%

ARE SURFACE WATERS AND GROUNDWATERS

LESS THAN 1%

WATER AVAILABLE FOR HUMAN CONSUMPTION AND FOR THE ECOSYSTEMS

WATER EXTRACTION USE IS...

69%

AGRICULTURAL SECTOR

20%

INDUSTRIAL SECTOR

11%

MUNICIPAL SECTOR

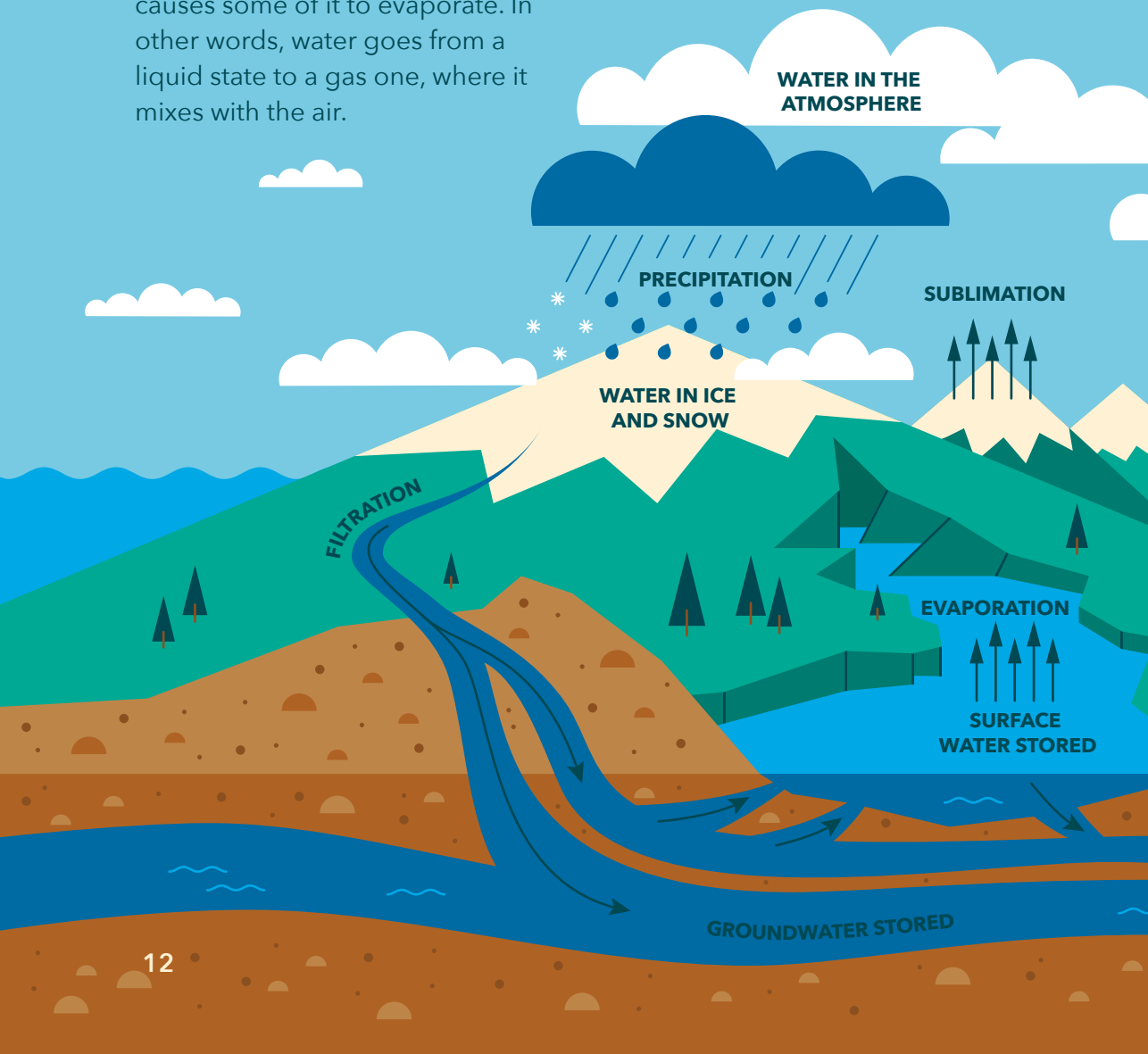
Taken from
https://www.abs.gov.au/statistics/environment/environmental-management/water-account-australia/latest-release

The water cycle

Water undergoes transformation but is not created nor destroyed. The water we have today is the same as what dinosaurs once drank, continuously cycling through the Earth's layers—a process known as "the water cycle."

The rays of the sun heat the water of oceans, rivers, and lakes, which causes some of it to evaporate. In other words, water goes from a liquid state to a gas one, where it mixes with the air.

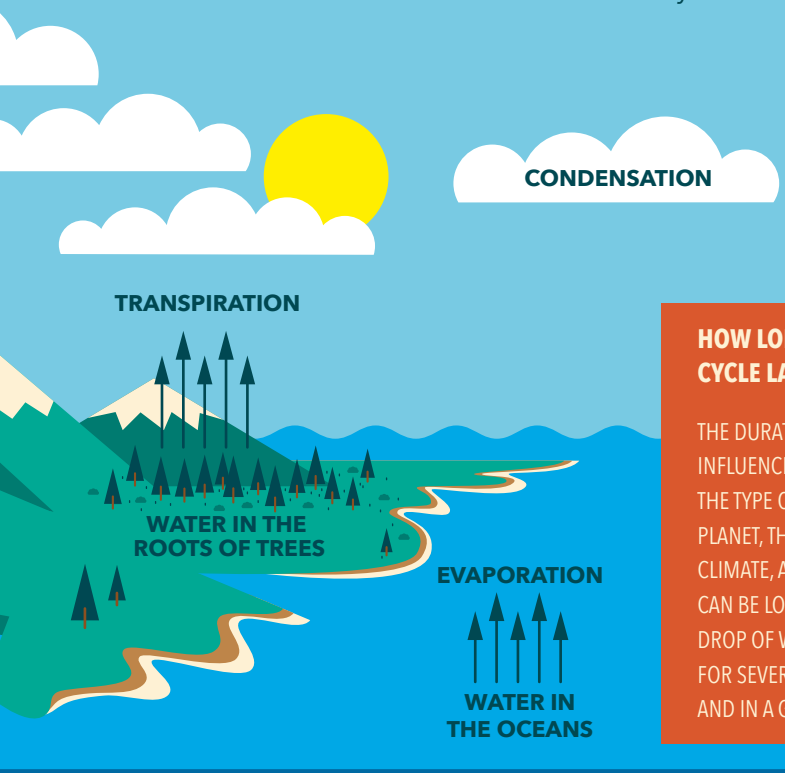
When water evaporates, it transforms into steam, rising into the atmosphere until it encounters cool air currents. Upon cooling, the steam condenses, forming droplets that gather to create clouds.



Clouds are transported between locations by air currents and winds. As clouds accumulate water droplets, they grow heavier until Earth's gravity pulls them down, resulting in rainfall. In colder conditions, the water freezes, leading to snowfall instead of rain.

The water that falls on the surface of the Earth finds its way until it reaches a river or seeps into the soil looking for a place to stay. This is how subterranean rivers and aquifers are formed. While on the land surface, water is used by plants, forests, and living beings.

In the end, all that water will flow into the ocean, where it will evaporate again to start a new cycle.



HOW LONG DOES THE WATER CYCLE LAST?

THE DURATION OF THE WATER CYCLE IS INFLUENCED BY THE PLACE. DEPENDING ON THE TYPE OF SOIL, THE LOCATION ON THE PLANET, THE HEIGHT ABOVE SEA LEVEL, AND THE CLIMATE, AMONG OTHER FACTORS, THE CYCLE CAN BE LONGER OR SHORTER. FOR EXAMPLE, A DROP OF WATER MAY BE IN THE ATMOSPHERE FOR SEVERAL DAYS, IN A LAKE FOR DECADES, AND IN A GLACIER FOR THOUSANDS OF YEARS.

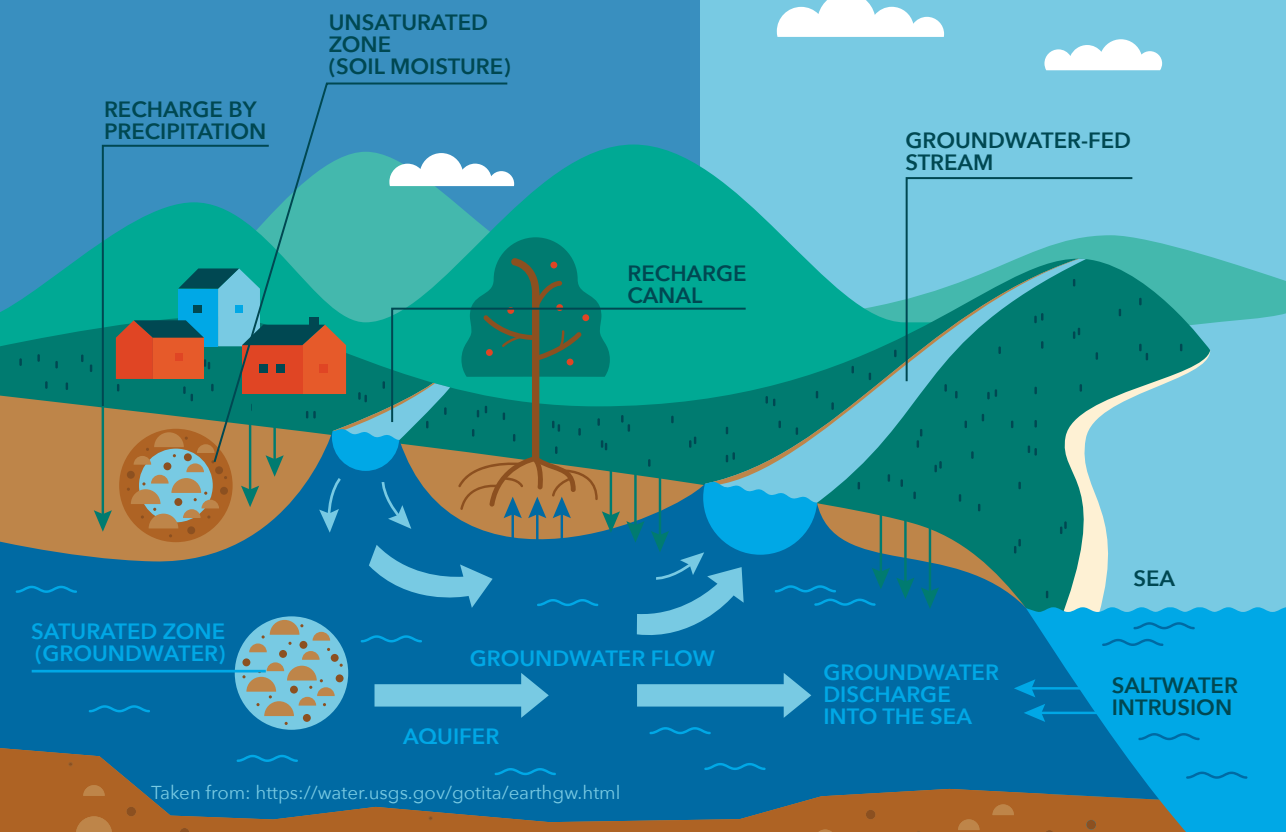
✳ UNDERSTAND THE WORDS

WHAT IS AN AQUIFER?

AN AQUIFER CONSISTS OF GROUNDWATER ACCUMULATED UNDERNEATH OUR FEET, BETWEEN IMPERMEABLE UNDERGROUND LAYERS (THROUGH WHICH WATER CANNOT PASS) AND PERMEABLE ONES.

THE CAPACITY TO ACCUMULATE WATER DEPENDS ON HOW POROUS THE SOIL IS, THAT IS, THE SPACE BETWEEN THE GRAINS THAT FORM IT. WATER FLOWS THROUGH THESE TINY SPACES AND FILLS THEM. WHEN THIS HAPPENS, WE SAY THE SOIL IS SATURATED WITH WATER.

AQUIFERS ARE VERY IMPORTANT BECAUSE THANKS TO THEM WE CAN OBTAIN WATER FOR HUMAN CONSUMPTION AND CARRY OUT SEVERAL PRODUCTIVE ACTIVITIES, SUCH AS AGRICULTURE AND INDUSTRY



Taken from: https://water.usgs.gov/gotita/earthgw.html

Australia and New Zealand, neighboring South Pacific countries forming the ANZ region have distinct landscapes. Australia, with some desert areas, conceals a hidden gem – the Great Artesian Basin (GAB), one of the world's largest aquifers, holding water for about two million years deep underground. New Zealand, on the other hand, enjoys abundant freshwater resources, including crystal-clear lakes fed by icy mountains, contributing to refreshing tap water and a significant source of electricity.

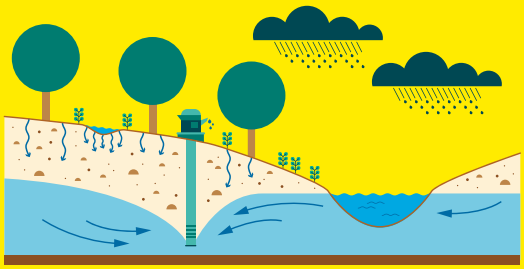
HOW IS WATER EXTRACTED FROM AQUIFERS?

WATER IN AQUIFERS CAN NATURALLY FLOW TO SURFACE FORMING SPRINGS, LAKES OR STREAMS. BUT SOMETIMES, WE NEED TO EXTRACT THE GROUNDWATER USING BIG MACHINERY TO BUILD WELLS. DO YOU REMEMBER DIGGING A HOLE AT THE BEACH AND WATCHING THE WATER COMING FROM THE UNDERLYING SAND? WELL, YOU HAVE JUST BUILT A WELL. FOR DEEP AQUIFERS LIKE THE GAB, WE NEED TO USE BIG EXCAVATORS AND DRILLS TO GO DEEP IN THE GROUND AND THEN USE PUMPS TO EXTRACT THE WATER.

PUMPS ARE POWERFUL TOOLS FOR WATER TRANSPORT. THEY ARE CAPABLE OF EXTRACTING WATER FROM DEEP UNDERGROUND SOURCES AND DELIVERING IT TO SPECIFIED LOCATIONS. PUMPS HAVE A SPECIAL PART CALLED A MOTOR THAT PROVIDES THE POWER THEY NEED. INSIDE, THEY ALSO HAVE FAST-SPINNING BLADES CALLED IMPELLERS. THESE IMPELLERS GRAB WATER AND MOVE IT THROUGH A PIPE.

THINK OF YOUR HEART – IT'S LIKE YOUR BODY'S PUMP, MOVING BLOOD THROUGH YOUR VEINS USING ENERGY FROM THE FOOD YOU EAT.

TO ACCESS WATER FROM DEEP UNDERGROUND, WE UTILIZE A "PUMP WELL" ENCLOSED WITHIN A TUBE-SHAPED "CASING WELL." THIS CASING NOT ONLY HOUSES THE PUMP BUT ALSO INCORPORATES A "GRAVEL SCREEN" AT ITS BOTTOM, GUARANTEEING THE EXTRACTION OF CLEAN WATER DEVOID OF CONTAMINANTS.



BUT HOW MUCH WATER CAN WE EXTRACT FROM AQUIFERS?

When we use more underground water than nature can refill, the water level in the ground goes down, and that's called a "DROPPED WATER TABLE". It's happening in many places around the world because we're using more water and getting less rain, which isn't good for our environment.

Ecosystems and watersheds

Just like human beings live in houses and neighborhoods, living beings inhabit ecosystems and watersheds.

- An ecosystem is a group of living beings that share the same habitat. These beings interact with each other and their environment (soil, water, light, air), which is also a part of the ecosystem.

- A watershed is like a big neighborhood. It is an area or region where all the rainwater that falls infiltrates (because the soil absorbs it) or runs off the land surface, forming small rivers. All this water feeds a main river or ravine. Often, the height of the mountains divides the watersheds depending on the side that water runs off. On one side a river will be born, on the other a different river.

A watershed is like a store of freshwater where you can find different natural ecosystems, just like towns and cities.

It is very important to maintain the balance on a watershed and between the ecosystems in it. Human activities such as agriculture and industry, and the growth of cities are elements that can modify this natural balance. That is why they must be carried out with great care.

LEARN AND THINK

HOW IS THE WATER CYCLE WHERE YOU LIVE?

Rainfall varies across different regions. For example, look at how much it rains per year in the different Capital Cities in the ANZ region:

Darwin, Australia	1724 mm/year
Sydney, New South Wales, Australia	1213 mm/year
Perth, Western Australia, Australia	737 mm/year
Auckland, New Zealand	1119 mm/year
Wellington, New Zealand	1319 mm/year
Christchurch, New Zealand	612 mm/year

Data taken from:
http://www.bom.gov.au/climate/australia/cities/
https://www.stats.govt.nz/indicators/rainfall

← WATER PRECIPITATION IS MEASURED IN MILLIMETRES (MM).

1 MM OF WATER EQUATES TO 1 LITRE OF RAIN ON A SQUARE METRE. IN OTHER WORDS, IF YOU POUR 1 LITRE OF WATER IN 1 SQUARE METRE, THE HEIGHT OF WATER IN THAT SQUARE METRE WILL BE 1 MM.

- Do you know how much it rains where you live?
- Which are the driest months?
- Does it rain the same every year?

HOW IS THE ECOSYSTEM WHERE YOU LIVE?

- Do you know the name of the closest river to your city?
- What are the main features of your ecosystem? Think about the type of vegetation, the climate, type of fauna, among other elements of the nature that form it.

Chapter 2

The water molecule and its amazing properties

All things and living beings, even us, are made of millions of atoms, which are particles that cannot be divided. It is the smallest component of something.

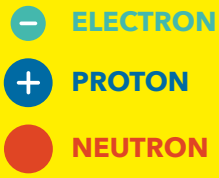
Atoms from various elements combine to form molecules creating new substances such as water! When molecules get together, they create more complex structures, like a rock, a rose, a cat, or a human being, among many others.

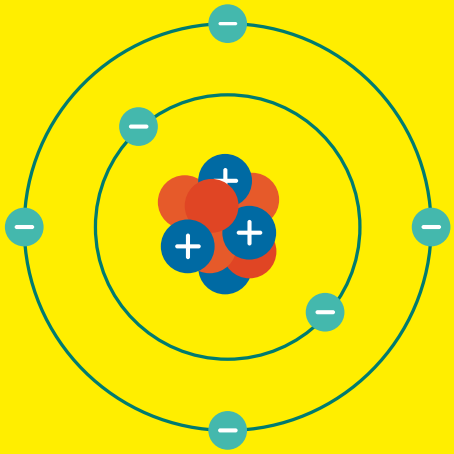
Let's start with the atom

Picture an atom like a tiny solar system! In the centre, there's a nucleus with protons and neutrons huddling together, and zooming around them are electrons, just like planets circling around the Sun.

- Protons have a positive charge (+).
- Electrons have a negative charge (-).
- Neutrons have no charge.

An atom is balanced when it has the same number of protons and electrons, so its charge compensates.





A very special molecule

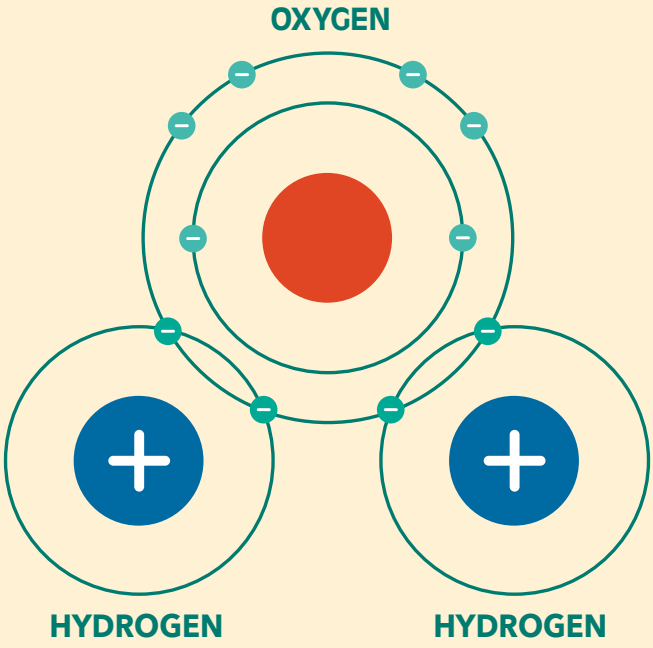
A water molecule is formed by an oxygen atom and two hydrogen atoms.

When a molecule is formed, the atoms share some electrons. In the case of water, the molecule has the oxygen atom at its centre and two hydrogen atoms at the sides, each with its orbit of electrons surrounding them.

Oxygen has 8 electrons from which it shares one with each hydrogen. In turn, each hydrogen shares one electron with oxygen. As consequence:

- The **atom of oxygen** keeps 6 electrons that it does not share, concentrating this way an area of **negative charge** around itself.
- The **atoms of hydrogen**, by leaving their electrons on the side of oxygen, are left with a **positive charge**.

That is why we say that water is a polar molecule. On the side or pole of oxygen, it has a negative charge, and on the hydrogen side, it has a positive charge.



Hydrogen bonds

How does a water molecule connect with another? Precisely because of the force of attraction: an oxygen atom (negative) attracts a hydrogen atom (positive) but from another molecule, acting as a magnet. Then a hydrogen bond is formed.

This way, each water molecule is connected to the others through hydrogen bonds.

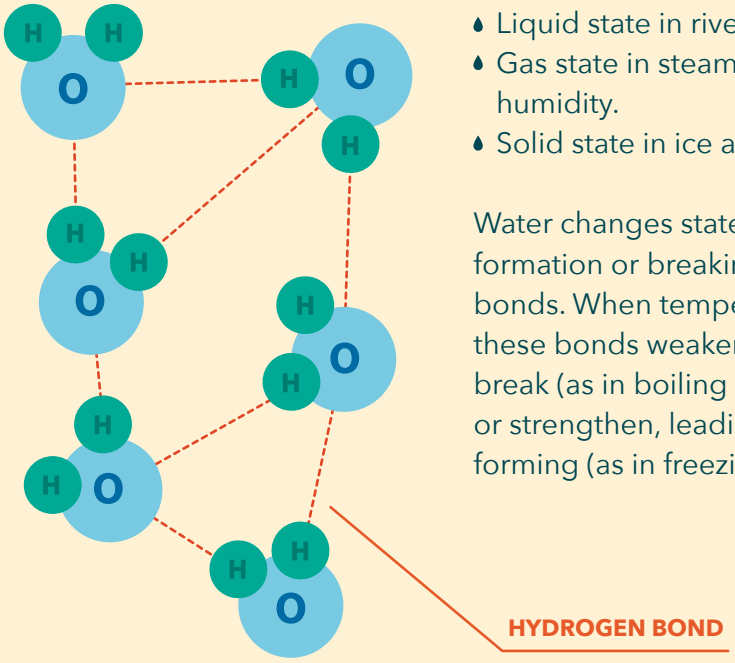
These bonds are what make water so special and with incredible properties that allow many phenomena in nature, the human body, and industrial processes.

As you might have seen, we can find water in three states in nature: liquid, gas, and solid.

WHY DOES ICE FLOAT ON WATER?

EVEN THOUGH WATER AND ICE ARE PART OF THE SAME SUBSTANCE, IF YOU ADD ICE TO A GLASS OF WATER YOU WILL SEE THAT IT FLOATS.

WHEN WATER FREEZES AND TURNS INTO ICE, ITS MOLECULES ARRANGE THEMSELVES IN A CRYSTALLINE STRUCTURE THAT IS LESS TIGHTLY PACKED THAN THE MOLECULES IN LIQUID WATER. THIS CAUSES ICE TO BE LESS DENSE, ALSO LESS HEAVY, THAT IS WHY IT FLOATS!



- Liquid state in rivers, lakes, and seas.
- Gas state in steam, clouds, and air humidity.
- Solid state in ice and snow.

Water changes states because of the formation or breaking of hydrogen bonds. When temperature changes, these bonds weaken, causing them to break (as in boiling water into steam) or strengthen, leading to more bonds forming (as in freezing water into ice).

Heat capacity of water

Heat capacity measures how substances absorb heat without immediate temperature changes. Water's high heat capacity is due to its strong hydrogen bonds, which require a lot of energy to break, slowing down heating. This ability of water to absorb and retain heat explains its high capacity.

If you've been to the beach, you've probably noticed that the sand can be very hot during the day, while the water remains cool. However, at night, the situation reverses: the sand cools down more quickly than the water. This is because water has a higher heat capacity than sand, meaning it takes longer to cool down. As a result, water retains the heat it absorbed during the day, keeping it warmer at night.

Due to its heat capacity, water is an excellent temperature regulator, both in our bodies and nature.

In our bodies, during a fever, sweating helps cool us down but also leads to dehydration. By ingesting more water, we help the body regulate its temperature.

Similarly, in nature, forests are cooler than open fields because of tree transpiration. Trees release water vapour, which captures heat and keeps temperatures lower.

Notice how in arid climates like deserts (with little water), the temperature difference between day and night is much bigger than in climates with water.

As you can see, water plays a crucial role in regulating these temperature changes.

WHAT DOES IT MEAN THAT TREES TRANSPIRE?

TREES AND PLANTS ABSORB WATER THROUGH THEIR ROOTS AND THEN ELIMINATE IT THROUGH THEIR LEAVES. THIS IS CALLED TRANSPIRATION.

THIS WATER, WHICH HELPS REGULATE THE TEMPERATURE OF THE FORESTS, ALSO TAKES PART IN THE WATER CYCLE BECAUSE WHEN IT EVAPORATES, IT GOES BACK TO THE ATMOSPHERE AND TRANSFORMS INTO CLOUDS.

HOW MUCH DOES TEMPERATURE VARY IN YOUR CITY?

Australia's climates vary widely; For instance, Alice Springs, situated in the desert region of the Northern Territory, experiences extremely hot temperatures, often exceeding 40°C during the summer months.

Australia's hottest city, Darwin, located in the Northern Territory, maintains average maximum temperatures of 31°C to 33°C year-round. In contrast, Tasmania typically experiences colder temperatures, averaging between 10°C to 12°C.

Whakatane in New Zealand often reaches summer highs of 24-26°C, despite being cooler than Australia. Conversely, the coldest areas, usually in the South Island's high mountains, maintain year-round maximum temperatures of 5-7°C. Dunedin, among New Zealand's coldest cities, sees winter lows averaging 5-7°C and maximum temperatures ranging from 9-11°C.

HOW DOES TEMPERATURE CHANGE IN YOUR CITY BETWEEN DAY AND NIGHT?

WHAT IS THE HIGHEST TEMPERATURE IT REACHES? IN WHAT SEASON?

WHAT IS THE LOWEST?

HOW DOES TEMPERATURE RELATE TO WATER AVAILABILITY IN YOUR REGION?

Two forces that move water

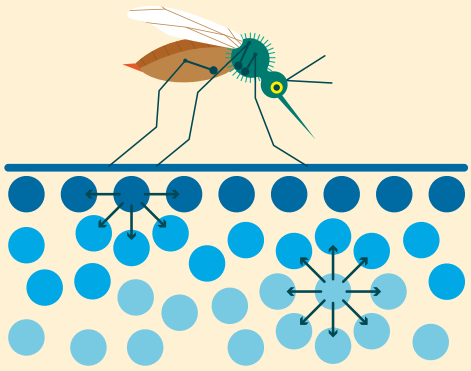
From the water molecule and hydrogen bonds that bind different molecules, scientists have discovered other interesting characteristics of water:

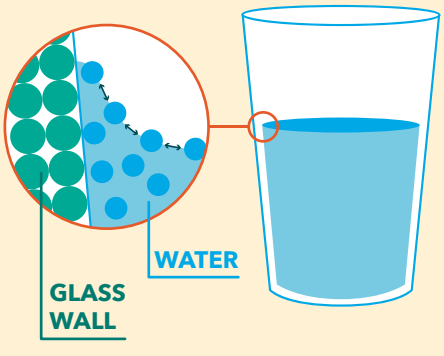
- **Surface tension:** is a fundamental property of water, resulting from the cohesive strength between its molecules. The attraction of water molecules is particularly strong due to the presence of hydrogen bonds. You can think of surface tension like an invisible film on the surface of the water, similar to a thin "skin" that holds the water molecules together. This property allows water to form droplets and supports objects like insects or small needles to float on its surface without sinking

✳ UNDERSTAND THE WORDS

COHESIVE STRENGTH IS THE ATTRACTION BETWEEN PARTICLES THAT ARE NEXT TO EACH OTHER IN THE SAME BODY. IN OTHER WORDS, IT IS THE STRENGTH THAT BINDS PARTICLES TOGETHER.

ADHESIVE STRENGTH IS THE ATTRACTION BETWEEN TWO DIFFERENT MOLECULES. FOR EXAMPLE, IT IS THE STRENGTH THAT ATTRACTS WATER TO THE SURFACE OF A CONTAINER.



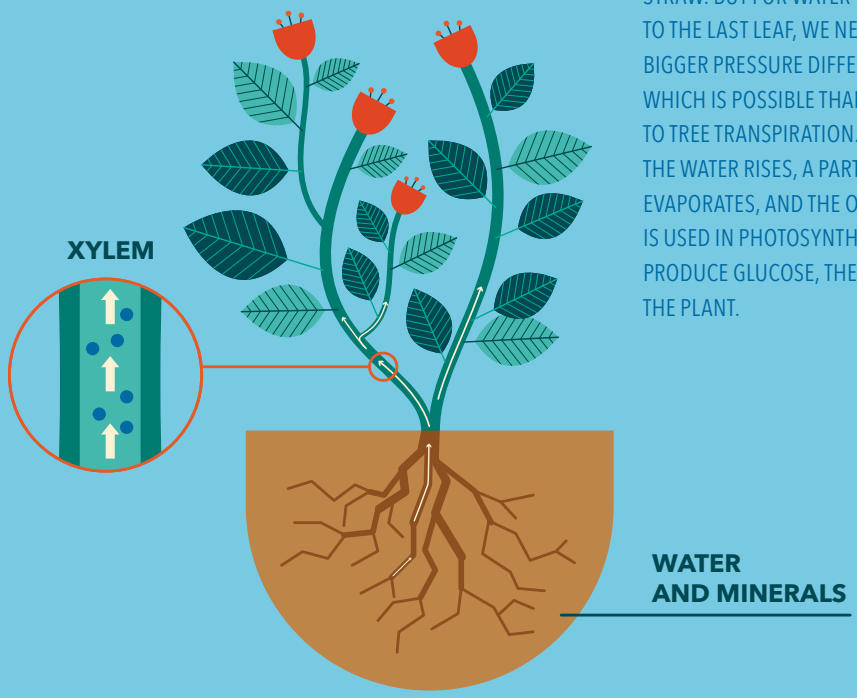


- **Capillarity:** is the water's ability to rise against the force of gravity. This happens when water joins another type of molecule that attracts it by its positive or negative charge. When the adhesive strength is bigger than the cohesive one, water can rise through very thin glass tubes called capillaries. If we look inside the capillary tube with a big magnifier, we will see that the water surface is not flat but concave; it is like water was climbing.

HOW DOES WATER GET TO THE TREETOPS?

TRUNKS AND STEMS ARE MADE OF HUNDREDS OF TINY CAPILLARY TUBES CALLED XYLEM THROUGH WHICH WATER CAN RISE. THANKS TO A PRESSURE DIFFERENCE, WATER CAN TRAVEL FROM THE ROOTS TO THE LAST LEAF ON THE TREETOP.

SINCE THERE IS MORE WATER IN THE GROUND THAN IN THE PLANT, A PRESSURE DIFFERENCE OCCURS. WATER PASSES THROUGH THE WALLS OF THE ROOTS, AND THEN IT STARTS TO RISE DUE TO CAPILLARITY, JUST LIKE WHEN WE DRINK A BEVERAGE FROM A STRAW. BUT FOR WATER TO GET TO THE LAST LEAF, WE NEED A BIGGER PRESSURE DIFFERENCE, WHICH IS POSSIBLE THANKS TO TREE TRANSPIRATION. AS THE WATER RISES, A PART OF IT EVAPORATES, AND THE OTHER IS USED IN PHOTOSYNTHESIS TO PRODUCE GLUCOSE, THE FOOD OF THE PLANT.



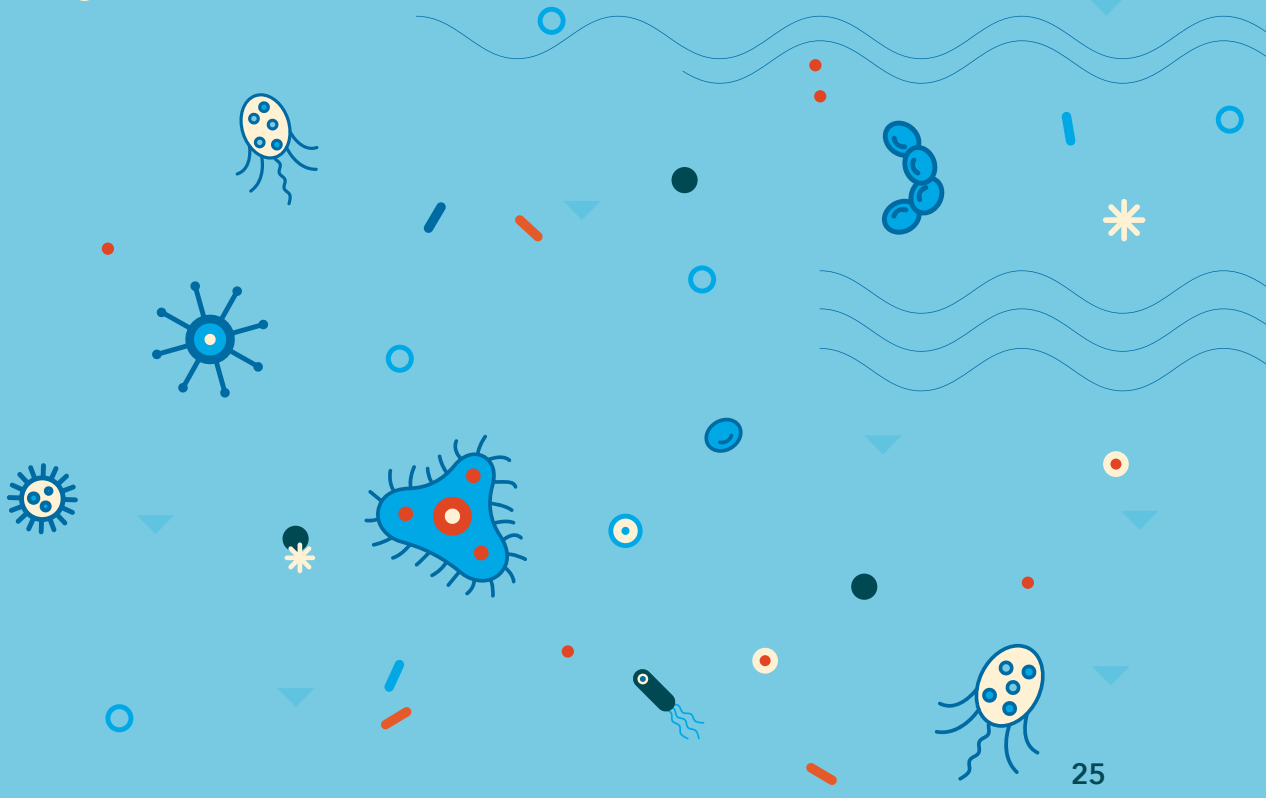
A world in the water

Another great water feature is that it can contain a large amount of other dissolved substances. It is like a big vehicle that transports many things: nutrients, mineral salts, foods, microorganisms. But as it carries these, it can also transport dangerous substances for the human body or nature: contaminants, toxic substances and diseases.

This occurs due to its condition as a polar molecule, which attracts other molecules and reacts to a lot of substances to form or disintegrate others.

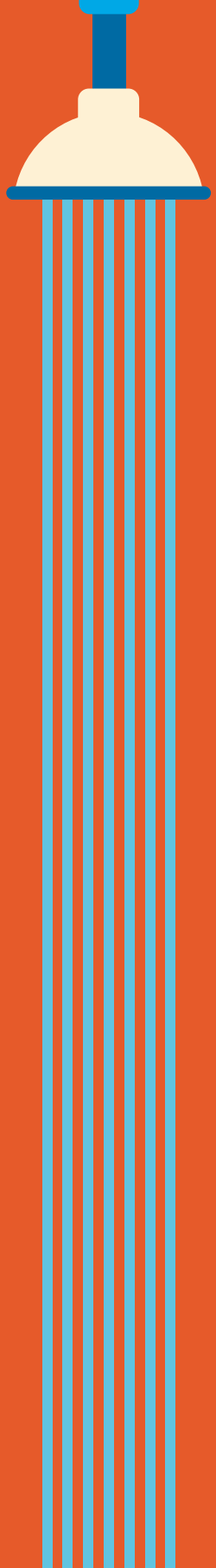
You may not believe this, but you can find dissolved gases in water, like oxygen, the same we need to breathe. We can have aquatic life like algae, fish, mollusks, and microorganisms that are not visible to the naked eye because there is oxygen in the water.

As you can see, water has properties that allow many different reactions, processes, and phenomena in nature and our human body.



Chapter 3

Urban water cycle



Have you ever wondered where does the water you consume come from? And where do the waters used and discharged go to, like the ones used in sanitation?

All water follows a path from its extraction from nature to its return, ensuring it maintains a quality that is safe for living organisms and the environment.

Learn about the urban water cycle and discover all the knowledge and work that make it possible.

Potable water

Potable water is the one that we can drink because it is clean and healthy. The word potable comes from the verb potare in Latin that means to drink.

Potable water must meet specific criteria to ensure its safety. It should have no discernible odor, taste, or color, indicating purity. Additionally, it must be free from contaminants such as minerals, chemicals, and pathogenic microorganisms like bacteria and viruses, which can pose health risks.

If you live in the city, water gets to your house through a network of underground pipes and comes out from the tap so your family can cook, do the laundry, take showers, and go to the bathroom. But before that, it travelled a long way.

Water sources

The origin of the water we consume is in nature. It may come from:

- Rivers, streams, and lakes
- Aquifers (groundwater).
- Glaciers
- Seawater

In the ANZ region, a significant portion of the water for consumption comes from surface water, typically making up 60-80% of the supply, while groundwater accounts for approximately 20%. These water sources undergo purification to ensure the water is safe for human consumption.

In our region we can find different water sources, for example:

WESTERN AUSTRALIA, AUSTRALIA

In 2006 Perth built the Kwinana Desalination Plant, becoming the first seawater desalination plant in Australia. If you live in Perth, 39% of your water comes from the sea.

NEW SOUTH WALES, QUEENSLAND, AUSTRALIAN CAPITAL TERRITORY, SOUTH AUSTRALIA, AND VICTORIA, AUSTRALIA

The Murray-Darling Basin, in the southern part of the Great Artesian Basin, divides into two parts. The northern Basin supplies drinking water to areas in New South Wales and Queensland, while the southern Basin serves Victoria, the Australian Capital Territory, and parts of South Australia.

AUCKLAND, NEW ZEALAND

The Waikato River is New Zealand's longest river, starting its journey to the sea from high in the central North Island volcanic zone, flowing northwards towards the upper North Island and plays a crucial role in providing drinking water to the Auckland region.

OTAGO, NEW ZEALAND

The main water source for the Otago region is the Clutha River known for its high flow rate, especially during periods of snowmelt from the Southern Alps.

CAN YOU GET DRINKING WATER FROM THE SEA?

YES, MANY AUSTRALIAN CITIES HAVE DESALINATION PLANTS THAT USE A SPECIAL TREATMENT CALLED REVERSE OSMOSIS TO TURN SEAWATER INTO DRINKING WATER. APPROXIMATELY 2% OF THE WATER FOR CONSUMPTION IN AUSTRALIA COMES FROM DESALINATION PLANTS. THIS METHOD IS PARTICULARLY VITAL IN REGIONS WHERE DRINKING WATER IS SCARCE OR OFTEN AFFECTED BY PROLONGED DROUGHTS.

https://www.abs.gov.au/statistics/environment/environmental-management/water-account-australia/latest-release

From the water source to your home

The process of delivering safe drinking water involves a complex journey from its origin in nature to our homes. Highly skilled professionals and operators are responsible for ensuring water quality at every stage of this journey, adhering to stringent laws and health standards. Let's delve into the various stages involved in this vital process:

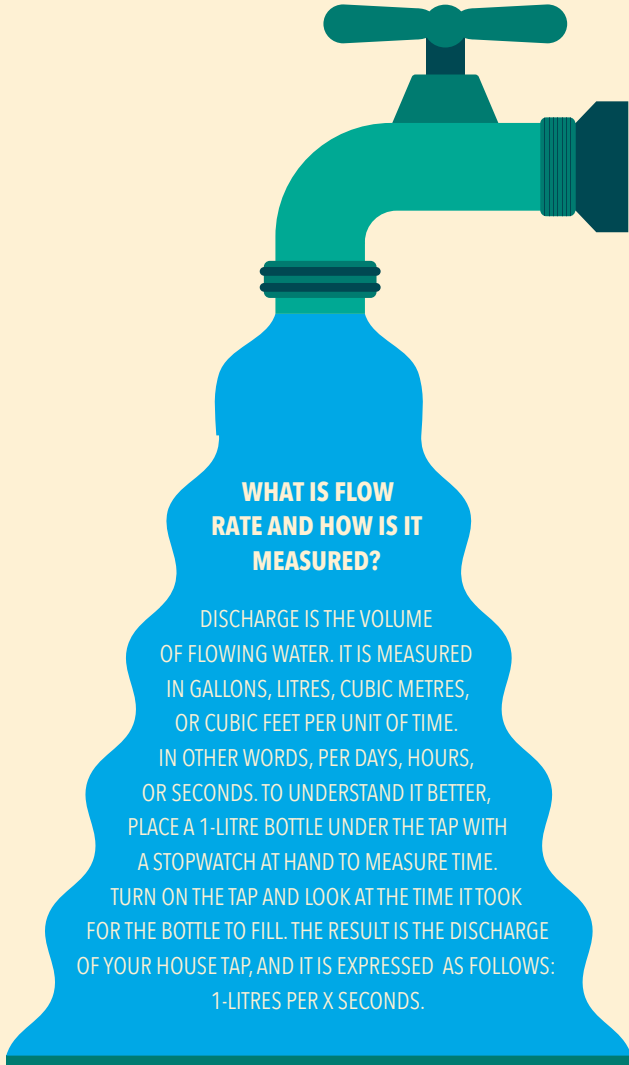
RAW WATER INTAKE

It is the first step of the urban water cycle: taking water from nature to a drinking water treatment plant.

To move water, we need to use pumps like the ones you learned about in chapter 1.

When carrying out this process, there must be monitoring stations in place to evaluate water quality and aspects such as turbidity, conductivity, temperature, and pH, among many others. With this information, we can know whether water can be treated to be turned into drinking water.

It is also very important to control the discharge of water being extracted from nature.



WHAT IS FLOW RATE AND HOW IS IT MEASURED?

DISCHARGE IS THE VOLUME OF FLOWING WATER. IT IS MEASURED IN GALLONS, LITRES, CUBIC METRES, OR CUBIC FEET PER UNIT OF TIME. IN OTHER WORDS, PER DAYS, HOURS, OR SECONDS. TO UNDERSTAND IT BETTER, PLACE A 1-LITRE BOTTLE UNDER THE TAP WITH A STOPWATCH AT HAND TO MEASURE TIME. TURN ON THE TAP AND LOOK AT THE TIME IT TOOK FOR THE BOTTLE TO FILL. THE RESULT IS THE DISCHARGE OF YOUR HOUSE TAP, AND IT IS EXPRESSED AS FOLLOWS: 1-LITRES PER X SECONDS.

✳ UNDERSTAND THE WORDS

TURBIDITY IS RELATED TO WATER TRANSPARENCY. WHEN THERE ARE PARTICLES SUSPENDED THAT DO NOT LET LIGHT PASS THROUGH, WE SAY IT IS TURBID.

CONDUCTIVITY IS THE WATER CAPACITY TO CONDUCT ELECTRICITY, WHICH IS A SIGN OF THE TYPE OF SUBSTANCES DISSOLVED IN IT.

PH IS A MEASUREMENT THAT DETERMINES WHETHER WATER IS TOO SOUR (LIKE LEMON JUICE).

POTABLE WATER TREATMENT PLANT

When water gets to the treatment plant it passes through several processes to clean and purify it.

Pretreatment

Big solids, such as sticks, stones, and sand, are eliminated. First, water passes through bar screens in which these materials get stuck, and then it goes into grit chambers, in which sand settles out to the bottom due to its weight.

Coagulation-flocculation

In this process, smaller solids are eliminated. For this purpose, chemical compounds (called coagulants and flocculants) are added, which cause the solids to stick together, become bigger and heavier, and then drop because of their weight.

Sedimentation

Water sits in a big tank for the time required, so the aggregation of solids (flocs) settles out to the bottom.

Filtration

Water passes through sand and anthracite (a very hard coal) filters that help eliminate the smallest solids that were not removed during the previous step.

Disinfection

Chemical agents, such as chlorine or ozone, or ultraviolet light are used to eliminate pathogenic microorganisms that may cause diseases to humans.

During this process, it must be ensured that water quality levels are according to regulation, so sensors are put in place to measure pH and temperature, among other factors. Just like when your mum or your dad checks your temperature to see if you are sick, a water treatment plant must also control some parameters to see if things are going well or not.

Storage and distribution

Once treated, potable water is stored in large tanks. Additional chlorine is then introduced to prevent the regrowth of microorganisms within the distribution pipes.

The distribution network is composed of kilometres of pipes that run under cities, streets, buildings, and houses and act like arteries that carry water to every corner of a country.

These networks, invisible to our eyes, are very important and must be protected from damage and filtration so water quality and distribution is not affected. The older the city, the older is its distribution network; some are over 100 years old!

On average, New Zealand cities lose about 20% of their water, while in Australia, it's around 10% due to network leaks. To avoid this, companies in charge of producing and delivering potable water must constantly keep an eye on the pipes' condition with electrical sensors that detect pressure

differences. These instruments allow them to evaluate whether water has lost strength or if there is filtration.

In regional areas not connected to the distribution network, water is delivered by tank trucks, and families store it in their own tanks. Many residents also collect and store rainwater.

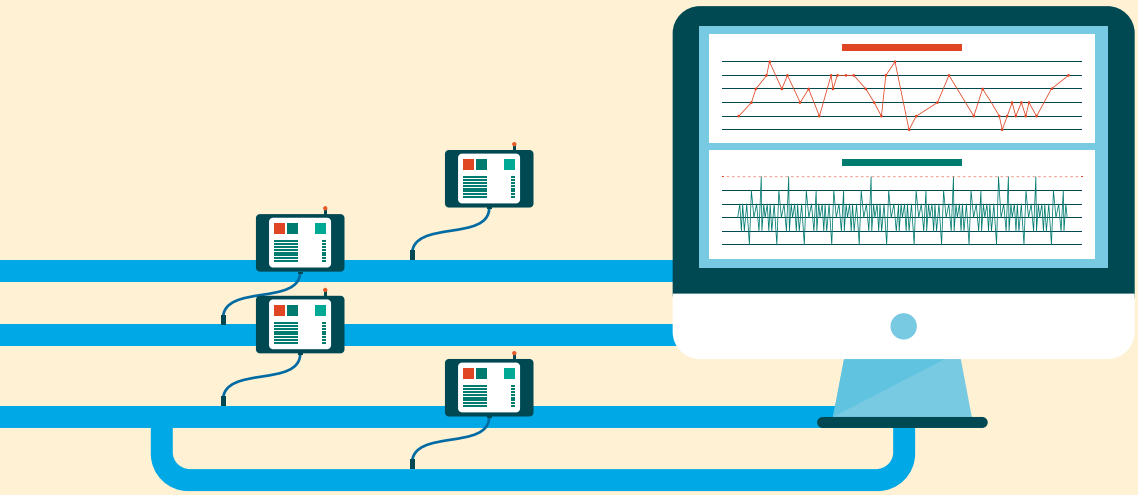
That is how clean, crystal potable water gets to your house.

WHO WORKS IN WATER TREATMENT?

TO PRODUCE WATER AND ENSURE ITS QUALITY, WE NEED A BIG TEAM OF TECHNICIANS AND MECHANICAL, ELECTRICAL, AND CHEMICAL ENGINEERS.

EACH TECHNICIAN HAS A SPECIFIC ROLE: ENSURE WATER QUALITY, HANDLE MECHANICAL EQUIPMENT, CONTROL ENGINES, AND CHECK THE CONNECTIONS. ALL OF THEM WORK AS A TEAM.

YOU COULD ALSO BECOME A WATER PROFESSIONAL. IT DOES NOT MATTER WHAT SUBJECT YOU LIKE AT SCHOOL BECAUSE EVERYTHING IS CONNECTED!

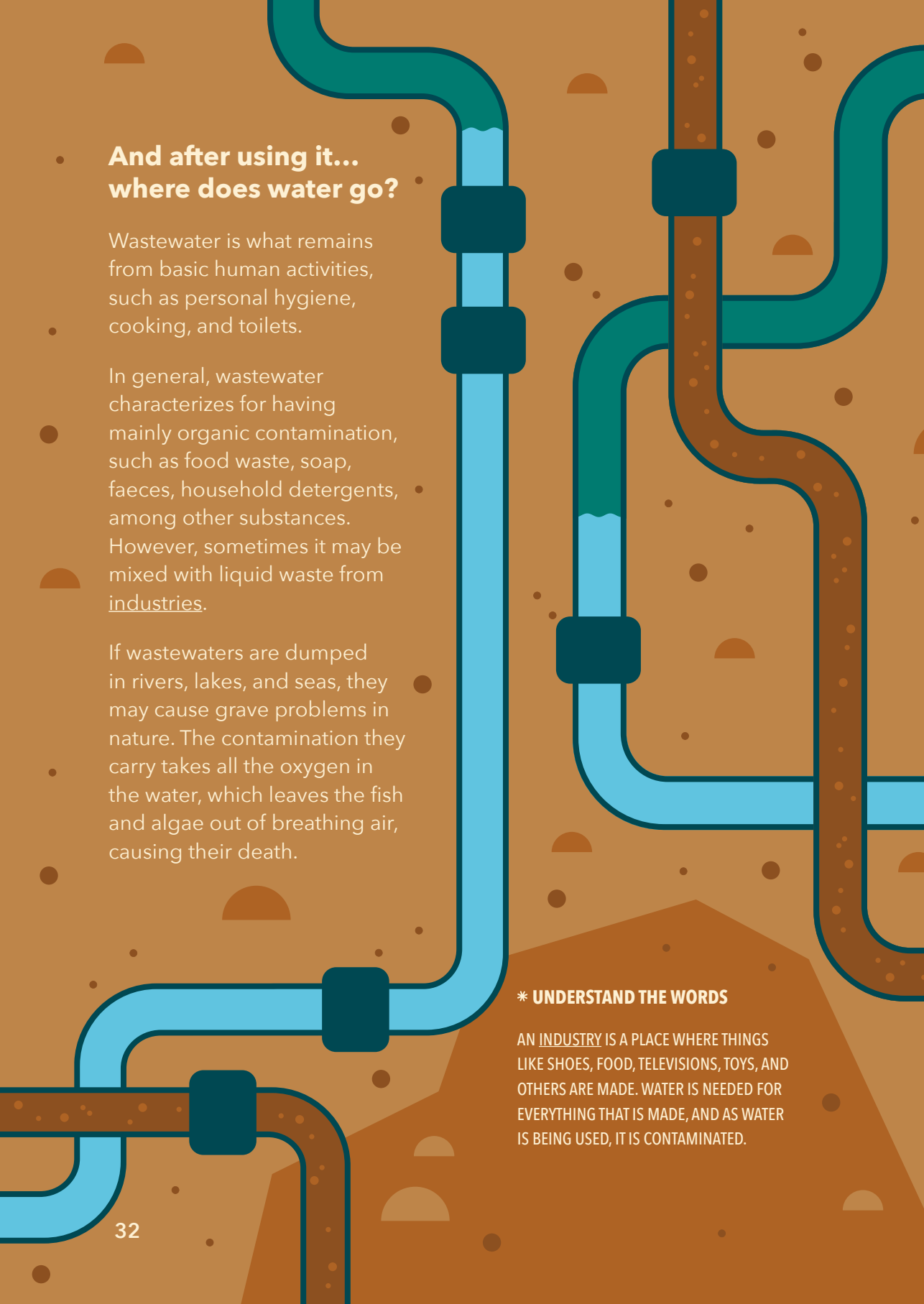


And after using it... where does water go?

Wastewater is what remains from basic human activities, such as personal hygiene, cooking, and toilets.

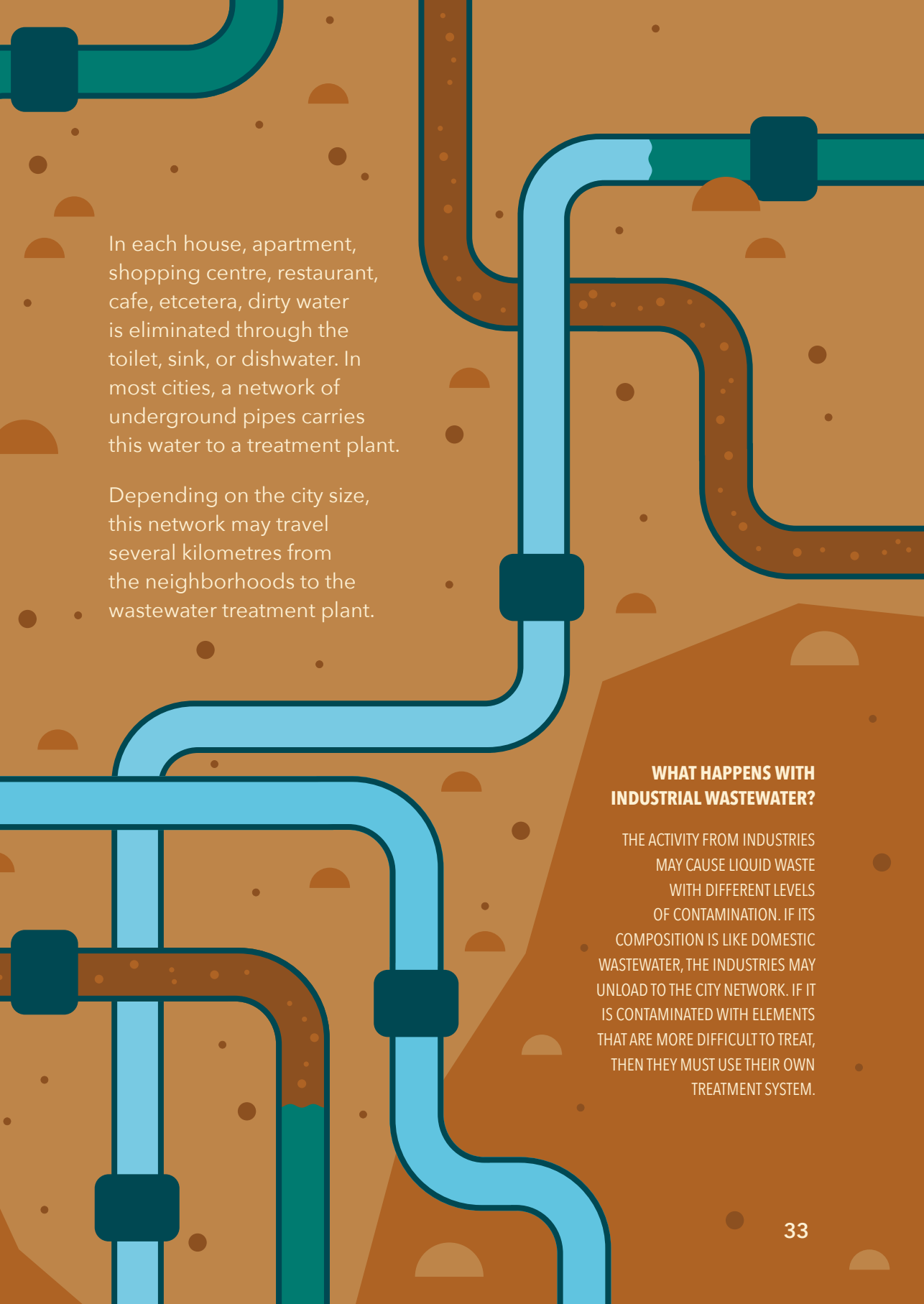
In general, wastewater characterizes for having mainly organic contamination, such as food waste, soap, faeces, household detergents, among other substances. However, sometimes it may be mixed with liquid waste from industries.

If wastewaters are dumped in rivers, lakes, and seas, they may cause grave problems in nature. The contamination they carry takes all the oxygen in the water, which leaves the fish and algae out of breathing air, causing their death.



*** UNDERSTAND THE WORDS**

AN INDUSTRY IS A PLACE WHERE THINGS LIKE SHOES, FOOD, TELEVISIONS, TOYS, AND OTHERS ARE MADE. WATER IS NEEDED FOR EVERYTHING THAT IS MADE, AND AS WATER IS BEING USED, IT IS CONTAMINATED.



In each house, apartment, shopping centre, restaurant, cafe, etcetera, dirty water is eliminated through the toilet, sink, or dishwater. In most cities, a network of underground pipes carries this water to a treatment plant.

Depending on the city size, this network may travel several kilometres from the neighborhoods to the wastewater treatment plant.

WHAT HAPPENS WITH INDUSTRIAL WASTEWATER?

THE ACTIVITY FROM INDUSTRIES MAY CAUSE LIQUID WASTE WITH DIFFERENT LEVELS OF CONTAMINATION. IF ITS COMPOSITION IS LIKE DOMESTIC WASTEWATER, THE INDUSTRIES MAY UNLOAD TO THE CITY NETWORK. IF IT IS CONTAMINATED WITH ELEMENTS THAT ARE MORE DIFFICULT TO TREAT, THEN THEY MUST USE THEIR OWN TREATMENT SYSTEM.

Wastewater treatment plant: a big strainer

1. PUMPING STATION
Water enters the treatment plant through a **pumping station**. Upon arrival, it falls to a basin, where is pushed through pumps to the next step. At this point, the flow rate that enters the plant is measured.

2. PRETREATMENT
The treatment starts by removing the biggest solids that have come through the pipes with the water, objects that we can easily identify, such as bits of plastic, paper, fabric, and wood. For this, big bar screens act as a colander, letting water through but stopping the solids. After that, these items are raked by mechanical combs, put in containers, and sent off to a landfill.

The next step consists of removing sand and grease. Since sand is composed of heavy particles, water is pumped through a wider canal than the pipes. This way, the water slows down, and sand particles have enough time to settle out, or in other words, to sink to the bottom of the tank.

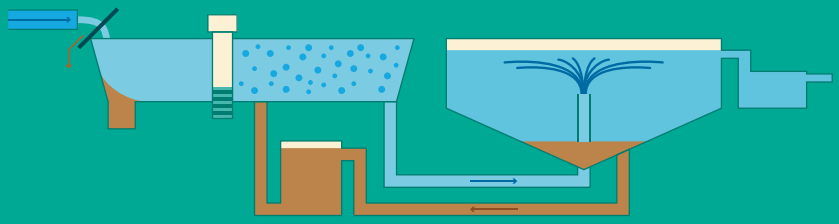
Air is injected from the bottom of the tank to remove grease and oils, creating air bubbles that catch grease and oil molecules. Since these are lighter than water, they form a film on the surface, ready to be cleaned by special sweepers that remove them from water and take them to a collector.

✳ UNDERSTAND THE WORDS

A LANDFILL IS A PLACE THAT RECEIVES, COMPRESSES, AND DISPOSES OF THE SOLID WASTE GENERATED IN A CITY IS. THE CONTENTS OF THE GARBAGE TRUCK END THERE.

3. BIOLOGICAL TREATMENT

After removing big solids, sand, and grease, water enters a biological treatment stage known as activated sludge. Here, millions of microorganisms, particularly bacteria, break down organic matter present in the water. These bacteria act as natural recyclers, consuming organic pollutants and transforming them into simpler, harmless substances. However, just like us, bacteria need to breathe, so big machines called blowers pump in air to give them oxygen. As the bacteria eat, they grow and multiply, similar when you feed a pet fish. But if there are too many bacteria, some must be removed so the rest can keep working properly.



The mixture of water and activated sludge goes to the next basin, where it sits so in time the clarified water will rise to the top, and the sludge will settle out to the bottom.

4. DISINFECTION

The last step of the treatment is disinfecting clarified water.
On it, pathogenic microorganisms (the ones that cause diseases) are removed. In some cases, water needs to be filtrated to eliminate the smallest solids before is suitable to be reused.

AFTER ALL THESE TREATMENTS, WATER IS READY TO BE RETURNED TO THE ENVIRONMENT WITHOUT CAUSING ANY HARM.

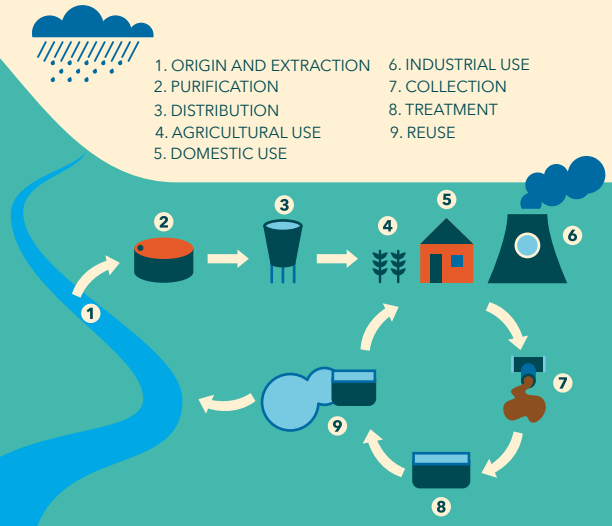
This is the urban water cycle

So far, we have gone through the urban water cycle, or when humans take water from nature, use it, and then return it safely and responsibly.

CAN WE REUSE WATER THAT HAS BEEN TREATED?

OF COURSE, WE CAN. DEPENDING ON THE WATER QUALITY AT THE END OF THE TREATMENT, IT CAN BE REUSED TO IRRIGATE SOME CROPS, DO THE LAUNDRY, CLEAN, AMONG OTHER ACTIVITIES. REUSING WATER HELPS US LOWER THE CONSUMPTION OF WATER TAKEN FROM NATURE.

In a watershed, you can find as many urban water cycles as cities exist in it. The most important thing is to protect the natural cycle and avoid excess extraction from the watershed since it affects cities, ecosystems, flora, and fauna.



LEARN AND THINK

WHAT IS WASTEWATER? WHAT IS IT LIKE?

To understand what wastewater is, carry out this experiment:

MATERIALS

- 1 plastic bottle of one litre or more
- 2 spoonsfuls of oil
- 1 spoonful of shampoo
- 1 piece of soap
- 3 spoonsfuls of vinegar
- Bits of bread
- 1 handful of sand
- Some potato peels and other vegetables in small pieces.

STEPS

1. Take the water bottle and fill it halfway up.
2. Add the oil, shampoo, soap, and vinegar to the bottle. Put the lid on and shake it a bit, so it gets mixed.
3. Add the bits of bread and peels of potatoes or other vegetables you have gathered.
4. Add the sand, cover it, and shake it again.
5. Watch the bottle and describe: what color is the water now?
6. Let it sit for some days and watch if there is some change

What you have made is a sample of wastewater.

Can you think of a way to separate and remove the contaminants from the water so it can go back to being transparent? Propose a way of doing it by applying what you learned in this chapter.

Chapter 4

Water in Australia & New Zealand

Australia and New Zealand are both part of the Oceania region.

Australia's ancient history dates back to the First Nation cultures thriving for thousands of years. It was once known as 'Terra Australis' and is home to unique creatures like kangaroos and koalas. Surprisingly, more than a third of Australia's vast land is arid desert.

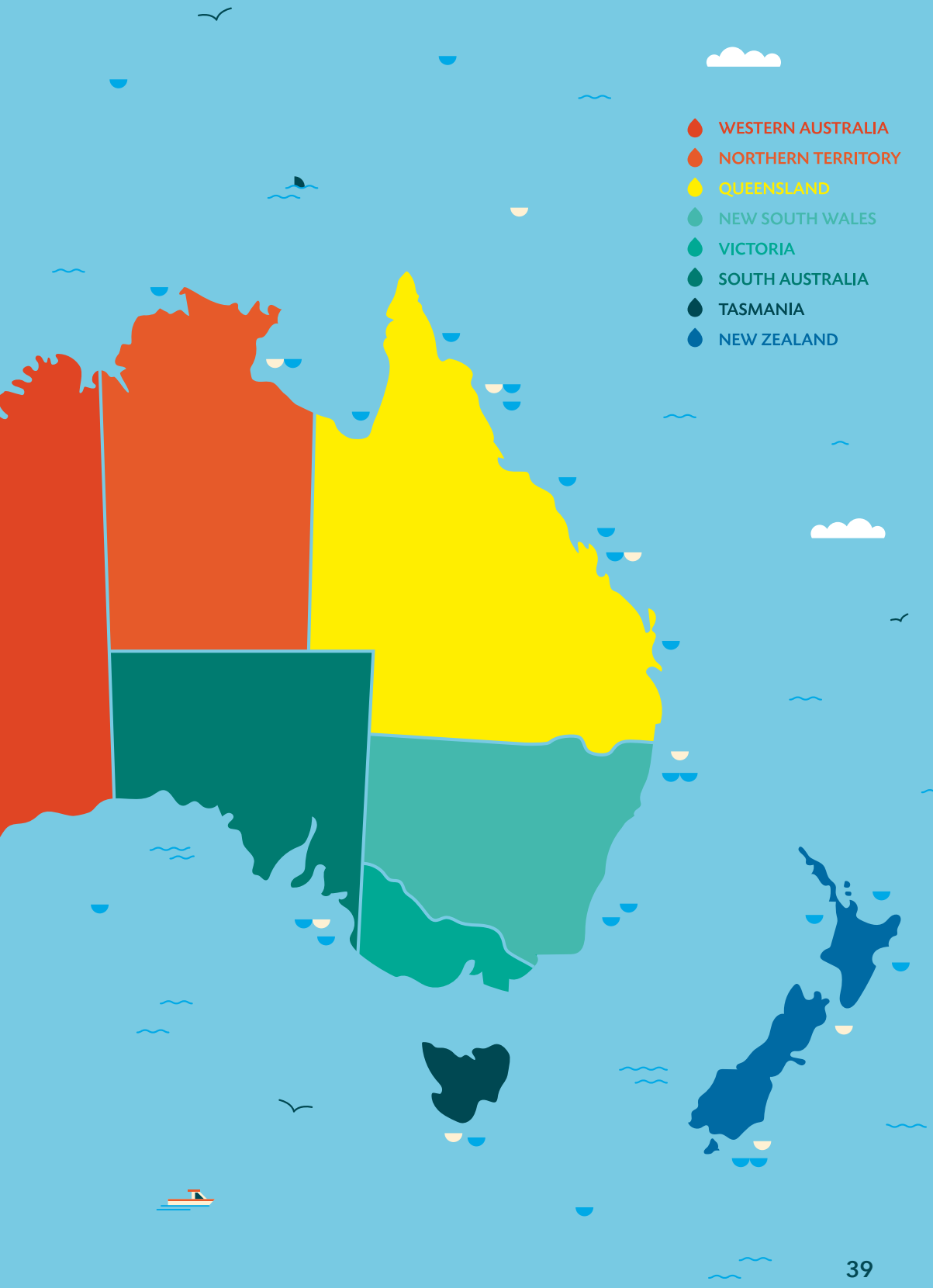
Meanwhile, in New Zealand, Polynesian explorers arrived around 1250-1300 AD, laying the foundations for the enduring Māori culture. The Kiwi bird, found nowhere else, is their cherished symbol.

Both countries are large, but their populations are relatively small. Australia has 26 million people, and New Zealand has around 5 million. They're ethnically diverse, with over 100 languages spoken, but English is the main language.

Most people live in cities, about 70%, and in New Zealand, it's even more—around 86%.

These are two remarkable lands with rich histories and unique wildlife.

Where do they get water?
What importance do they give it?


WESTERN AUSTRALIA
NORTHERN TERRITORY
QUEENSLAND
NEW SOUTH WALES
VICTORIA
SOUTH AUSTRALIA
TASMANIA
NEW ZEALAND

A lot of water!

Australia, the sixth-largest country at 7.7 million sq km, boasts the vast Great Barrier Reef, stretching over 344,400 sq km, visible even from space, surpassing New Zealand's total territory of 268,000 sq km

The ANZ region has only a tiny percentage of the world's freshwater resources. It accounts for less than 1% of the world's freshwater resources.

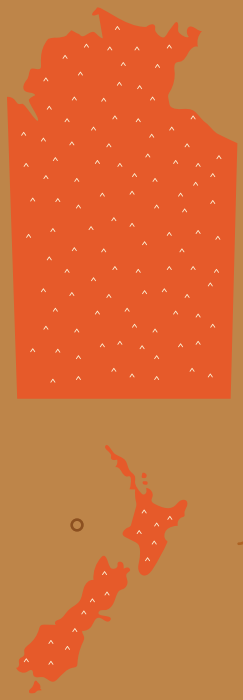
The Sydney desalination plant, Kurnell, is among the world's largest. With a daily capacity of up to 250 million litres, it can supply drinking water to around 2.5 million people.

Both Australia and New Zealand have similar daily water consumption per person, around 161-350 litres, which could be up three times higher than the average in Europe.

That is a lot of WATER!!

Our region is home to a remarkable variety of ecosystems and biological diversity, from fish, birds, and insects to a range of vegetation, including rainforests, wetlands, deserts, and glaciers. Protecting and valuing this treasure is vital for life. Here´s the kicker: Access to water isn´t evenly spread across the board. It´s like a complex puzzle influenced by geography, climate, water usage, and the effects of climate change.

For example:



Sometimes Australia has long periods without rain, called droughts. These periods of low rainfall can lead to water stress, reducing the availability of drinking water.

In the northern part of Australia, the tropical weather brings a lot of rain. From time to time, this heavy rain can lead to big floods which also impacts the water quality by carrying contaminants into lakes, dams, and other water resources.

New Zealand benefits from consistent rainfall and snowmelt in the Southern Alps, providing a reliable source of drinking water. While water resources are generally abundant, some regions may experience occasional, localized water shortages due to variations in rainfall.

Climate change has swiftly and significantly affected water resources, with rising temperatures leading to increased evaporation and reduced water availability, especially in water-scarce areas. It can also fuel more intense tropical cyclones, impacting water infrastructure in the ANZ region.

✳ UNDERSTAND THE WORDS

CLIMATE CHANGE IS A PHENOMENON RELATED TO GLOBAL WARMING OBSERVED BY SCIENTISTS. AS A RESULT OF INDUSTRIAL AND HUMAN ACTIVITIES, A LARGE AMOUNT OF CO2 HAS ACCUMULATED IN THE ATMOSPHERE. THIS CAUSES AN INCREASE IN GLOBAL TEMPERATURE AND, IN TURN, A DRASTIC CHANGE IN THE CLIMATE OF SOME REGIONS, WHICH THEN SUFFER FROM HEAVY RAINS AND FLOODS OR SEVERE DROUGHTS.

WATER STRESSES A SITUATION WHERE THERE'S INSUFFICIENT WATER OF SUITABLE QUALITY TO MEET DEMANDS, HAS AFFECTED BOTH AUSTRALIA AND NEW ZEALAND. AUSTRALIA'S "MILLENNIUM DROUGHT" FROM LATE 90S TILL EARLY 2000S SIGNIFICANTLY IMPACTED WATER RESOURCES, WHILE NEW ZEALAND'S "BIG DRY" BETWEEN 2007 AND 2010 WAS WIDESPREAD AND SEVERE.

Water sources in the ANZ Region

Australia boasts over 500 rivers. The Murray-Darling River system is the longest, flowing across multiple states has a total length of approximately 3,672 kilometres. The Darling River length is roughly equivalent to driving from Sydney to Perth, which bridges the width of the Australian continent.

The Darwin River Dam is the main water source for Darwin and nearby regions in the Northern Territory. Despite the river's relatively small size, it hosts a diverse range of wildlife, including freshwater crocodiles known as "freshies," enriching the local ecosystem.

Sydney, the largest city in Australia, relies on the Warragamba Dam, one of Australia's largest reservoirs, with a capacity equivalent to 812,000 Olympic-sized swimming pools.

Located in Western Australia, Lake Argyle is one of Australia's largest artificial lakes and it serves various purposes, including irrigation for agriculture and as a source of water for the town of Kununurra.

Lake Eyre and Lake Torrens, salt desert lakes in South Australia, often remain dry, but they can temporarily transform into inland seas during heavy rainfall. The water in these lakes requires extensive desalination to be suitable for drinking.

In South Australia, water is sourced from several reservoirs and dams, including the Happy Valley Reservoir and the Myponga Reservoir, which store water from the River Murray and local catchments.

Among New Zealand's approximately 3,800 lakes, Lake Taupo stands out as the grandest. Located in the North Island within the Waikato region, it boasts an expansive surface area of approximately 616 square kilometres, making it the largest freshwater lake in Oceania and the second deepest in New Zealand. Formed by the Oruanui eruption approximately 26,500 years ago, Lake Taupo now resides within the caldera (the volcanic crater) of this ancient volcano.

The Waikato River, also located in the North Island within the Waikato region is one of New Zealand's longest rivers (425 kilometres) and is a significant source of drinking water for cities such as Hamilton and Auckland.

The Tasman Glacier, New Zealand's largest, lies on Mount Cook's eastern slopes, enhancing its scenic beauty. While not suitable for drinking due to contamination concerns, it serves as a significant research site for glaciology, climate change, and geomorphology.

The Clutha River, in the south eastern part of the South Island. New Zealand's longest river by volume, supplies drinking water to some communities in the Otago region.

Stewart Island, a part of New Zealand, is the country's third-largest island, situated off the southern coast of the South Island. The Freshwater River, known for its considerable volume and length, flows through the island, boasting a rich biodiversity of native freshwater fish species, such as brown trout and whitebait.

How did first nation and indigenous people of Australia and New Zealand improve the quality of the water?

Aboriginals of Australia, Torres Strait Islanders and Indigenous of New Zealand employed efficient methods to ensure the safety of their drinking water. They commonly employed the practice of boiling water, in addition to natural filtration using materials like sand, stones, and specific plants. In New Zealand, they harnessed the natural filtering properties of harakeke (flax) leaves[1], while the Gunditjmara Aboriginal people in southwest Victoria used honeysuckle cones (banksias) as filtration straws to clean muddy water[2]. Boiling water in containers made from bark or shells was a prevalent and highly effective means of eliminating harmful germs.

Indigenous Australians built wells and tunnels to access groundwater. They also used the landscape, following dingos to waterholes and ants to groundwater[3]. The clean water was carefully stored in hollowed-out logs and specialized vessels, ensuring it remained free from contaminants.

Aboriginal and Torres Strait Islander peoples of Australia and the Indigenous peoples of New Zealand have deep cultural ties to water[4]. They use their special knowledge about water to help take care of rivers and lakes today. This shows how much they care about nature and want to keep it safe for everyone. It's like a special bond between them and the natural world that they want to keep forever.

1. https://teara.govt.nz/en/flax-and-flax-working/page-2
2. www.australiancurriculum.edu.au/media/5086/ccp-tbi-7-10.pdf
3. https://www.abc.net.au/science/news/ancient/AncientRepublish_1590192.htm
4. https://aiatsis.gov.au/blog/right-water

Navigating New Shores: The Role of Water in early European settlement.

Australia and New Zealand were both colonized by the British during the late 18th and 19th centuries. Australia's colonization began in 1788, when Captain Arthur Phillip led the First Fleet to establish a penal colony in Sydney Cove. This marked the formal beginning of British settlement in Australia[5].

Meanwhile, New Zealand's colonization took place later, starting in the early 1800s. Missionaries, traders, and whalers were among the first European settlers to arrive in New Zealand. They established trading posts and interacted with the indigenous Māori population[6]. In 1840, the Treaty of Waitangi was signed between the British Crown and Māori chiefs, formally establishing British rule in New Zealand.

As colonization progressed, more settlers from England and Europe migrated to both Australia and New Zealand, attracted by the promise of new opportunities, fertile lands, and resources. This influx of settlers contributed to the rapid development and transformation of both countries during the 19th century.

Water was vital for the early settlers in both countries. As the population grew, so did the demand for water. Early settlers understood the necessity of purifying water to prevent diseases. Additionally, they had to manage water effectively because it was used for irrigation in agriculture and to power mills for grinding grain to make food.

Early settlers implemented water supply systems to supply urban centres with potable water. These systems encompassed reservoirs, pipelines, and water tanks for sourcing and distributing water from rivers or groundwater reservoirs.

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5. https://www.parliament.nsw.gov.au/about/Pages/1788-to-1810-Early-European-Settlement.aspx

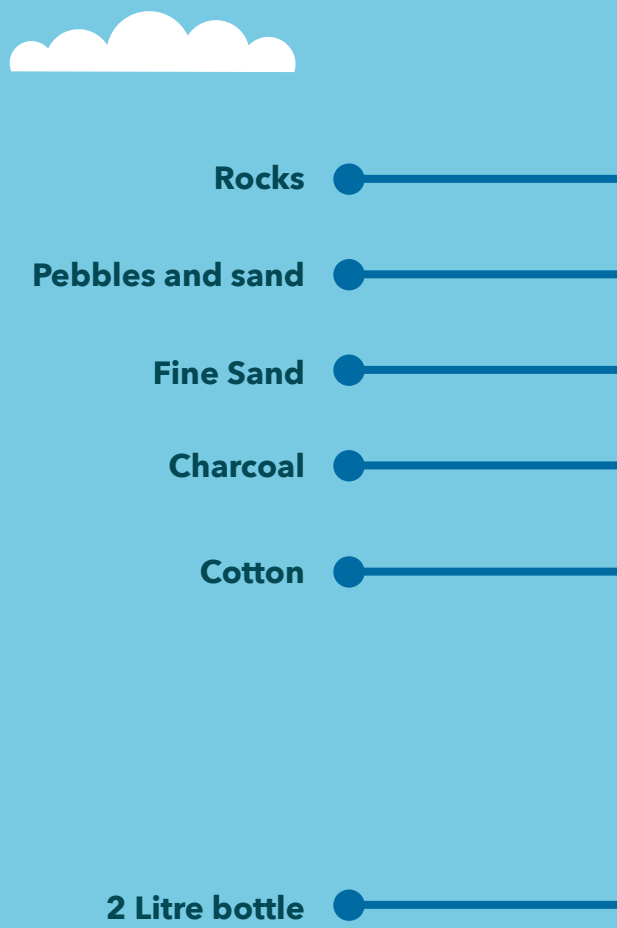
6. https://nzhistory.govt.nz/culture/history-of-new-zealand-1769-1914

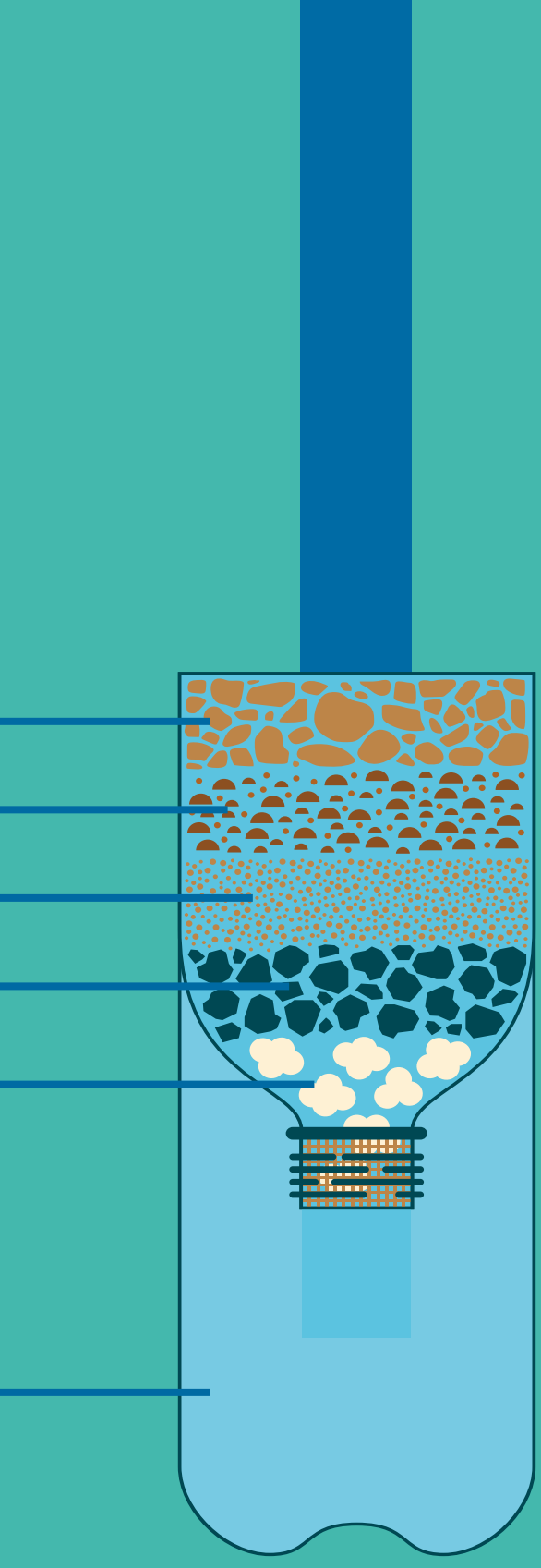
LEARN AND THINK

Hey there, future scientists! If you're curious about how our ancestors used to clean water, let's do a fun experiment together! We're going to make a simple water filter using stuff you can find at home. Here's what we need to do:

Materials Needed:

1. Two large plastic bottles
2. Clean sand
3. Gravel (Tuscan Path 15kg 30-50 mm White pebbles)
4. Rocks
5. Activated charcoal (available at pet stores or online, if you have a fish tank sometimes is used here)
6. Cottons
7. Coffee filter or cloth
8. Dirty water (you can use muddy water from outside)





STEPS

1. **Ask a grown-up to cut the bottles in half.** Then flip one of the bottle's top half over and put it in the bottom, so the top looks like a funnel. The top part is your filter.
2. **Place the coffee filter** (or bandanna, sock, etc.) **at the bottom of your filter.**
3. **Stuff cotton balls into the neck of the bottle.**
4. **Start filling you filter**
   - Start by adding a layer of charcoal, it will help to remove small impurities.
   - Add a layer of sand
   - Then, add some small rocks on top of the sand. They'll help filter bigger solids
5. **Filter Your Water:**
   - Ask a grown-up to carefully pour the dirty water into the filter
   - Watch as it drips down into the bottom container, getting cleaner as it goes!

So, are you ready to be water wizards and make your own filtration system? Let's get started and see how clean we can make our water.

Different times, same problems

In the current era, the ANZ region faces ongoing difficulties in managing water effectively. These challenges arise from various sources, with one major issue being the increasing need for water.

As the population grows, more water is needed for activities like farming, factories, and homes. Unfortunately, some of this water becomes dirty because of things like pollution from factories and farms.

Also, when we change nature too much, like cutting down trees or changing the flow of rivers, it can make water dirty and affect the environment.

Another problem is that the pipes and systems that carry water are sometimes old and have leaks, which means water gets wasted.

But don't worry! We can work on fixing these problems by implementing new technology, making rules to keep water clean, and working together with people from different places. This way, we can make sure everyone has enough clean water for drinking and other important things.

CIRCULAR WATER ECONOMY

Circular Water Economy principles address water scarcity, particularly in arid regions, by emphasizing efficient water use through strategies like reuse and recycling. This ensure there is enough water for everyone while promoting sustainability.

Circular Water Economy principles involve maintaining the cleanliness of beaches, rivers, and lakes, which prevents pollution and ensures safe water for various activities. Additionally, reusing water instead of wasting it contributes to environmental responsibility and helps us prepare for challenges like droughts and weather changes. Thus, by protecting our water, we're also safeguarding the environment.

In addition to technological solutions, Circular Water Economy principles recognize the importance of natural ecosystems, such as wetlands, in maintaining water quality and ecosystem health. Programs like Australia's National Wetlands Program and New Zealand's National Policy Statement for Freshwater Management highlight the critical role of wetlands in sustainable water management.

These ecosystems act as natural sponges during floods, absorbing excess water and filtering pollutants. They also provide homes for wildlife, showing how nature-based methods help with flood control and protecting biodiversity.

By combining technology with nature-based solutions, we promote sustainable and resilient water management practices.

✳ UNDERSTAND THE WORDS

BIODIVERSITY REFERS TO THE VARIETY OF LIVING ORGANISMS, INCLUDING PLANTS, ANIMALS, FUNGI, AND MICROORGANISMS, THAT EXIST IN A PARTICULAR ECOSYSTEM OR ON EARTH AS A WHOLE. IT'S LIKE THE WIDE RANGE OF DIFFERENT SPECIES AND THE DIFFERENT ROLES THEY PLAY IN THEIR ENVIRONMENT.

WATER SUPPLY RESILIENCE IS ABOUT ENSURING THAT OUR WATER SYSTEMS CAN CONTINUE FUNCTIONING EFFECTIVELY, EVEN IN THE FACE OF CHALLENGES LIKE POLLUTION OR CHANGES IN THE WEATHER. BY ENHANCING WATER SUPPLY RESILIENCE, WE GUARANTEE A STABLE, SECURE, AND CLEAN WATER SUPPLY FOR EVERYONE, REGARDLESS OF THE OBSTACLES THAT MAY ARISE.

Working so water can reach everyone

In major cities across Australia and New Zealand, most residents enjoy access to clean and safe drinking water from their household taps. However, the situation varies significantly in smaller towns and remote regions. Approximately 400 communities, face the challenge of inadequate access to clean water. This affects roughly 200,000 people in Australia alone. The water in these areas often contains harmful substances such as chemicals and bacteria, making it unsafe to drink.

In New Zealand, a considerable number of people, around 823,000, do not receive their water from traditional systems. Instead, they rely on alternative sources such as rainwater tanks.

Indigenous communities, with deep historical ties to the land and water, are particularly impacted by these challenges. Large-scale projects like dam construction can disrupt their connection to water, which holds significant cultural and traditional value.

Efforts are underway to address these issues and ensure equitable access to clean water for all residents. It is crucial to monitor water quality rigorously and implement measures to guarantee universal access to safe drinking water, regardless of geographical location or background.

Resolution 64/292 (2010)

United Nations historical resolution recognizing:

"The right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights"

WATER GOALS

Did you know that Australia and New Zealand were part of a significant event in 2023 called the United Nations Water Conference in New York? It marked the first time in nearly 50 years that countries worldwide gathered to discuss water-related issues.

At the conference, nations reviewed their efforts for clean water access and set goals for 2030. They stressed water's global significance, advocating for its recognition as a shared resource and fundamental human right for safe drinking water and sanitation. It was emphasized that water isn't just a threat but a source of health, well-being, and sustainability.

A significant outcome of the conference is the Water Action Agenda. It's a collection of commitments made by each country to better manage water resources.

Both Australia and New Zealand have pledged several commitments on this agenda. They're focusing on updating their national water policies, protecting water-related ecosystems and biodiversity, monitoring water quality to safeguard freshwater and coastal areas, and investing in water and sanitation projects for underserved regions, among other actions.

We can all contribute to this cause! By following the 5R principles – REDUCE, REUSE, RECOVER, RECYCLE, AND REPLENISH – we can each do our part in conserving water and safeguarding our planet's precious resources.

LEARN AND THINK

DOES EVERYONE HAVE ACCESS TO WATER IN YOUR CITY?

- Do you know if everyone has access to water in your city? Ask an adult. If they do not know, ask them to help you look for information on the internet.
- What solutions can you think of so every person can have access to water?
- How could we help solve water scarcity? Think about something you could do and something authorities should do.

Chapter 5

Sustainability, the great challenge

Sustainabili–what? What a long word!
Sus-tain-a-bi-li-ty!

This must be a collective concern. It means to use resources responsibly, without exhausting them nor exceeding their capacity for regeneration, so future generations can keep counting on them.

Do you think it is possible? What could we do to accomplish it?

Goals for a sustainable world

Many individuals and organizations worldwide are deeply invested in sustainability and the future of our planet.

One prominent advocate for global cooperation and progress is the United Nations (UN). Through its initiative, the UN has established 17 Sustainable Development Goals (SDGs), outlining key objectives to address pressing global issues and promote a sustainable future for all. Take a closer look at these goals on the next page to understand their significance in shaping our collective efforts towards a better world.

✳ UNDERSTAND THE WORDS

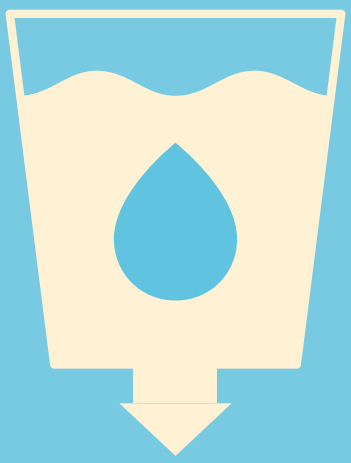
SUSTAINABILITY AND SUSTAINABLE ARE SYNONYMS. BOTH WORDS REFER TO THE IDEA OF MAINTAINING SOMETHING, OF PRESERVING IT. THAT IS WHY YOU WILL FIND THAT, IN SOME PLACES, WE USE THE TERM SUSTAINABILITY AND IN OTHERS SUSTAINABLE. BOTH EXPRESSIONS ARE VALID TO REFER TO THE NECESSITY TO PRESERVE NATURAL RESOURCES FOR A LONG TIME WITHOUT EXHAUSTING THEM NOR HARMING THE ENVIRONMENT.

These goals are like promises to make the world a better place for everyone. They aim to ensure that everyone can live well and help the planet, too. It's important for countries, companies, and people to work together to achieve these goals and create a brighter future for all of us.

Sustainable Development Goals

Taken from: https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/

DID YOU SEE GOAL NUMBER 6?



"Clean water and sanitation." It means ensuring water availability, its sustainable management and sanitation for everyone.

- Sustainability for water means using the right amount without wasting it and return it to nature free of contamination.
- Water sanitation means that people can safely access it and that wastewater must be treated before returning it to the environment or reusing it.

We have learned that we need water every day and for all our activities. We cannot live without water. The great challenge is ensuring that this resource is available in enough quantity and quality for every human being, today and in the future.

Quantity and quality

Two current problems related to water are shortage and contamination. That means that we do not always have enough availability of this resource to satisfy the needs of a region or, if we do, then it is not safe. Why does this happen?

What´s causing water scarcity in areas where it once wasn´t a problem?
The main reasons are:

- **Climate change.** As you learned in the last chapter, two consequences of this phenomenon are a decrease in rainfall (which causes droughts) or, the other way around, an increase in precipitation (which causes floods).
- **The excessive usage of water available in watersheds.** One example is when groundwater or river water becomes insufficient for the population's needs due to excessive irrigation of water-intensive crops.
- **Deforestation of watersheds.** It is the severe reduction of plants and native trees in a place. Because of this, when it rains, the vegetation does not retain water, the underground layers cannot absorb it, and it runs off the surface dragging part of the soil into the rivers.

*** UNDERSTAND THE WORDS**

NATIVE TREES AND PLANTS ARE THE ONES THAT GROW IN THEIR REGION OF ORIGIN, AND THEREFORE ARE INDIGENOUS TO THE AREA'S ECOSYSTEM. ON THE OTHER HAND, A NON-NATIVE TREE WAS BROUGHT FROM ANOTHER AREA, WHICH MEANS THAT SOMEONE INTRODUCED ITS CULTIVATION IN THAT REGION. FOR EXAMPLE, EUCALYPTUS TREES, KNOWN AS GUM TREES, ARE A PROMINENT FEATURE OF AUSTRALIA'S LANDSCAPE, WITH A HUGE VARIETY OF OVER 700 SPECIES. CONVERSELY, WILLOW TREES, INTRODUCED TO AUSTRALIA FROM EUROPE AND ASIA FOR EROSION CONTROL AND ORNAMENTAL PURPOSES, HAVE BECOME INVASIVE, PARTICULARLY ALONG WATERCOURSES, WHERE THEY OUTCOMPETE NATIVE VEGETATION.

WHY IS THE QUALITY OF WATER NOT ALWAYS SAFE?

- It often occurs from natural causes, such as catastrophic events or soil characteristics. For example, when a volcano erupts, it deposits large amounts of ashes and minerals that reach the water and contaminate it. It may also happen with heavy rains on eroded soil, dragging debris, and muddying the rivers. In other cases, there are natural mineral deposits in groundwater that, in high concentrations, are harmful to our health.
- Water quality is also affected by human action, mainly by domestic, agricultural, and industrial activities that cause food waste, faeces, and urine, pathogenic microorganisms, detergents, chemical substances, agricultural fertilizers, and pesticides, among others.

When things like these happen, the characteristics of water change and it is dangerous to reuse it. Then it is no longer safe to drink it, irrigate crops or practice water activities in that place.

WHO IS AFFECTED BY WATER CONTAMINATION?

IT NOT ONLY AFFECTS HUMANS BUT CAN ALSO DAMAGE THE FLORA AND FAUNA OF A PLACE. FOR EXAMPLE, IF THE CONTAMINATION REACHES RIVERS AND LAKES, IT REDUCES THE OXYGEN IN THE WATER, WHICH CAUSES THE DISAPPEARANCE OF NATURAL VEGETATION AND THE DEATH OF FISH AND OTHER AQUATIC ANIMALS. AND IF AN OIL TANKER SPILLS OIL IN THE OCEAN, THIS DENSE BLACK LIQUID ADHERES TO BIRDS' FEATHERS, MAMMAL'S FUR, AND FISH'S SCALES, CAUSING THEIR DEATH.

HOW CAN WE HELP REDUCE WATER CONTAMINATION?

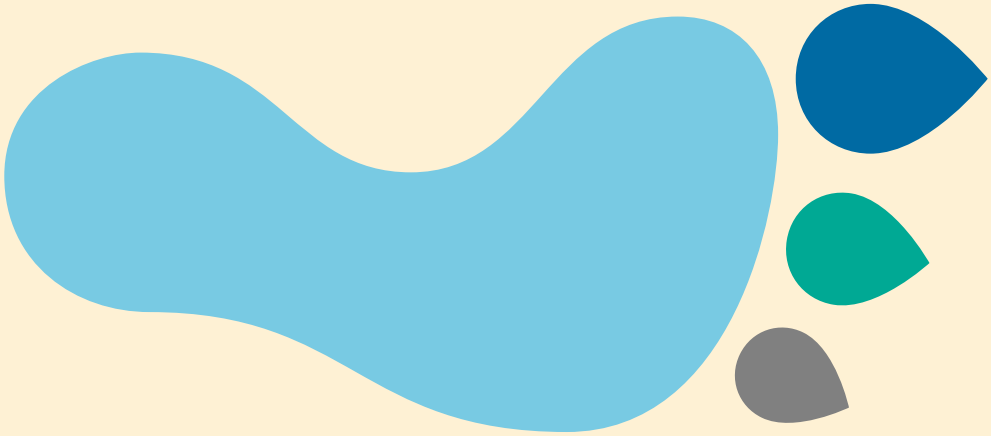
1. Practicing responsible consumption by selecting eco-friendly products, minimizing waste generation, and recycling whenever possible.
2. Demanding that industries reduce hazardous materials in their operations and control their waste production.
3. Maintaining sewage systems by avoiding disposing of objects or trash down toilets or manhole covers
4. Reducing pesticides and other chemical products in agriculture because they may filter through the ground and contaminate groundwater.

Can you think of other measures to help preserve the quality of our water?

Water footprint

Have you ever wondered how much water you use to do everything you need to do during the day? For example, when you take a shower, brush your teeth, flush the toilet, water your plants, and in the foods you consume.

Also, the things we use and eat every day needed a lot of water to be produced. A glass of milk, a notebook, your clothes, everything, absolutely everything, needs water in its production chain.



This is what we call water footprint, the total volume of water used from the production until the consumption of a product, in addition to the water needed to treat the pollutants that it produced.

Water footprint consists of three water sources:

Blue water → it comes from natural sources such as rivers, lakes, aquifers, and surface water extracted from a basin.

Green water → it comes from the rain stored temporarily on the surface of the earth.

Grey water → it is wastewater from activities like bathing and laundry, excluding toilet waste, often recycled for non-potable uses.

FOOD AND BEVERAGES

1 APPLE
70 LITRES

VS

1 GLASS OF APPLE JUICE
190 LITRES

1 KG OF POTATOES
900 LITRES

VS

1 BAG OF CHIPS
185 LITRES

1 KG OF BARLEY
1300 LITRES

1 SLICE OF BREAD
40 LITRES

1 KG OF CORN
900 LITRES

1 LITRE OF MILK
1000 LITRES

1 KG OF CHEESE
5000 LITRES

1 EGG
200 LITRES

1 KG OF CHICKEN
3900 LITRES

1 KG OF BEEF
15.500 LITRES

1 HAMBURGER
2400 LITRES

1 KG OF PORK
4800 LITRES

1 KG OF RICE
3400 LITRES

1 KG OF CANE SUGAR
1500 LITRES

1 KG OF COCONUT
2500 LITRES

1 CUP OF COFFEE
140 LITRES

1 CUP OF TEA
35 LITRES

CLOTHES AND OTHERS

1 COTTON SHIRT
2700 LITRES

1 KG OF LEATHER
16.600 LITRES

1 LEGAL SIZE SHEET
10 LITRES

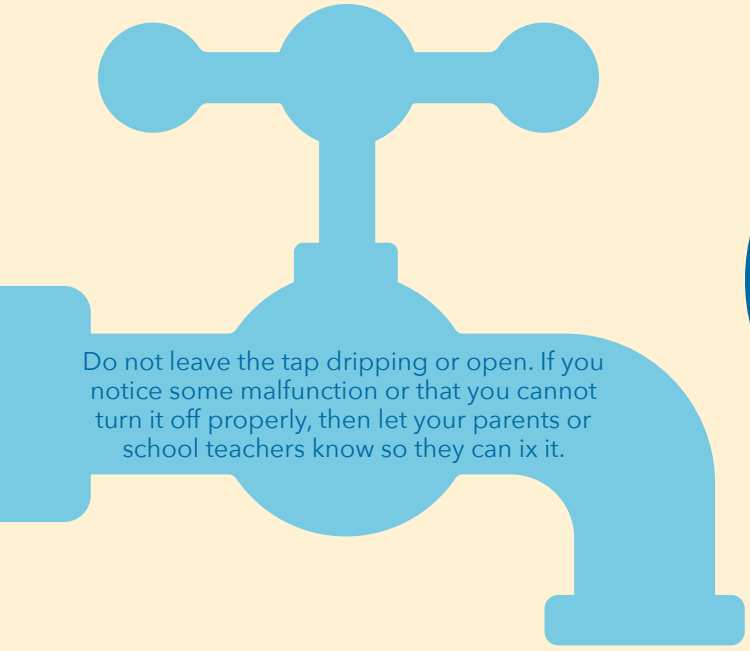
Data taken from Soy responsable, soy mejor, student handbook from SISS, Superintendency of Sanitary Systems (http://www.siss.gob.cl/586/articles-16787_recurso_1.pdf)

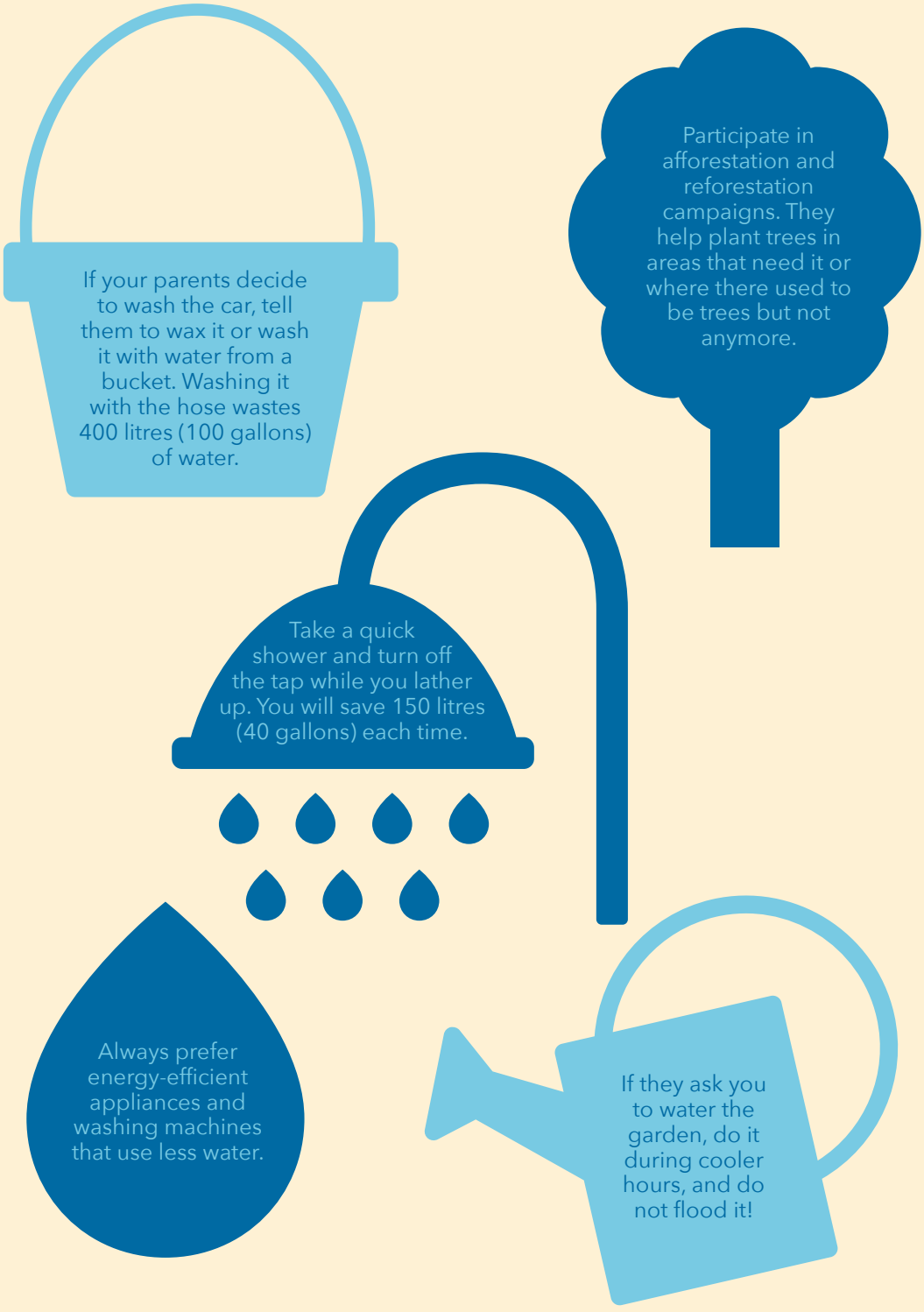
How can I help if I am just a child?

We can all help to preserve water. The first thing is having responsible habits and consuming only the water and things we need. For example, try not to waste food or school supplies, so you do not need to buy more.

Read the suggestions and think about which ones you could follow on your own and which ones you could talk about with the adults you live or study.

You only need one glass of water to brush your teeth. With half the water rinse your mouth, and with the rest clean your brush.





Source: Virtual Center of Information about Water, 2017
(https://agua.org.mx/sustentabilidad/#huella-hidrica)

LEARN AND THINK

DO YOU KNOW HOW MUCH WATER YOUR FAMILY USES IN YOUR HOUSE?

Since we wake up in the morning until we go to bed, we do not notice the number of times we use water and how much we consume. Check the following information:

Activity	Estimated litres
Washing your hands	2 - 18 litres
Brushing your teeth	2 - 12 litres
Filling up the tub	200 - 300 litres
Taking a shower	80 - 120 litres
Using the washing machine	60 - 90 litres
Using the dishwasher	18 - 30 litres
Doing the dishes	15 - 30 litres
Flushing the toilet (new model)	5 - 7 litres
Flushing the toilet (old model)	13 - 22 litres
Cooking and drinking	10 litres - day
Mopping the floor	10 litres - day
Washing the car	400 litres
Water 100 m^2 (1000 ft^2) of lawn	1000 litres

Data taken from Soy responsable, soy mejor, student handbook from SISS, Superintendency of Sanitary Systems (http://www.siss.gob.cl/586/articles-16787_recurso_1.pdf)

If we are not careful enough, we can waste much more water. For example:

A running tap wastes 5 to 10 litres (1 – 2 gal) per minute.	A leaky tap or tap wastes 30 litres (8 gal) per day.	A tap or tap that is constantly dripping wastes 700 litres (185 gal) per day.

How much water do you consume and save in your house? To calculate, learn to read the water metre and record the data. Follow these steps:

1. Locate the water metre and read it every day at the same time for a week.
2. Record the information for seven days in a table like the one below.

Day	Metre reading		Consumption in m^3
	TODAY	YESTERDAY	
0	101000		
1	101600	101000	600
2	102390	101600	790
3	102990	102390	600
4	103780	102990	790
5	104566	103780	786
6	105003	104566	437
7	105495	105003	492
	Weekly total		**4495**

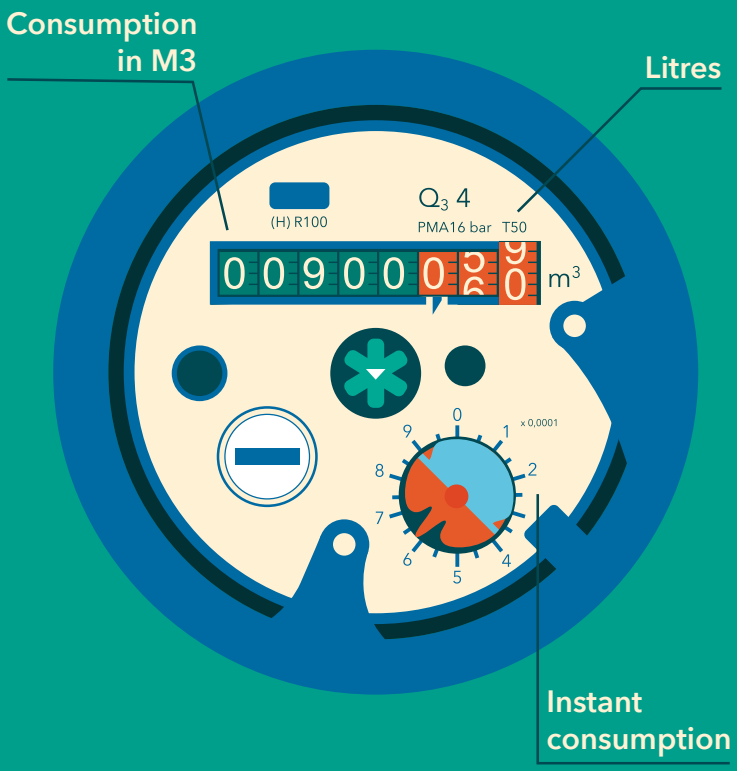
← YOU MUST SUBTRACT YESTERDAY'S READING TO TODAY'S READING TO GET THE CONSUMPTION OF THE LAST 24 HOURS.

REPEAT THIS STEP EVERY DAY FOR A WEEK.

YOU MUST TAKE THE READING EVERY DAY AT THE SAME TIME TO MAKE SURE IT CORRESPONDS TO A WHOLE DAY!

3. Divide the weekly total by the number of days to get the average consumption of water in your house. Write the result down in your notebook.
4. Estimate how many people live in your house and divide the average by the number of people. That is the average daily consumption per person.

- According to the results, how many litres or gallons of water per person are consumed daily in your house?
- What actions could you take as a family to lower your water consumption? Share with them the examples on the last page and talk about them.
- Once everyone has committed to save water, begin a new week of reading, and calculate again how much water is consumed in your house. Did you manage to reduce it?

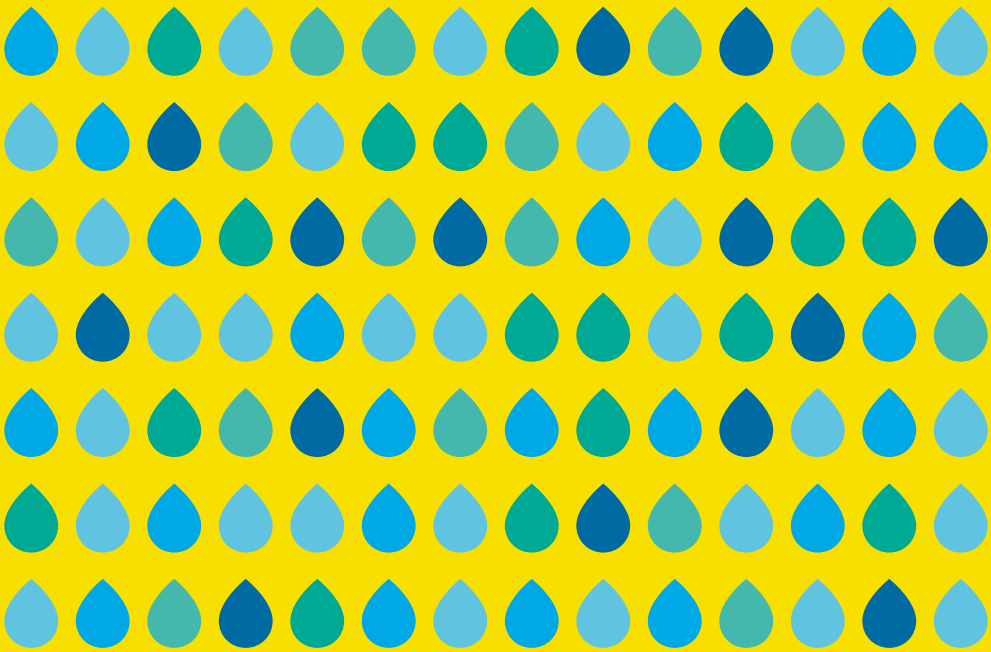


WHAT IS MY WATER FOOTPRINT?

- Write down what you usually eat during the day, look for the water footprint of each food item and add the results.

Meal	Content	Water footprint
Breakfast	1 glass of milk and 1 scrambled egg sandwich.	40 + 200 + 200 litres
Lunch	Beef patty with rice	
Afternoon snack	1 yogurt	
Dinner	Vegetable soup	
	TOTAL	

- With the information on the previous pages, can you calculate the water footprint of the clothes you are wearing today?
- What could you do to reduce your water footprint?



Let's save water!

We have reached the end of this book, but the beginning of a new story, the one you will be able to tell the boys and girls of future generations.

It can only be possible if you start practicing what you have learned on these pages and continue studying and understanding the problems that water faces nowadays.

We say goodbye, wishing you the best…

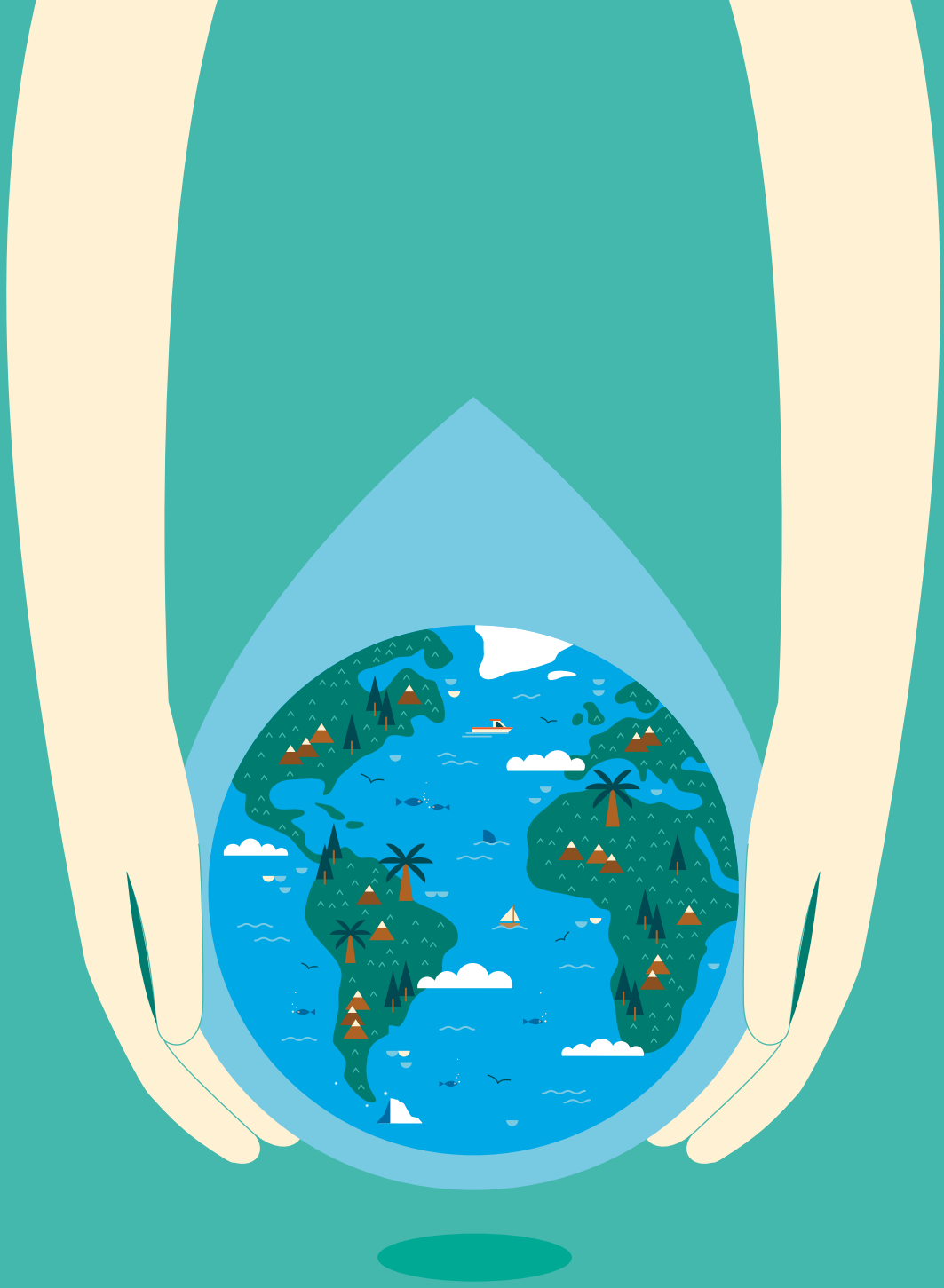
… that the word sustainability guides your daily actions.

… that you commit to small measures that may bring big positive changes to our planet.

… that people of the future may get to see the natural wonders of the world like the Great Barrier Reef and the Tasman Glacier.

… that everyone, today and tomorrow, can drink a glass of crystalline freshwater and look at the thousands of little stars over the rippling surface of a lake at sunset.

The future of water and our planet is a task that includes everyone.



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Xylem Inc., through its Watermark program, is committed to the preservation of this valuable resource, water. We want this book to contribute to our ANZ region, children and young people, so they learn from these words and take action because every drop counts!