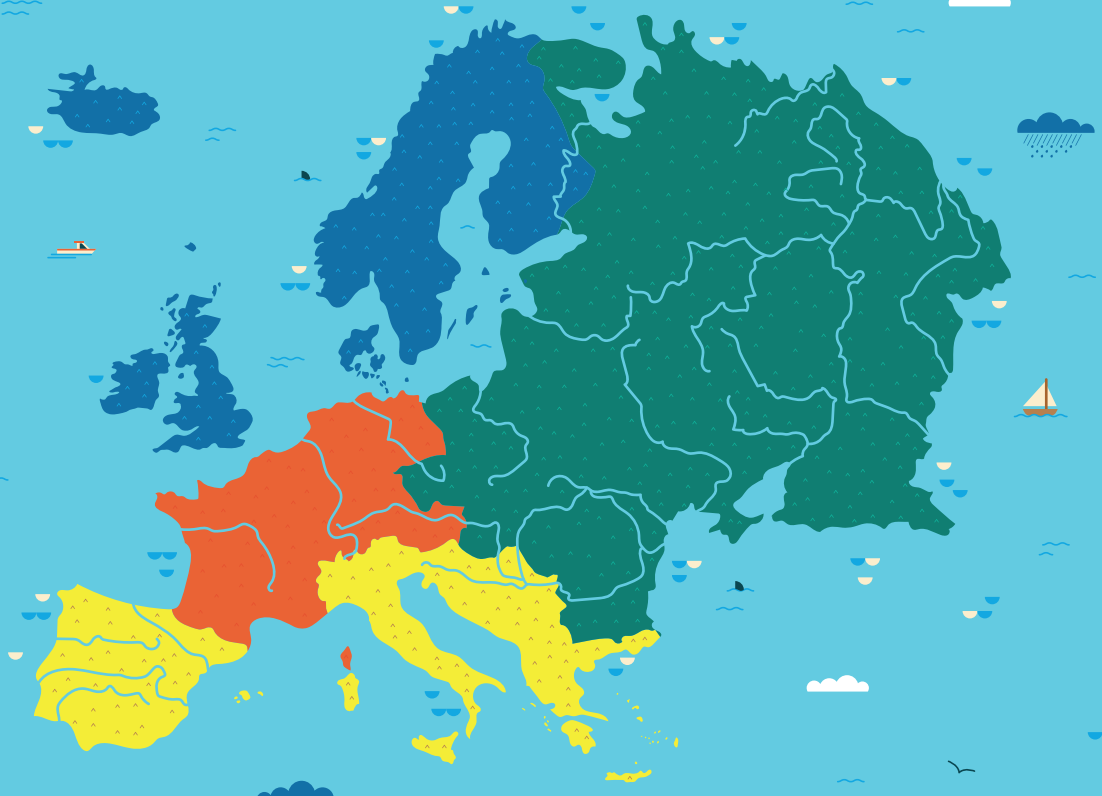
Denise Pouleurs - Anton Glushchenko

THE GREAT BOOK OF WATER

EUROPE



xylem
watermark

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THE GREAT BOOK OF WATER EUROPE

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Index

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 vacation!

After a whole day of traveling, with my sister and my parents in my uncle's car –a parrot green kombi– we arrived at a small town. We traveled 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 in Latin America 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

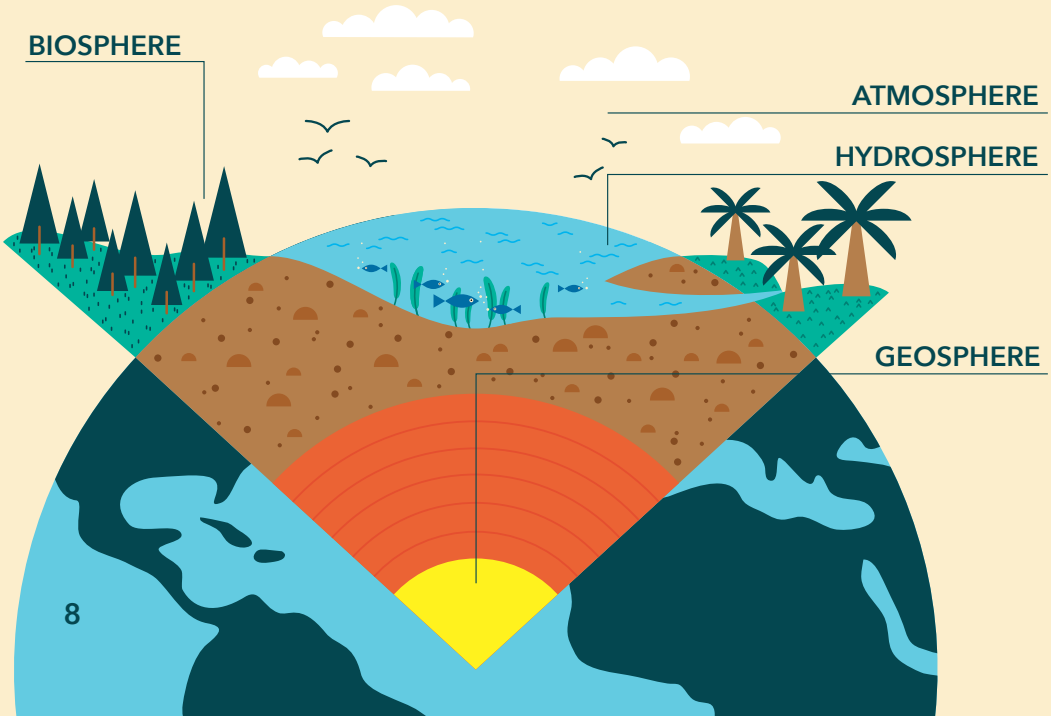
Planet Earth, planet water

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. Identify the layers and what is in them.



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 center of the planet, and it has three levels: crust, mantle, and core.

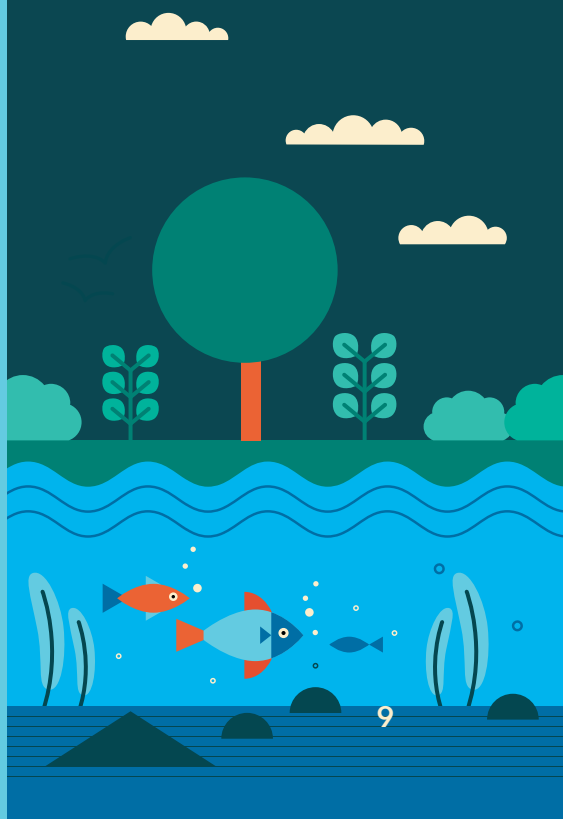
HYDROSPHERE (WATER)
It is all the water that exists on Earth, in its many forms, states, colors, and flavors. Here you can find the oceans, seas, rivers, lakes, groundwater currents, glaciers, and the water present in the atmosphere.

BIOSPHERE (LIVING BEINGS)
This layer includes living beings and the different ecosystems where they inhabit and interact, such as forests, rainforests, deserts, savannahs, 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.

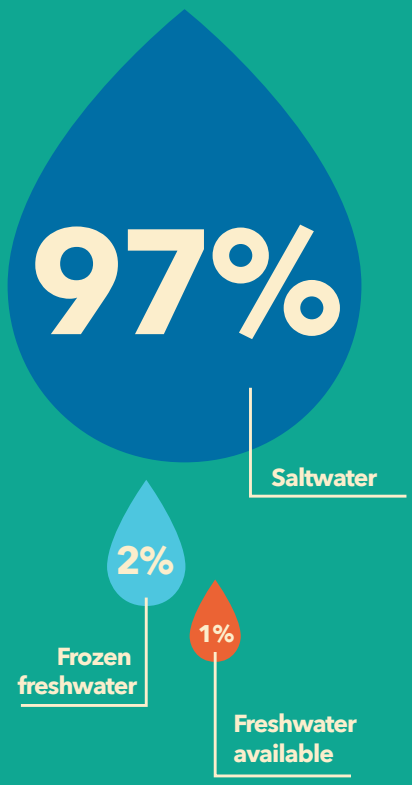
Saltwater contains an excess of dissolved minerals which gives it a salty flavor. That is the water you can find in oceans and seas.

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 freshwater available.

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?

BECAUSE OF THE RIVERS THAT FLOW INTO THE SEAS AND OCEANS. IN ITS CURRENTS, RIVERS CARRY MINERALS FROM THE EROSION OF ROCKS. OUT OF THESE MINERALS, THE MOST COMMON IS SODIUM CHLORIDE, ALSO KNOWN AS SALT. FOR MILLIONS OF YEARS RIVERS HAVE TAKEN SALT FROM THE SURFACE OF THE EARTH TOWARD THE OCEANS.

70%

PLANET EARTH

IS WATER-COVERED

97% Saltwater

3% Freshwater

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

ITS EXTRACTION PER USE IS...

69%

AGRICULTURAL SECTOR

19%

INDUSTRIAL SECTOR

12%

MUNICIPAL SECTOR

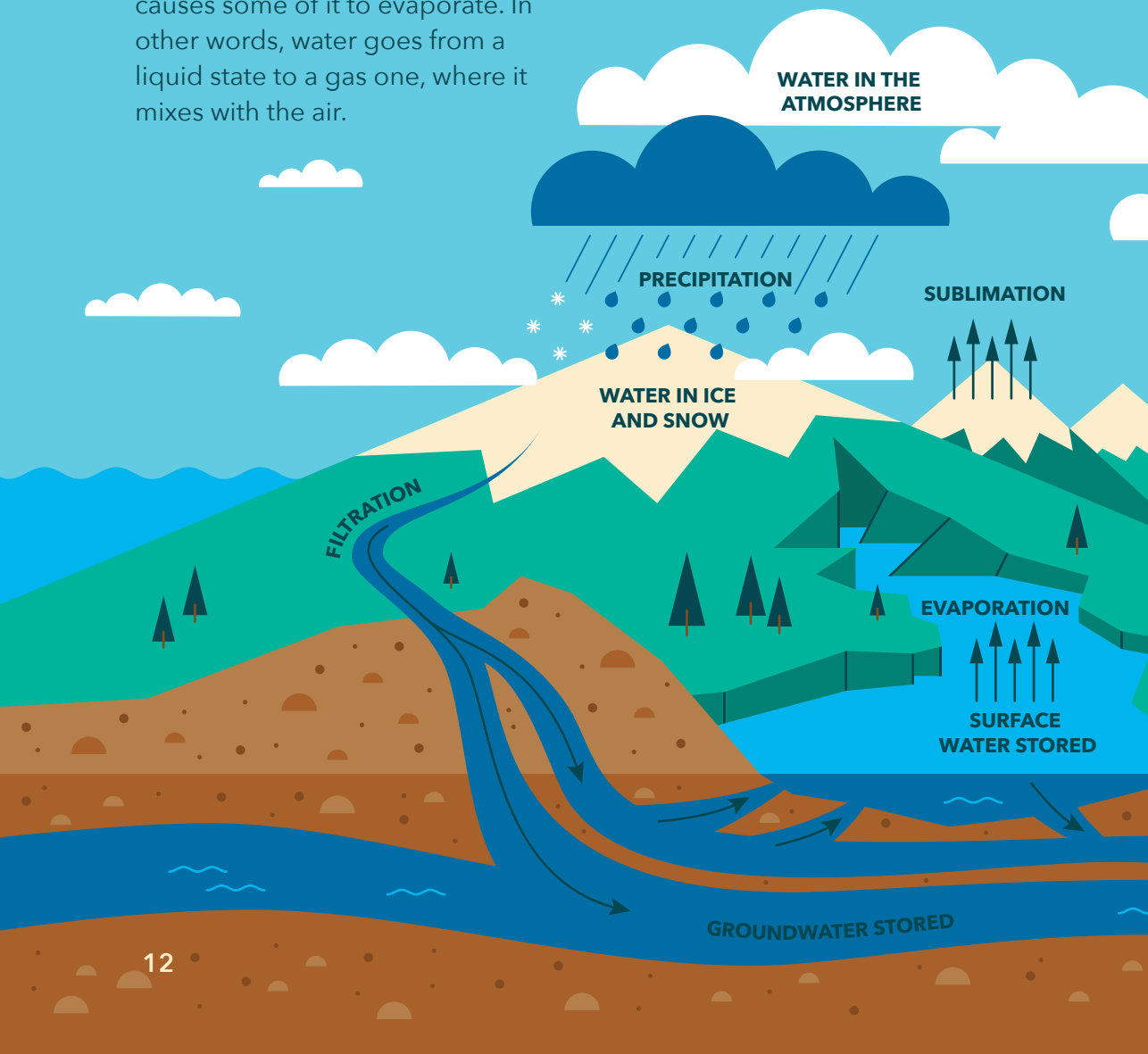
Taken from Agua.org.mx, Fund for the Communication and Water Education (https://agua.org.mx/en-el-planeta/)

The water cycle

Water is neither created nor destroyed but transformed. The one we have today is the same one that dinosaurs drank from and has traveled over and over through the layers of the Earth. This is what we call “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.

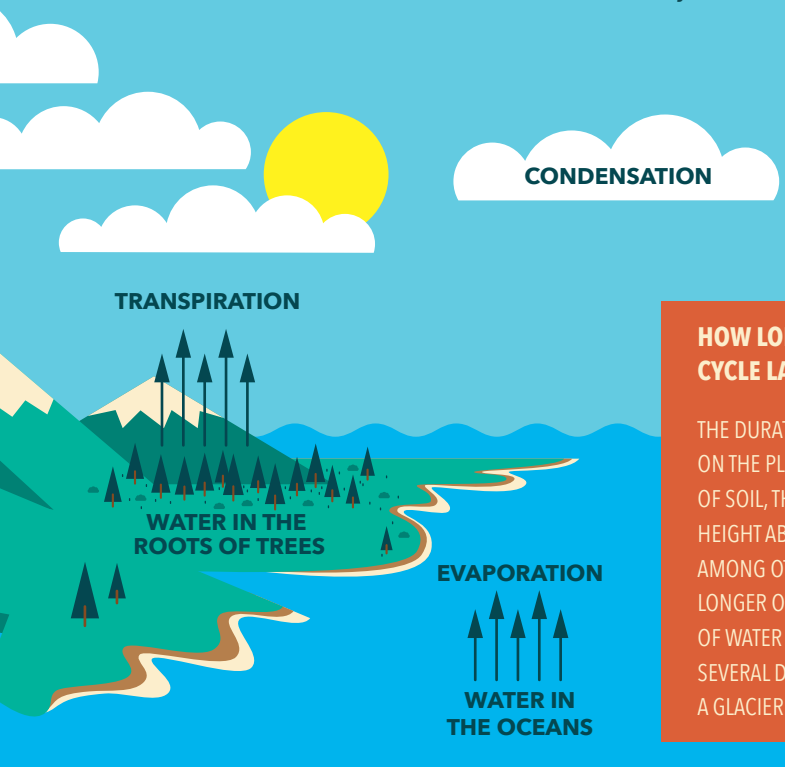
When water evaporates, it turns into steam. In this state, it rises to the atmosphere until it reaches cool air currents. Then, that steam is condensed, and water goes back to its liquid state as drops produced by clouds.



These clouds travel from one place to another, helped by air currents and the wind. When clouds have enough water, droplets start to gather, growing and getting heavier. Then, the Earth's gravity attracts them, and it starts to rain. If it is too cold up there, the water freezes and falls as snow.

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 DEPENDS ON 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.

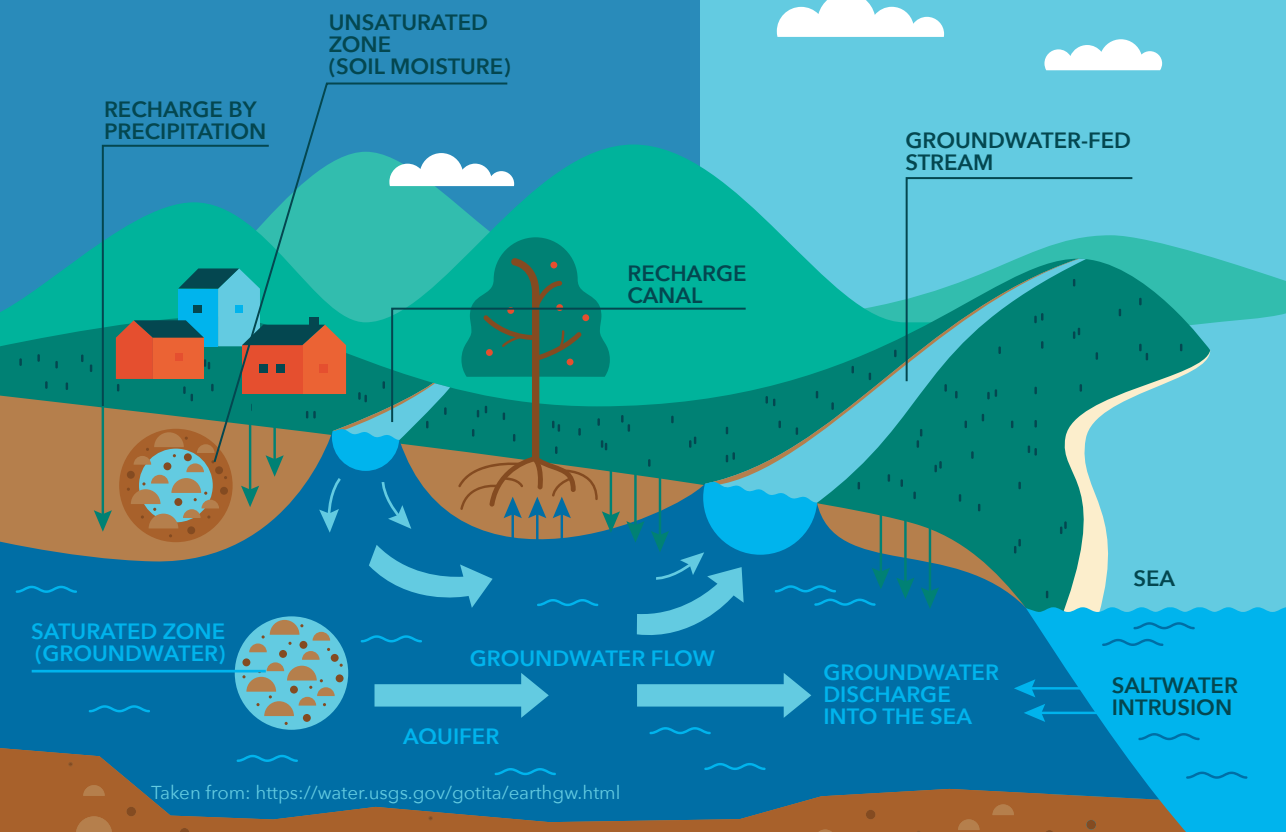
* UNDERSTAND THE WORDS

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

The European States abstracted around 38 billion m^3 of groundwater each year, accounting for 65% of total water abstraction for public water supply. A supply of high-quality and sufficient volumes of water to the public is essential for domestic uses such as drinking, food preparation and hygiene.

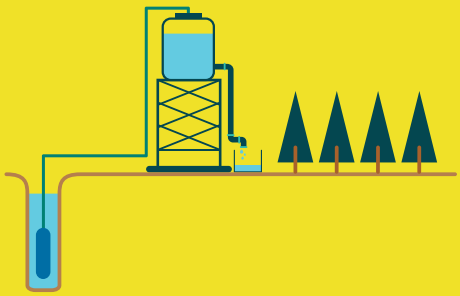
HOW IS WATER EXTRACTED FROM AQUIFERS?

THE WATER FROM AQUIFERS CAN BE USED TO IRRIGATE CROPS AND PRODUCE DRINKING WATER, AMONG OTHER ACTIONS FOR THE BENEFIT OF A POPULATION. BUT HOW DO WE EXTRACT IT FROM THE SUBSOIL TO THE SURFACE? USING A PUMP!

A PUMP IS A MACHINE THAT MOVES WATER FROM ONE PLACE TO ANOTHER, GENERALLY UPWARD, WHERE IT DOES NOT FLOW NATURALLY DUE TO THE ACTION OF GRAVITY.

PUMPS NEED SOME TYPE OF ENERGY TO BE ABLE TO FUNCTION, WHICH IS SUPPLIED BY AN ENGINE.

IN THEIR INTERIOR, PUMPS HAVE SEVERAL PROPELLERS (CALLED IMPELLERS) THAT ROTATE VERY FAST TO DELIVER ENERGY IN THE FORM OF SPEED TO THE WATER WE WANT TO PUMP. IT IS LIKE THESE IMPELLERS WERE PUSHING THE WATER SO IT CAN RISE AND GET TO THE SURFACE OF THE EARTH.



When water is at great depth, below the surface of the earth, you must use a well pump. Well pumps allow us to extract water over 200 meters (650 ft) deep below the surface of the earth.

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?

It does not rain the same everywhere. For example, look at how much it rains in the following European capitals:

Ljubljana, Slovenia	1368 mm/year
Zurich, Switzerland	1048 mm/year
Amsterdam, Netherlands	838 mm/year
Paris, France	637 mm/year
London, United Kingdom	557 mm/year
Madrid, Spain	436 mm/year
Athens, Greece	365 mm/year

Data taken from the web site Currentresults.com (https://www.currentresults.com)

← WATER PRECIPITATION IS MEASURED IN MILLIMETERS (MM).

1 MM OF WATER EQUATES TO 1 LITER OF RAIN ON A SQUARE METER. IN OTHER WORDS, IF YOU POUR 1 LITER OF WATER IN 1 SQUARE METER, THE HEIGHT OF WATER IN THAT SQUARE METER 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.

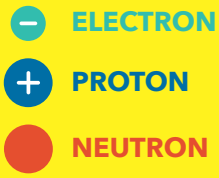
The atoms of several elements join to form molecules, with which new substances or materials are created, like water! When molecules get together, they create more complex structures, like a rock, a rose, a cat, or a human being, among many others.

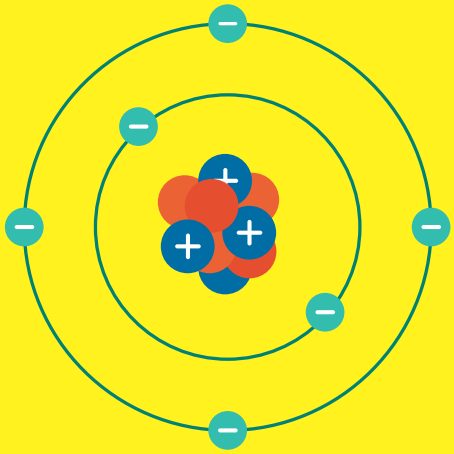
Let's start with the atom

Think of an atom as a miniature solar system, composed of a nucleus of grouped protons and neutrons, with electrons revolving around it, just like the planets 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

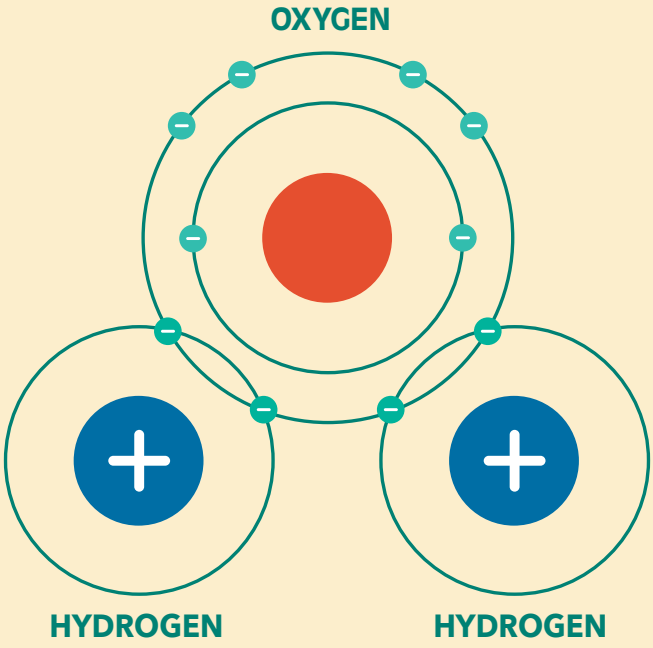
A water molecule is formed by an oxygen atom and two hydrogen atoms.

When a molecule is formed, the atoms share some electrons. In the case of water, the molecule has the oxygen atom at its center 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.

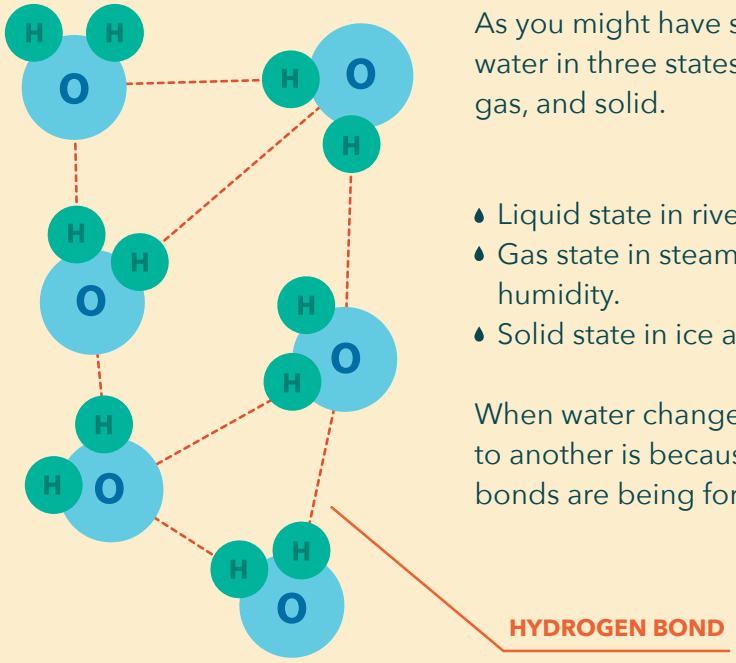
This way, each water molecule is connected to the others through hydrogen bonds.

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

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. THIS HAPPENS BECAUSE ICE IS LESS DENSE, SINCE THE DISTANCE BETWEEN ITS MOLECULES IS BIGGER THAN THE DISTANCE OF THE WATER MOLECULES IN A LIQUID STATE.

BEING LESS DENSE OR CRAMPED, ICE IS ALSO LESS HEAVY, THAT IS WHY IT FLOATS!



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

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

When water changes from one state to another is because hydrogen bonds are being formed or broken.

Heat capacity of water

Hydrogen bonds are so strong that it takes a lot of power to separate the molecules, which is why water can store a great amount of energy in the form of heat. That means it has a high **heat capacity**.

If you have been to the beach, you surely have noticed that the sand is very hot, and that water is a lot cooler at noon or afternoon. But at night is the other way around: the sand is colder and the water warmer. This happens because water has a bigger heat capacity than sand, which is why it takes it longer to cool down. So, at night, water keeps the heat that accumulated during the day.

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

For example, when we have a fever, we sweat because our body is lowering the temperature through the elimination of sweat, and that makes us thirsty.

That way, by ingesting more water, we help the body regulate its temperature.

And what about nature? Something similar happens. For example, in arid climates like deserts, the temperature difference between day and night is much bigger than in climates with water because it helps regulate the changes.

On the other hand, forests are always cooler than open fields because of tree transpiration. The water they evaporate captures the heat of the air, which reduces high temperatures, and that way, forests stay cool.

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.

Two forces that move water

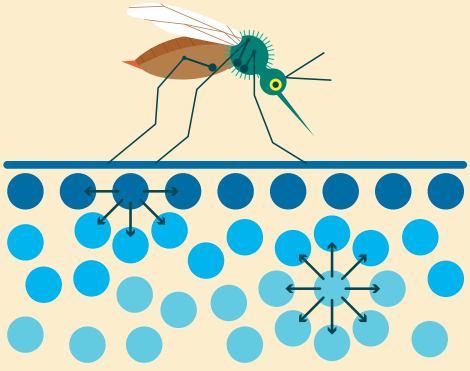
From the water molecule and hydrogen bonds that bind different molecules, scientists have discovered other interesting characteristics of water:

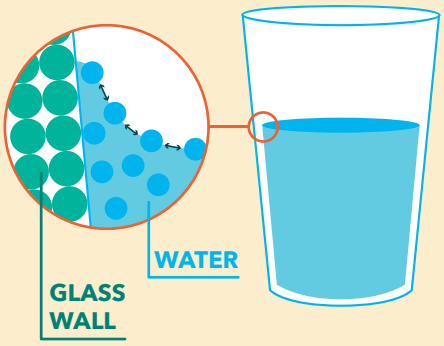
- **Surface tension:** since hydrogen bonds are so tough, water has high cohesive strength, which results in surface tension. It forms spherical droplets in the water that do not break easily, as if there was an invisible net on which an insect could walk without sinking, to give an example.

✳ 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.



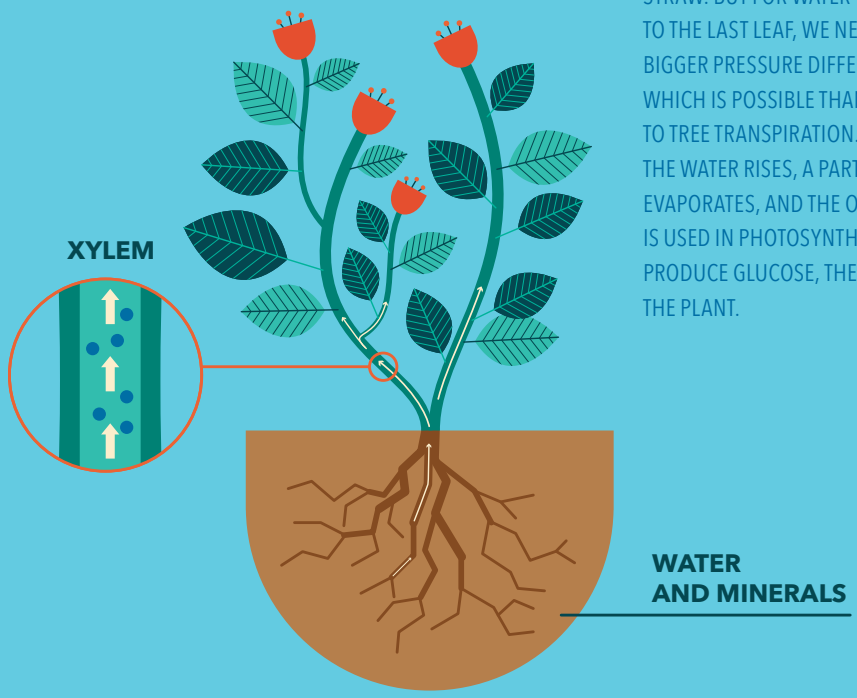


- **Capillarity:** is the water's ability to rise against the force of gravity. This happens when water joins another type of molecule that attracts it by its positive or negative charge. When the adhesive strength is bigger than the cohesive one, water can rise through very thin glass tubes called capillaries. 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, 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.

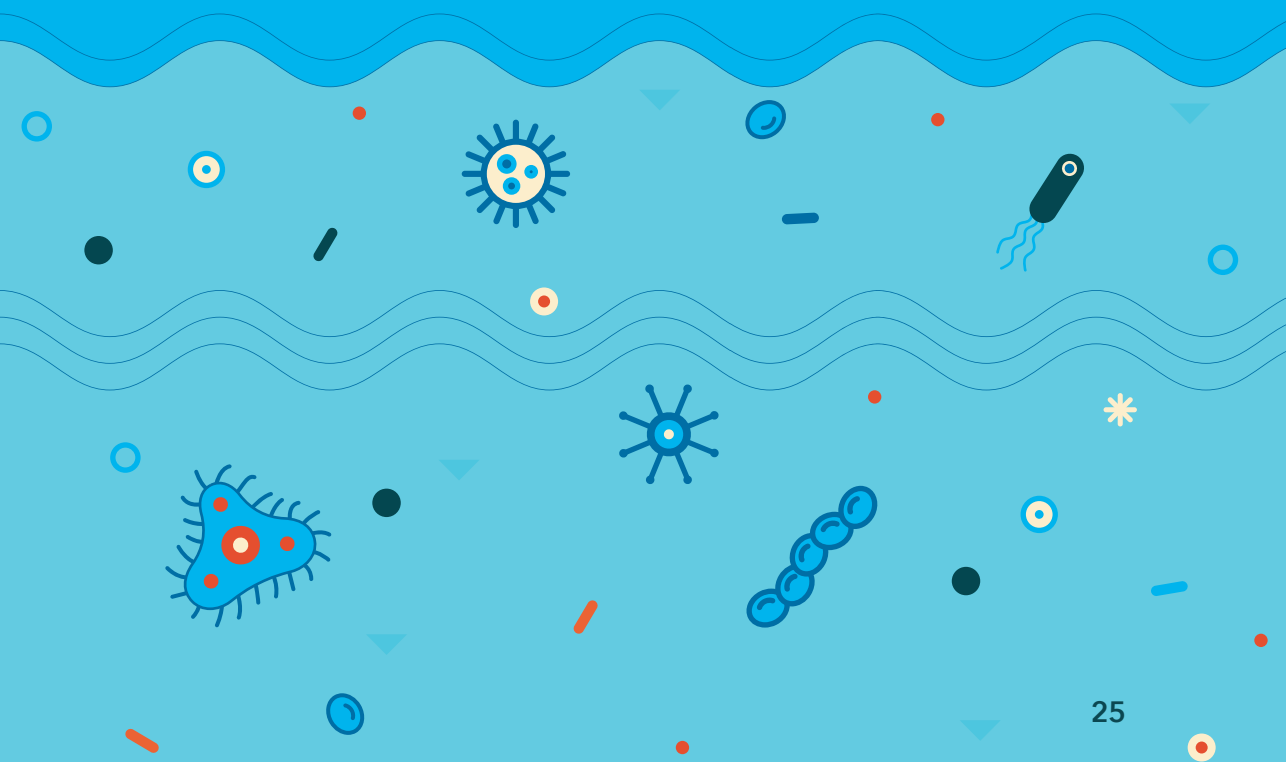
LEARN AND THINK

HOW MUCH DOES TEMPERATURE VARY IN YOUR CITY?

Italy is one of the hottest countries in Europe. It's recorded the highest-ever temperature in Europe of 48.8 °C in the town of Syracuse on the island of Sicily.

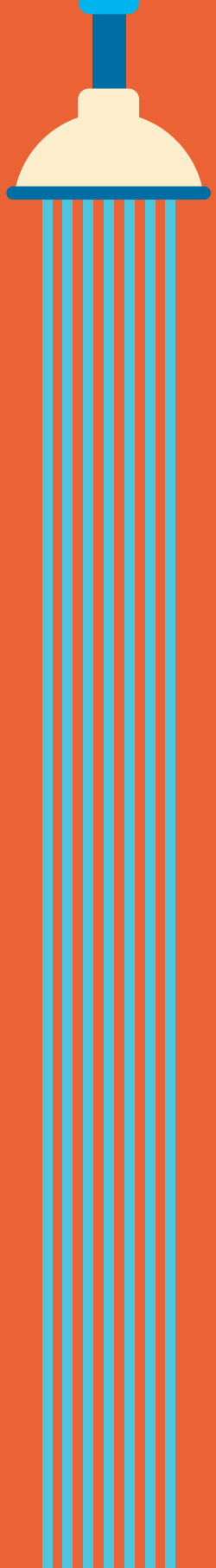
Reykjavík, Iceland is officially the coldest city in Europe in terms of average highs throughout the entire year. The daily high is a measly 7 °C across the year, and even in mid-summer, temperatures rarely get higher than 16 °C. Lying not far from the Arctic Circle, Reykjavík is also the northernmost capital in Europe.

- 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?



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 this water has a route from when it is taken from nature until it returns to it with a quality that does not damage living organisms.

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*.

This type of water has no smell, flavor, or color. Besides, it needs to be free of any substances that can harm our health, like some minerals, chemical compounds, and pathogenic microorganisms (that cause diseases) like bacteria and viruses.

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

Water sources

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

- Glaciers in high peaks.
- Lakes and ponds.
- Aquifers (groundwater).
- Rivers and ravines.

All of these are water sources. After the water is taken it goes through a purification process that will leave it fit for human consumption.

In Europe, most water is abstracted from surface waters. Around 75% of total water abstraction is from rivers and reservoirs, and 25 % from groundwater.

BERLIN, GERMANY
Any water Berliners use for washing, drinking and industrial purposes is supplied by well systems directly from aquifers below the city .

MADRID, SPAIN
It obtains water from the Canal de Isabel II. The source of the water is the Sierra del Guadarrama, the mountains surrounding Madrid.

ROME, ITALY
Lake Bracciano is a major source of Rome's drinking water.

WARSAW, POLAND
It is supplied mostly from surface water sources comes from the Vistula River and the Zegrze Reservoir. The remain part comes from groundwater sources.

CAN YOU GET DRINKING WATER FROM THE SEA?

YES, YOU CAN! SALTWATER CAN ALSO BE A SOURCE OF DRINKING WATER. ESPECIALLY FOR SOME PLACES WHERE DRINKING WATER IS NOT AVAILABLE FOR THE POPULATION, IT IS NECESSARY TO USE WATER FROM THE OCEANS.

WE USE A SPECIAL TREATMENT CALLED **REVERSE OSMOSIS**, WHICH ALLOWS US TO REMOVE SALTS AND TURN SEAWATER INTO DRINKING WATER.

From the water source to your home

The water path from nature until you drink it is long and complex. The professionals and operators that make this possible are full of knowledge and dedication. In addition, there are laws and health standards that drinking water should meet. Learn about the stages:

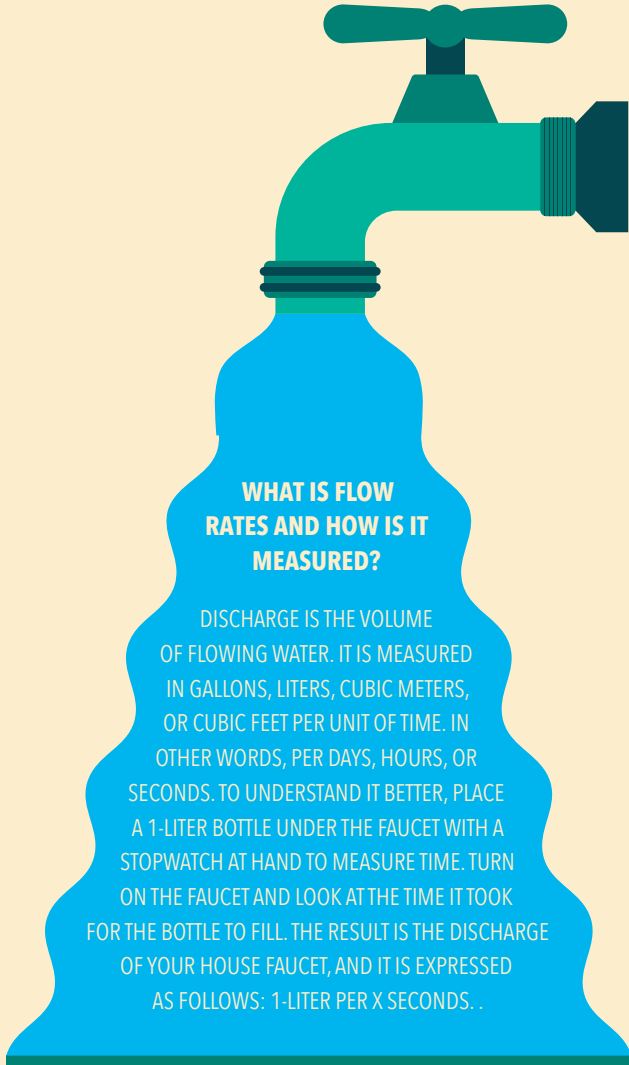
RAW WATER INTAKE

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 RATES AND HOW IS IT MEASURED?

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

When it is ready, potable water is stored in big tanks. While there, a bit more chlorine is added to ensure that microorganisms do not grow back in the distribution pipes.

The distribution network is composed of kilometers 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, cities lose 30% of the water in production plants due to flaws in the network. 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.

If there are areas of a city that are unconnected to the distribution network, tank trucks are sent. After families get water from these trucks, they store it in their tanks.

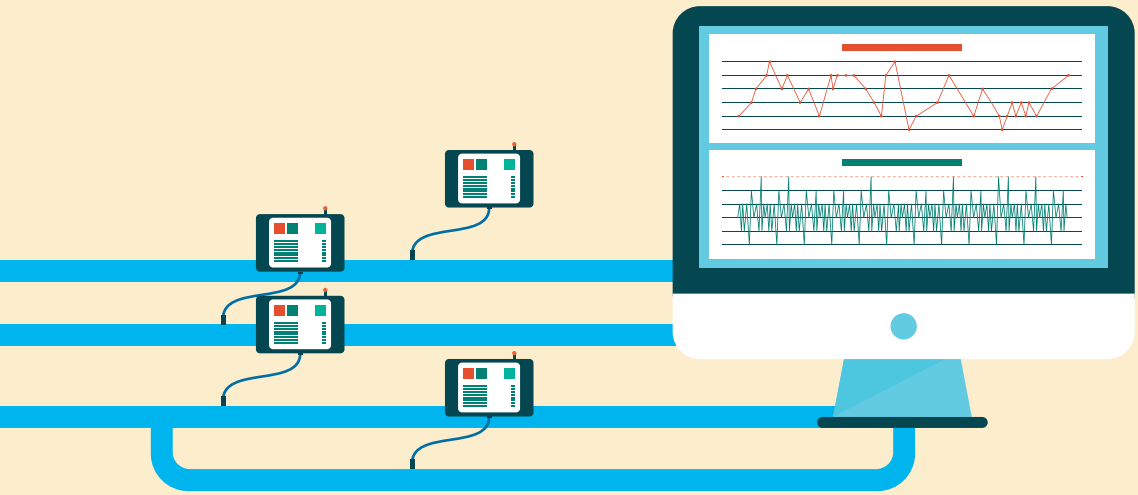
That is how clean, crystal potable water gets to your house.

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!

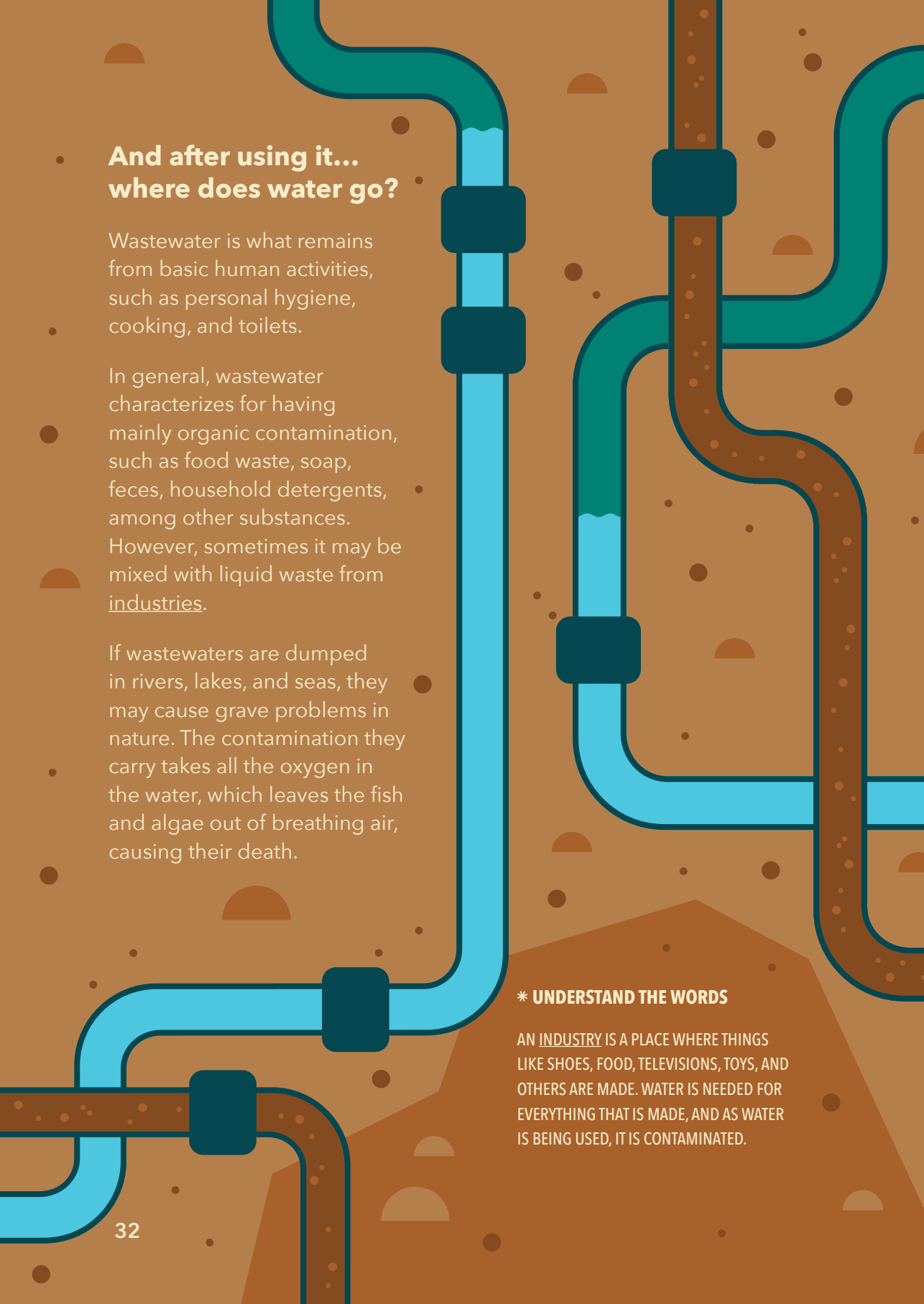


And after using it... where does water go?

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, feces, 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.

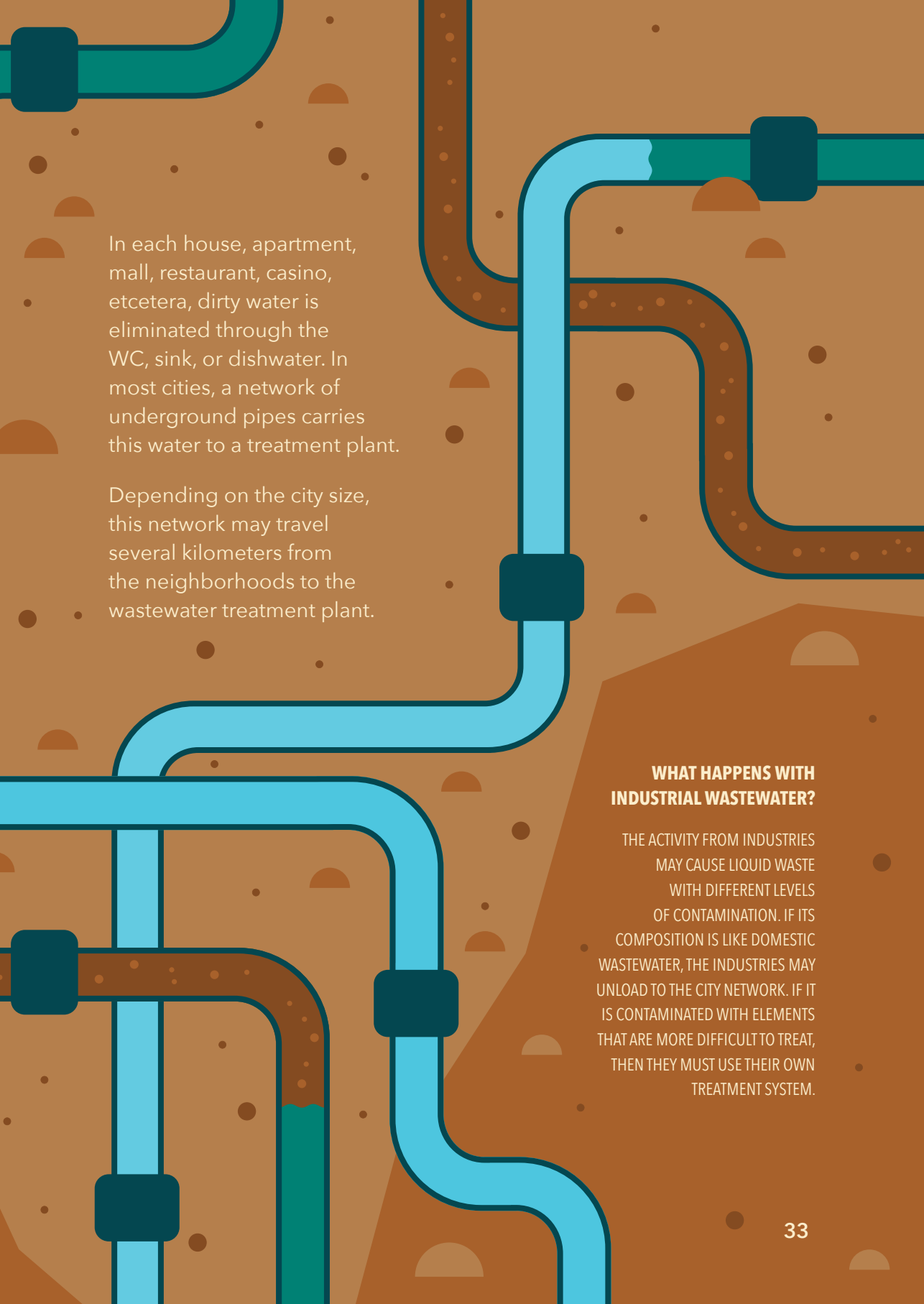


*** UNDERSTAND THE WORDS**

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, mall, restaurant, casino, etcetera, dirty water is eliminated through the WC, 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 kilometers 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 solids, sand, and grease, the next step is a biological treatment or activated sludge. The name is because water has taken a brown color, like sludge, and because there are millions of active microorganisms in the basin: our friends, bacteria. They are the ones that digest all organic matter present in the water.

Bacteria need oxygen to break down organic matter, which they receive through big machines called blowers. Blowers take air from the atmosphere and inject it into the bottom of the tank. The result is that bacteria eat, grow and multiply, producing more bacteria. They also generate CO^2, which is released into the atmosphere.

Since there are excess bacteria in the basin, a part is removed so there is an even concentration, and the ones left keep working.

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.

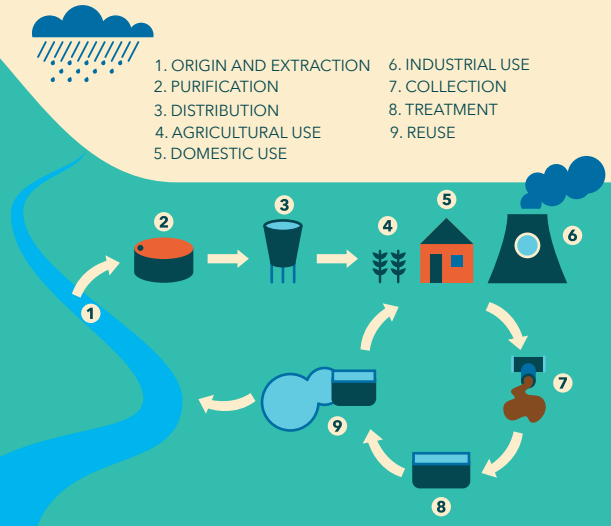
This is the urban water cycle

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 liter 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.

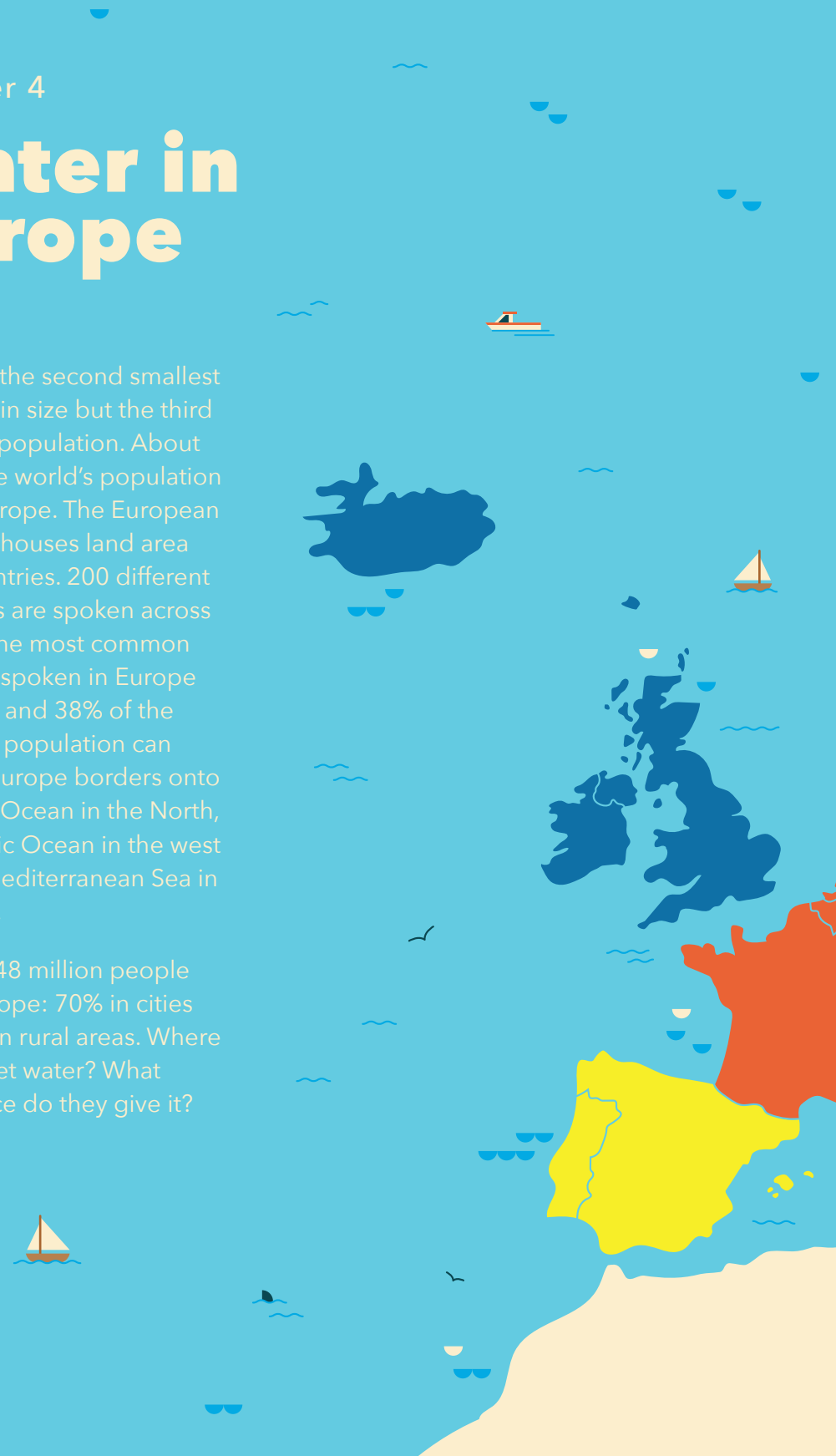
Can you think of a way to separate and remove the contaminants from the water so it can go back to being transparent? Propose a way of doing it by applying what you learned in this chapter.

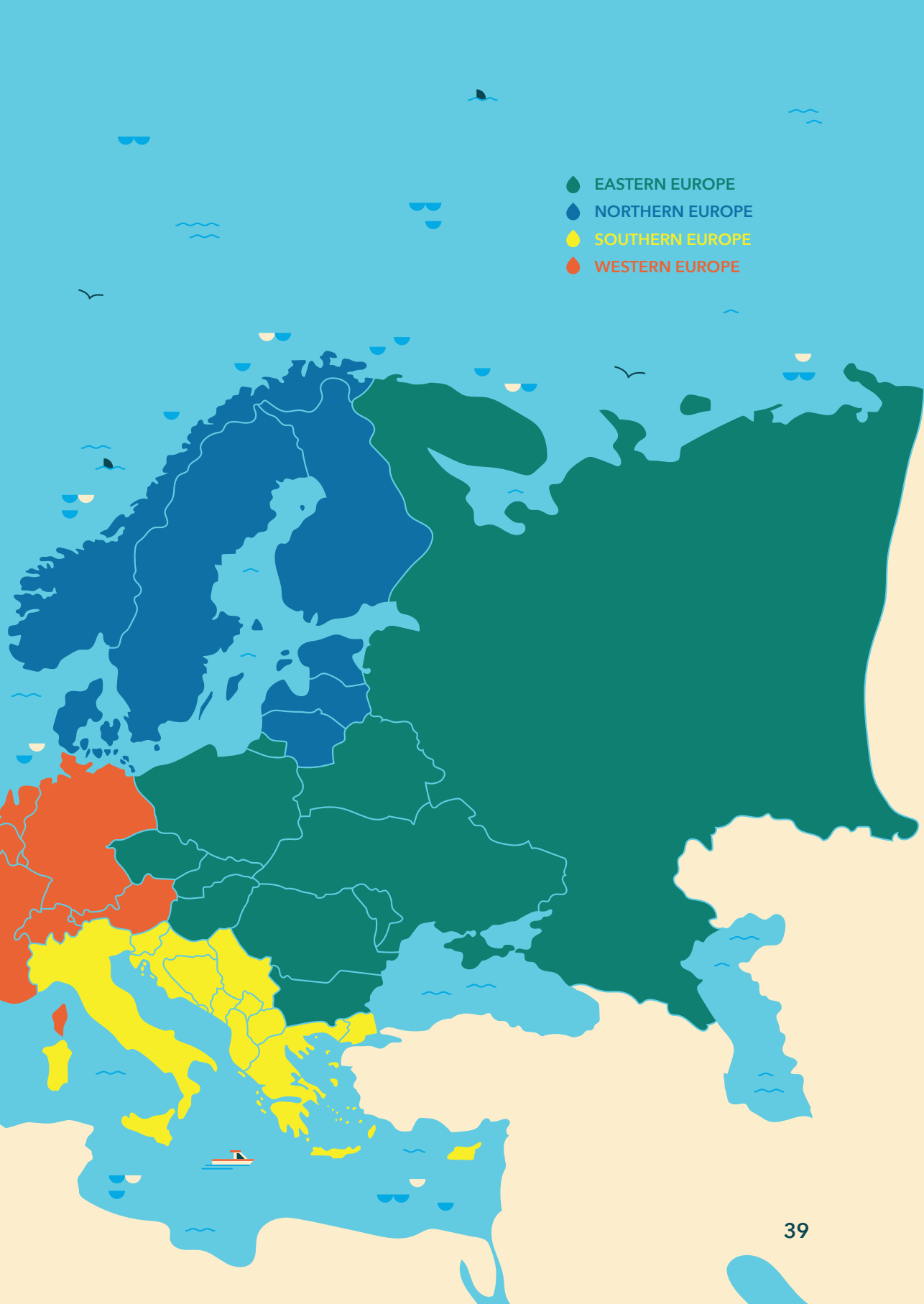
Chapter 4

Water in Europe

Europe is the second smallest continent in size but the third largest in population. About 10% of the world's population lives in Europe. The European continent houses land area of 50 countries. 200 different languages are spoken across Europe. The most common language spoken in Europe is English, and 38% of the European population can speak it. Europe borders onto the Arctic Ocean in the North, the Atlantic Ocean in the west and the Mediterranean Sea in the South.

Around 748 million people live in Europe: 70% in cities and 30% in rural areas. Where do they get water? What importance do they give it?




EASTERN EUROPE
NORTHERN EUROPE
SOUTHERN EUROPE
WESTERN EUROPE

A lot of water!

Europe covers 2% of Earth's surface, making it the second-smallest continent, but ranks number 3 among regions of the world by population.

15,5% of the freshwater of the planet is in our continent, in the form of lakes, rivers, aquifers, and ice.

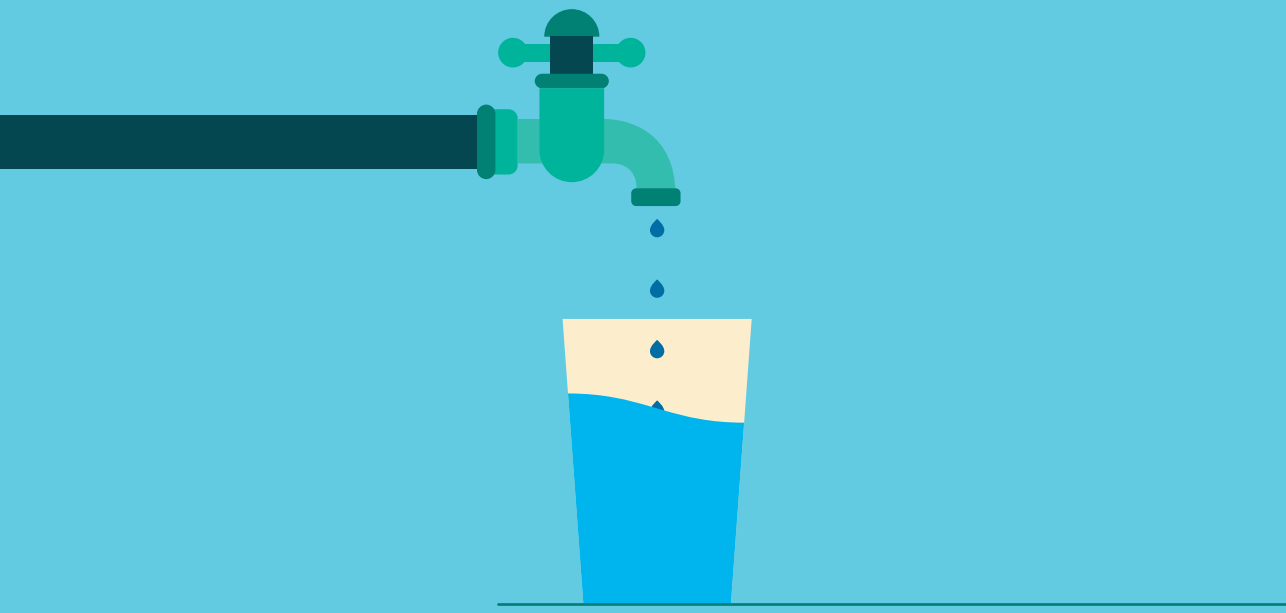
The total length of the drinking water network we have is 4.3 million km of pipes, which represents 11 times the distance from the Earth to the Moon.

100 litres per day is the average water consumption in Europe, giving a total consumption of more than 33.2 billion m^3/year.

That is a lot of WATER!!

Europe has a lot of water resources, which are mostly clean. In most European countries people can drink tap water. However, about 30 % of Europe's population is affected by water stress during an average year. The situation is expected to worsen as climate change is increasing the frequency, magnitude, and impact of droughts.

Overall, Europe needs to strengthen the resilience of its ecosystems and use water more efficiently to minimize the impacts of water stress on people and the environment.



*** UNDERSTAND THE WORDS**

WATER STRESS IS A SITUATION WHERE THERE IS NOT ENOUGH WATER OF SUFFICIENT QUALITY TO MEET THE DEMANDS OF PEOPLE AND THE ENVIRONMENT. DROUGHTS AND WATER SCARCITY ARE NO LONGER RARE OR EXTREME EVENTS IN EUROPE, AND ABOUT 20 % OF THE EUROPEAN TERRITORY AND 30 % OF EUROPEANS ARE AFFECTED BY WATER STRESS DURING AN AVERAGE YEAR.

CLIMATE CHANGE IS THE ONGOING INCREASE IN GLOBAL AVERAGE TEMPERATURE AND ITS IMPACT ON THE EARTH'S CLIMATE SYSTEM. THE TRENDS ARE PARTICULARLY WORRYING FOR SOUTHERN AND SOUTH-WESTERN EUROPE, WHERE SUMMER RIVER FLOWS COULD DECREASE BY UP TO 40% UNDER A 3°C TEMPERATURE INCREASE SCENARIO.

Water sources in Europe

In Europe, around 75 percent of all water abstracted annually, and 40 percent of all drinking water, comes from surface waters, such as rivers, lakes and reservoirs—with considerable variation from one country to another.

Whereas some countries (such as Austria and Denmark) completely rely on groundwater for drinking water, others (Greece, Ireland and the United Kingdom) source most of their drinking water from surface water bodies.

Surface water use is prevalent in Spain. It meets about 80 percent of the total water demand and is used to irrigate over two-thirds of the total irrigated land.

Europe is a home to 115,000 rivers (with a total length of approximately 1.2 million kilometres) and 26,000 lakes.

Only 70 European rivers have a catchment area that exceeds 10,000 square kilometres. Europe's 31 largest rivers have catchments that exceed 50,000 square kilometres and drain approximately two-thirds of the continent. The catchment for the Danube spans 16 countries across central Europe and the Balkans. Other large rivers drain into the North Sea (including the Rhine and the Elbe), the Atlantic Ocean (including the Loire and the Douro/ Duero) and the Mediterranean Sea (including the Rhone, the Ebro and the Po).

Smaller rivers are prominent in many parts of Europe, particularly in the United Kingdom, Italy and Scandinavian countries. The UK, for example, has almost 1,500 river systems comprising over 200,000 kilometres of watercourses.

These rivers are characteristically short, shallow and subject to considerable human impact. For this reason, UK rivers are especially sensitive to changes resulting from climatic variation or the net effect of a range of human factors.

Historically, many European cities have been built around rivers and lakes. These water bodies have provided not only a source of freshwater but transportation infrastructure that connects them to places from where they can source raw materials or access markets where they can sell their produce.

A brief history of water

Water is life – and life on earth is linked to water. Our existence is dependent on water, or the lack of it, in many ways, and one could say that our whole civilization is built on the use of water.

The first cities in Europe occurred during antiquity (500 B.C. – 500 A.D.) around the Mediterranean region. The most urbanized areas were the Eastern Mediterranean, the Apennine Peninsula (modern Italy), and the southern part of the Iberian Peninsula, most of which were areas of quite modest rainfall.

The quality of the water was examined by the senses: taste, smell, appearance and temperature. Also the health of the people and animals using a water source was considered. Throughout antiquity tasty or tasteless, cool, odourless and colourless water was considered the best, and stagnant, marshy water was avoided. The ancient Greeks and Romans were also quite aware of the dangers of water coming from hills and mountains where mining was practiced.

HOW DID ANCIENT PEOPLE IMPROVE THE QUALITY OF THE WATER?

USING SETTLING TANKS, SIEVES, FILTERS AND THE BOILING OF WATER WERE METHODS USED DURING ANTIQUITY WATER IF WATER DID NOT SATISFY THEIR QUALITY REQUIREMENTS. BOILING OF WATER WAS WIDELY RECOMMENDED BY THE MEDICAL AUTHORS. THAT WOULD HAVE DIMINISHED THE BIOLOGICAL RISKS OF POOR-QUALITY WATER. BUT IT WAS ECOLOGICALLY AND ECONOMICALLY NOT FEASIBLE IN EXTENSIVE USE SINCE FIREWOOD AND OTHER COMBUSTIBLES WOULD SOONER OR LATER HAVE BECOME A SCARCE RESOURCE AROUND THE MEDITERRANEAN.

How did ancient water supply systems work?

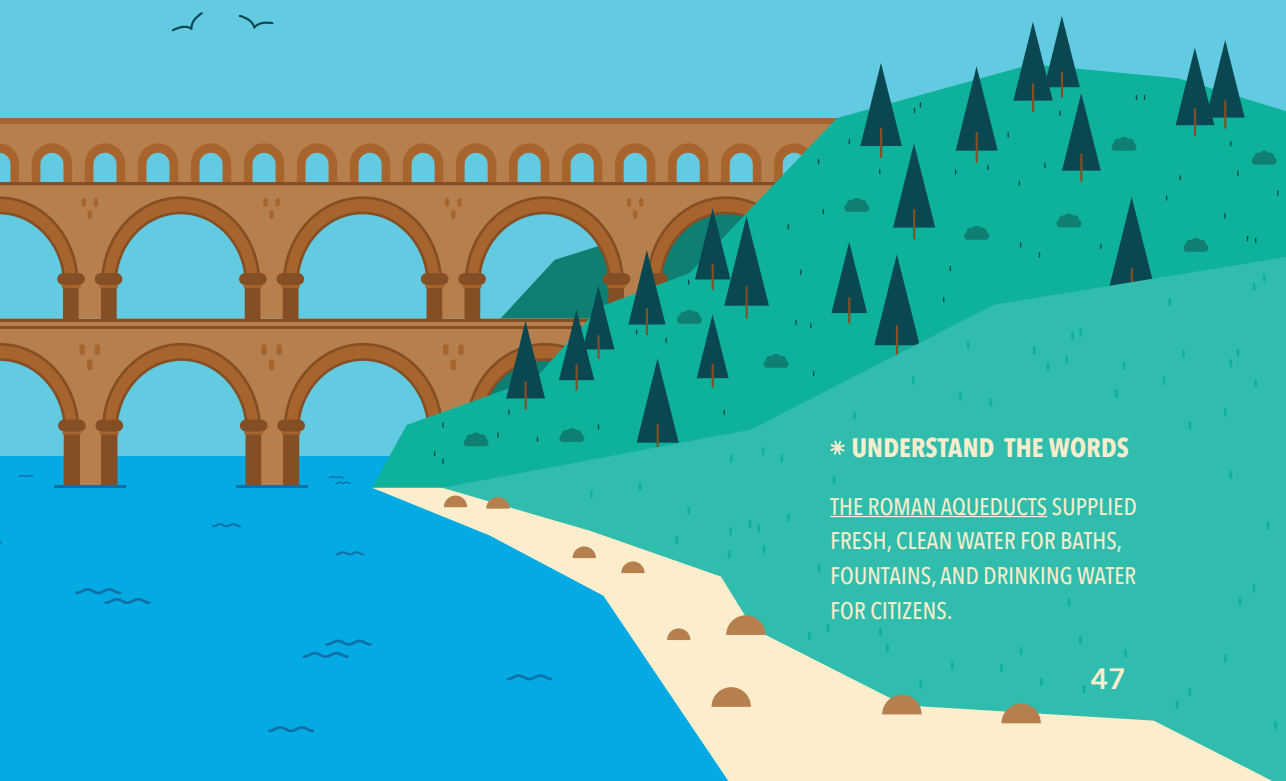
The Roman aqueduct was a canal used to transport fresh water to populated areas. Aqueducts were an amazing feat of engineering for the time. Although earlier civilisations in Egypt and India also built aqueducts, the Romans improved on the structure and built an extensive and complex network across their territories. Evidence of aqueducts remains in parts of modern France, Spain, Greece, and Turkey.

Aqueducts required a great deal of planning. They consisted of a series of pipes, tunnels, canals and bridges. Gravity and the natural slope of the land allowed aqueducts to carry water from a freshwater source, such as a lake or spring, to a city. Once in the city, the water was used for drinking, irrigation and to supply hundreds of public fountains and baths.

Roman aqueduct systems were built over a period of about 500

years, from 312 B.C.E. to C.E. 226. Both public and private funds paid for their construction. Aqueducts were often built by high-ranking rulers, including Roman emperors Augustus, Caligula, and Trajan.

Perhaps the most recognisable feature of Roman aqueducts is the rounded stone arch bridges. Some of these can still be seen today crossing European valleys. However, these bridges were only a small part of the hundreds of kilometres of aqueducts throughout the empire. The capital city of Rome alone had some 11 aqueduct systems, supplying fresh water from sources as far away as 92 kilometres. Despite their age, some of the aqueducts still function and supply water to modern Rome. The Aqua Virgo, an aqueduct built by Agrippa in 19 B.C.E. during the reign of Augustus, still supplies water to Rome's famous Trevi Fountain in the heart of the city.



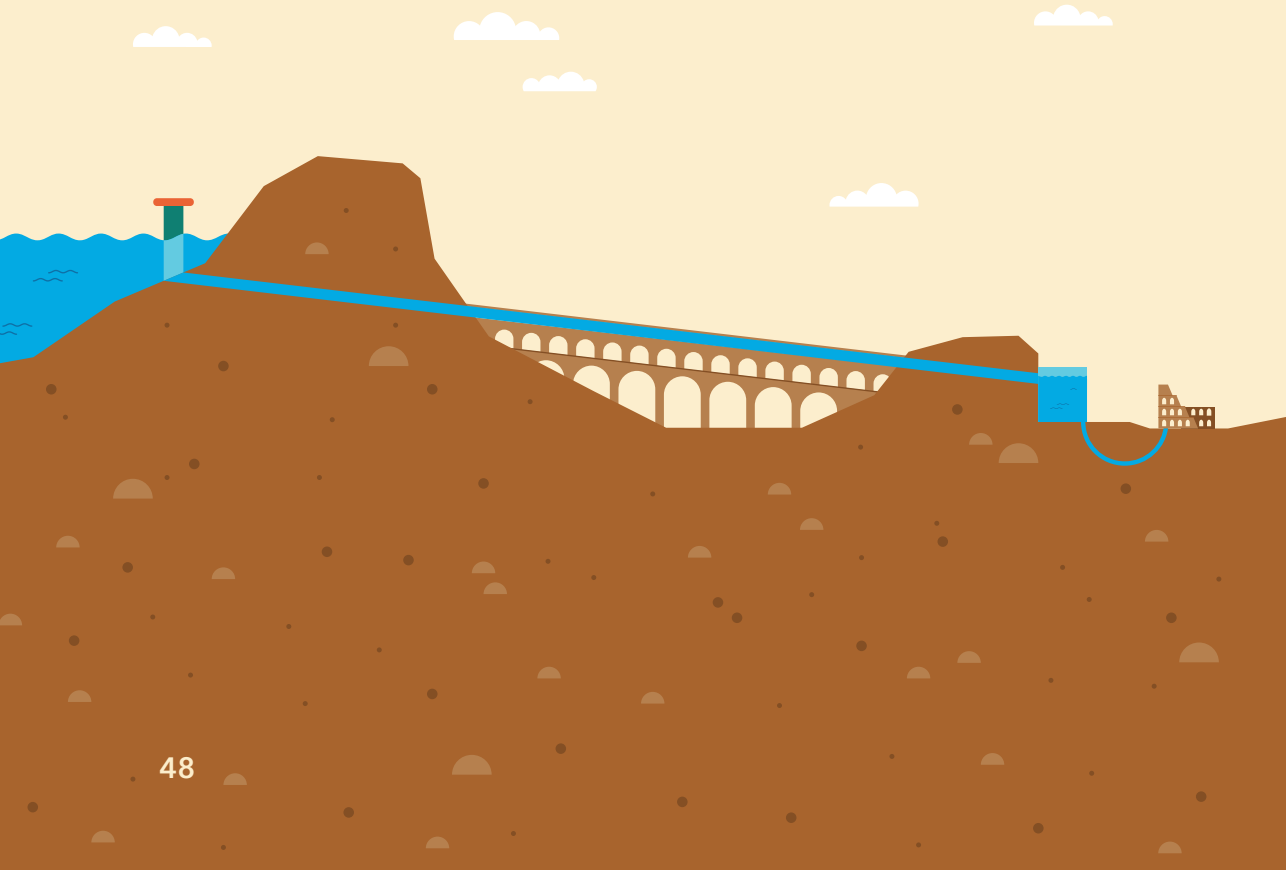
*** UNDERSTAND THE WORDS**

THE ROMAN AQUEDUCTS SUPPLIED FRESH, CLEAN WATER FOR BATHS, FOUNTAINS, AND DRINKING WATER FOR CITIZENS.

Water use

Water used in large quantities has been deemed as an essential part of civilized way of life in different periods: Roman baths needed a lot of water as does the current way of life with water closets and showers. Particularly high rates of water use are noticed when it is not properly charged for. The evidence indicates that as soon as water but also wastewater are charged according to the real costs wastage diminishes remarkably. Although at the global scale the great majority of water is used for irrigation, the highest priority of water use purposes is for the community water supply.

Throughout history there have been different solutions to guarantee an ample amount of water for human settlements. Indigenous people have been very ingenious in drawing their water. They have considered water a very crucial and often a sacred element. In the long run the availability of abundant or adequate amount of water has been one of the crucial factors for the development of a society – cities and communities.



Future water challenges

Today there is a global shortage of potable water. When making fundamental decisions concerning water supply and sewerage, it is also necessary to be ready to make big investments. Services that are now at a high operational level were not achieved easily and without massive inputs and efforts.

The level of water supply and sanitation in a society is not necessarily bound with time and place as much as the capability of that society to take responsibility for developing the living environment of its citizens and proper policies. In some cases, the situation was even better earlier than nowadays. Decisions have been made concerning water and sanitation systems – e.g. the universal acceptance of the water closet as a cultural necessity – that through path dependence have limited future options. There have also been situations where the choice of a technology has been regarded as problematic from the first beginning but has been chosen anyway. For instance, lead pipes were considered hazardous for health already in antiquity but continued to be used in house connections until recently.

Water supply and sanitation systems have always required continuous maintenance and adequate rehabilitation. This was already evident with the Roman aqueducts: calcium carbonate incrustation forming within the conduits needed to be removed constantly or it would have stopped the flow of water. The same is true for modern systems: they must be maintained to function properly.

LEARN AND THINK

DOES EVERYONE HAVE ACCESS TO WATER IN YOUR CITY?

Although most people in the EU have good access to high quality drinking water, water scarcity is predicted to increase as our climate changes. Regions across Europe are already experiencing drastic impacts on the frequency of droughts and changes in weather patterns such as rainfall and storm intensity as a direct result of climate change.

- 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 renovation, 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 people in this world, as well as groups and associations they form, are concerned about sustainability and the future of the planet.

One of the most important groups that currently exist and that works for the good of all countries is the United Nations (UN). This organization has established 17 Goals of sustainable development. Review them on the next page and pay attention to what they are targeting.

*** 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.

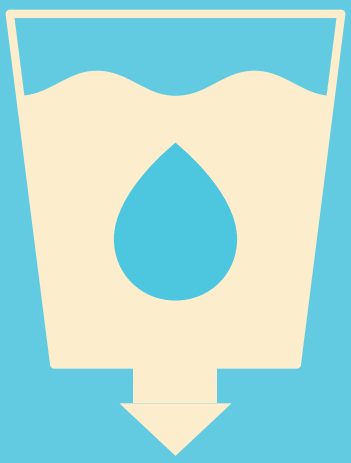
These objectives or goals are a commitment to work for a development where everyone has the possibilities of living well, growing up, and contribute with their work but, at the same time, protecting the environment.

Countries, companies, and people must unite and cooperate to make this a better world for every one of its inhabitants; in other words, ourselves.

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?

Why is there not enough water in regions where it used to be before?
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.** An example of this is when there is not enough groundwater or river water for the population, after using it for watering species that need too much water.
- **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, COCOA IS NATIVE FROM TROPICAL REGIONS IN LATIN AMERICA BUT ORANGE TREES WERE INTRODUCED BY THE SPANISH CONQUERORS WHO HAD TAKEN THEM TO THEIR CONTINENT FROM INDIA, WHERE ORANGES ARE NATIVE.

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, feces, 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?

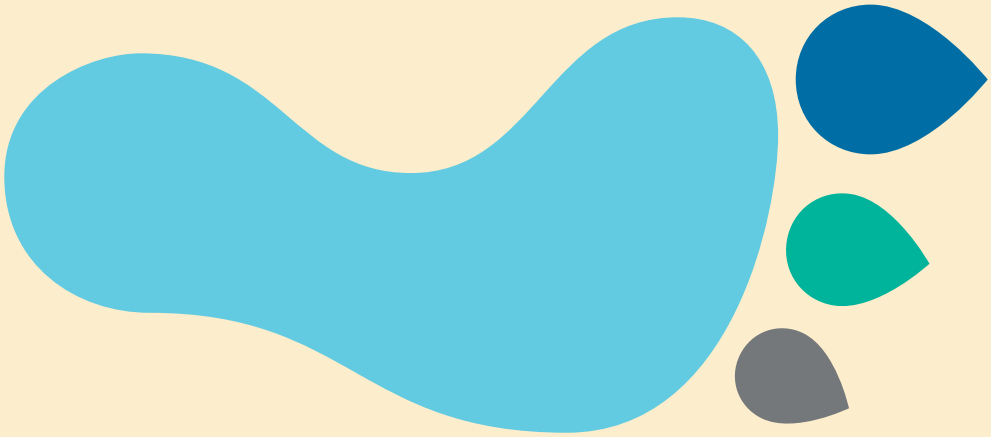
1. Consuming responsibly, choosing less-polluting products, generating less waste, and recycling what we cannot avoid.
2. Demanding that industries reduce hazardous materials in their operations and control their waste production.
3. Keeping sewage in good condition, not throwing objects or trash down the toilet or maintenance hole 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 → is the one needed to clean the water polluted in the process.

FOOD AND BEVERAGES

1 APPLE
70 LITERS

VS

1 GLASS OF APPLE JUICE
190 LITERS

1 OF POTATOES
900 LITERS

VS

1 BAG OF CHIPS
185 LITERS

1 OF BARLEY
1300 LITERS

1 SLICE OF BREAD
40 LITERS

1 OF CORN
900 LITERS

1 LITER OF MILK
1000 LITERS

1 OF CHEESE
5000 LITERS

1 EGG
200 LITERS

1 OF CHICKEN
3900 LITERS

1 OF BEEF
15.500 LITERS

1 HAMBURGER
2400 LITERS

1 KILO OF PORK
4800 LITERS

1 KILO OF RICE
3400 LITERS

1 KILO OF CANE SUGAR
1500 LITERS

1 KILO OF COCONUT
2500 LITERS

1 CUP OF COFFEE
140 LITERS

1 CUP OF TEA
35 LITERS

CLOTHES AND OTHERS

1 COTTON SHIRT
2700 LITERS

1 KILO OF LEATHER
16.600 LITERS

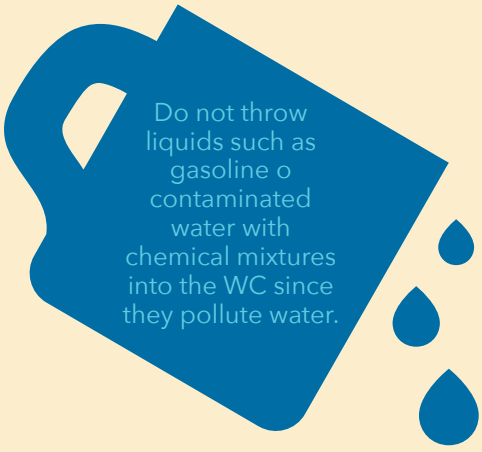
1 LEGAL SIZE SHEET
10 LITERS

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)

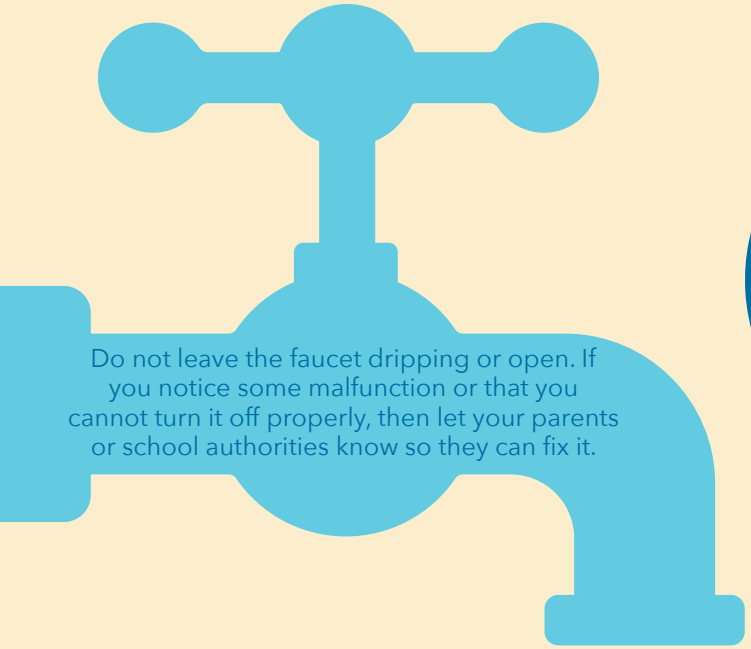
How can I help if I am just a child?

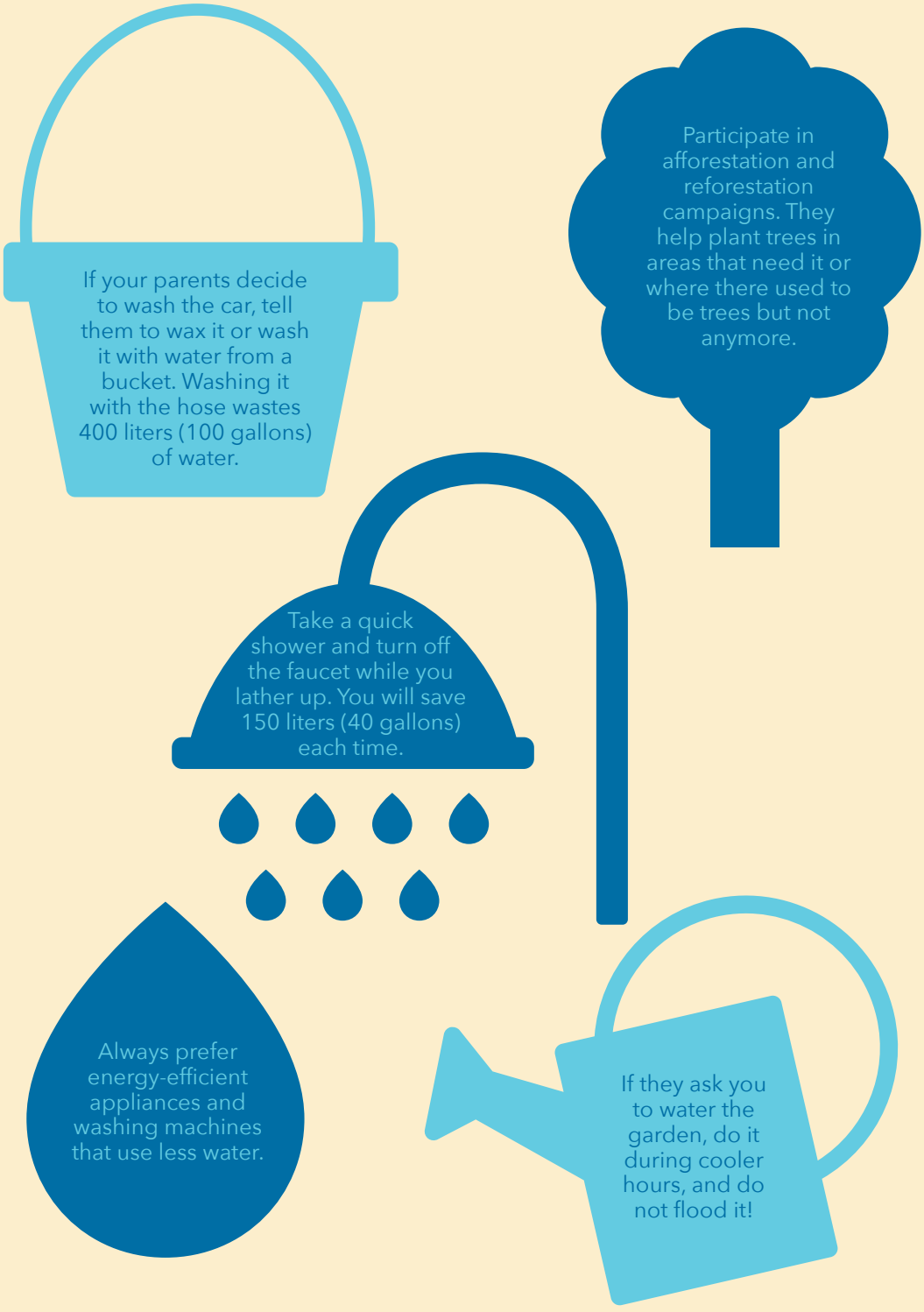
We can all help to preserve water. The first thing is having responsible habits and consuming only the water and things we need. For example, try not to waste food or school supplies, so you do not need to buy more.

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

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

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

1. Locate the water meter 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	Meter 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**

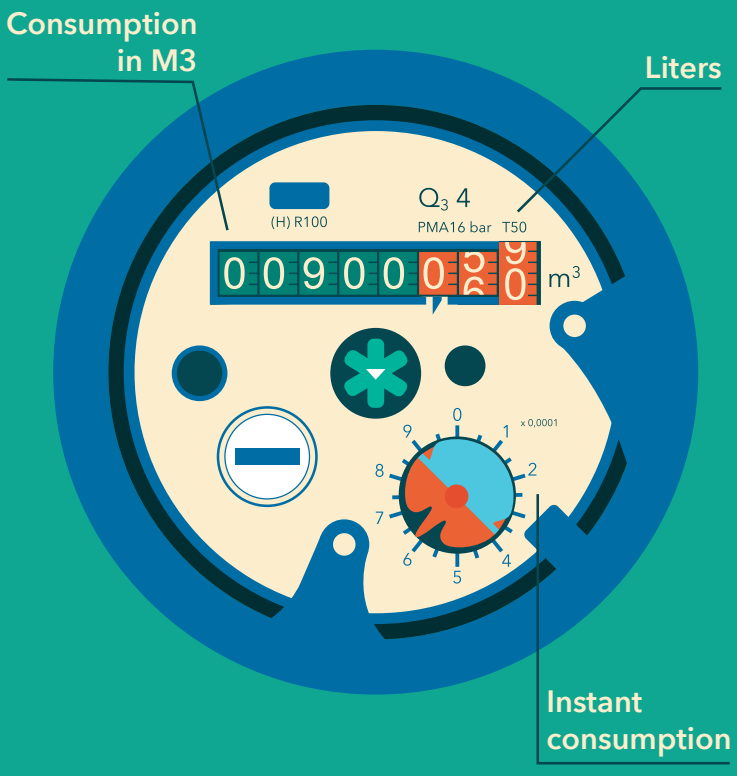
← YOU MUST SUBTRACT YESTERDAY'S READING TO TODAY'S READING TO GET THE CONSUMPTION OF THE LAST 24 HOURS.

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 liters 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?

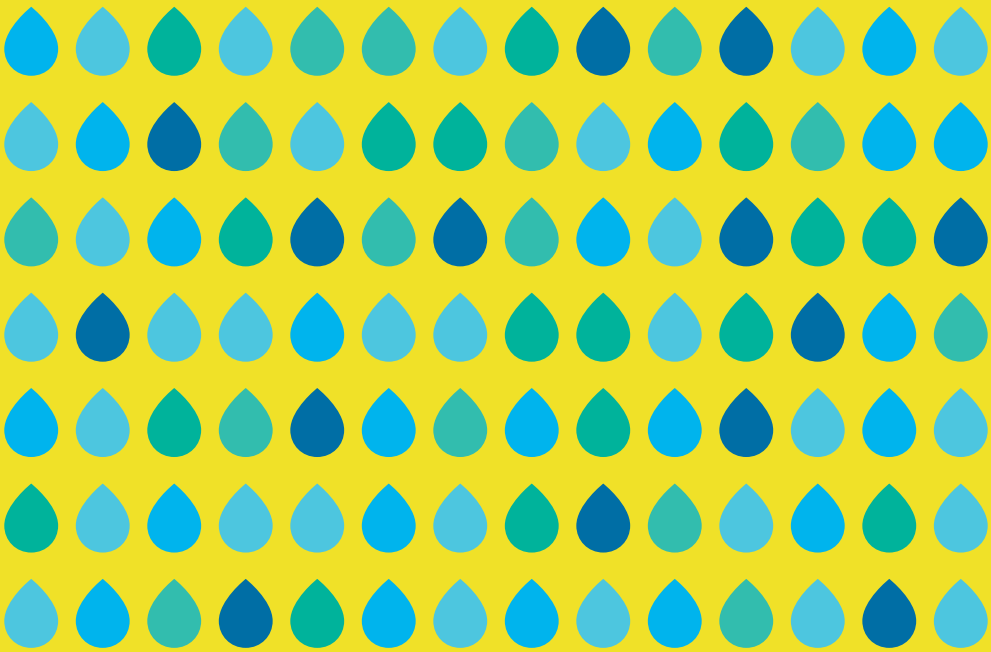


WHAT IS MY WATER FOOTPRINT?

- 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 liters
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…

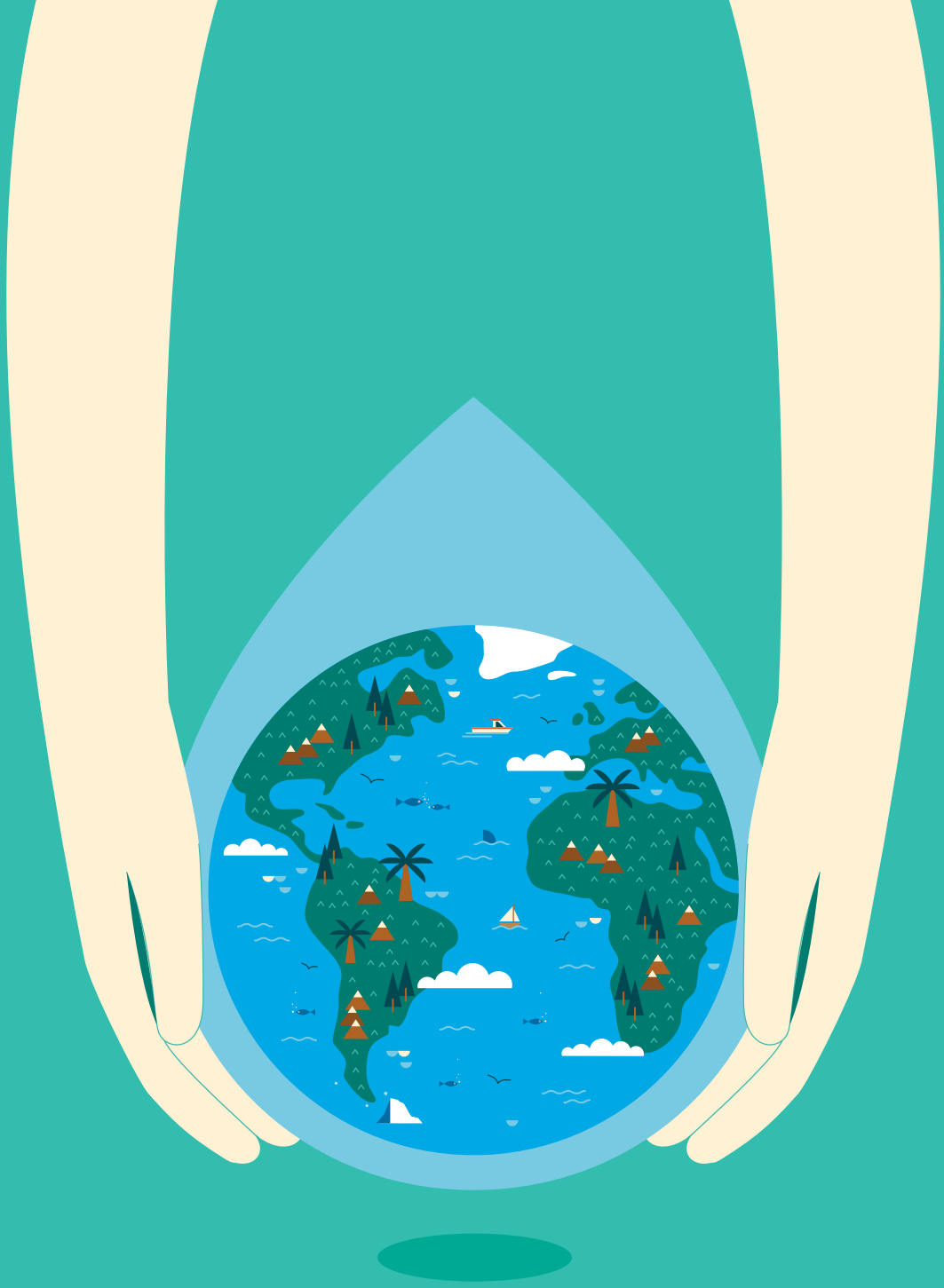
… that the word sustainability accompanies your daily actions.

… 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 glaciers of the world, the Amazon Forest, and the Andean moors.

… 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.



THE GREAT BOOK OF WATER
EUROPE

Denise Pouleurs - Anton Glushchenko

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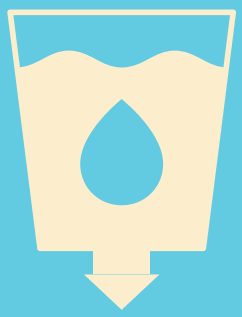
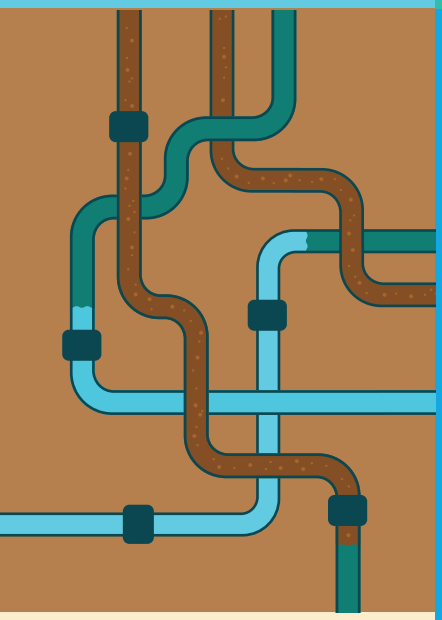
Xylem Inc., through its Watermark program, is committed to the preservation of this valuable resource, water. We want this book to contribute to our Latin American region and children and young people, so they learn from these words and take action because every drop counts!

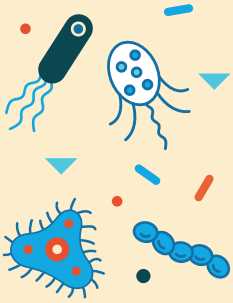




Water is so prevalent in our lives that we don't see it, it becomes transparent. But the truth is that, today more than ever, we need to preserve this valuable resource in a sustainable way.

Xylem Inc., through its **Watermark** program, invites you to read this book and discover many things about this vital element that today is being threatened, from its properties as a molecule to how it is distributed to our houses.

We want this book to contribute to our Europe region, so children and young people learn from these words and take action… because every drop counts!



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