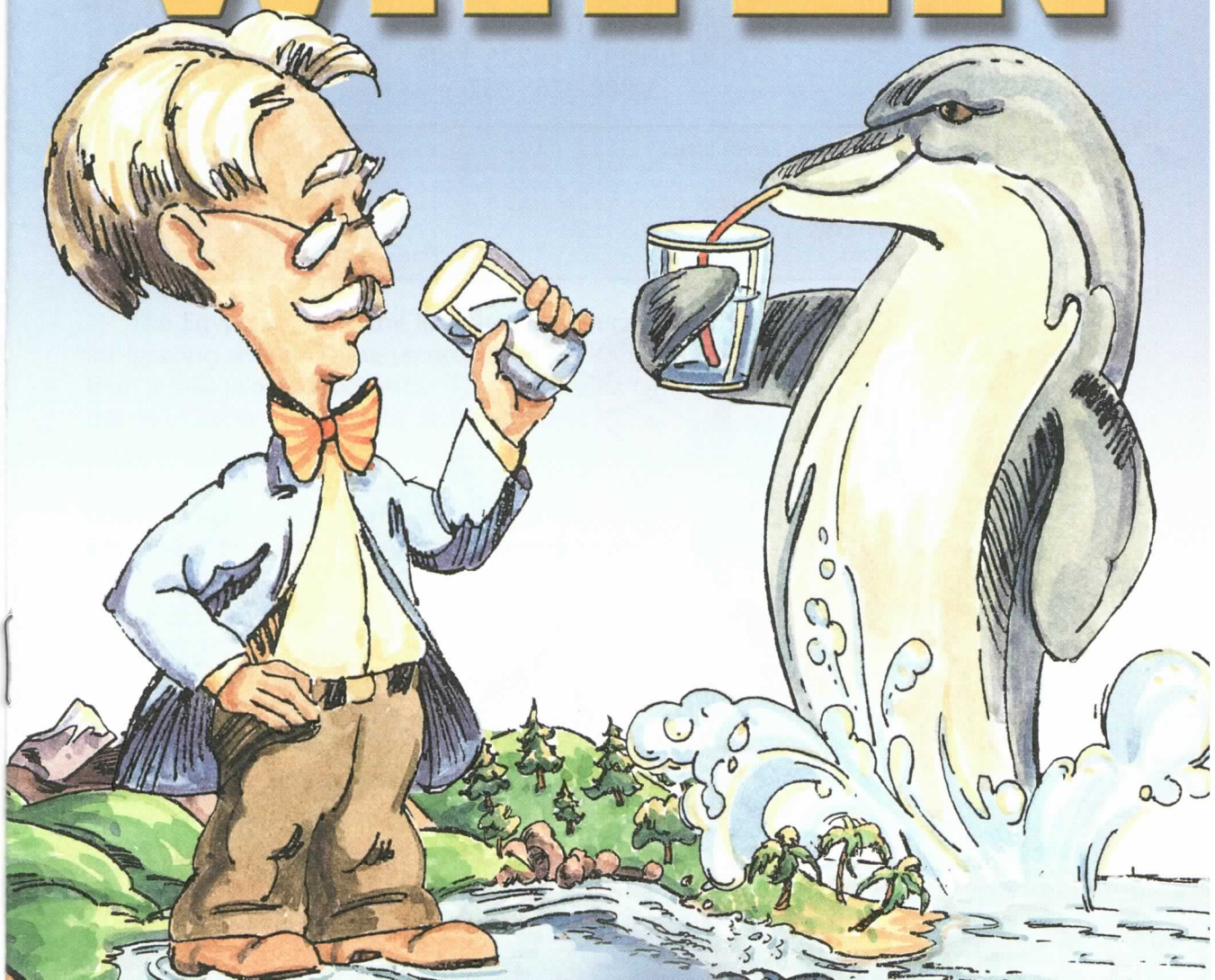
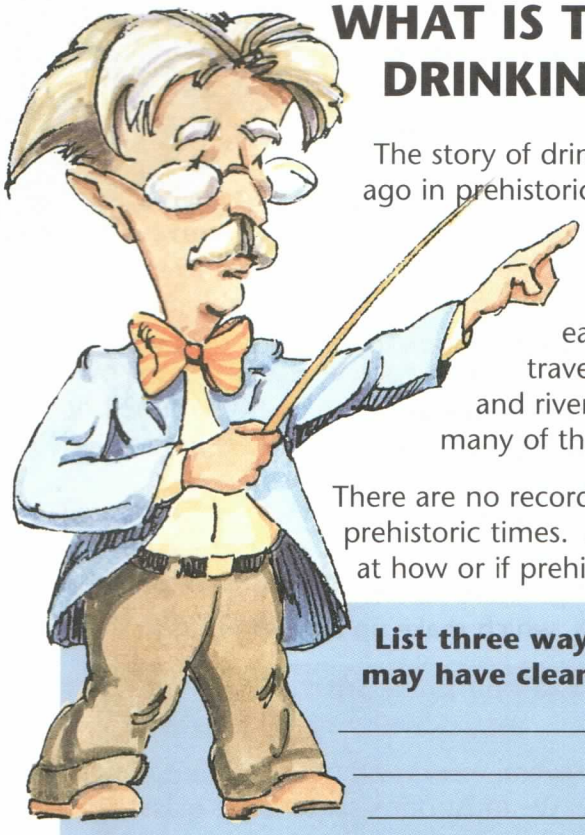
THE STORY OF DRINKING WATER



WHAT IS THE STORY OF DRINKING WATER?



The story of drinking water begins thousands of years ago in prehistoric times. People who lived during these times built their homes on lakeshores or along rivers so they would have water to drink and wash in, and so they could easily move from place to place, traveling on the waters. The water in lakes and rivers was much cleaner back then because many of the impurities that exist today didn't then.

There are no records of how water was cleaned in prehistoric times. And, without records, we can only guess at how or if prehistoric people cleaned their water.

List three ways you think prehistoric people may have cleaned their water.

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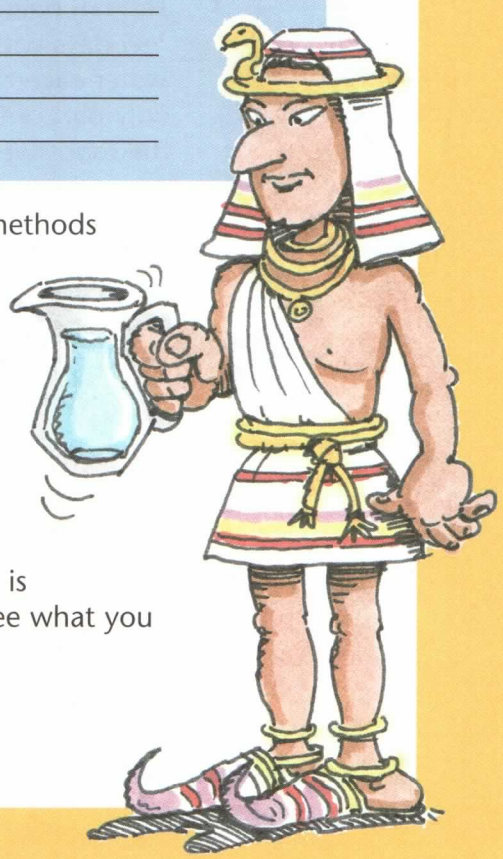
The Egyptians were the first people to record methods for treating water. These records date back more than 1,500 years to 400 A.D. They indicate that the most common ways of cleaning water were by boiling it over a fire, heating it in the sun, or by dipping a heated piece of iron into it. Filtering boiling water through sand and gravel and then allowing it to cool was another common treatment method.



Water treatment is much more complex today and is discussed a bit later in this booklet. But first, let's see what you know about water.

WHAT DO YOU KNOW ABOUT WATER?

Without water, the earth would look like the moon.

There wouldn't be any trees ... or animals ... or humans.

All living things need water to live. Next to the air we breathe, water is our most important need.

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

- Water makes up 83% of our blood.
- Water makes up almost 70% of our brain.
- Water makes up nearly 90% of our lungs.
- Water transports body wastes.
- Water lubricates body joints.
- Water keeps body temperature stable.
- Water is a part of cells, which make up all living things.

Human beings can live several weeks without food, but only a few days without water. We must drink six to eight glasses of water each day. But drinking water or other liquids provides only part of the water we need. The other part comes from the foods we eat.

For example:

- A tomato is about 95% water.
- An apple is about 80% water.
- A pineapple is about 80% water.
- An ear of corn is about 80% water.
- Bread is about 35% water.

List other foods that have water in them.

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*All foods have water in them.

WHAT DO YOU KNOW ABOUT WATER ... ON EARTH?

About 70% of the earth's surface is covered with water.

Ninety-seven percent of the water on the earth is **salt water**. Salt water is filled with salt and other minerals, and humans cannot drink this water. Although the salt can be removed, it is a difficult and expensive process.

Two percent of the water on earth is **glacier ice** at the North and South Poles. This ice is fresh water and could be melted; however, it is too far away from where people live to be usable.

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

List some of the ways you use water in your life. Which do you think is the most important?

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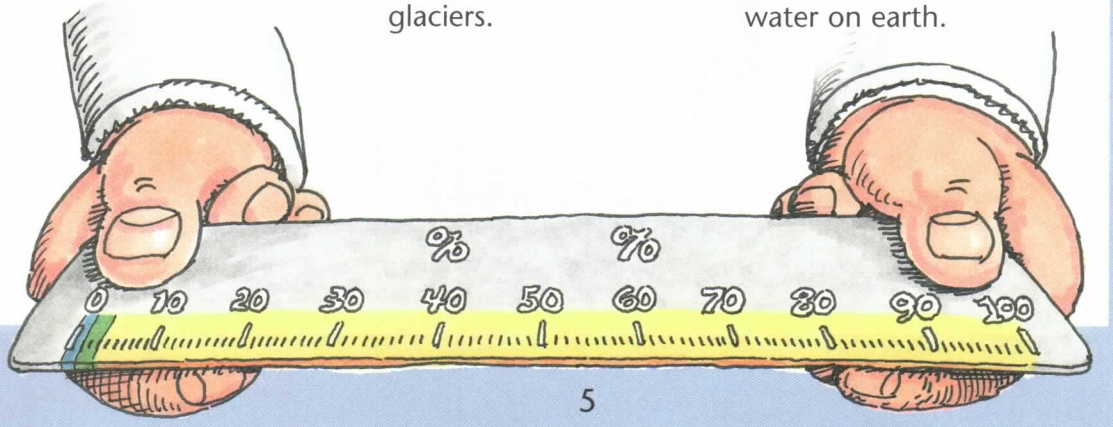
Water on the earth

This ruler has 100 spaces representing 100% of the water on earth.

One space of **Blue** is 1% of the spaces on the ruler. This shows the fresh water we can use.

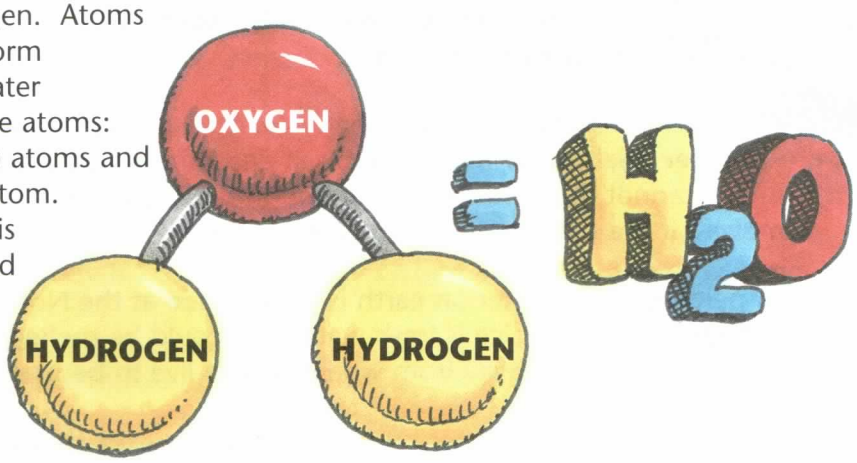
Two spaces of **Green** are 2% of the spaces on the ruler. This shows the water frozen in glaciers.

Ninety-seven spaces of **Yellow** are 97% of the spaces on the ruler. They show the amount of salt water on earth.



WHAT DO YOU KNOW ABOUT THE WATER MOLECULE?

Everything is made of **atoms**. An atom is the smallest particle of an element, like oxygen or hydrogen. Atoms join together to form **molecules**. A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (O) atom. That's why water is sometimes referred to as H_2O. A single drop of water contains billions of water molecules.



What is a **solvent**?

A solvent is a liquid that can dissolve other substances. Water is the most common solvent in nature. This is why many minerals are found in water. How do we take advantage of this ability of water to dissolve almost anything?

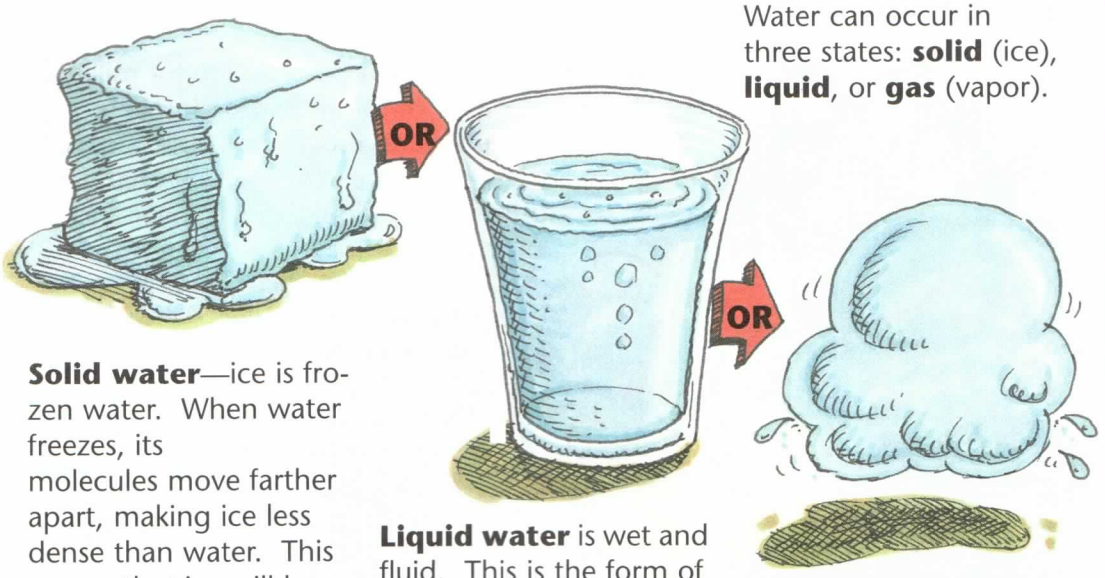
We use water to dissolve many things.

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

What drinks or foods do you mix in water?

WHAT DO YOU KNOW ABOUT WATER AND ITS THREE FORMS?

Pure water is tasteless, odorless, and colorless. Water can occur in three states: **solid** (ice), **liquid**, or **gas** (vapor).



Solid water—ice is frozen water. When water freezes, its molecules move farther apart, making ice less dense than water. This means that ice will be lighter than the same volume of water, and so ice will float in water. Water freezes at 0° Celsius, 32° Fahrenheit.

Liquid water is wet and fluid. This is the form of water with which we are most familiar. We use liquid water in many ways, including washing and drinking.

Water as a gas—vapor is always present in the air around us. You cannot see it. When you boil water, the water changes from a liquid to a gas or water vapor. As some of the water vapor cools, we see it as a small cloud called steam. This cloud of steam is a miniversion of the clouds we see in the sky. At sea level, steam is formed at 100° Celsius, 212° Fahrenheit.

The water vapor attaches to small bits of dust in the air. It forms raindrops in warm temperatures. In cold temperatures, it freezes and forms snow or hail.

What do you think would happen if ice did not float? What would happen to the fish and plants in the water? How does the ice on top of a lake help the fish and plants that live underneath?*

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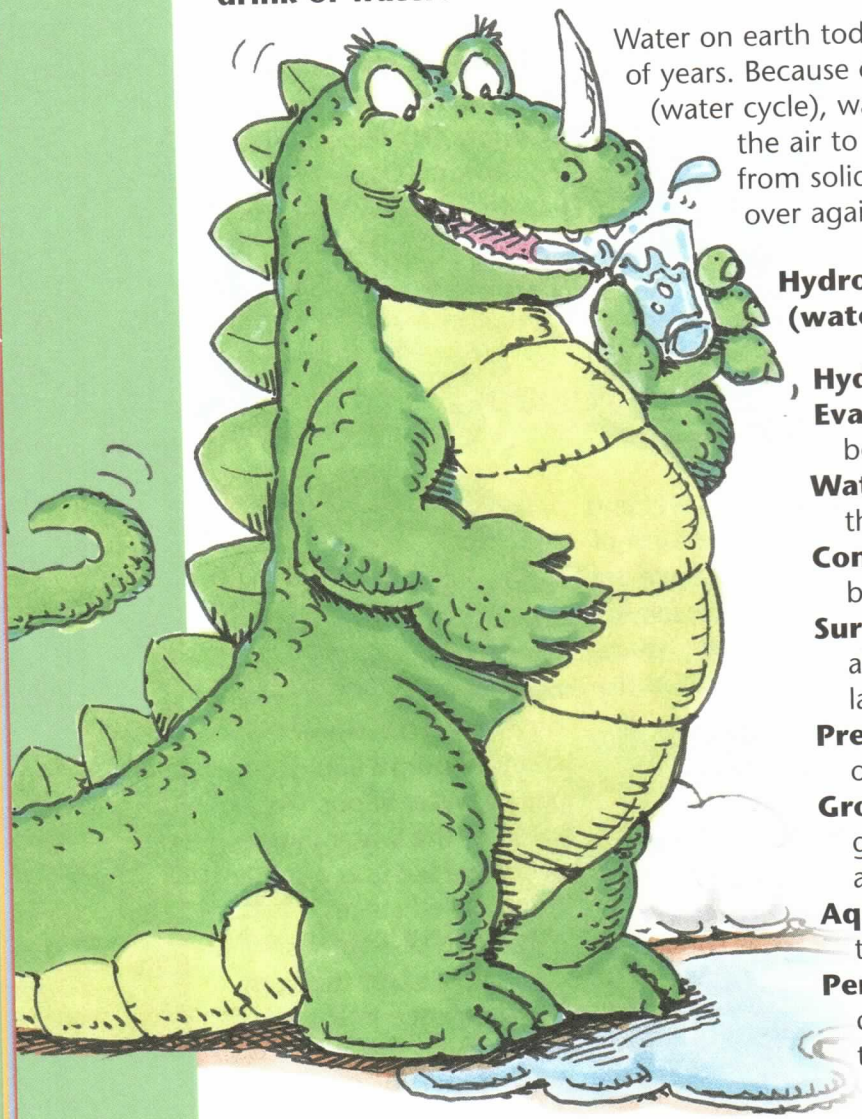
*If ice did not float, lakes would freeze from the bottom up. The plants and fish would also freeze, and most of them would die. But the ice on top keeps the water underneath protected from the cold. It is like a blanket that keeps the water at a safe temperature for the living things in the lake.

WHAT DO YOU KNOW ABOUT THE WATER CYCLE?

Would you believe that a dinosaur could have once used your last drink of water?



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

Hydrologic cycle (water cycle) vocabulary

Hydrologic—relating to water
Evaporation—liquid water becoming a gas
Water vapor—water as a gas in the air
Condensation—water vapor becoming a liquid or a solid
Surface runoff—water that runs along the soil and goes into lakes and rivers
Precipitation—rain, snow, sleet or hail
Groundwater—water under the ground that supplies springs and wells
Aquifer—a water source under the ground
Percolation—water moving downward through openings in the soil

It is not a secret ... water is wonderful!

Use this code to fill in the message:

◆ ◫ ◩ △ , □ ◫ ◩ ◨ , ○ △ ◪ ★ and ○ ◨ ◇ ◇ ◭ are forms of precipitation.

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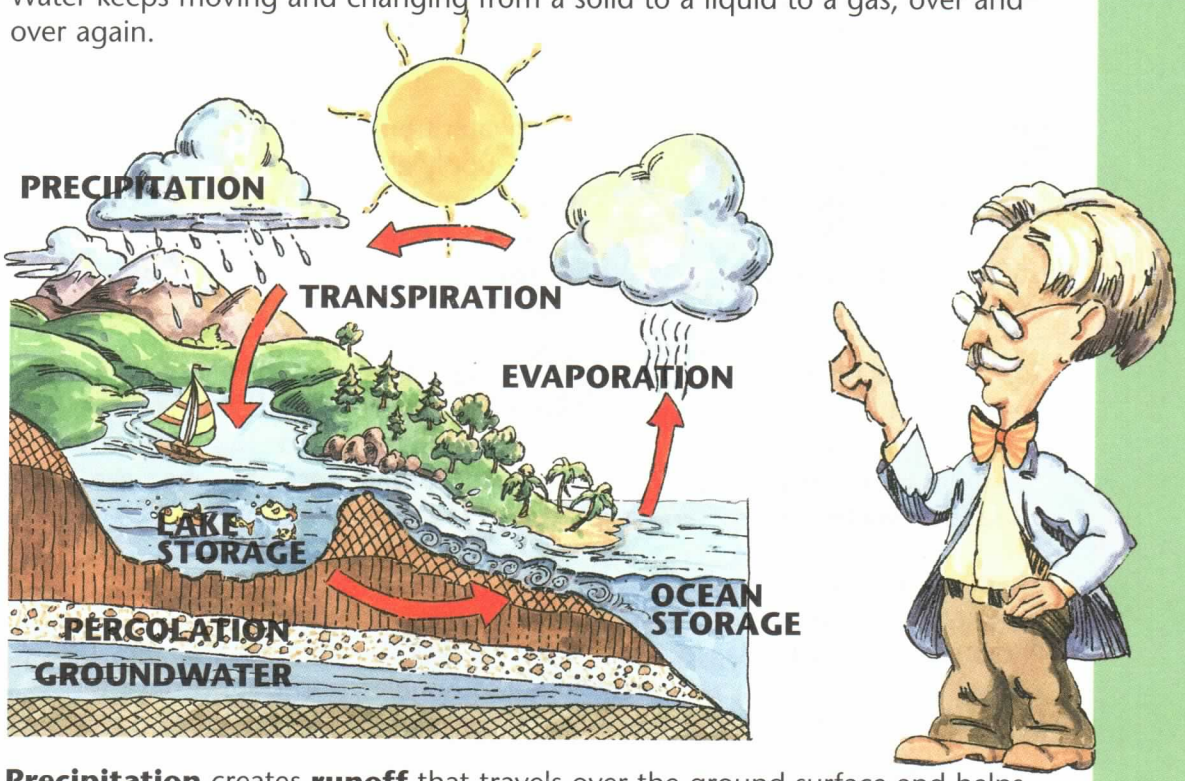
_ _ _ _ , _ _ _ _ , _ _ _ _ and _ _ _ _ _ are forms of precipitation.

*Rain, hail, snow and sleet are forms of precipitation.

THE HYDROLOGIC CYCLE

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



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

What do you think would happen if the hydrologic cycle stopped?

**All life on earth would end. Without this never-ending cycle, plants would die. Underground sources would soon be emptied. Rivers, lakes and oceans would overflow and flood large areas of land. The whole ecological cycle would end.*

How many inches of precipitation does the area you live in receive in one year?

**If you don't know, you can find the answer in your local library.*

WHAT DO YOU KNOW ABOUT WATER SUPPLY?

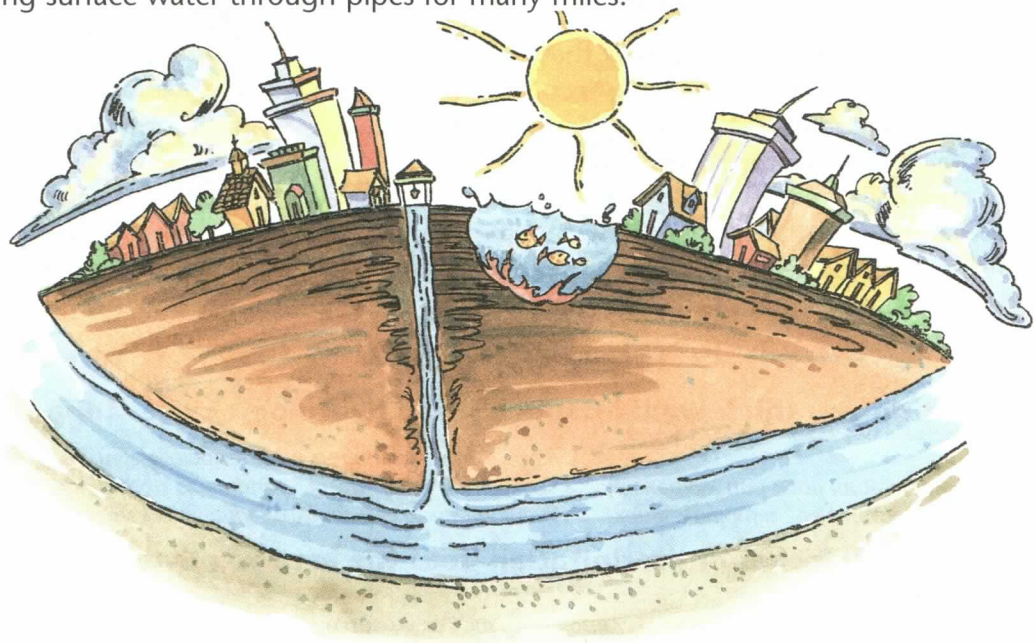
There are three parts to water **supply** ... **source–treatment–distribution**.

In some places, people spend most of their day carrying water for their families to use. More than two billion people on earth do not have a good water supply and must carry their water by hand. Their water might not even be clean.

Most people in North America get their water from **utilities**. Utilities are companies or government agencies that supply electricity, gas, or water to the public. Water utilities get their water from a natural **source** (a river, lake, or aquifer). Utilities also **treat** (clean) the water to remove impurities. The utility then **distributes** (sends) the water to homes and businesses for people to use.

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

Miami, Honolulu, San Antonio, and Mexico City depend mostly on groundwater sources. Chicago, Montreal, Detroit, Toronto, St. Louis, Pittsburgh, and Guadalajara are on the shores of rivers or lakes, so they use surface water. Cities such as New York, Los Angeles, and Denver have to bring surface water through pipes for many miles.

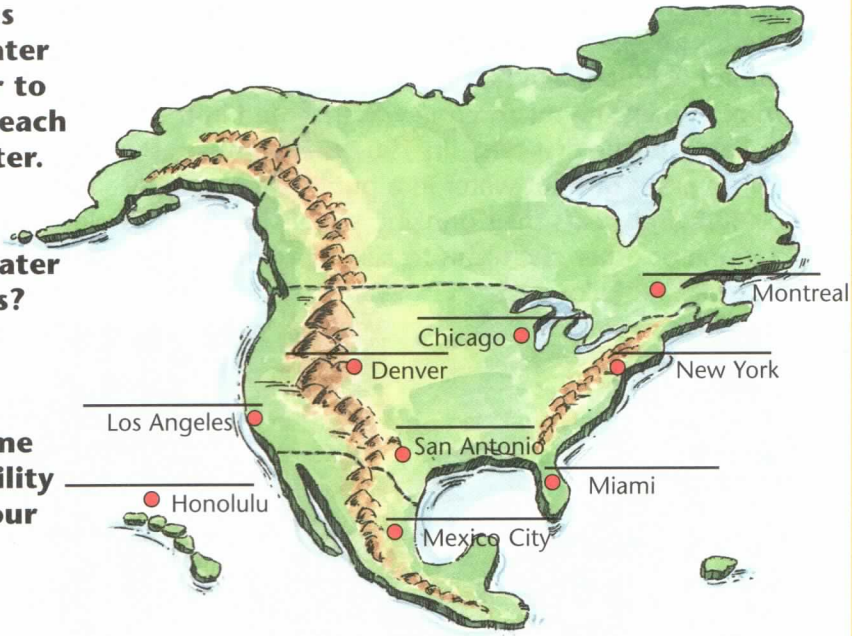


WHAT DO YOU KNOW ABOUT WATER SOURCES?

Fill in the blanks with surface water or groundwater to indicate where each city gets its water.

What is the source of the water your family uses? Where is it on the map?

What is the name of the water utility that supplies your water?



Pollution of water sources

Water can be polluted with animal and/or chemical wastes. Even deep underground aquifers can be polluted from the surface. For example, oil thrown on the ground or in a sewer can pollute the water and is very hard to remove.

Everyone must do his or her part to keep our water sources clean.

Utilities must clean water very carefully. They test water and measure the amounts of any pollutants to make sure the water is safe. They can measure very small amounts of pollutants in bodies of water—parts per million, parts per billion, and even parts per trillion. The water that the water companies deliver to people must meet strict rules of purity. It's hard to imagine but

- One part per million would be equal to one drop in 10 gallons (38 liters) or a small fish tank.
- One part per billion would be equal to one drop in 10,000 gallons (38,000 liters).
- One part per trillion would be equal to one drop in 10,000,000 gallons (38,000,000 liters).

Water that utilities send out must be safe for everyone to use.

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

WHAT DO YOU KNOW ABOUT WATER TREATMENT?

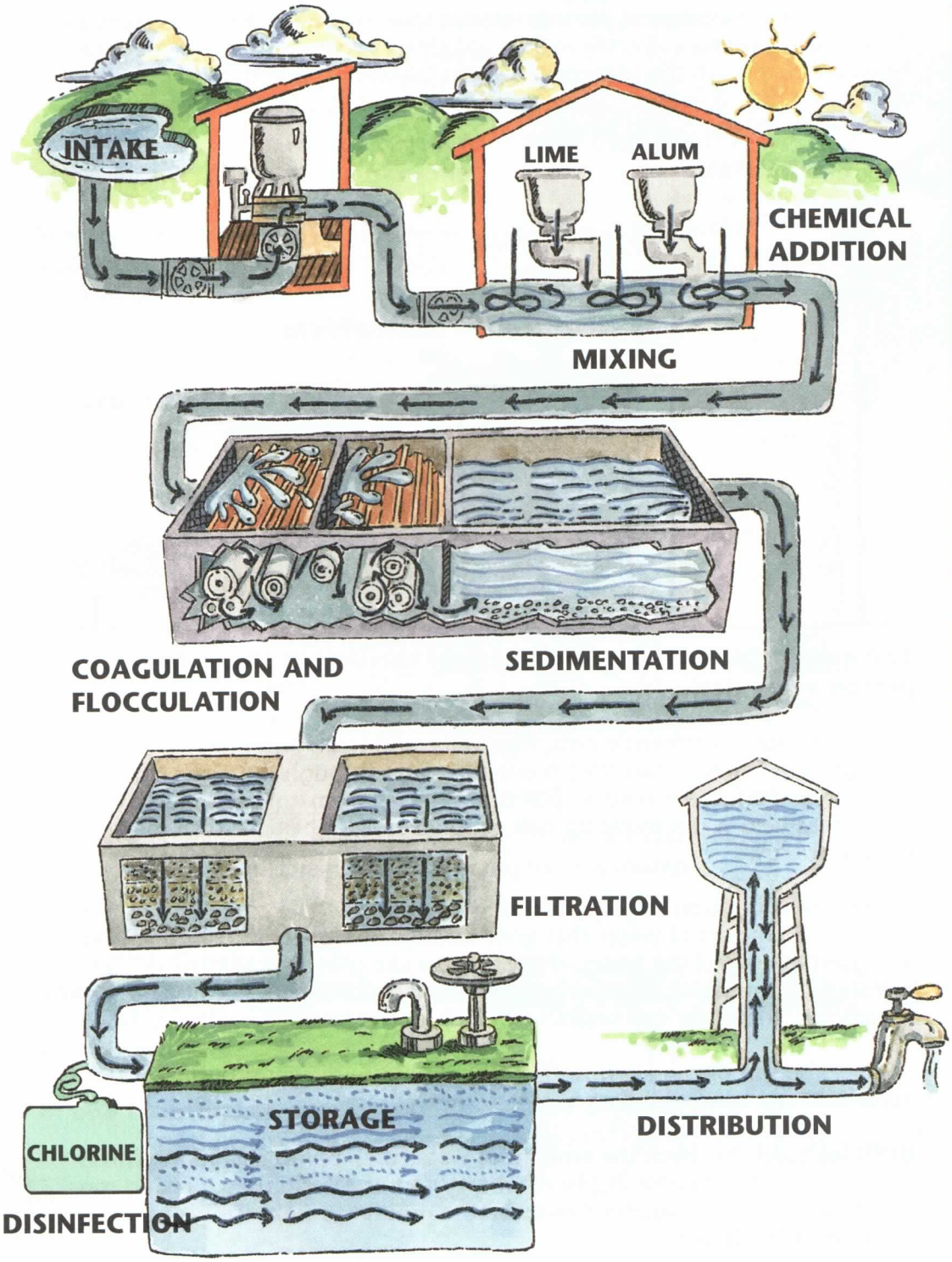
Water treatment is the process of cleaning water. Treatment makes the water safe for people to drink. Because water is a good solvent, it picks up all sorts of natural pollutants. In nature, water is not always clean enough for people to drink. When the microscope was invented in the 1850s, germs could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

A Treatment Plant

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

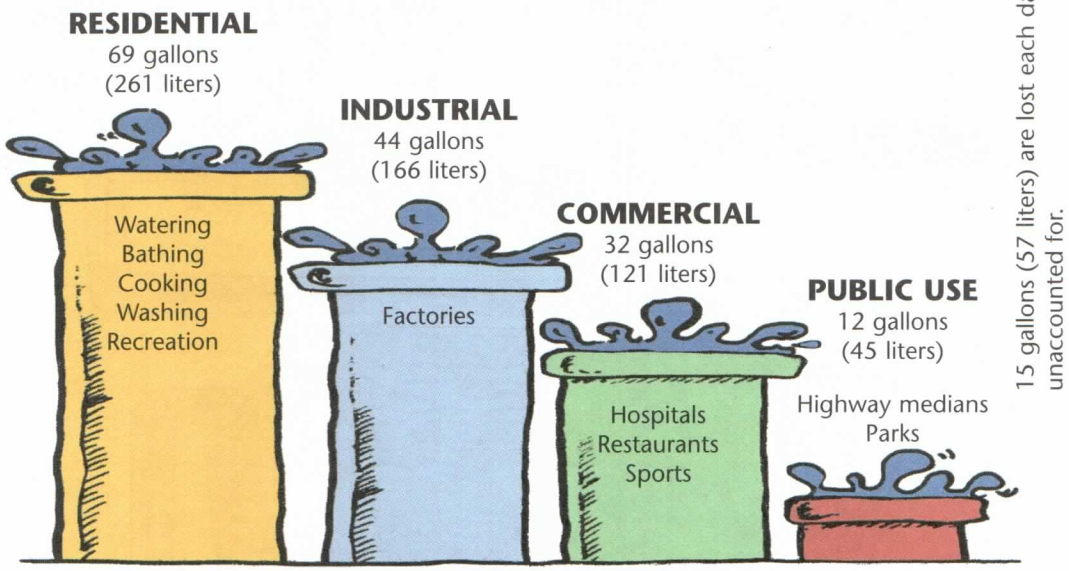
The water is sampled and tested throughout the treatment plant. Sampling is performed to make sure the processes are working and that the water is safe before it leaves the plant. In North America, governments have set standards for drinking water. When water leaves a treatment plant, it is as clean or cleaner than required by these standards.

Water Treatment



WHAT DO YOU KNOW ABOUT WATER DISTRIBUTION?

The third part of a water supply system is distribution. This is when water is sent from the treatment plant to homes and businesses. Each day, about **42 billion gallons** (159 billion liters) of clean drinking water are produced by water systems in the United States and Canada. This water is then distributed to consumers. Some of the water is also stored in reservoirs or tanks ready for the public to use.



172 gallons (651 liters) are treated in the United States for each person every day.

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

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

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

Utilities carefully check the amount of water they pump each day. This is very important to people in places where groundwater is used. Taking too much water from an aquifer can cause the ground to sink. This is called **ground subsidence**.

WHAT DO YOU KNOW ABOUT WATER COSTS?

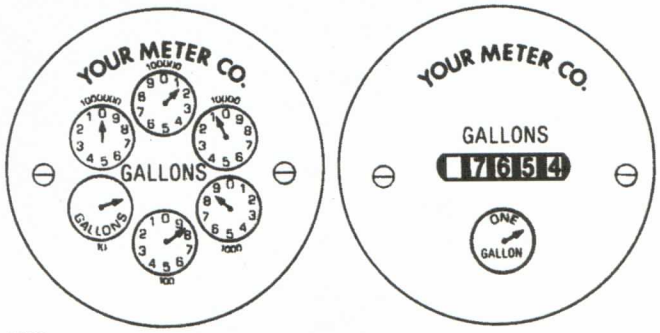
A **water meter** measures the amount of water coming into your home or business. Your water meter may be located in your basement or outside in a pit or hole. A **meter reader** reads the water meter on a regular basis. The utility bills you for the amount of water used. The bill covers the costs of treating and distributing the water. Sometimes, a utility must buy water. All of these costs and the wages for the utility's staff must be met.

Water is a bargain. The average price of water in the United States is about $1.50 for 1,000 gallons (3,800 liters). At that price, a gallon of water costs less than one penny. **How does that compare with one can of soft drink**?

Here are two kinds of water meters used in North America.

The first water meter is read like a traditional clock. The second water meter is read like a digital clock.

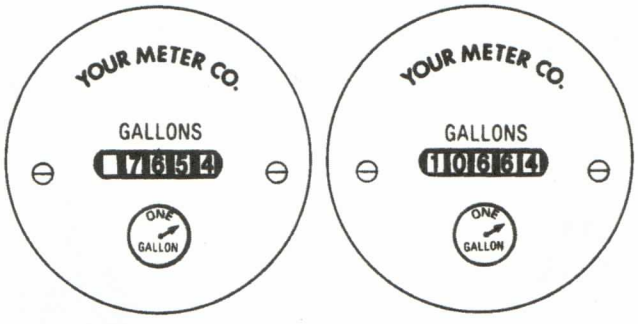
Water meters can measure in gallons, cubic feet, or cubic meters. The water meters shown here are measuring in gallons.



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

Find out how much water the Smith family used in one month. Just subtract the first reading from the second reading.

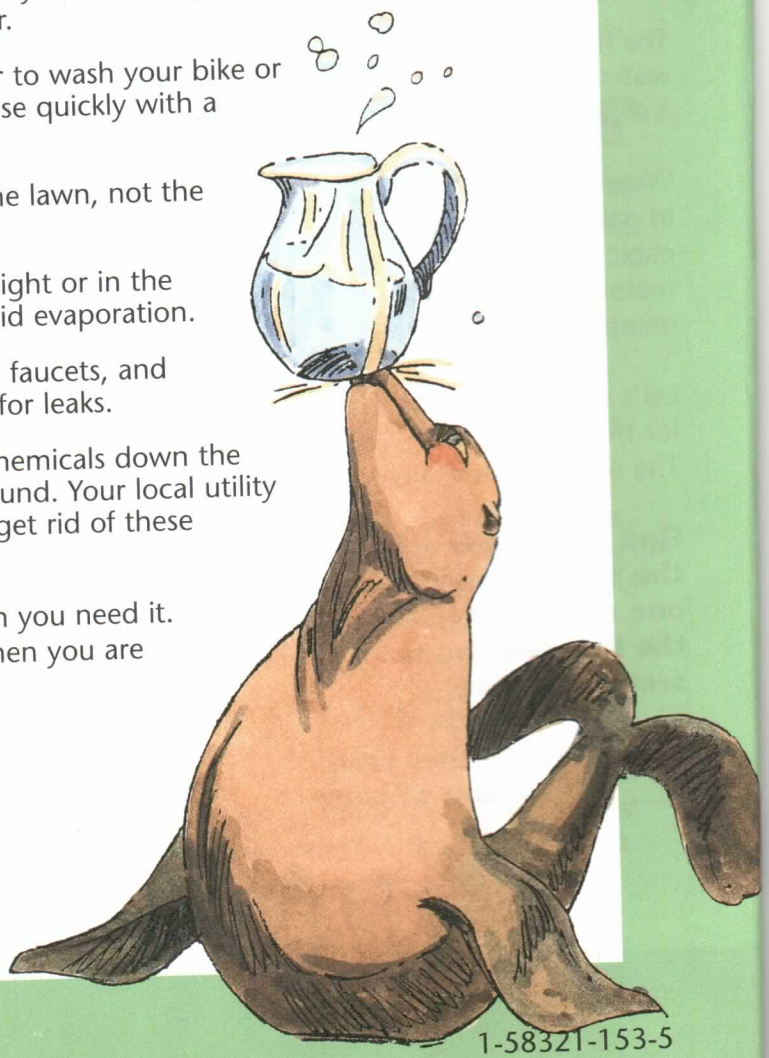
In one month they used _____* gallons of water.



*3,010

WHAT CAN YOU DO TO SAVE WATER?

1. Check household faucets for leaks. A faucet with even a slow drip can waste a lot of water. Just think, 15 drips per minute add up to almost 3 gallons (11 liters) of water wasted per day, 65 gallons (246 liters) wasted per month, and 788 gallons (2,980 liters) wasted per year!
2. Keep showers to 5 minutes or less in length. A five-minute shower takes 10 to 25 gallons (38 to 94 liters) of water.
3. Turn off the water while brushing your teeth or washing your hands.
4. Keep a pitcher of water in the refrigerator. Then you won't have to run tap water to cool it.
5. Use dishwashers and clothes washers for full loads only.
6. Use a broom to sweep your driveway, garage, or sidewalk instead of using water.
7. Use a bucket of water to wash your bike or the family car and rinse quickly with a hose.
8. Be careful to water the lawn, not the sidewalk or street.
9. Water your lawn at night or in the early morning to avoid evaporation.
10. Check outside hoses, faucets, and automatic sprinklers for leaks.
11. Never throw oil or chemicals down the drain or into the ground. Your local utility can tell you how to get rid of these pollutants.
12. Use water only when you need it. Always turn it off when you are finished.



American Water Works Association

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