The Water Cycle

A Science A–Z Earth Series

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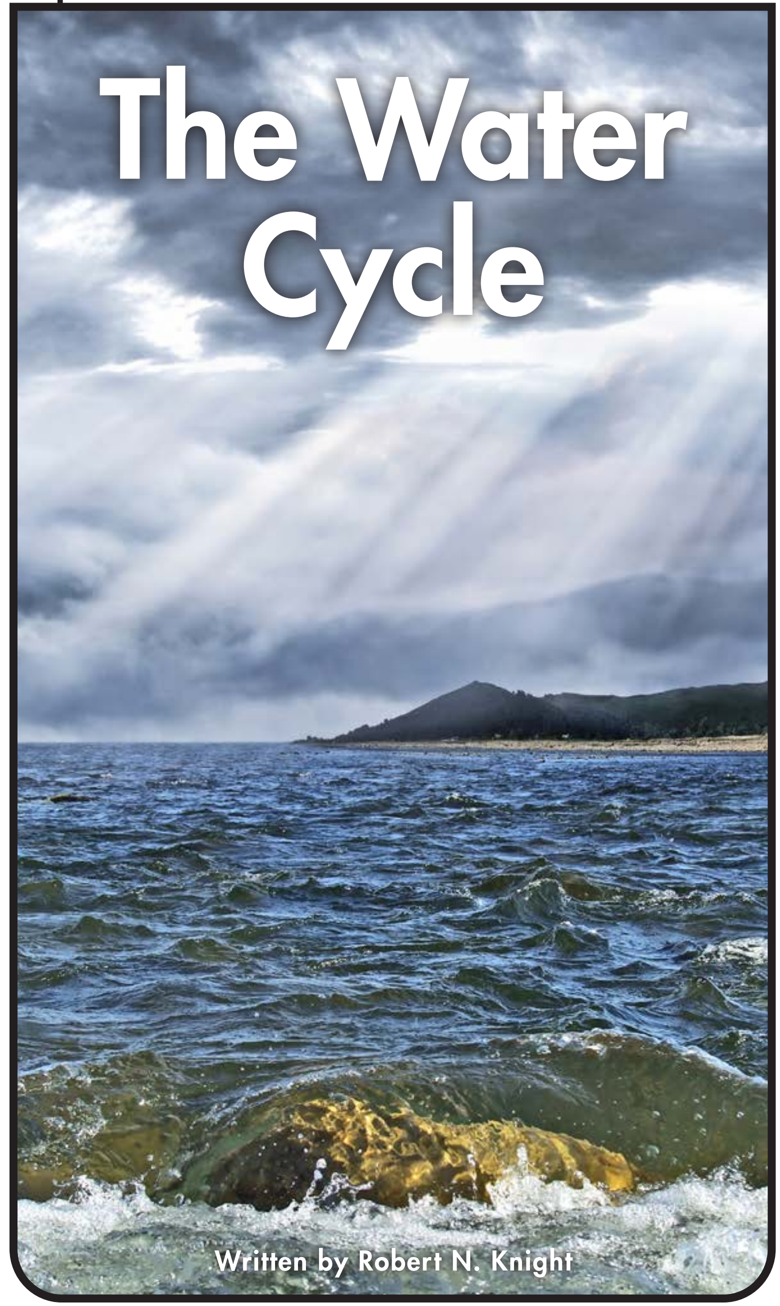
The Water Cycle



Written by Robert N. Knight

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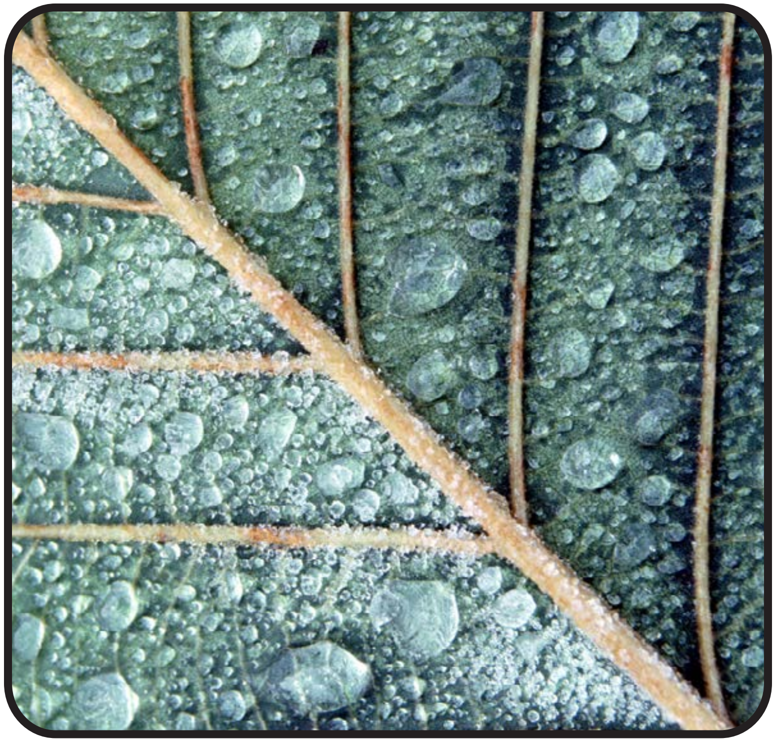

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KEY ELEMENTS USED IN THIS BOOK
The Big Idea: Understanding the water cycle is crucial to understanding how what we do with water—polluting, farming, damming, using, wasting, conserving—affects everyone's water.
Key words: absorb, aquifer, cloud, condensation, conservation, cycle, dam, delta, deposition, drought, Earth, energy, erosion, evaporation, flow, freeze, fresh water, gas, glacier, groundwater, hail, ice, irrigation, lake, liquid, melt, ocean, polar caps, pollution, precipitation, rain, river, runoff, salt water, sandbar, sediment, sleet, snow, soil, solid, state of matter, stream, surface water, temperature, thunderstorm, water, water cycle, water molecule, watershed, water vapor, weather, well **Key comprehension skill:** Cause and effect *Other suitable comprehension skills:* Sequence events; main idea and details; interpret charts, graphs, and diagrams; author's purpose **Key reading strategy:** Summarize *Other suitable reading strategies:* Visualize; connect to prior knowledge; retell; ask and answer questions

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cirrus clouds

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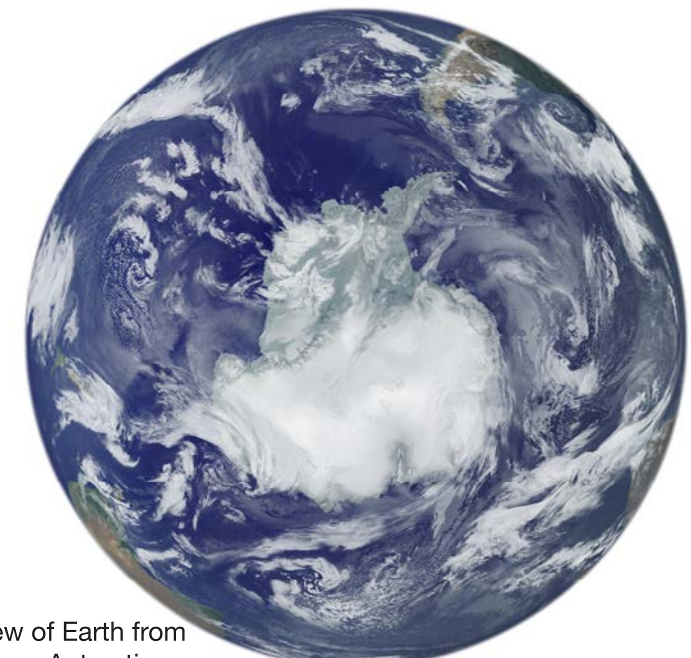
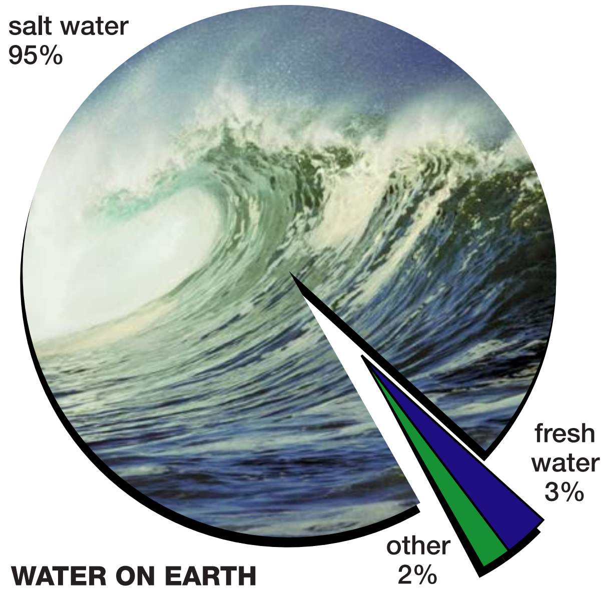
Introduction

People call Earth the “water planet” because water covers three-fourths of its surface. We have lots of water, but most of it we can’t use. The world population is growing, and as it grows, more people compete for this supply of water. Also, as we pollute more of our water supply, the water we need is getting scarcer.

This book explores how Earth’s water moves from place to place. It describes the changes water undergoes as it moves. It also describes how we use water and what we can do to conserve and protect it.


View of Earth from above Antarctica



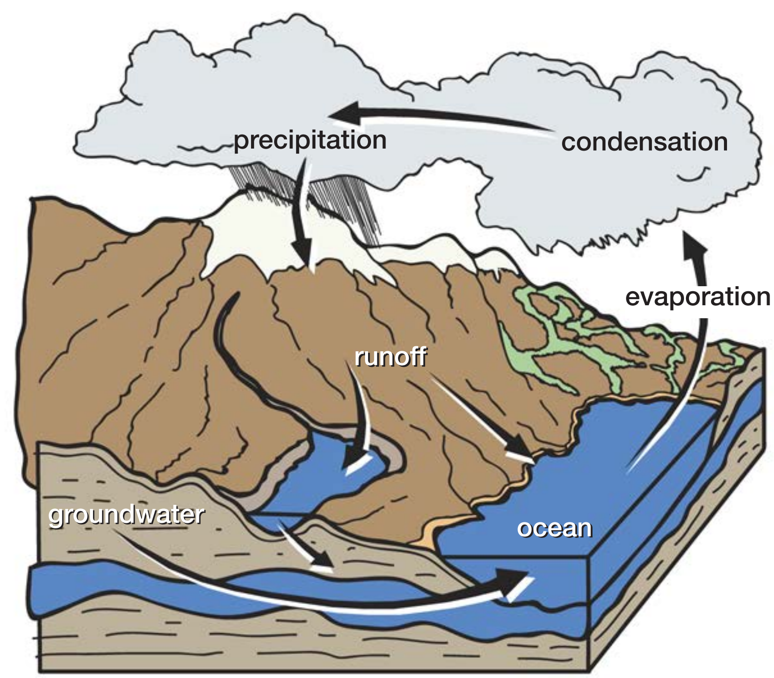
About 95 percent of Earth's water is contained in the oceans that cover most of the planet's surface. Ocean water contains many kinds of minerals. These minerals give ocean water its salty taste, which is why it is called salt water. Drinking salt water just makes you thirstier. People and many other animals can get sick or die if they drink too much salt water.

About 3 percent of Earth's water is fresh water. Lakes, rivers, and streams all contain fresh water that comes from rain and melted snow. Fresh water also exists underground. But most of Earth's fresh water is contained in glaciers found in mountains as well as icebergs and ice sheets found around the North and South Poles.

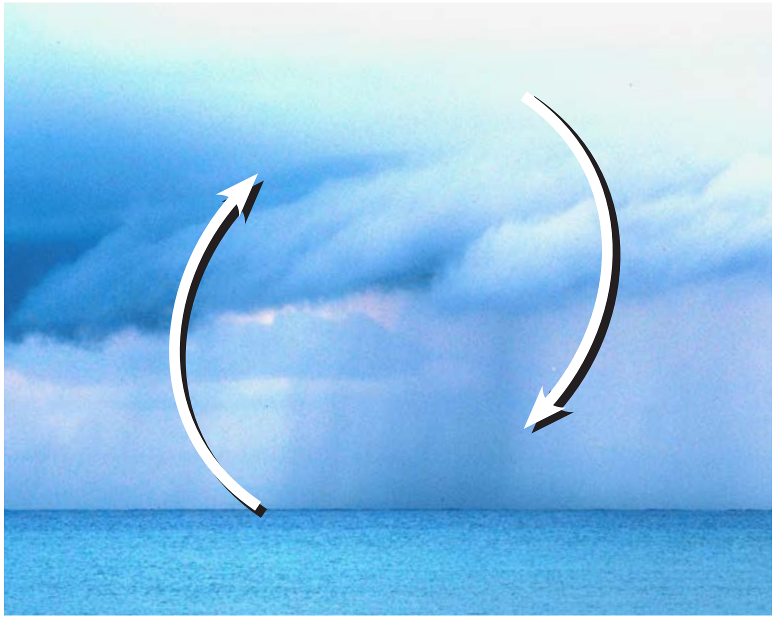
The Movement of Water

Matter is found in three states: liquid, solid, and gas. We are used to seeing Earth's water in its liquid state. Water also exists in its solid state as ice and in its gas state as invisible **water vapor**.

Earth's water often changes from one state of matter to another as it moves from place to place. The changes and movement of Earth's water are all parts of the **water cycle**. The water cycle has been going on for billions of years, moving Earth's water from the oceans to land and back to the oceans.



Water evaporates into the air, forms clouds, and precipitates down. On the ground, water flows downhill until it meets the ocean.


evaporation and condensation

Energy from the Sun powers the water cycle. This energy helps water change from one state to another.

The water cycle begins with **evaporation**. During evaporation, liquid water changes into invisible water vapor. Heat and light from the Sun hit Earth's water in oceans, rivers, lakes, and even the smallest puddles. The tiny particles that make up water, called **water molecules**, absorb this energy. As they gain more and more energy, the molecules move faster and faster and begin to spread apart. Soon they absorb enough energy to escape Earth's surface water and enter the air as water vapor.

When water vapor in the air rises into the atmosphere, it begins to cool. Water molecules begin to collect on dust particles floating in the air. They gather to form tiny water droplets. This process, called **condensation,** happens whenever water changes from a gas back to a liquid. This is the next step in the water cycle.

As more and more water vapor condenses, the droplets start to form clouds. As more droplets form, the clouds get thicker and darker.

You can tell a lot about what weather might be coming by looking at clouds. High, wispy clouds mean there is ice and moisture above, and the weather may be changing. Fluffy, spread-out clouds may mean there is a little water above, but not enough for rain. Very tall clouds with dark bottoms usually mean that a thunderstorm with heavy rain is coming.


Seattle on a clear day and a cloudy day

Word Wise

There are many types of clouds, each with its own name. Cloud names come from the Latin language. Part of the word may describe the height of a cloud. *Cirro* means "high," and *alto* means "mid-level." Another part of the word may describe a cloud's shape. *Cirrus* means "feathery" or "curly," *stratus* means "layered," and *cumulus* means "fluffy" and "pillowlike." A cloud with *nimbo* in its name produces precipitation.

Here are some cloud names that come from Latin words.

cumulonimbus:
large, fluffy rain clouds

nimbostratus:
thick layers of rain clouds

altocumulus:
mid-level fluffy clouds

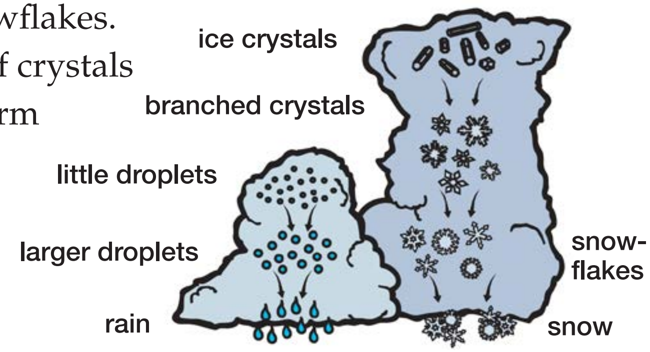
cirrostratus:
high, layered clouds

cirrus:
feathery clouds

Precipitation

Rain, snow, sleet, and hail are different kinds of **precipitation**. The temperature inside a cloud determines what kind of precipitation will fall.

When the air in a cloud cools, the water droplets come closer together. Small droplets join to make larger drops. If the temperature inside the cloud is above freezing, raindrops form. If the temperature is below freezing, the water droplets freeze into tiny crystals of ice. These ice crystals come together to form snowflakes. When lots of crystals join, they form snowflakes that fall to the ground.



CONDITIONS FOR RAIN AND SNOW INSIDE A CLOUD

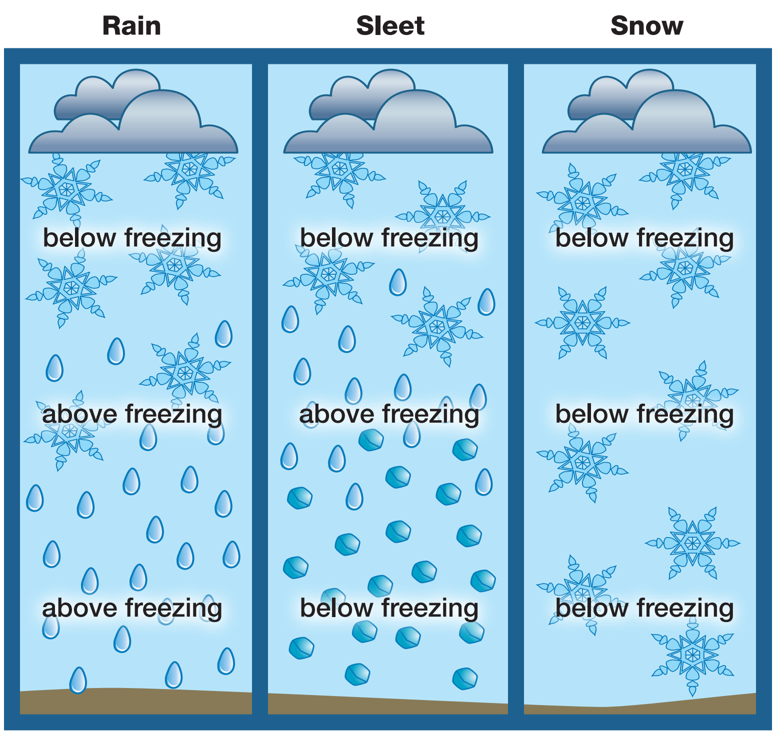
Do You Know?

Hailstones are a special type of precipitation. Hailstones are balls of ice that form when wind blows raindrops up to the top levels of a cloud. The raindrops freeze in these colder, higher parts. As they fall back down through the cloud, more water droplets gather on the hailstones. A strong wind blows the hailstones back up, and another layer of ice forms. This happens again and again. Finally, the hailstones get so heavy that they fall to the ground.

The temperature of the air between a cloud and the ground also has an effect on the type of precipitation that falls to Earth.

Precipitation may start as snow and melt on the way down, if the temperature is above freezing. If it is colder below a cloud than within the cloud, the falling rain refreezes as it falls, producing sleet or freezing rain.

Freezing rain sometimes coats objects on the ground with ice that is over an inch thick. This is an ice storm.



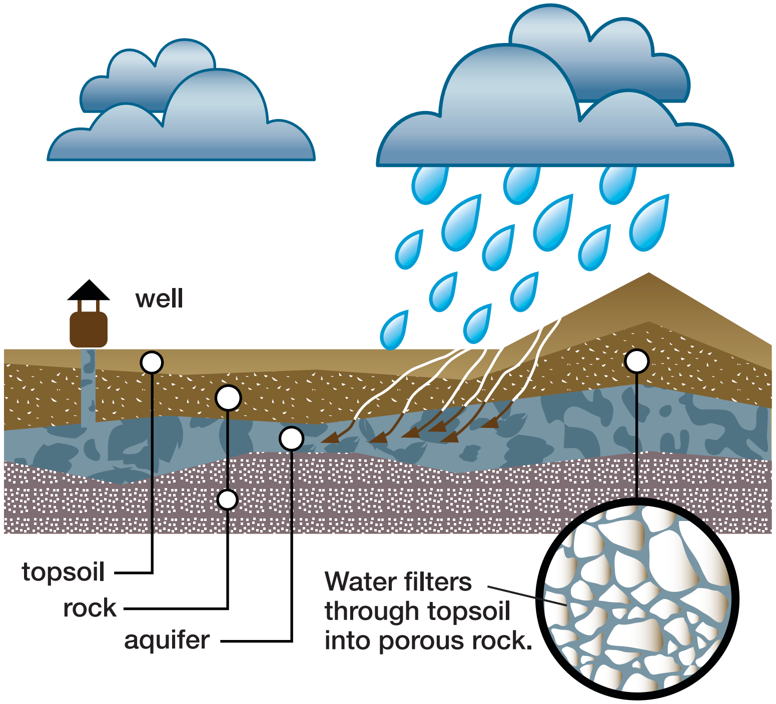
The air temperature in and below the cloud, and above the ground, affects precipitation.

Water on the Ground

When precipitation reaches the ground, it usually runs along the surface or soaks into the ground. Water running on top of the ground is called **surface water**. It flows downhill under the influence of gravity, a force that pulls everything down to Earth. Some surface water enters streams and rivers as **runoff**. Smaller streams and rivers flow into larger rivers. These larger rivers empty into large bodies of water, such as lakes and oceans. The rivers and streams, together with the land that surrounds them, are called a **watershed**.

Water that soaks into the soil is known as **groundwater**. Groundwater collects in the tiny spaces between particles of soil and in layers of porous rock. These underground reservoirs of water are known as **aquifers**.

Aerial view of water running off land into streams



Groundwater supplies us with much of the fresh water we need. People drill deep wells into aquifers and pump the water out for drinking. However, if people use the water faster than it can be replaced by the water cycle, the well goes dry.

People can pollute groundwater. Sometimes harmful chemicals are buried in or dumped on the ground. These chemicals can mix with rain soaking into the ground and can seep into wells and aquifers. It is almost impossible to remove pollution once it has entered an aquifer. Pollution in groundwater reduces Earth's supply of fresh water.

Erosion

Surface water can move with a force strong enough to wear away rock and soil. We call this process **erosion**. The faster water moves, the more powerful its force. During heavy rain, fast-moving runoff can remove huge amounts of rock and soil, dumping it into streams and rivers.

Farmers and foresters are very concerned about erosion. Good crops need rich, thick topsoil. In nature, forests or thick beds of grass cover the dirt in rainy areas. They help absorb water. When farmers remove the natural plants to plant crops, much of the soil is left bare. Heavy rains wash this exposed soil into the rivers. Planting trees and other plants helps keep soil in place.

Erosion cuts away rock and soil.

WOWSER!

The Grand Canyon is over 1.6 kilometers (1 mi.) deep and up to 30 kilometers (18 mi.) wide. That's a lot of erosion!

Grand Canyon, Arizona

The Grand Canyon is a very deep canyon. It took many millions of years to create the layers of rock in the Grand Canyon. But the fast-moving waters of the Colorado River cut through those layers of soft rock, gouging out the canyon in only one million years. The river and other runoff are still cutting the canyon today. Rivers have eroded rock and soil to form canyons and valleys all over the world.

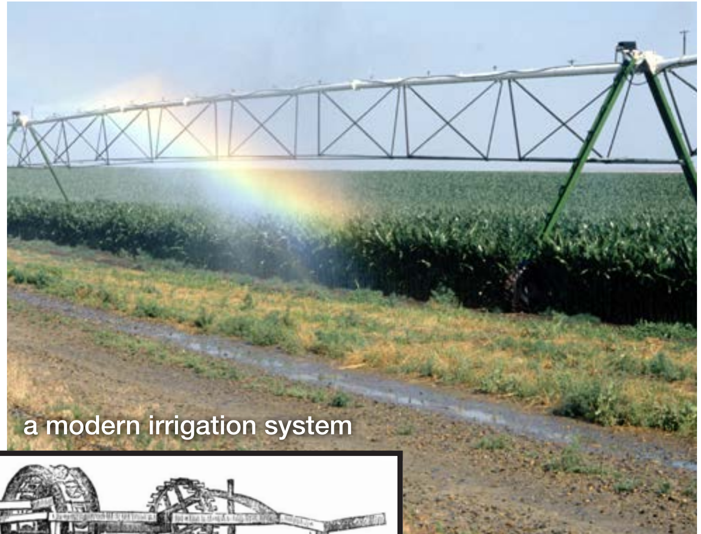
Deposition

Streams and rivers carry eroded sand and soil downstream. These particles of sand and soil are called **sediment**. When a stream or river slows down or comes to a stop, it drops the sediment. This process is called **deposition**.

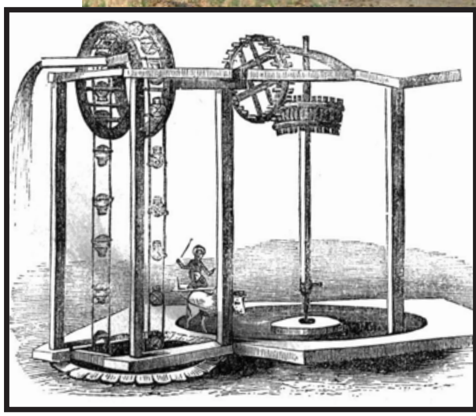
When rivers make turns or bends as they flow toward the ocean, the water slows down along the inner edge of each turn. Sediments settle out of this slower-moving water and form **sandbars**.

When a river finally reaches a large lake or ocean, it slows down, and the sediment it is carrying settles out of the water. The sediment gradually builds up, forming new land called a **delta**. As more and more sediment builds up, the delta emerges and grows. Thousands of years of deposition can build many square miles of delta where a river empties into the ocean. The Nile Delta provides rich farmland for Egypt.

The Nile Delta in Egypt as seen from space (left); delta farmland (right).



a modern irrigation system



an ancient irrigation system

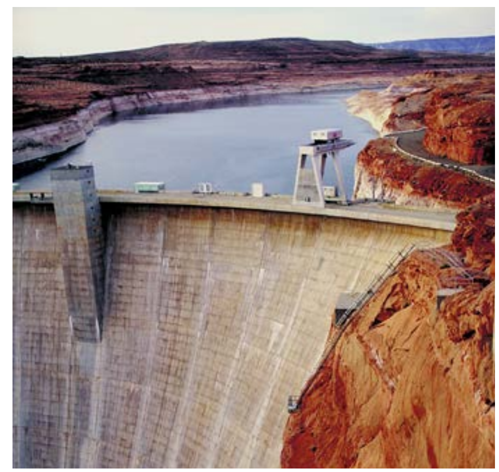
Controlling Water

For thousands of years, people have known about the importance of water. They built their towns and villages near water. They built canals and ditches to force water to go where they needed it. They also built dams and holding ponds to store water and created irrigation systems to bring water to their fields. They knew that a drought could destroy their food crops.

Today, people build dams that are hundreds of feet high. Dams trap water when there is a lot of rain. The stored water is then available throughout the year for irrigation. Dams also create electricity as well as lakes for recreation. Large pipes in the ground carry water hundreds of miles. Irrigation systems deliver water to crops hundreds of miles from the river. Today, farmers even use irrigation systems to turn desert into farmland.

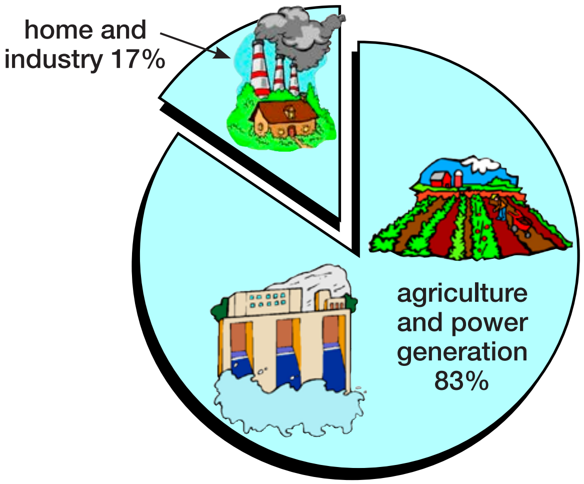
After people have used water in homes and buildings, it is sent to sewage treatment plants. These plants clean the water and return it to the water cycle.

Glen Canyon Dam at Lake Powell in Arizona



WOWSER!

The human body is about 60% water. There wouldn't be much of you left if the water evaporated.



Water Uses

The polar caps and glaciers hold four-fifths of the world's fresh water as ice. Only 1 percent of Earth's water is available for use by living things.

The United States uses 40 percent of its fresh water to irrigate food crops. Industry and households share what remains. Power plants and other factories use water for cooling. That water evaporates to become part of the water cycle again. Some industries use water for cleaning or production and then release it back into the water cycle.

At home, people use water for drinking, bathing, and watering their gardens. In some parts of the world, clean drinking water is hard to find. Fresh water may become an even more valuable resource in the future.

Water Conservation

Where will our future fresh water come from? Some countries are digging deeper wells to find more water. Some towns are building plants to make fresh water from salt water.

Scientists are discovering ways to conserve water. For example, new toilets use about half as much water as they did 20 years ago. Drip irrigation systems deliver water directly to plants.

People can learn that our supply of fresh water is very limited. We can learn how to conserve water and stop waste.

Desalination plants remove salt from salt water.

Things you can do to save water:

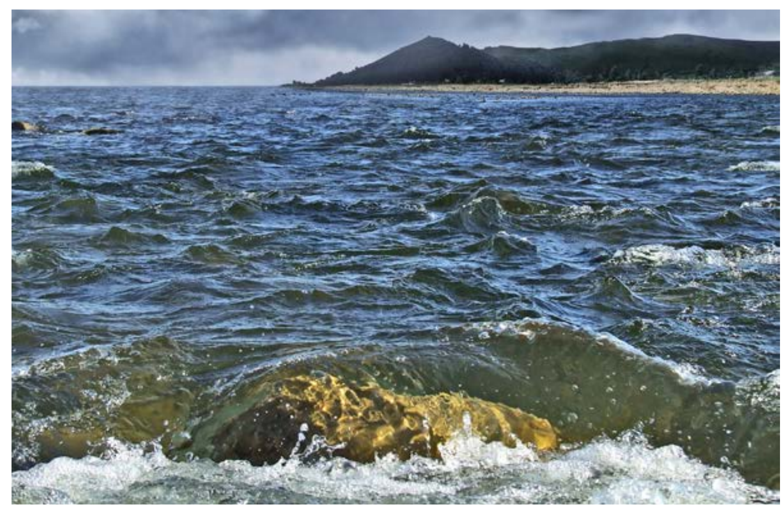
- Turn off the water when you're not using it.
- Don't run water when you brush your teeth.
- Take shorter showers.
- Fix leaking faucets.
- Wash dishes and clothes only when you have a full load.
- Collect rainwater for plants.
- Water the lawn in the evening.
- Put lawn sprinklers on timers.
- Install drip systems.

Conclusion

In addition to air, water is one of our most important resources. Without it, living things could not survive.

Earth would be a dry and barren planet if there were no water. The landscape would look much different. There would be no oceans, lakes, or rivers. There would be no canyons or valleys.

Water moves constantly through the air, over the land, and under the land. As it does, it changes states between liquid, solid, and gas. This water cycle gives us rain, snow, and the water we drink. Since we can only use a small part of the water on Earth, it is very important that people use water thoughtfully. We cannot afford to waste or pollute this precious resource.



Glossary

aquifer	an underground layer of rock, sand, or other material through which groundwater flows (p. 12)
condensation	the process by which water changes from a gas to a liquid state (p. 8)
delta	a triangle-shaped area of land formed by sediment at the mouth of a river (p. 16)
deposition	the act or process by which wind or water sets down sediment (p. 16)
erosion	the gradual wearing away of rock or soil by water, wind, or ice (p. 14)
evaporation	the change of water from a liquid state to a gas state, due to an increase in temperature (p. 7)
groundwater	water held underground in soil or rock, often feeding springs and wells (p. 12)
precipitation	water that falls from clouds in the form of rain, snow, sleet, or hail (p. 10)
runoff	excess water, not absorbed by the soil, that flows downhill (p. 12)

sandbar	a long ridge of sand formed in a body of water by currents or tides (p. 16)
sediment	particles of dirt and rock that are carried by water, wind, or ice and deposited elsewhere (p. 16)
surface water	water found above ground, on land (p. 12)
water cycle	the path water takes, and the changes it goes through, as it cycles through the environment (p. 6)
water molecules	a small particle of water, made up of hydrogen and oxygen (p. 7)
water vapor	the gaseous state of water (p. 6)
watershed	the area of land that catches rain and snowmelt when it flows as runoff (p. 12)

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