Chapter 5
Water, Water Everywhere

What is the most important resource on Earth? Water! Think of it: Almost everything we do involves water, from the food we eat to brushing our teeth. We use a lot of water, but there is a fixed amount of water on Earth and in its atmosphere. What makes this possible is that water is recycled through Earth's water cycle, the *hydrologic cycle*. Though 71 percent of our planet is covered by water, people can't use most of it because it is seawater, frozen at the poles, or deep underground. Only 0.003 percent of all water on Earth is clean, fresh water that is usable. As Earth's population continues to grow, clean water is becoming a limited resource. How we care for our water influences our daily lives, affects life on land and in the oceans, and shapes our future on Earth.

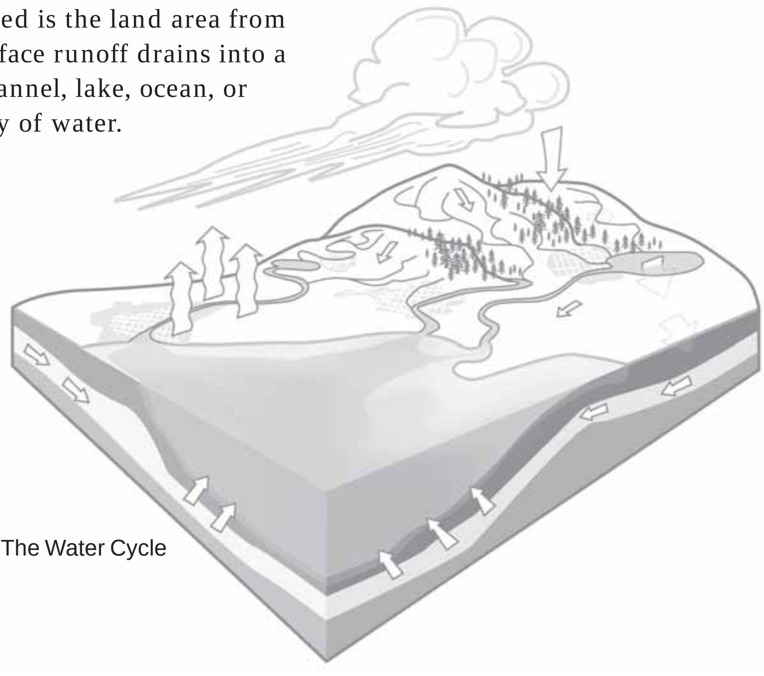
Water on Earth moves between the atmosphere, land, and oceans in a journey known as the hydrologic or water cycle. Water falls from the atmosphere as snow, hail, or rain onto land and ocean. The sun's heat provides energy to evaporate water from Earth's surface water (oceans, lakes, etc.). Plants also lose water to the air in a process called transpiration. The water vapor eventually condenses, forming tiny droplets in clouds. When the clouds meet cool air over land, precipitation in the form of rain, sleet, or snow is triggered, and water returns to the land or sea. Some of the precipitation soaks into the ground. Some of the underground water is trapped between rock or clay layers; this is called groundwater. But most of the water flows downhill as runoff, eventually returning to the sea.

New Words
watershed; hydrologic cycle (water cycle), point and nonpoint source pollution

Water travels over land through *watersheds*. Wherever we are on Earth, unless we are in the ocean, we are in a watershed—even in a desert! A watershed is the land area from which surface runoff drains into a stream channel, lake, ocean, or other body of water.

California Coastal Commission Area of Critical Concern: Water Quality and Wetlands

Relevant California Science Content Standards, Grade 5: Earth Sciences 3.a, d, e



The Water Cycle

Grade 5 Activities

These activities focus on water: its sources, cycles, and uses. Students will gain an appreciation of this valuable and limited resource, learn from where their domestic water comes, and learn actions they can take to conserve it.

Activity Goals

5.1. A Drop in the Bucket

Students will:

1. Calculate the percentage of fresh water available for human use.
2. Explain why water is a limited resource.

5.2. Alice in Waterland

Students will:

1. Trace their domestic water to its source prior to human use and to its destination after use.
2. Identify potential effects from human water use on terrestrial and aquatic wildlife.
3. Develop and practice responsible water conservation behaviors.

5. 3. Branching Out!

Students will:

1. Predict where water will flow in watersheds.
2. Describe drainage patterns in watersheds.

Tracking water from its source, to its uses, to where it ends up helps us understand why water is a precious resource, especially in California. In the northern part of our state, we have little summer rain to replenish water supplies that are drained by use over our dry summers. The southern half of our state is relatively dry year round, and does not receive much rain in the winter or spring, either. Water from northern California is transported to southern California via the California Aqueduct and the Central Valley Project. This water comes from snow runoff from the interior mountain range, the Sierra Nevada.

Water—how much there is, and how clean it is—is one of the biggest issues we Californians will face in the future. Available water will determine our daily water use habits, what we eat, how much we pay for it, where we go for vacations, and where we live. We need to manage our use of clean water so there is enough to maintain wetlands and natural places, for agriculture, home use, for electricity, and to support business and industry. There are many things we can do to make sure that water entering wetlands and the ocean is not harmful to the plants and animals that live in these habitats, and we can learn about ways that we can keep the water clean in rivers, lakes, and the ocean.

What happens when we don't take care of our water? *Polluted runoff, watersheds, and wetlands!*

Polluted water reaches coastal streams, wetlands, and our oceans from both *point sources* and *nonpoint sources*. Point sources are those that can be traced back to a particular place, usually an outlet or pipe from a stationary location, where pollution is dumped or discharged into a body of water. Because point sources originate from one particular place, there typically are just one or a couple of kinds of pollutants introduced to the water.

Nonpoint source pollution, on the other hand, comes from many diffuse sources across the land. It originates when rainfall, snowmelt, or irrigation runoff flows over the landscape and picks up pollutants as it heads for larger water bodies. These pollutants might consist of oils and greases, metals, bacteria, trash, pesticides, or other contaminants depending on the areas the water runs over before reaching the ocean. In agricultural areas, pesticides, sediments, and nutrients are the prime types of pollution for wetlands, waterways, and the ocean. Runoff in urban areas carries oil dripped from cars, trash, plastics and pet waste from the streets and sidewalks, and an assortment of chemicals (detergent, lawn fertilizer, paint, insecticides) from every day life.

When pollutants enter wetlands and oceans they can harm the plants and animals that depend upon clean water to live. Luckily, there are plenty of things people and cities can do to prevent nonpoint source pollution and to provide for healthy oceans in the future. We can practice wise water use, watch what we put down household drains and storm drains, and be aware of the chemicals we use in gardens—every little effort goes a long way. See page 55 for more tips.

Grade 5 Activity

Science skills

- Calculating
- Predicting
- Inferring
- Graphing

Concepts

- Though nearly three-fourths of Earth is covered with water, there is a finite amount of water on Earth.
- Very little (.003 percent of the total amount of water on Earth) is potable.
- Contamination of fresh water resources reduces the amount of water available for all life.

California Science Content Standards

Earth Sciences

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept, student will know:

3.a. Most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.

3.d. The amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

3.e. Students know the origin of the water used by their local communities.

Activity 5.1 A Drop in the Bucket

Earth is a water planet, but when you break down the percentages, there isn't much clean water for us to use.

Background

Ironically, on a planet extensively covered with water (71 percent), this resource is one of the main limiting factors for life on Earth. The "Water Availability Table" in this activity summarizes the major factors affecting the amount of available water on Earth.

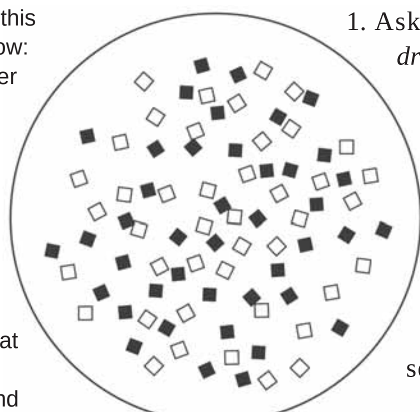
If all the clean, fresh water were distributed equally among all people, there would be about 1.82 million gallons (7 million liters) per person. While this is a large amount per individual, it is only about 0.003 percent of the total amount of water on Earth—not very much in the big picture.

For some, water may appear to be plentiful, but for others it is a scarce commodity. Why are some people in need of water while others have more than they need? Where you live and how you use water makes the difference. Geography, climate, and weather affect water distribution. Agriculture, industry, and domestic use affect availability.

The water we drink and use every day comes from our watershed. In the U.S., 61 percent of our population relies on lakes, rivers, and streams as our source of drinking water. The other 39 percent rely on groundwater that they pump from the ground.

This activity is broken into two sections: In *How Much Potable Water Is There?*, students predict the proportion of potable water on Earth; and *A Drop in the Bucket* is a teacher-led demonstration of the surprisingly small amount of potable water on Earth.

Activity 5.1a
How Much Potable Water Is There? Predict!



1. Ask students "What is 'potable' water?" (*Water suitable for drinking.*) What are some undrinkable waters? Students are to predict the proportion of potable water on Earth compared to the rest of the water on the planet. Students work in small groups (4-6 students). Hand out paper to groups (one sheet white paper, one sheet each of two different colors). Have one student in each group draw a large circle with a marker on the white sheet of paper. One of the colored papers represents available fresh water (potable water); the other represents the rest of the water on the planet.

2. Instruct students to tear the two sheets of colored paper into a total of 100 small pieces. Ask them to predict how many pieces will represent potable water and how many pieces will indicate the rest of the water on the planet. Instruct each group to arrange the 100 pieces within the circle so that these pieces reflect their predictions. Have groups record the

California Mathematics Content Standards

Number Sense

1.1. Estimate, round, and manipulate very large (e.g., millions) and very small (e.g., thousandths) numbers.

1.2. Interpret percents as a part of a hundred; find decimal and percent equivalents for common fractions and explain why they represent the same value; compute a given percent of a whole number.

Objectives

Students will:

- Calculate the percentage of fresh water available on Earth for human use.
- Know Earth is covered mainly by water, but that only a small amount is available for human consumption.
- Explain why water is such a limited resource.
- Appreciate the need to use water resources wisely.

Materials

1. Two colors of construction paper for each group of four students
2. Sheets of white paper
3. Markers
4. Water
5. Globe or world map
6. 1000 ml beaker (or a clear 1 liter bottle)
7. 100 ml graduated cylinder
8. Small dish
9. Table salt
10. Freezer, ice bucket, or ice cube tray
11. Eyedropper or glass stirring rod
12. Small metal bucket
13. Photocopies of "Water Availability Worksheet," one per student

Time to complete

One hour

Mode of instruction

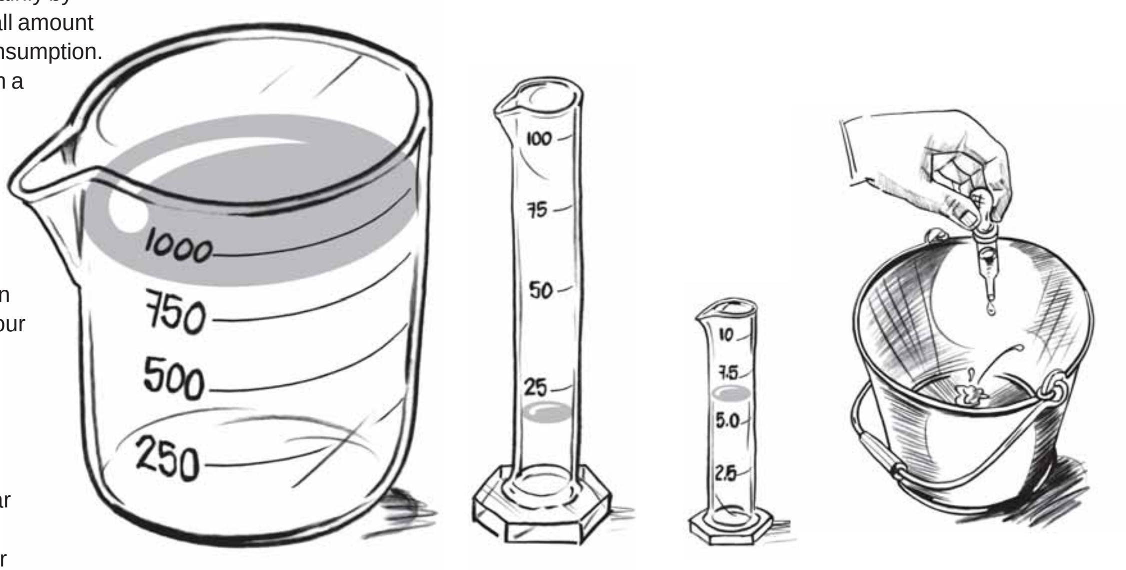
Small group activity followed by teacher demonstration, student worksheet, and whole class discussion.

number of pieces representing "potable" and "remaining" water. Have students translate these numbers into percentages, fractions, and decimals. (If they predict the amount of potable water to be ten pieces of paper out of 100, this is equivalent to 10%, 10/100=1/10, and 0.1.) Students write their numbers on the sheet of paper and set aside for later discussion.

Activity 5.1b
A Drop in the Bucket

1. Set all materials on table in front of students. Show class a liter (1000 ml) of water and tell them it represents all of the water on the planet.

2. Ask students where most of the water on Earth is located (refer to a globe or a map of the world). Pour 30 ml of the water into a 100 ml graduated cylinder. This 30 ml represents Earth's fresh water, about 3 percent of the total amount of water on Earth. Put salt into the remaining 970 ml in beaker to simulate ocean salt water unsuitable for human consumption.



1000 ml (total on Earth) | 30 ml (fresh) | 6 ml (non-frozen fresh) | 0.03 ml (potable)

3. Ask students what is at Earth's poles. (*Almost 80 percent of Earth's fresh water is frozen in ice caps and glaciers.)* Pour 6 ml of the 30 ml of fresh water into a small dish or cylinder and place the rest (24 ml) in a freezer, ice bucket, or ice cube tray. The 6 ml in the dish or cylinder (around 0.6 percent of the total water) represents non-frozen fresh water. Only about 1.5 ml of this water is surface water; the balance is underground, unavailable, or is not potable.

4. Use an eyedropper or a glass stirring rod to remove a single drop of water. Release this one drop into a small metal bucket (one drop equals about 0.03 ml). Students must be very quiet to hear the sound of the drop hitting the bottom of the bucket. This represents clean, fresh water that is not polluted or otherwise unavailable for use, about 0.003 percent (three thousandths of a percent) of the total amount of water on Earth! Write "0.003 %" on the board.

5. Discuss results of demonstration. A very small amount of water on Earth is available to humans.

Preparation

Collect materials. Review concept of percentages with students. This is a fun and relatively easy activity.

Outline

Before class

1. Collect materials the week before
2. Set up for classroom demonstration.
3. Photocopy "Water Availability Table," one per student.

During class

1. Hand out two pieces of white paper and two pieces of different colored paper to each group.
2. Conduct student predicting activity.
3. Conduct teacher-led demonstration.
4. Hand out "Water Availability Table" to each student. Complete worksheet.
5. Whole class discussion on demonstration.
6. Whole class discussion comparing results of student predictions to teacher demonstration.

ANSWER KEY 5.1b Water Availability Table

Total Water (100%) on Earth divided among all people (based on a world population of 6 billion people)
= 233.3 billion liters/person

Minus the 97% of each share (226.3 billion liters) that contains salt (oceans, seas, some lakes and rivers) 233.3 – 226.3 billion liters
= 7 billion liters/person

Minus the 80% of this 7 billion that is frozen at the poles (5.6 billion) 7 – 5.6 billion liters
= 1.4 billion liters/person

Minus the 99.5% of the 1.4 billion that is unavailable (too far underground, polluted, trapped in soil, etc.) (1.393 billion) 1.4 – 1.393 billion liters
= 7 million liters/person

Results and reflection

1. Students retrieve their earlier guesses at how much water on Earth is available to humans, and compare them to actual percent that is available. **A little more than one-half of one of the 100 pieces of colored paper represents potentially available water (0.6 percent.) Only one small corner of this half (0.003 percent) is potable water.** Have students explain their reasoning for their initial predictions. How would they adjust their proportions? Complete "Water Availablity Worksheet."
2. Ask students again if enough water is currently available for people. If the amount of usable water on the planet is divided by the current population of approximately 6 billion, 7 million liters of water is available per person. Theoretically, this exceeds the amount of water an individual would require in a lifetime, but keep in mind that humans use the majority of potable water for industry and agriculture, and that other organisms use water, not just humans.
3. Why does more than one-third of the world's population *not* have access to clean water? Discuss with your class the main factors affecting water distribution on Earth (e.g., land forms, vegetation, proximity to large bodies of water, economics, and politics), and the environmental influences that affect the availability of water (drought, contamination, flooding).

Conclusions

Though 71 percent of the Earth is covered with water, very little of this (0.003 percent) is potable, or usable by humans. We must take care of our fresh water resources to ensure there is enough water for the natural diversity of life on Earth.

Extensions and applications

1. Students develop a television commercial stating reasons why water is a limited resource.
2. Students can identify areas of the globe where water is limited, plentiful, or in excess and discuss the geographical and climatic qualities contributing to these conditions. For example, large variations in precipitation occur within states (Death Valley receives as little as 2 to 5 inches [5 to 12.5 cm] per year. Only 100 miles away, mountain ranges receive more than 30 inches [76 cm] per year. These variations dramatically impact plants, people, and other animals.)
3. Have students bring in newspaper or magazine articles about droughts and floods worldwide; identify the locations on a world map.
4. How would global warming affect the amount of usable water on Earth? (*Polar ice caps would melt, adding more water to the oceans; sea level would rise, putting low lying coastal lands and small islands in danger. Worldwide weather changes would occur, due to global ocean temperature changes.)* What areas of the world would be most affected? (*Low lying coastal areas.*) How would students' lives be changed by melting polar ice caps? (*Weather changes, coastal changes, food production changes, etc.*)

Adapted from

A Drop in the Bucket is used with permission from Project WET/Montana State University from the *Project Wet Curriculum and Activity Guide.* For further information about Project WET (Water Education for Teachers), contact the national office at (406) 994-5392, or the California Project Wet, Water Education Foundation, (916) 444-6240, *www.watereducation.org*

Water Availability Worksheet

How much water is there on Earth? Is it all usable? Is there enough usable water for everyone to have as much as they need? Use this table to calculate how much clean water is available for all our uses.

Quantity to be divided among all people on Earth	Amount available (liters per person)	Percentage of total water
All the water on Earth	233.3 billion	100%
Only the fresh water (calculate 3% of the total amount available)		
Only the non-frozen fresh water (calculate 20% of the remaining amount available)		
Available fresh water that is not polluted, trapped in soil, or too far below ground to use (calculate 0.5% of the remaining amount available)		

1. Where is all this water? Is it distributed equally around the world?

2. How will future population growth affect the amount of water available for us to use?

3. How will our lives be affected if we don't have enough clean water?

4. What can we do to make sure there is enough clean water in California's future?

Grade 5 Activity

Science skills

- Visualizing
- Estimating
- Extrapolating
- Analyzing

Concepts

- Water is a precious resource.
- How people use water may affect terrestrial and aquatic wildlife.
- In coastal towns of California, treated water from household waste often goes into the ocean, and untreated runoff goes down storm drains, which can lead to the ocean as well.
- Becoming aware of the many ways in which water is used will help students adopt a wise water use ethic.

California Science Content Standards

Earth Sciences

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept, student will know:

3.d. The amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

3.e. Students know the origin of the water used by their local communities.

Activity 5.2
Alice in Waterland

Take a trip through your water faucet and learn more about your city's water system. Where does water come from? Where does it go?

Background

Water use is such an automatic and habitual daily activity that we often don't understand the consequences. Seldom do we connect the water that comes out of the faucet to its sources in the natural world.

A model that traces the dynamics of water is called the water cycle or the hydrologic cycle. The water cycle follows the path of water from when it falls in the form of rain or other precipitation on a *watershed* (the land area from which surface runoff drains into a stream channel, lake, ocean, or other body of water); to its travel as runoff that flows into streams, groundwater, lakes, reservoirs, estuaries and oceans; to its eventual return to the atmosphere through evaporation; to its formation into clouds; to its condensation in the form of precipitation as it falls on a watershed. The great storehouses of water—glaciers and icecaps—are also part of this cycle. All forms of life on Earth are dependent upon and affected by this cyclical journey of water.

In between water's source and the sea, we divert water from its natural course for our uses. About 8 percent of total water use in the U.S. is for domestic use, 33 percent is for agricultural purposes, and 59 percent is for industrial/commercial uses (U.S. Geologic Circular 1001). Each time we draw water from its natural setting or modify the natural journey of water, we are likely to have an impact on wildlife and habitats. For example, dams flood river and stream valleys, and draining wetlands removes water from natural wildlife nurseries.

Once water is diverted from its natural path and is used by humans, it is often contaminated or polluted. The effects of this polluted water may be devastating: salinity from irrigation damages soil's productivity, runoff containing agricultural fertilizers and pesticides impairs lake and river habitats, and toxic chemicals can poison human and wildlife water supplies. Contamination can enter the water cycle with damaging consequences for people, wildlife, and the environment.

Humans have choices in how we use and how we treat water. We can make decisions to use water respectfully and carefully, and conserve water as a part of our daily lifestyle. Water conservation reduces or prevents destruction of natural habitats by lessening the need for dams and other interventions. It also reduces the depletion of underground water stores which supply water for riparian and other habitats. Water conservation may also decrease wastewater discharges into sensitive environments such as estuaries.

In addition to conservation, we can also pay attention to what we put into water and the water cycle—being careful with potential toxins like pesticides, detergents, fertilizers, motor oils, aerosols, cleaning fluids

California Mathematics Content Standards

Statistics, Data Analysis, and Probability

1.2. Organize and display single-variable data in appropriate graphs and representations (e.g., histogram, circle graphs) and explain which types of graphs are appropriate for various data sets.

Objectives

- Students will trace their domestic water to its source prior to human use and to its destination after use.
- Students will identify potential effects from human water use on terrestrial and aquatic wildlife.
- Students will identify, develop, and practice responsible water conservation behaviors.

Time to complete

Two 45-minute sessions, plus time to draw murals. Two-week homework.

Mode of instruction

May be conducted indoors or outdoors. Teacher reads text for visualization exercise, followed by whole class discussion. Students create a mural based on visualization. Students keep track of water use at home, create a chart with total use of water by the class's homes. Students create a list of water conservation practices.

Materials

1. "Water Use Worksheet," one for each student (double-sided, cut in half, week one and week two will go home separately)
2. Long sheets of butcher paper for murals
3. Art supplies for murals

Preparation

If possible, contact your local water district, water treatment plant, or wastewater district to inquire whether they have educational materials to send out, or conduct tours for students. Gather and organize local knowledge and educational resources of water sources such as local reservoirs and rivers, and wastewater discharge (to a river, groundwater, or ocean). Gather materials, photocopy and cut "Water Use Worksheet" (double-sided).

and powders, and caustic acids, as well as fuels and their byproducts. We can affect both the quantity and quality of available water through our personal and public conservation practices.

This activity encourages students to develop a greater awareness of water use and the effects of water use on wildlife and habitats. In addition, students are encouraged to develop a personal ethic of responsible water use, and demonstrate it through their actions.

Activity

1. Tell students they are going on a simulated field trip. Just like Alice followed the White Rabbit down the rabbit hole, they are going to shrink down to a size that will let them travel up their faucets at home and into their water pipes. *You may want to adapt the text so it will apply to your local settings. If you are in a rural community and many of the students have well water as their domestic source, you can convert the simulated field trip to begin at a faucet there at the school.* Even if this text does not apply to all students' situations, it can be used to explore a typical source of water and its routes somewhere in California.

2. Ask students to picture in their minds what you will describe for them in the following words:
"Are you comfortable? Good. Close your eyes, and picture yourself small enough to climb into the faucet in your kitchen at home…see yourself with magic powers that allow you to travel through the water that comes from the faucet to its origins… You will be able to pass through all the pipes, valves, and other barriers on the way… The first part of the journey takes you through the pipes in your house to where they connect to your water source… If you live on a farm or ranch, the source would probably be a well or perhaps a spring. In the city, the water source for your home probably would be far away… First you get into a water main, the pipe that carries water to all the houses and businesses in your neighborhood…then you follow the main until you come to a pumping plant where water pressure is maintained… Past the pumping plant is a place where the water is purified… This may be very complex—a place with filters, chemical tanks, and treatment equipment… Beyond the purification plant, the water may be in an aqueduct or open channels coming from a reservoir… The reservoir is a huge lake where water is stored… There are often trees and bushes on its edges… Wildlife is common, fish are usually abundant and people might use the site for boating and fishing… Natural streams usually flow into the reservoir… They drain large areas of the land's surface which are called watersheds… A watershed is the land area that catches and transports water through streams, underground flow, and rivers… The water in a watershed contains all the water that is naturally available for use by all living things in that area… If you want, stay here. Try to see the plants and animals that live in the area. Or, follow your route all the way back through the reservoir and channels and treatment plant and pumping plant to the water main and the pipes in your house and out your faucet. Now, open your eyes."

Outline

Before Class

1. Photocopy “Water Use Worksheet,” one sheet, double-sided. Cut into two halves; the second half (“Week 2”) will have the “Wise Water Use Tips” on the back. For students to be able to see changes in their water use habits, be sure the students do not see the tip sheet until the second week.
2. Gather art materials for mural.

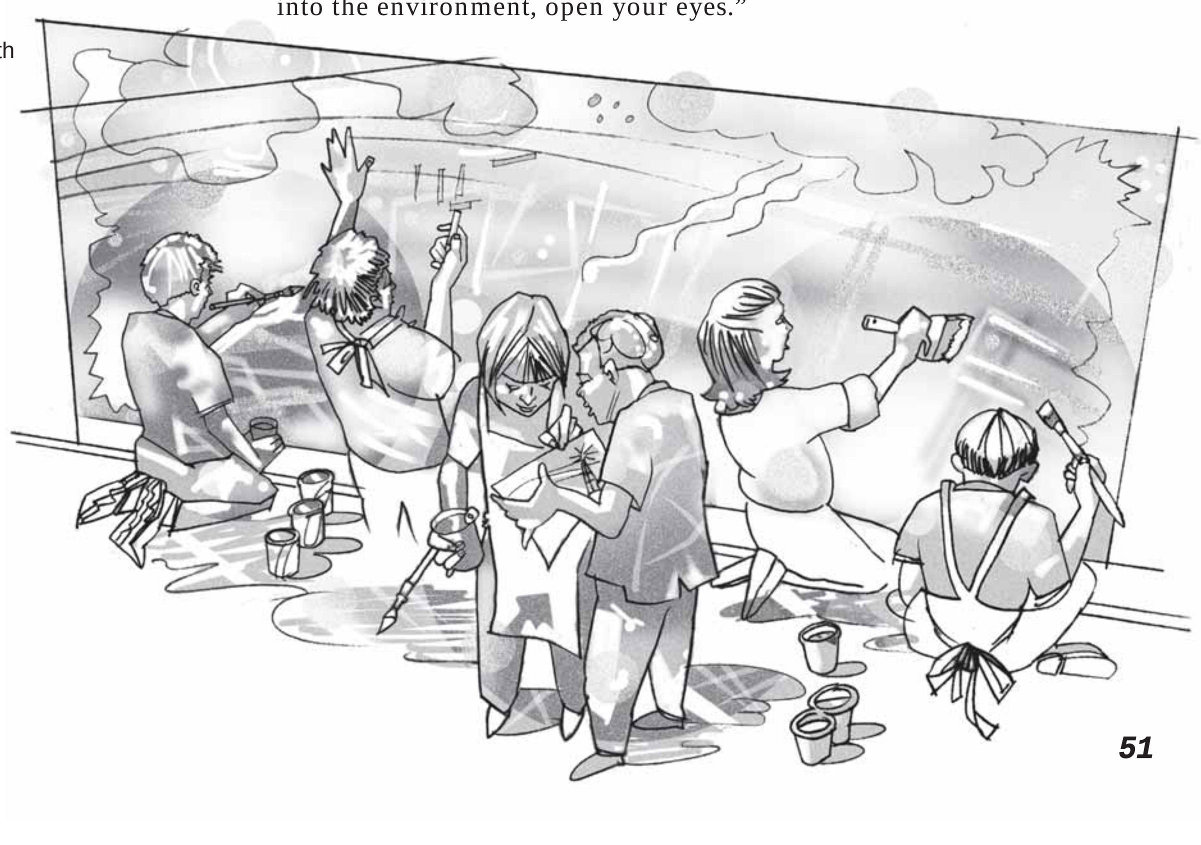
During Class

1. Whole class discussion on water use.
2. Read visualization text for simulated field trip from faucet to reservoir.
3. Whole class discussion of journey.
4. Read visualization text for simulated field trip from drain to ocean, river, or septic tank.
5. Whole class discussion of journey.
6. Students create murals of upstream and downstream.
7. On a Friday, hand out “Water Use Worksheet, Week 1.” The next Friday, hand out “Water Use Worksheet, Week 2.” Make sure the “Wise Water Use Tips” are sent home with students for Week 2 ONLY.
8. Students collect data beginning Saturday and continue through the next Friday.
9. After data has been collected for Week 1, make master chart summarizing use. Brainstorm water saving ideas.
10. Students gather data for another week; tabulate results.
11. Compare water use tables for both weeks.

3. After this simulated field trip, discuss as a group the journey of the water from its source to the faucet. Identify components of the journey. Emphasize places where wildlife habitat is affected—positively, negatively, or with unknown effects—by the intervention of people as they use the water or influence how water is to be used.

4. Have students create an “origins” mural on a single long sheet of butcher paper, depicting the origins and journey of water from their home to its source. Emphasize wildlife and habitat all along the way.

5. Repeat the process for a journey down the drain and into the wastewater system. Read aloud:
“Picture yourself small again. This time the journey will be down the drain in your sink. You move along through the used water system to a treatment site... If you live on a farm, the site will probably be a septic tank… A septic tank is usually a large concrete box… Here bacteria break down the substances carried in the water… Once the water is cleansed to the degree possible, it flows out through drainage fields and back into groundwater sources or streams… If you live in a city, there is much more water being used and large water treatment plants must attempt to cleanse the water before it is returned to rivers and streams… In these treatment plants there are great filters and holding tanks… The water must be held in place for solid substances to settle out by gravity… Air is often pumped through the waste water to increase the oxygen content so bacteria can break down the impurities more quickly… Eventually the treated water is released into rivers, streams, or the ocean… It again re-enters the natural habitat for wildlife… There it provides an essential component for continued life… If all was done well, animals, plants, and humans will safely re-use the water…It will nourish the crayfish caught by the raccoon…It will provide the pond for the turtle… It will provide the refreshing drink for someone like yourself in some downstream city… After you have followed the water out into the environment, open your eyes.”



6. Repeat the discussion and create a “downstream” mural. Include places where humans and wildlife are affected—positively, negatively, or with unknown effects—by the re-entry of this water into the hydrologic cycle.

7. As a class, evaulate both murals—origins and downstream. Identify, list, and discuss places in which the quality of the water in the water cycle may be affected by human activities.

8. Now, shift the emphasis to the amount of water that people typically use. On a Friday, hand out the “Water Use Worksheet Week 1,” one for each student.

9. Ask students to keep track of how much water is used in their homes for seven days, from Saturday to Friday. Students may post the sheet on their refrigerator and have each family member help by putting a mark in the section designated after each water use. The miscellaneous section is for special uses not listed (filling a fish tank, bathing the dog). Students bring in their results on Monday.

10. On Monday, make a master chart on the board that summarizes total use in class’s homes for the seven days. Brainstorm places where water might be conserved. Challenge each student to reduce use and invite his or her family to join in. On Friday, hand out “Water Use Worksheet Week 2” with the “Wise Water Use Tips” on the back (preferable; you can photocopy onto another page if necessary). Students will monitor use for another seven-day period (from Saturday to Friday) while using the wise water use tips. Students bring in their results on Monday.

11. On Monday, tabulate results from Week 2. Compare class results with Week 1. Was there a significant reduction in water use? Hold a classroom discussion on what was easy to change and what was harder.

Results and reflection

1. Students draw and label a flow chart tracing water in their community: from where it comes—to their homes—to where it goes after leaving their home.
2. Using the “Water Use Worksheet Week 1,” have students total the number of gallons of water their families used in personal hygiene activities, home maintenance activities, and “other” activities. Have students create a chart or graph (for instance, a pie chart) to illustrate the three types of activities as a part of their family’s total water usage. Ask students what type of activity used the most water? The least? How are these facts illustrated by their chart or graph? Repeat this activity with “Water Use Worksheet Week 2.” Students compare the two charts for changes in their family’s water use.
3. Once the results are tabulated, discuss how wildlife, habitat, and humans benefit from human water conservation. Discuss potential appropriateness and effectiveness of water conservation behaviors. Discuss ways to protect the quality of water we use. List and discuss actions that each of us can take to reduce or prevent pollutants from entering the hydrologic cycle.
4. Have students name three ways they could conserve water. Ask how much water could they conserve using each method for a year? How might wild animals be affected by their water conservation actions?
5. Ask students for examples of ways that water quality can be affected negatively by human use. Ask for examples of actions people can take to protect the quality of water.

Conclusions

The water cycle recycles Earth’s water supply. Keeping water free of pollutants and using wise water conservation practices will keep our water supply usable for humans, plants, and wildlife. Students can make choices about the amount of water they use and what they put down the drain. The ocean is downstream from us all.

Extensions and applications

1. Locate your community’s water source. Visit it on a field trip.
2. Have students monitor water use in the school, and identify ways to conserve water. Dripping faucets? Running toilets? Runoff from watering plants?
3. Take field trips to purification plants and treatment plants.
4. Students may create a poster campaign to raise the awareness in the school or community about water conservation and water quality.

Adapted from

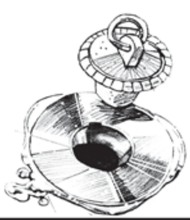
Alice in Waterland, ©2000, 1992, 1985. Council of Environmental Education. Reprinted with permission from *Project WILD Aquatic Activity Guide*. The complete Activity Guide may be obtained by attending a Project WILD workshop. For more information, contact the California Project WILD Aquatic Office at (916) 653-6132.

Further references:
California Dept. of Water Resources Website, materials for classrooms and poster are available. *www.owe.water.ca.gov/education*

Water Use Worksheet

How Much Water Does Your Household Use?

WEEK 1 What it takes	What you do	How many times? (~~||||~~ ||)	Total gallons
3 gallons	Flushing a toilet		
3 gal. (water left running) 1 gal. (water turned off)	Brushing teeth		
5 gal./min. (old showerhead) 2.5 gal./min. (new showerhead)	Shower (avg. shower length ____)		
40 gal. if full	Taking a Bath		
10 gal.	Washing Dishes		
40 gal.	Washing clothes		
40 gal.	Watering lawn		
40 gal.	Washing a car		
OTHER: estimate gallons used			



How Much Water Does Your Household Use?

WEEK 2 What it takes	What you do	How many times? (~~||||~~ ||)	Total gallons
2.5 gal. (with a ½ gal. bottle in tank)	Flushing a toilet		
3 gal. (water left running) 1 gal. (water turned off)	Brushing teeth		
5 gal./min. (old showerhead) 2.5 gal./min. (new showerhead)	Shower (avg. shower length ____)		
40 gal. if full/20 gal. if ½ full	Taking a Bath		
10 gal.	Washing Dishes		
40 gal.	Washing clothes		
40 gal.	Watering lawn		
0 gal. (carwsh that recycles water)	Washing a car		
OTHER: estimate gallons used			

The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard.

–**Gaylord Nelson**
Former Governor of Wisconsin
Founder of Earth Day

Wise Water Use Tips

Shower
Get yourself wet in the shower, then turn the water off while you lather up. Turn it back on to rinse off. Reduces the number of minutes shower is on. Or, ask your parents to purchase a low-flow showerhead. Any new showerhead made in the U.S.A. will use a maximum of 2.5 gallons/minute.

Brushing your teeth
Turn the faucet on briefly to wet your brush, then turn it off until you're done brushing and ready to rinse. Uses less than 1 gallon.

Washing clothes
Wait to run the washing machine until you have a full load. This reduces the number of loads you need to do.

Washing dishes
Wait to run the dishwasher until you have a full load. This reduces the number of loads you need to do.

Toilet
If your toilet was made after 1992, it uses an average of only 1.6 gallons/flush. If your toilet is older, try placing a plastic bottle filled with water in the tank. This reduces the amount of water used for each flush by the amount of water in the bottle.

Bathtub
Fill the bath only halfway, saves 20 gallons.

Washing a car
Take your car to a carwash that recycles water. Saves 40 gallons and reduces water pollution.

Watering your garden
Water just once per week, deeply, in the early morning to reduce evaporation. Keep a bucket in the bathroom and kitchen for when you're waiting for water to warm up. Use to water plants. Encourage adults to plant native and drought-tolerant plants to reduce watering even further.

Cleaning house
To clean the driveway or patio, use a broom instead of the hose. Save water, get exercise!

Grade 5 Activity

Science skills

- Observing
- Predicting
- Hypothesizing
- Analyzing

Concepts

- Water flows through and connects watersheds.
- Wherever you are, you are in a watershed.

California Science Content Standards

Earth Science

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept, student will know:

3.a. Most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.

3.d. The amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

3.e. Students know the origin of the water used by their local communities.

Objectives

Students will:

- Investigate drainage patterns.
- Observe how watersheds distinguish different land areas.
- Discover the origin of the water used in their local community.

Time to complete

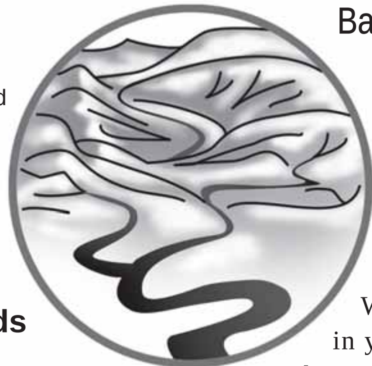
Two 50-minute periods. If making permanent watershed, allow at least three days for materials to dry before conducting experiments.

Mode of instruction

Small group model making followed by experiments and analyses.

Activity 5.3 Branching Out

Where does your water come from? Build a model watershed and predict where the water will travel across the land.



Background

The water cycle is the path water takes through its various states—vapor, liquid, and solid—as it moves through Earth's systems (oceans, atmosphere, ground water, streams, etc.). As we see a rushing stream or a river gushing during a major rainstorm, we may ask, Where does all this water come from? As we watch water flow down a street during a heavy rainstorm, we may ask, Where does all the water go? Answers may be found right in your own neighborhood! No matter how dry it looks, chances are there is water flowing far below your feet. Wherever you are, you are in a *watershed*, the land area from which surface runoff drains into a stream channel, lake, ocean, or other body of water.

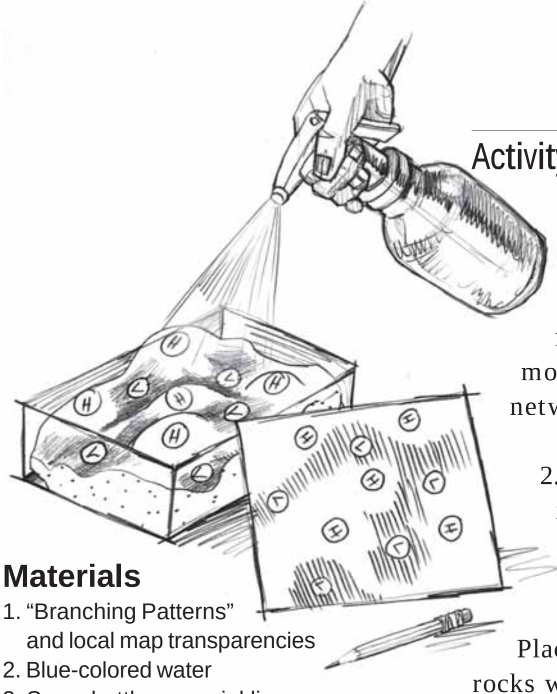
The pattern water makes as it flows through a watershed is familiar to students who have drawn pictures of trees or studied the nervous system. By investigating drainage patterns, we can better understand how watersheds distinguish different land areas.

When the ground is saturated or impermeable to water (when water cannot soak into the ground) during heavy rains or snowmelt, excess water flows over the surface of land as runoff. Eventually this water collects in channels such as streams. Watersheds are known by the major streams and rivers into which they drain.

Watersheds are separated from each other by areas of higher elevations called ridge lines or divides. Near the divide of a watershed, water channels are narrow and can contain fast-moving water. At lower elevations, the slope of the land decreases, causing water to flow more slowly. Eventually, water collects in a wide river that empties into a body of water, such as a lake or ocean.

From a bird's eye view, drainage patterns in a watershed resemble a network similar to the branching pattern of a tree. Tributaries, similar to twigs and small branches, flow into streams, the main branches of the tree. Like other branching patterns (e.g., road maps, veins in a leaf), the drainage pattern consists of smaller channels merging into larger ones.

Watersheds are either closed or open systems. In closed systems, such as Mono Lake in northeast California, water collects at a low point that lacks an outlet. The only way water leaves is by evaporation or seeping into the ground. Most watersheds are open—water collects in smaller drainage basins that overflow into outlet rivers and eventually empty into the sea.



Activity

1. Ask students what they know about watersheds. Is there one near their home? (*Trick question: Wherever you live, you are in a watershed, even if that watershed is covered with asphalt.*) What is in a watershed? How can you tell one from another? Can you name a local watershed? Tell students they are going to build a model of a watershed to see how water flows through a branching network of drainages.

2. Depending on whether a temporary or more permanent model is being built, students will do the following:

Temporary model

Instruct students to select six rocks and wrap them with white scrap paper. Lay them in a square or rectangular aluminum tray. Place larger rocks near one end of the tray. Cover the paper-covered rocks with plastic wrap.

Permanent model

Instruct students to lay rocks in a square or rectangular aluminum tray, with larger rocks near one end. Snugly cover the rocks and exposed areas of the tray with plastic wrap. Apply strips of papier-mâché to cover the rocks. For a studier model, apply several layers of papier-mâché. When the mâché has dried, coat the model with white paint and waterproof sealant, or waterproof white paint.

3. Students will sketch a bird's eye view of the model. They should mark points of higher elevations with "H"s and low spots with "L"s. To identify possible ridgelines, connect "H"s.

4. Tell students the model will soon experience a rainstorm. Where do they think water will flow and collect in the model? Have them sketch their prediction on their drawings. Indicate the crevices in their models and possible locations of watersheds.

5. Students will spray blue-colored water over the model and note where it flows. Water may need to be sprayed for several minutes to cause a continual flow. Assist students in identifying branching patterns as water from smaller channels merges into larger streams.

6. Students will use blue pencil to mark on their drawings the actual branching patterns of water. Some imagination and logic may be required. Ask them to confirm the locations of watersheds by noting where water has collected in the model.

7. Ask students to determine if smaller watersheds overflow into larger ones. Does all the water in the model eventually drain into one collection site (open watershed system)? Does the model contain several closed water systems (collection sites that lack an outlet)?

8. Students will place tracing paper or an overhead transparency over their drawings and draw the drainage patterns. Groups compare and contrast each other's drawings. Discuss how the networks of smaller channels merge together to become larger.

Materials

1. "Branching Patterns" and local map transparencies
2. Blue-colored water
3. Spray bottles or sprinkling cans, one for each model
4. Drawing paper and pencil
5. Blue pencils
6. Tracing paper or blank transparency sheets
7. Photocopies of a local map showing rivers (watersheds also if available), one for each student
8. Overhead projector

Note: Students may build a temporary, simpler model, or a durable version that can be used for further experiments. Materials for both are listed here.

For both models

1. Five to ten rocks, ranging from 2 to 6 inches (5 to 15 cm) in height. If groups of students are making their own models, each group will need its own rocks.
2. Square or rectangular aluminum tray, large enough to hold rocks. A large disposable baking or turkey roasting pan will work.
3. Plastic wrap (thick plastic wrap from a grocery or butcher shop works best).

For temporary model

White scrap paper, newsprint, or butcher paper

For permanent model

<u>Note: Allow extra time to make this model</u>. Begin it at least three days before the experiments are to be conducted—the papier-mâché needs to dry overnight, and then the paint needs time to dry completely.

1. Papier-mâché materials (strips of newspaper dipped in a thick mixture of flour and water)
2. Water-resistant sealer and white paint (or white waterproof paint)

Preparation

Collect materials, photocopy transparencies and maps, build models, and keep a space open in the room for the models to be worked on and displayed.

Outline

Before class:

1. Decide whether you will build the more durable and permanent watersheds or the lighter and more fragile temporary watersheds. Purchase or have students bring in appropriate materials (see list) based on this decision.
2. Have students bring in all other materials (rocks, blue pencils).
3. Photocopy map of the area around your school, with rivers and streams. One copy for each student.
4. Photocopy onto overhead transparency "Branching Patterns" sheet.

During class

1. Show overhead transparency of "Branching Patterns."
2. Arrange students into small groups of 3-4 students.
3. Using sample model making materials, illustrate how to make the model.
4. Distribute materials to each group.
5. Oversee model manufacturing (depending upon which model you choose, assembling the model will be completed in one day or over a series of days).
6. Allow students to proceed with experiments, roving from group to group to assist.
7. Whole class discussion on watersheds.

9. Hand out photocopied maps of local area with streams, rivers, and lakes. Students locate streams and rivers and draw a circle around land areas they think drain into the river.

10. Students pick one river on the map and follow its path in two directions (upstream and downstream). If the entire river is pictured, one direction should lead to the headwaters or source, and the other direction merge with another river or empty into a body of water.

Results and reflection

1. Students predict where water will flow and collect in watershed model, and write their predictions on a piece of paper.
2. Students test their predictions and use the results to confirm or modify their projected drainage patterns.
3. Students will compare the drainage pattern of watersheds to other branching networks.
4. Students write a story about or draw a map of drainage patterns in their watershed. Label mountains, rivers, streams, reservoirs, lakes.

Conclusions

Watersheds have a branching pattern that distributes water from rain and snow into streams, rivers, and lakes. Water moves from high to low areas, collecting in drainage basins. These drainage basins are the source of water for most of our communities.

Extensions and applications

1. If the model were a real land area, would the drainage patterns be the same thousands of years from now? Students should consider the effects of natural and human-introduced elements (e.g., landslides, floods, erosion, evaporation, water consumption by plants and animals, runoff from agricultural fields, droughts, dams). Have students write one page describing what the future watershed looks like.
2. Students may finish their models by painting landscapes and constructing scale models of trees, wetlands, and riparian areas. Introduce human influences, such as towns and roads.
3. As in the game "Pin the Tail on the Donkey," blindfold students and have them randomly touch a point on a map of California. Have students explain likely routes water would take in that area. Where is the closest large river? Lake? Ocean? Are there dams on the river?
4. Students may make a topographic map of their model. First, they totally waterproof the model. Next, they submerge it, one-half inch at a time, in water. At each increment, while viewing from above, they trace the water level onto a sheet of glass or clear plastic held over the model. Students can make elevation lines and draw the map true to scale.

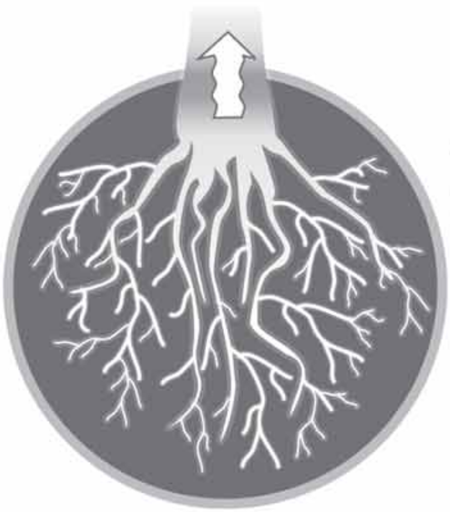
Adapted from

Branching Out is used with permission from Project WET/Montana State University from the *Project Wet Curriculum and Activity Guide.* For further information about Project WET (Water Education for Teachers), contact the national office at (406) 994-5392, or the California Project Wet, Water Education Foundation, (916) 444-6240, *www.watereducation.org*

Other References

Project GLOBE. www.globe.gov

Branching Patterns

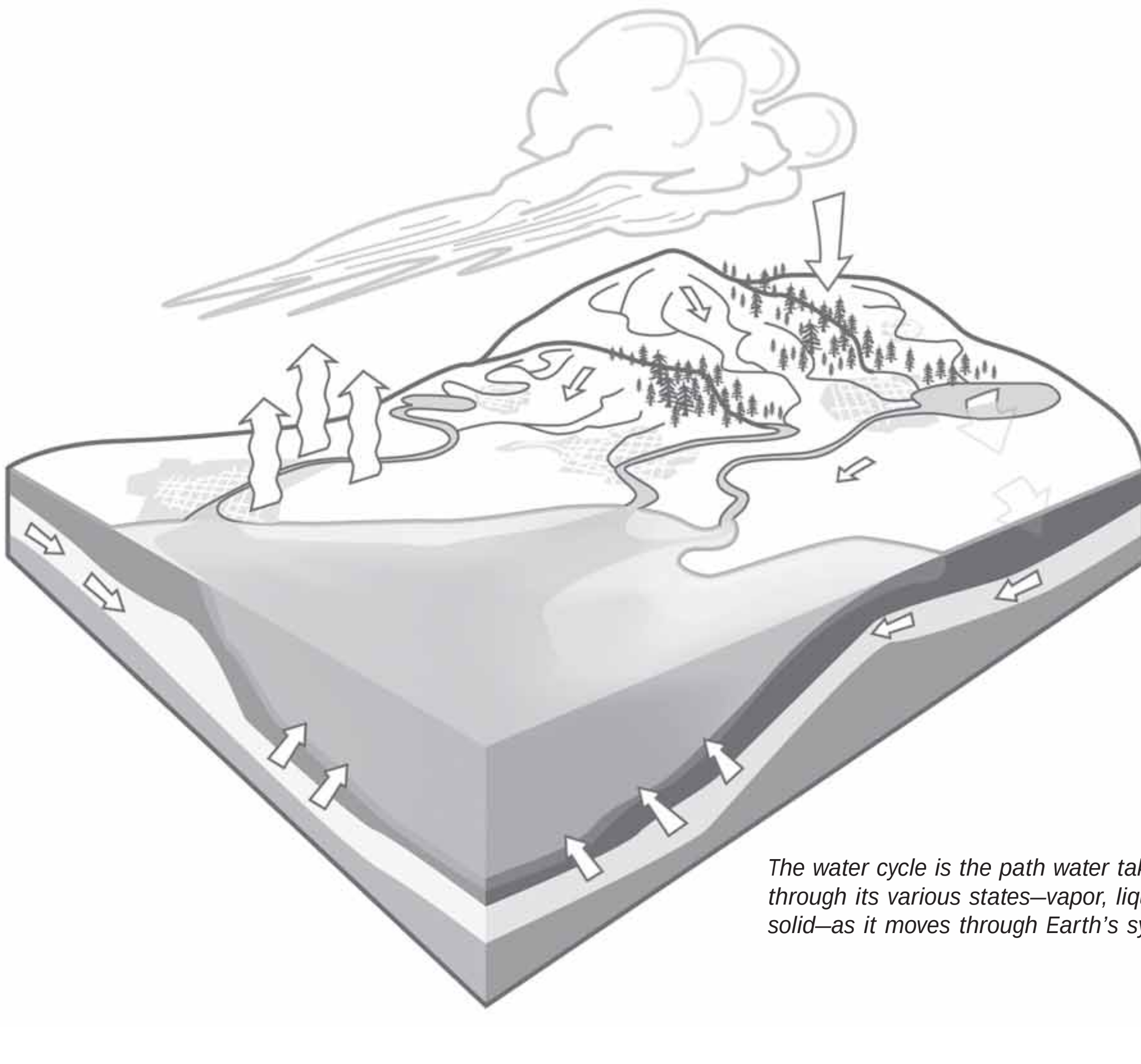


SECONDARY ROOTS FEEDING PRIMARY TREE ROOTS

TRIBUTARIES FEEDING MAIN WATERWAY

WATERSHED

The Water Cycle



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Notes