

LESSON 2



THE CALIFORNIA FOREST
FOUNDATION

Water: The Forest's Most Valuable Resource

This lesson can be completed in the classroom or at home. Your teacher will explain to you how to participate in assignments and group discussions if you are completing the lesson at home.

Today's Topic: Water from the Forest

Introduction to California's Water

Watch the video, [Water: The Forest's Most Valuable Resource](#), to start your exploration of the water supplies in California. As you watch, pay attention to where California gets its water and, in particular, to the California watershed areas. Then, think about the watershed area where you live. Discuss with your classmates where the water you use comes from, and how far away it may start!

Read and Respond

Read the passages below about how California manages its water supplies and how water is connected to the forests. Then, you will discuss in a group what you learned. Follow your teacher's instructions about how to be part of these group discussions.

Water: Where It is Found

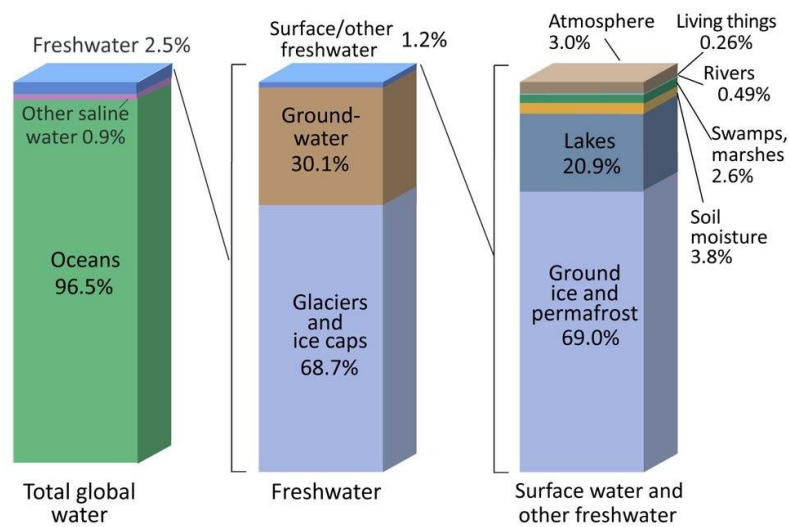
When you think about water, what is the first thing that comes to mind? It might be puddles. It might be the oceans. It might even be what falls from the sky. However you think of water, it is important to know what it is and where you can find it.

Water is the reason life exists on Earth. Your body (and the bodies of most living things) is made up of mostly water. Living things need water to survive. People need water to stay healthy.

Plants need water to grow. As you can see, this “liquid of life” is pretty important! How many times in a day do you use water?

Almost everywhere you look on Earth there is water. But, where do you have to look to find it?

Where is Earth's Water?



Earth's Water
Image Credit: USGS

Almost all of Earth's water is found in the oceans. In fact, 96.5% of all of the water on Earth can be found in oceans. Ocean water is too salty for drinking or watering plants. In fact, if you drink ocean water you will actually be thirstier than if you did not drink it at all.

People mostly use fresh water. Fresh water is not salty. Only 2.5% of Earth's water is fresh. Most of this is found frozen in glaciers and in the ice caps (the North and South Poles). The second largest amount of fresh water is found underground. This freshwater source is called groundwater. **Groundwater** is water found underground in the cracks and spaces between soil, rocks, and sand. Areas with large amounts of groundwater are called **aquifers**. An aquifer is a space between underground rocks where water collects. The rest of Earth's freshwater sources come from surface water. **Surface water** is water found on the top of Earth's surface and includes lakes, streams, rivers, ponds, and swamps. Surface water is mostly the result of precipitation and extra water runoff.

California has a long coastline. It stretches 1,352 kilometers along the west side of the state. This entire length borders the Pacific Ocean. There have been some efforts to use ocean water by taking the salt out of it, but most of the water used in California comes from surface water or groundwater. California has more than 3,000 lakes and reservoirs. It also has more than 100 rivers. This might bring you to ask, “Where does California’s fresh water come from?”

California’s Water and Forests

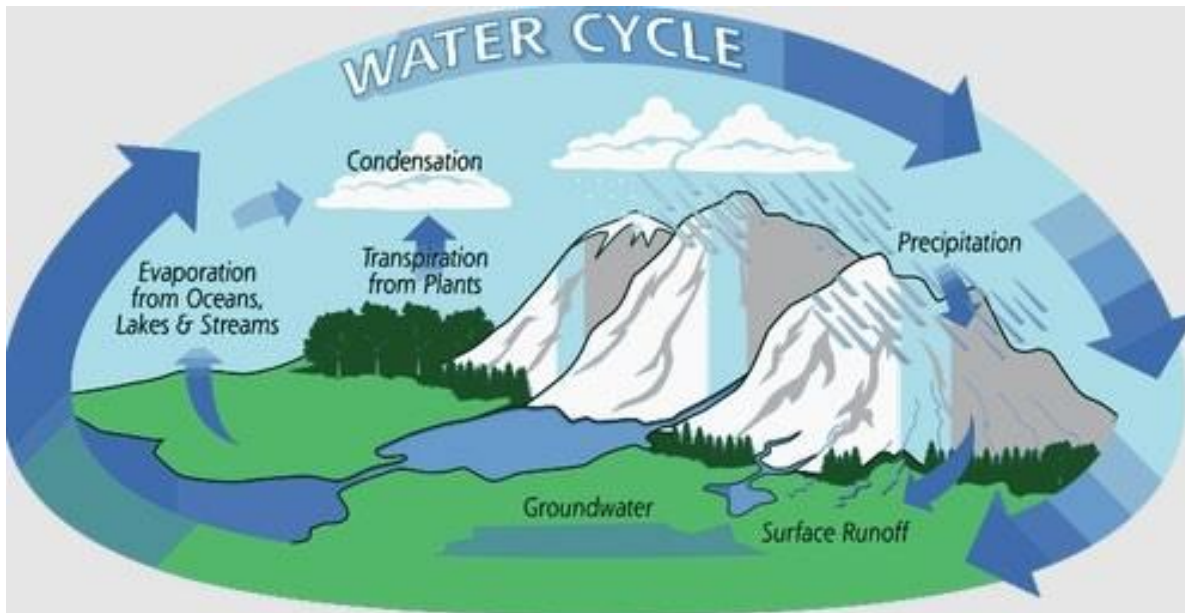
Believe it or not, most of California’s water comes from the forests in some way. Water starts as rain, snow, or ice falling from the sky. This is called **precipitation**. Precipitation happens when water vapor in the air cools and falls back to Earth as rain, snow, or ice. Precipitation can sink into Earth’s surface. It can also collect in reservoirs, watersheds, lakes, and ponds. The sun can heat up the water on Earth’s surface.

When the surface water heats up enough it returns to the atmosphere as water vapor. This process is called **evaporation**.

When water vapor cools it becomes liquid water again. This process is called **condensation**. The atmosphere is cooler than Earth’s surface, which causes the water vapor to fall back to Earth as precipitation.

Plants also release water back into the environment. This process is called **transpiration**. Transpiration is when plants lose water through their leaves and stems.

Evapotranspiration is a term used to describe the combination of water being evaporated from Earth’s surface and being transpired by plants. All of these processes happen over and over again in what is called the **water cycle**.



The Water Cycle

Image Credit: NASA

The key parts to the water cycle are:

- **Condensation** - when water vapor becomes liquid water
- **Precipitation** - rain and snow coming down from the sky
- **Runoff** - when water moves across Earth's surface
- **Evaporation** - the movement of water from Earth back to the atmosphere
- **Transpiration** - when water evaporates through the leaves and stems of plants

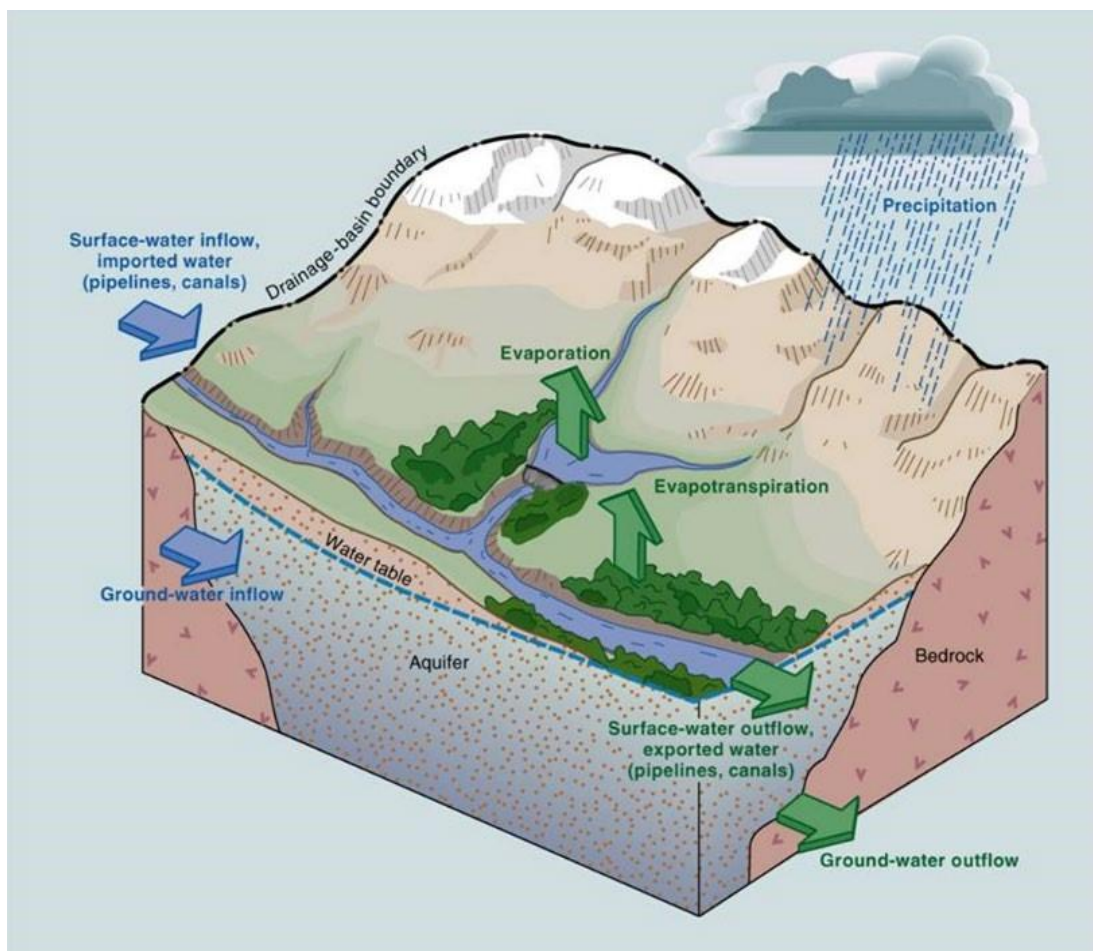
The Sierra Nevada mountain range causes precipitation to fall from the clouds. As air moves over the top of the mountains, the water vapor cools and condenses and falls back to Earth as precipitation. In fact, the forests surrounding the Sierra Nevada mountains supply 65% of the fresh water in California. The trees and soil slowly filter, or clean, the water as it makes its way to streams, rivers, and lakes. Trees and soil can also help filter the water removing debris and pollutants as the water flows through the ground. Trees and soil are able to filter water by trapping pollutants and debris, preventing it from reaching water supplies, and trees can also help prevent flash floods. Forests reduce the flow of water across the surface of the land. It is important to remember that there are large differences in how each region gets and uses water. While the northern part of the state receives heavy precipitation, the southern part is very dry.

California's Watersheds

California gets most of its water from mountain ranges and forests. Snow and ice melt, and the water travels across the land and through the soil to fill the lakes and reservoirs. A **watershed** is an area of land that drains water into a specific area. Normally these areas are rivers or lakes. Watersheds can be different sizes. For example, a small mountain stream may have a small watershed, but river systems can have large watersheds that span hundreds of miles.

Watersheds are very important. Some of the things they do are:

- collect water from rain and melting snow and ice
- release water as runoff
- clean water
- provide habitats for many plants and animals



Parts of a Watershed

Image Credit: USGS

One of California's major watersheds is found in the Sierra Nevada mountain range. There are 16 water systems in this area that provide water for about two-thirds of all of the state. This watershed covers nearly one-fourth of the state's area and is home to much of the state's forests. The forests serve as the source of water for the watershed areas. The melting rain and snow from the tree-covered mountains flow through the forests, which act as filters for all the water passing through them.



Sierra Nevada Watershed

Another area of California's watershed is found in the central part of the state, near San Francisco Bay. This area covers more than 75,000 square miles and includes the San Francisco Bay.

It runs from the Cascade Mountains in the north to the Tehachapi Mountains in the south. This watershed provides water for a large percentage of the state. It also has many different habitats. These include freshwater and saltwater areas. These habitats are especially important for migrating salmon and birds.



San Francisco Bay Watershed

The rivers and streams that flow from the forests produce most of the surface water that is used for drinking and farming. Snow and ice are stored in the winter. When the snow and ice melt in the spring, they turn into runoff, which flows into streams. The water flows into streams and rivers. A lot of this water is used in the big cities and on farms throughout the rest of the year. The forests keep the water clean. They reduce erosion of soil into streams. They also filter pollution out of the runoff.

Managing Water Sources in California

Water is very important to life in California. So are forests. The forests and water supplies are connected to each other. Residents need to do everything they can to protect the forests and waterways in the state. The headwaters of most of California's water sources (lakes, rivers, etc.) are located in the forests. Many of these areas provide habitats for animals and plants in addition to freshwater supplies. Water usage in the state can be divided into three different categories: environmental, urban, and agricultural.

Environmental water usage includes the waters protected by both state and federal laws. These waters are important for maintaining wetlands and other water habitats, wildlife preserves, and sport and recreational usage. These water sources are largely isolated from the major urban and agricultural areas of the state.

Urbanization is the process that occurs when populations shift from rural to urban environments. Urbanization is one factor that can cause interruptions to California's water supply. Urbanization, however, can happen in environmentally sustainable ways so that urban water supplies can provide people and businesses with the water they need. For example, urban forests are often planted and maintained in many areas. Urban forests can include city parks, tree-lined streets, landscaping, and many other types of planned green spaces.

Even though urban populations in California have been growing, the urban water usage for the state overall has been declining over the past two decades. Water conservation efforts have encouraged residents to continue to save water and choose to use water supplies thoughtfully. Small changes in how water is used can have a large impact on conservation efforts. Some efforts to conserve water include watering lawns and gardens after dark or in the early morning, running full loads of dishes and laundry, and having water-saving devices like low-flow toilets and showerheads. California has enacted laws that promote the safe and responsible use of water.

As the population in urban areas increases, the flow of rivers and streams in the area is affected. People put up roadways and other structures that could interrupt the flow of natural waterways. These barriers, including fences, can impact the movement of animals from one place to another.

One way to remedy the effect of these structures on waterways is to build a **culvert**. A **culvert** is a structure that allows water to flow under or around a road. To learn more about culverts, watch the video: [Culvert and Road Restoration by the U.S. Forest Service](#).



Culvert Under a Road

Image Credit: Pi.1415926535

All man-made structures affect the land and wildlife, culverts included. Some culverts can prevent animals from going upstream or moving between different habitats. While the presence of human-made structures may prevent the loss of soil through erosion (because the land is covered with concrete), putting up any structure can cause the loss of habitat for many plants and animals. The water provides places to live, food sources, drinking water, safe passage and migration routes, and breeding grounds for many living things. When these get taken away there is a large effect on nature.

One way to mitigate some of the environmental impacts of urbanization is by building **wildlife corridors**. Wildlife corridors are built to connect wildlife populations that are separated by human-made structures. The corridor can be a bridge, tunnel, or an open space that is off limits to humans to allow animals to freely roam. Corridors connect areas of forest, grasslands, meadows, or waterways. These corridors allow animals to continue to feed, reproduce, and find shelter, increasing their chance of survival. Wildlife corridors also help contribute to conservation efforts. Allowing space for native vegetation to grow allows gas emissions from things like factories and vehicles to be captured by native plants and supports waterways. The corridors are also helpful in forestry and farming efforts.



Wildlife Corridor Under a Highway

Image Credit: United States Department of Transportation

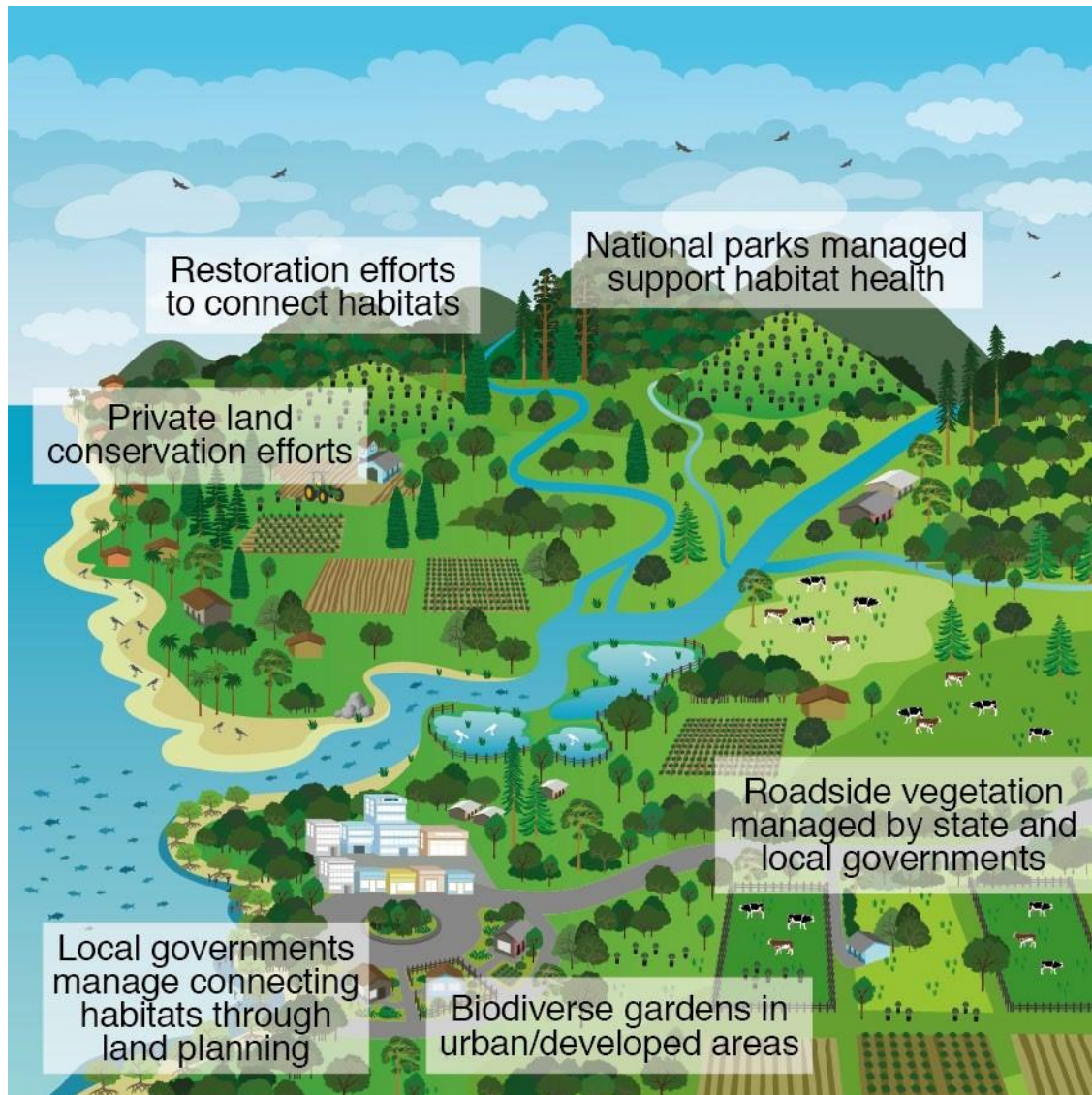


Wildlife Corridor Over a Highway

Image Credit: Benjamin P. Y-H. Lee, University of Kent

The size and scope of wildlife corridors varies greatly from a small area along a river bank to large areas that cover miles of land. An example of a small corridor might be a small area along a forest creek that has been revegetated to connect two patches of forest land. Community groups and individuals often help maintain and build these smaller-scale corridors.

Larger-scale corridors that span miles and often cover multiple landscapes often require collaboration between many groups to build and manage. Large-scale corridors often work to connect several smaller-scale corridors as part of a larger effort. To learn more about wildlife corridor efforts in California, read about [habitat connectivity from the California Department of Fish and Wildlife](#).



How Wildlife Corridors Connect Areas

In addition to urban water use, California also uses water for agriculture. An increase in high-yield groups such as nuts and fruits has increased the economic return on agricultural water usage in the state, even with an overall decrease in water use for agricultural purposes.

In order to continue to maintain California's water supply and to plan for drought, additional measures to maintain groundwater supplies are needed. California state law now requires groundwater basins in the state to have long-term balance plans by the early 2040s.

California has the nation's largest human population, the most diverse and economically important agricultural industry, and the greatest diversity of environmental resources. With all of these competing interests, the proper allocation and sustainable management of water—the most limiting resource—is crucial for the future of the state. California forests, both publicly and privately managed, play a critical role in the storage, purification, and transportation of this precious resource. The collaborative planning processes among all competing users of water is the key to proper conservation for beneficial uses, with forests playing a central role in this process.

Research

Who Owns and Manages California's Forests?

More than 30% of California's land is forested. California forests may be managed by the federal government, like Sequoia National Park, but they may also be run by the state, other public entities, or private organizations. There are many forests in California owned by Native American tribes. Some forests are even owned by individual people. Use the data or websites provided by your teacher to fill in how much of California's forests are owned by each group.

- _____ % of California forests are national forests.
- _____ % of California forests belong to the State of California.
- _____ % of California forests belong to Native American Tribes.
- _____ % of California forests belong to industry (businesses).
- _____ % of California forests belong to individual people.

National forests belong to everyone—including you! People most often use these areas for recreational activities. Hunting, hiking, fishing, and camping are all activities that people can enjoy in national forests. One-third of the national forests are designated as timberland available for harvesting. Harvesting can improve the health and resiliency of our watersheds. We remove some trees so the ones we leave can thrive. The types and number of trees that can be removed at one time is something that is controlled by the federal government. National forests are managed by the laws and practices set by Congress to “provide the greatest good, for the greatest number (of people), for the long run.”¹

California state-owned forests belong to the State of California. As with national forests, the state uses its forests to provide recreational activities like hunting, hiking, bird watching, camping, fishing, and canoeing. Harvesting can also happen in state-owned forests.

There are several Native American tribes that own and manage California forests. Some of these include the Klamath, Yurok, Karuk, and Hoopa. The ancestors of these indigenous peoples used forests as a source of food and shelter. They would also work to manage the forests to keep them healthy. They would set fires on purpose to promote new shoots on shrubs. This also kept the forest floor clear to reduce surprise attacks from other tribes. The forests remain an important part of Native American tribal heritage and culture. Today, Native American tribes continue to manage the forests using controlled burning.

Some California forests are owned by large companies. The management of these areas is up to the company. Most of the time, management of the forests is done by the owner or a board of directors. A board of directors is a group of people who help make decisions for a company. The company still has to follow rules about how they can use a forest. The California State Board of Forestry sets the rules. These rules state that companies using their forests must have a plan to make sure they do not overuse the forest resources. There are other groups that decide whether or not companies are using their forests responsibly. Companies that own forests usually manage their land for wood products, habitat conservation, water quality, and other activities.

Lastly, some of California's forests are owned by individual people. These people own the land that has the forest on it and may even choose to build their homes there. Many people use their forests for hunting, hiking, camping, and other recreational activities. Forest owners must be aware of local and state laws that say how the land can be used. Because these areas are privately owned, they are not under the same rules as those owned by large companies.

Finding Your Watershed

Everyone in California lives in some kind of watershed. Use [this webpage](#) from the U.S. Geological Survey to find out more about the one where you live.

After you find the watershed where you live, click on the related links to learn more about it.

Write down some general information (location, amount of water, sources of water, etc.) and then share what you learned with your class.

Build Your Own Watershed

Now it's time to make a model of a watershed! Your model will help you to see how water flows through a watershed.

Supplies needed:

- Paper
- Marker (nonpermanent)
- Spray bottle
- Water

Steps:

1. Start by crumpling a piece of paper.
2. Smooth it back out most of the way. It should still be a bit crumpled, showing small ridges (high points) and valleys (low points).
3. Imagine that this paper is a section of land and find the ridgelines (the tops of the fold-lines).
4. Use a marker (nonpermanent) to color along the ridgelines on your watershed.
5. Use a spray bottle of water to create a gentle "rainstorm" over your watershed.
6. Observe and record what happens after the misting.
7. Repeat this a couple of times.
8. As your "rainfall" accumulates, observe the pathways where the water travels and collects.

Once you have some water in your watershed, trace a stream back up to where it starts at the top of the ridge. The top is the edge of the watershed for your stream and lake. Trace the entire edge of the watershed with your finger, by following the ridgeline.

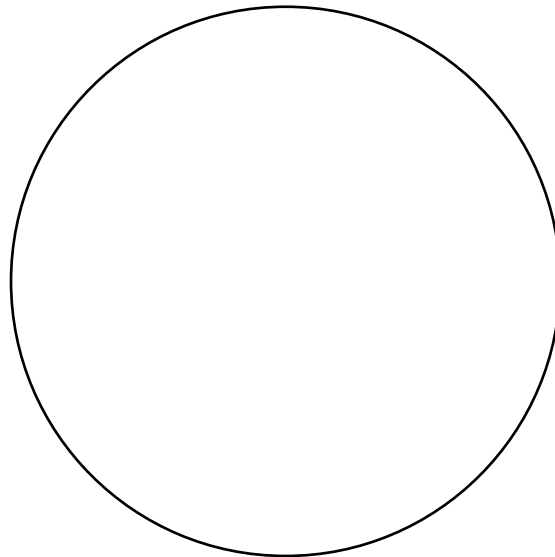
How does your model simulate water flow in a real watershed area? What land features do you notice in areas where water collects in pools instead of traveling downstream?

How California Uses Fresh Water

California's freshwater supplies are used in many ways throughout the state. Use the data in the table to make a pie chart to compare how fresh water is used in the state.

Table 1: How Fresh Water Is Used in California

Use	Percentage of supply
Irrigation for agriculture	40%
Urban use	10%
Environmental	50%



Take a look at Earth's water diagram from earlier in the lesson and compare that to the pie chart you just created.

Make a claim about the amount of fresh water available for use compared to how fresh water is used. Use evidence from what you have learned in the lesson and your pie chart to support your claim.

What Did You Learn?

Answer the following questions to test your knowledge.

1. Which statement explains how forests support water supplies in California?
 - a. Forests provide an additional source of water to add to the groundwater.
 - b. Forests clean the runoff by filtering the water through soil.
 - c. Forests prevent flooding by absorbing all precipitation.
 - d. Forests keep surface water levels constant by adding more over time.

2. Match each area of surface water with how much is found on Earth.

_____ Atmosphere	a. 0.49%
_____ Lakes	b. 3.0%
_____ Rivers	c. 3.8%
_____ Soil moisture	d. 20.9%

3. Through what process do trees and plants release water vapor into the atmosphere?
 - a. Precipitation
 - b. Condensation
 - c. Transpiration
 - d. Evaporation
4. California gets most of its fresh water from _____ in the northern part of the state.
5. Why is collaborative water planning and conservation important in California?

Apply to Real World

Group Activity

Your teacher will assign you to a group to work on your activity.

¹ <https://www.fs.fed.us/greatestgood/press/mediakit/facts/pinchot.shtml>