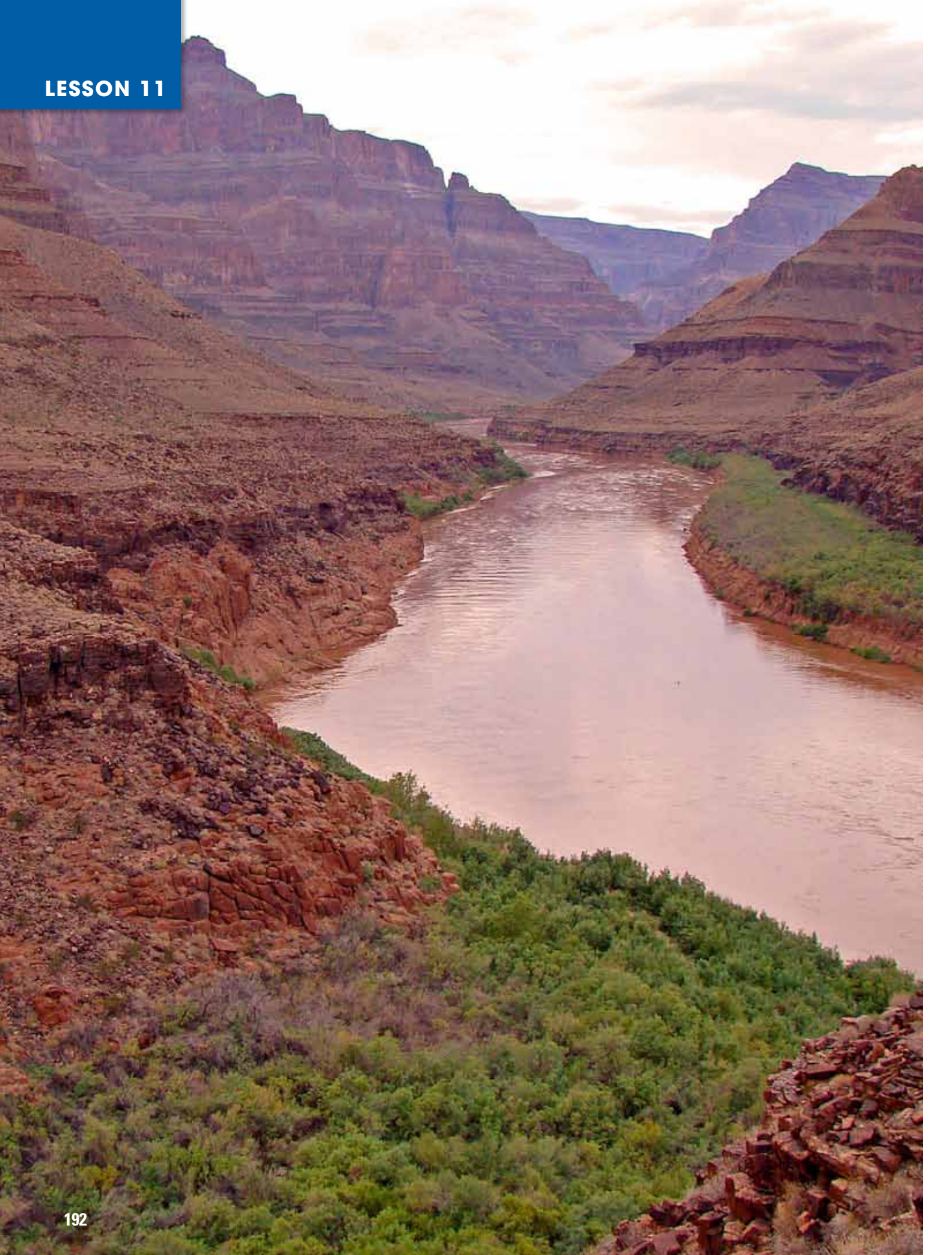


**LESSON 11**



# A Case Study in Water Use: The Colorado River

***How do people depend on the Colorado River and share its water?***

## Introduction

Many rivers flow through the United States, but few of them are as important as the Colorado River. The people who live in the West and in the Southwest depend on the Colorado River for many things. The river provides drinking water for more than 36 million people. It supplies water for more than 3 million acres of farmland. Dams on the river help produce much of the electricity used in the Southwest.

The Colorado River begins high in the Rocky Mountains. The beginning of a river is called its source. The Colorado wanders south and west through some of the driest parts of the country. Then it crosses into Mexico, where it ends in the Gulf of California. The river's total journey is 1,450 miles long.

Many smaller rivers flow into the Colorado. Rivers that join other, larger rivers are called tributaries. Each tributary adds water and soil, called silt, to the Colorado. This silt gives parts of the river a reddish brown color.

The history of the Colorado River Basin shapes how people use and share this river. Current challenges will affect its future. How can we use this resource wisely?

## Social Studies Vocabulary

conservation

drought

habitat

irrigation

municipality

reservoir

river basin

wastewater

◀ The Colorado River flows through the Grand Canyon on its way to the Gulf of California in Mexico.



Civics



Geography



History



A spring continuously fills this natural well in central Arizona. The well was a valuable water source used by early settlers of the region.

**river basin** the area around a river and its tributaries

**drought** a long period of time when little or no rain falls

## 1. The First Settlers in the Colorado River Basin

Today, millions of people live in the Colorado River Basin. A **river basin** is the area around a river and its tributaries. In the past, the Colorado River Basin was mostly an empty desert.

Two of the American Indian groups that once made their homes in this dry region were the Anasazis and the Hohokams. The Anasazis lived in the Four Corners area. This is where the states of Arizona, New Mexico, Utah, and Colorado meet today. The Hohokams lived in central Arizona.

The Anasazis and the Hohokams were farmers. They raised corn, beans, and squash in desert fields. Not enough rain fell to water their crops, so they built canals to carry water from rivers to their fields. Some Hohokam canals were so well built that they are still used today.

Around 1350, the Anasazis left their villages. Around the same time, the Hohokams also left. The name Hohokam means “those who have vanished.”

Why did these people leave their homelands? No one is sure, but the most likely answer is **drought**. A drought is a time when little or no rain falls. When no rain came and their rivers ran dry, the Anasazis and the Hohokams probably had two choices. They could leave and live, or stay and most likely die. They chose to leave their villages to live in other parts of the Southwest.

## 2. Explorers Arrive

Spanish explorers were the first Europeans to visit the Southwest. In 1540, a Spanish soldier named Francisco Vásquez de Coronado led an army north from Mexico. Coronado hoped to find cities made of gold. Instead, he found American Indian villages built from mud and stone.

In their search for gold, some of Coronado's men came upon the Grand Canyon. From high up on the canyon rim, the river at the bottom looked like a trickling creek. The men didn't bother to give it a name.

Spanish settlers eventually followed Coronado into the Southwest and lived off the land by farming and ranching. These settlers eventually named the muddy river flowing through the Grand Canyon. They called it the Colorado, which means "reddish color" in Spanish.

In 1869, an explorer named John Wesley Powell and a crew of nine men navigated down the Colorado in small boats. These men were the first Americans to see the Grand Canyon from the bottom. The trip took three months.

In 1871, Powell made a second trip down the Colorado. He wrote a report on the Colorado River Basin. He said that the region was too dry for much settlement. He believed that there wasn't enough water to support a large number of people.

John Wesley Powell explored the Colorado River in the 1800s. During his second journey, Powell made a map of the Colorado River.



### 3. A Wave of Settlement

Powell's warning did not stop settlers from coming to the Colorado River Basin. Some of them were farmers. Like the Anasazis and the Hohokams, they found that they could grow crops in the desert. They just had to bring a lot of water to their fields.

**irrigation** a way to bring water to dry land, using water from another location

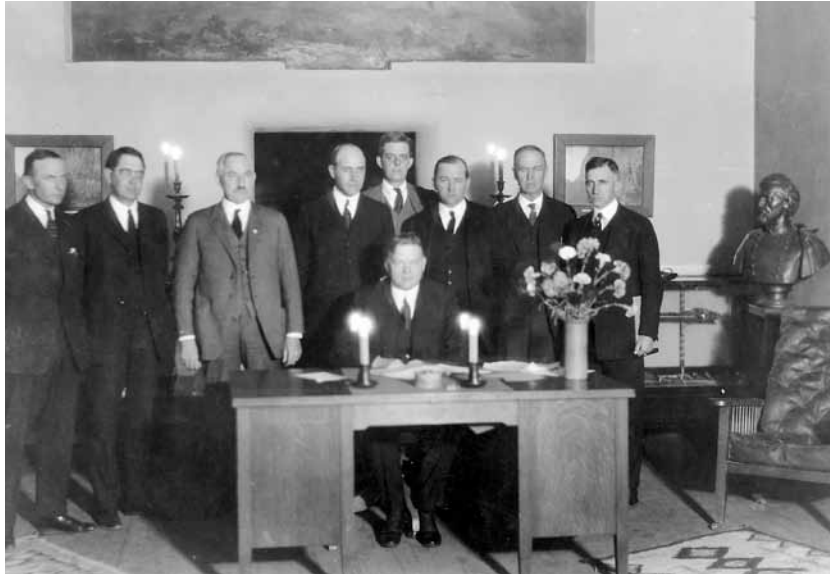
To do this, farmers used **irrigation**. Irrigation is a way to bring water to a dry area. Some irrigation systems use canals, pipes, and ditches to carry water from one place to another. This is how farmers irrigated the Colorado River Basin.

Other settlers became cattle and sheep ranchers. Sheep and cattle could live off plants that grew wild in the Southwest. But ranchers had to find drinking water for their animals. Some ranchers also needed water to raise crops of hay for their animals.

As the number of settlers grew, towns appeared in the basin. A few—such as Las Vegas, Nevada, and Phoenix, Arizona—grew into cities. People living in these towns and cities needed water for drinking, washing, and watering their gardens. All of these people looked to the Colorado and its tributaries for their water needs.

Canals in the river basin irrigate fields and provide drinking water for animals. Farming and ranching is only possible by bringing in lots of water.





Representatives from the seven basin states signed the Colorado River Compact on November 24, 1922. Mexico was not included in this agreement.

#### **4. Sharing the Water: The Colorado River Compact**

At first, the Colorado River had enough water for everyone. Water was divided up following the rule of “first in time, first in right.” This meant that people who settled first were first in line to draw water from the river. Those who came last were last in line.

This way of dividing water created a problem because those settlers first in line lived mostly in California. This meant that California had the right to use almost all of the river’s water. This didn’t seem fair to other states in the river basin.

In 1922, the seven states in the river basin reached an agreement known as the Colorado River Compact. The compact divided the basin into two parts. The Upper Basin includes Wyoming, Colorado, Utah, and New Mexico. The Lower Basin includes Nevada, California, and Arizona. The compact gave each part of the basin an equal amount of water from the Colorado River.

The Colorado River Compact said nothing about Mexico. Mexico’s water users worried that there would be no water left by the time the river crossed the border. So, the United States signed a separate agreement with Mexico. In it, the United States promised to leave some water in the Colorado River for Mexico.

## 5. Taming the River with Dams

The Colorado River Compact gave each state the right to a portion of the river's flow. But turning that right into a constant water supply was not easy. In wet years, the river flooded its banks. In dry years, the river barely flowed.

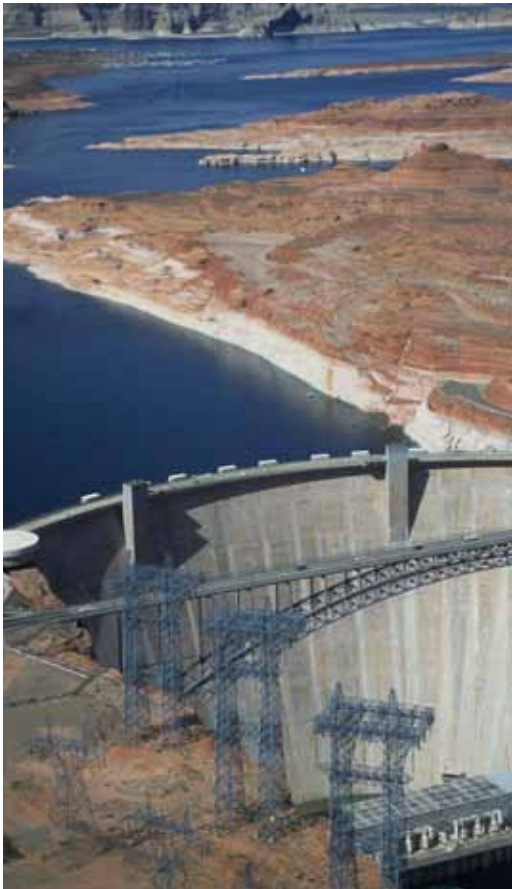
The only way a state could get and keep its share of river water was to trap and store it by building dams. As water backs up behind a dam, it forms a **reservoir**. A reservoir is a place where water is stored for people's use.

Since the 1930s, the states have built more than 80 dams on the Colorado River and its tributaries. These dams have tamed the river. In wet years, they prevent flooding by not letting too much water flow down the river at one time. In dry years, the reservoirs provide water to farms and cities.

Most dams generate electricity. Water rushing through openings in the dam causes huge machines to spin. These machines are called turbines. The spinning turbines create electricity. This electricity is sold to help pay for the dams.

**reservoir** an area where water is stored for people's use

Dams provide a constant supply of water and electricity to their users. The Glen Canyon Dam holds back some of the Colorado River to form Lake Powell.





## 6. Managing the Water

You've read how the Colorado River has been dammed to provide water and electricity for the seven compact states. But how does the water actually get to each home, business, or farm that needs it? Water has to be collected from the river, treated, stored, and then distributed. A municipal water system does all these things for you and others who use water.

A **municipality** is an agency, or business, organized by a state or city to perform a service. The service may be waste removal, fire protection, water and electricity delivery, and others. A water municipality delivers the water from the Colorado River to the people of the state. Municipalities cover a defined area, often a town, city, or even larger district. You may call your municipality the "water company."

A water company is responsible for many things. It stores and delivers the water through a system of reservoirs, pipes, pumps, or canals. And it must maintain these systems. The water company treats the water and keeps the water clean. For these services, the water company charges users a fee and, sometimes, taxes. Water companies also educate users on how to save water. By managing the water, a water municipality does its best to make sure that everyone gets the water they need now and in the future.

A water municipality delivers clean water to homes, businesses, and farms. It also helps to educate users on how save water.

**municipality** an elected agency, or business, that performs a service for the state or city





So far, the Colorado River has met the needs of its growing number of users. Families can save water by washing only full loads of laundry.

## 7. The Number of Water Users Grows and Grows

The dams helped people share water from the river, but, year after year, more and more people moved to the Colorado River Basin. These people built new houses and businesses. Still, the Colorado River provided water and electricity for everyone. Who are these water users?

The largest group is made up of farmers and ranchers. A farmer uses three gallons of water to grow one tomato. A rancher uses more than 600 gallons of water to raise the beef for one hamburger.

Families are major water users, too. People need water to drink, shower, flush toilets, and wash clothes. Did you know that one load of laundry can use 30 to 40 gallons of water?

Businesses are major water users as well. A clothing company needs about 1,800 gallons of water to make one pair of jeans from cotton.

Miners are also major water users. Gold, iron, copper, coal, and uranium are found in the Colorado River Basin. Miners use large amounts of water to wash these valuable ores from the soil.

So far, the Colorado River has met the needs of these water users. But, as more people move into the basin, there may not be enough water for everyone.

## 8. Wildlife Water Users

People are not the only water users in the Colorado River Basin. Mammals, birds, fish, and other animals need the river, too.

The taming of the river has hurt wildlife by destroying **habitats**. A habitat is the place where a type of animal typically lives in nature. The natural habitat of fish, for example, is water.

As you know, dams built on the Colorado have turned parts of the river into reservoirs. Otters, and other animals once lived along these parts of the river. Now their habitats have changed.

Dams have also changed the water in the river. Before the dams were built, the river water was muddy and warm much of the year. The river's water level was at its high point in spring. Today, the water released from a dam is clear and cold. The water level is highest in summer. That is when farmers and cities need water and electricity the most. These changes have hurt fish and other wildlife.

Today, some dam operators try to help wildlife by releasing more water in spring. But this change means less water for people during the summer months.

**habitat** the place where a type of animal typically lives in nature



Mammals, birds, fish, and other animals need the Colorado River. Dams on the river have hurt fish and other wildlife.

## 9. Is There Enough Water for Everyone?

The Colorado River Compact was based on the belief that about 17 million acre-feet of water flow down the river each year. An acre-foot is the amount of water it would take to cover an acre of land with one foot of water. (An acre is about the size of a football field without the end zones.)

After the United States signed an agreement with Mexico, this is how all that water was divided:

- Upper Basin states: 7 ½ million acre-feet
- Lower Basin states: 7 ½ million acre-feet
- Mexico: 1 ½ million acre-feet
- Total: 16 ½ million acre-feet

If the same amount of water flowed every year, this plan would work. But the river does not always carry this much water. In wet years, the flow may rise to more than 20 million acre-feet. In dry years, it often falls below 10 million acre-feet. And there are more dry years than wet years in the Colorado River Basin.

An acre-foot of water is about 326,000 gallons. This may sound like a lot, but it's not. A family of four uses 1 acre-foot of water each year. A farmer uses 3 acre-feet to water just one acre of land each year.

As more people settle in the Colorado River Basin, there may not be enough water for everyone.

The amount of water in the Colorado River changes if it is a wet or dry year. However, the number of water users in cities like Las Vegas keeps growing.





## 10. Meeting Future Water Needs: Farming

In the future, water users in the Colorado River Basin will face shortages. There are only two ways to solve this problem. One is to increase the supply of water. In the past, this was done by building dams. But most of the best places for dams have already been used. In addition, dams can hurt the natural environment.

The other solution is to use less water. This is called **conservation**. Conservation is the careful use of a resource. It sounds easy, but it is not. Using less water takes planning. It also takes new ways of thinking and new inventions.

Conservation efforts are already being made. Farmers are changing the way they irrigate their fields. Sprinkler and ditch irrigation systems lose much water to evaporation. If farmers can reduce evaporation, they can use less water. So farmers apply mulch, or a cover, to the soil and use drip systems. Irrigating at night can also help reduce evaporation.

Farmers are also changing when crops are grown and for how long. Some fields lie fallow, or unused, for a season. Cover crops, like soybeans or turnips, are planted after the main harvest. Cover crops are seeded in the remains or stems of harvested wheat or other crops. The soil is not tilled. This helps the soil hold water better and adds nutrients to the soil. Conservation efforts like these help farmers use less water.

In farming, sprinkler systems waste water to evaporation. Drip irrigation, like used here in the cornfields, helps reduce evaporation loss.

**conservation** the careful use of a resource

## 11. Meeting Future Water Needs: Cities

Turning off the water while you brush your teeth. Taking shorter showers. Only running a fully loaded dishwasher. What do these habits have in common? They are ways that you can help conserve water. Water conservation is important in homes as well as on farms. Tips like these are being followed in cities and towns of the river basin.

Conservation efforts are going beyond personal habits. For example, all new homes in the river basin are built with low-flow toilets. These toilets use less than two gallons with each flush. Older toilets use up to seven gallons per flush.

Conservation is happening outdoors. City gardeners are planting native plants to decorate their cities and reduce erosion. These plants usually don't need to be watered. Native plants are adapted to an area's climate. If you do need to water the garden, rain barrels are a way to reduce water use from a faucet. Rain barrels attached to homes or businesses capture runoff of water from roofs. This water can be used later to water gardens.

Many cities are recycling the water that goes down the drain every day. This water is called **wastewater**. Cities collect and treat wastewater so that it can be safely used again. Treated wastewater often irrigates plants in parks and grass at golf courses.

**wastewater** water that has been used

Water conservation can start in the home. Running only a fully loaded dishwasher is a water-saving habit.





Communities in the Southwest and all across the country are finding new ways to save water. You can help, too. Report leaky faucets at school and broken sprinklers around your community. Every little action helps. Rethinking the way you use water will help conserve it to make sure water is there when you need it.

It takes lots of water to keep a golf course green, especially in the desert. How can people conserve water in areas like this?

### **Lesson Summary**

If John Wesley Powell could see the Colorado River today, he would be amazed. The river he explored ran free from the Rocky Mountains to the Gulf of California. Today, giant dams slow the river's rush to the sea. Those dams have changed the Colorado River in ways that Powell could never have imagined.

When Powell explored the river, few people lived on the land around it. Now, more than 25 million people rely on the Colorado River Basin. Powell would be surprised to see so many people. He would also be surprised to find farms and cities blooming in the desert.

If Powell were here today, he might issue a new report on the Colorado River Basin. Water is precious, he might tell us. It is more precious than gold. So use the river's gift of water wisely and conserve it.

# Water in Your State

You just read how people in the Southwest and West depend on the Colorado River. Citizens worry there won't be enough water for the needs of a growing population.

Your state may also face a water problem. It may be a water shortage, water pollution, or flooding. You can do some research to find out your state's biggest water problem and what people are doing about it. Write these two big questions on a piece of paper:

*What is the biggest water problem facing our state?*

*How can we help solve it?*

Talk with your classmates about the best places to find answers to these two big questions. Use the library and the Internet to find sources. When you find a source, talk about who wrote the information. Does the writer want to persuade you to think a certain way? Does the writer want to only help certain businesses or groups? It is important to know that people have different opinions and want different outcomes when they suggest answers to problems.

For example, in Iowa, one of the most important water problems is pollution in streams and lakes. Much of the pollution comes from chemicals that farmers use to fertilize their crops or kill insects. The chemicals run through the land into the water. It can hurt fish as well as people's drinking water. If you were researching solutions to this problem, it is important to hear different opinions. Farmers may want to solve the problem without hurting their business. Others may want to stop farmers from using chemicals that harm the environment.

As rain or snow runs over land that has chemicals in it, the water picks up the chemicals. It flows into streams and lakes and pollutes the water.





## Solving the Problem

As you research your state's water problem, write the suggested solutions on your piece of paper. Under each solution, write the author's name and the book title or Web site address. Try to find the opinions of two or more groups of people. These may include farmers, business owners, homeowners, and conservation groups.

Now write a four-paragraph presentation that you can read to your class. In the first paragraph, describe the important water problem that your state faces. Include where in the state it is happening and describe why it is a problem.

In the second and third paragraphs, write about two or more ways that people can help solve the problem. In the last paragraph, summarize your presentation and make a prediction of how the water issue may be improved if people work together.

Read your presentation to your class. Ask your classmates if they have other suggestions that might help solve the problem. With your classmates, decide on a group project to share this information with people outside of school.

These students made a poster to remind people to not waste water.

This student explains how to help keep the water clean in her state.







# At Home in the Grand Canyon

For most people in the Southwest, lack of water is a problem. But the Havasupais who live in the Grand Canyon have a different challenge: flooding from Havasu Creek. How does water affect life for the Havasupais?

*Chop, chop, chop.* The helicopter flew through the air down into the Grand Canyon. Suddenly, the pilot saw a wall of water rushing toward Supai, the tiny village at the bottom of the canyon. Quickly, the pilot radioed an emergency warning.

Supai is the home of about 450 Havasupais, an American Indian tribe. In Supai, people soon saw the cascade of water coming from Havasu Creek. Many Havasupais ran from their homes and fled up the cliffs. Two people climbed eight feet up a tree to escape the churning water.

Lester Crooke, the tribe chairman at that time, said of the water, "It was really rushing through, bringing all kinds of big rocks and logs." Crooke and others helped people get to safety. Tourists who were hiking and camping nearby were rescued by helicopter. It was days before residents could return to the village, only to find many of their belongings destroyed.

To reach the village of Supai, you can walk or ride a mule down eight miles from the canyon rim. Or you can take a helicopter ride!



## Floods in the Canyon

The flood you just read about took the Havasupais by surprise. So too had larger floods in earlier years.

Most of the time, the Havasupais have some warning about a possible flood. The floods often come after days of heavy precipitation, either rainfall or snowfall. At those times, water runs down the sides of the canyon rims filling the creeks near Supai until they overflow. The Havasupais have time to react to this danger.

Rose Marie Manakaja is an elder in the tribe. "Our parents and grandparents taught us other signs to watch out for," she explained. "For example, the animals usually know when a flood is coming. The horses and mules twitch their ears and noses in a certain way. The dogs know, too."

But, sometimes, floods come unexpectedly. Then the residents of Supai are in great danger. In 1993, another surprise flood destroyed bridges, trails, and homes. This flood wrecked an irrigation system that was hundreds of years old. It washed away 43 acres of farmland and killed some of the farm animals. In all, the flood caused \$2.5 million in damages.

So how *do* the Havasupais live with the threat of floods in the Grand Canyon?



These are the Havasu Falls near Supai. Flooding of creeks can damage the beautiful pools near these falls.



The Havasupais have lived in the canyon for hundreds of years. Here, Havasupais gather in front of a schoolhouse around 1900.

### **Living with the Water**

Manakaja explained that the residents of Supai are used to these floods that come so suddenly and unexpectedly. “We grew up here,” she said. “To us, it is part of our life.”

The Havasupais have lived in the canyon for hundreds of years. Their name relates to the water nearby and means “the people of the blue-green water.”

Like other American Indians in the Southwest, the early Havasupais were farmers. In spring, summer, and early fall, they lived down in the canyon cultivating the land. There was plenty of water from Havasu Creek for irrigation of their fields as well as the orchards where they grew peaches.

In the Havasupai tradition, their creator Tadjupa said, “Here is the land where you will live. Go to the places where you find water. Mark off your land and live by the water.”

However, in late fall and winter, the water in the canyon could become a threat to their village. When the floods came, the water could cause great destruction. So the Havasupais moved up to the canyon rim where it was sunnier and safer. Above the canyon, the Havasupais gathered food and hunted deer and elk. They roamed over thousands of acres of rich hunting grounds.

## Conflict over Land

For centuries, the Havasupais lived with these cycles of nature. But the world above the canyon was changing.

By the late 1800s, thousands of Americans had moved west. Many were cattle ranchers who fenced off the land where the Havasupais hunted. Soon, conflict erupted over who had the right to use the land. In the 1880s, the U.S. government took action. It said that the Havasupais could keep only 518 acres out of the thousands of acres they had been using. All the land that was left to them was in the Grand Canyon and none at the top.

Now, without any land to escape to on the canyon rim, the Havasupais could no longer leave during flood times. So they learned to live with the water in good times and in bad.

In 1975, the government returned more than 185,000 acres of land on the canyon rim to the Havasupais. But the people of Supai stayed put. They loved their land in the canyon and wanted to live there, floods or not.

Some people think that the Havasupais should dam the creek to stop the flooding. To that, the Havasupais say no. They want to live with the natural environment rather than alter it. So they watch carefully for floods and leave their canyon when they must. The Havasupais have been at home in the Grand Canyon for many centuries and intend to stay there for many more. ♦



Today, the Havasupais live much as they did centuries ago. Here, a mule team hauls mail and other gear to Supai.