# WATER

Residents of the Mojave Desert live in an area that normally receives less than ten inches of rain a year, usually less than six. Some places in Death Valley receive less than two inches a year. In contrast, many areas in the northeastern United States receive more than sixty inches of rain annually. Before construction of dams along the Colorado River and development of an elaborate water delivery system, only a few thousand people lived in this region as there was no dependable water supply. Today over twenty million residents prosper here because of this system.

# WATER

## The Colorado River

From space the Colorado River is seen as an undulating blue line that extends 1,450 miles from the Rocky Mountains of Colorado to the Gulf of California. Plummeting from an elevation of fourteen thousand feet, the river descends through some of the most rugged and remote territory in the United States. Much of its course passes through the hottest, driest region in the country, where rainfall averages four to six inches a year and the temperature often rises to 120°F. Each year it carries nine million tons of salt and 136 million tons of silt to the sea, eroding rock over 1.7 billion years old and carving mile-deep canyons. The river and its major tributaries traverse through seven states, draining an area of 242,000 square miles.

This once-wild river has played a central role in human society for nearly two thousand years. Native American groups, such as the Anasazi, Mohave, Hualapai, and Paiute indians farmed its

fertile flood plains for centuries. Native fish, such as the Colorado squawfish and the humpback sucker, provided an important food source.

Early peoples had many different names for the Colorado. The Mohaves, who lived along its banks, called the river *Ahamcave* (along the water). The Paiutes of southern Utah called the Grand Canyon section of the Colorado *Pahaweep* (water down deep in the earth). Named the Tison or Firebrand River by white explorers of the 1500s, the river did not receive its present title until 1776 when a Spanish missionary traveled to the edge of the Grand Canyon and described what he saw as *El Rio Colorado* (the red river).

Rivers historically have been used as major routes of travel, often through land that was otherwise inaccessible. The Colorado, however, until tamed by Hoover Dam, remained an almost impenetrable obstacle to navigation. One of those who tried was Lt. J.C. Ives, sent by the United States Army in 1858 to travel up the Colorado by boat as far as possible from the Gulf of California. He piloted his steamboat five miles upstream from where Hoover Dam now stands and remarked:

> "The region is altogether valueless. Ours was the first, and will doubtless be the last, party of whites to visit this profitless locality. It seems intended by Nature that the Colorado River shall be forever unvisited and undisturbed."

It was not until 1869, when Maj. John Wesley Powell, a Civil War veteran, completed his historic journey down the river from Green River, Wyoming, that the Colorado was finally mapped in its entirety.

Today over twenty million people rely on the Colorado River as their primary water supply, including people living in Las Vegas, Nevada; Palm Springs, San Diego, and Los Angeles, California; and Phoenix and Tucson, Arizona. Two million acres of farmland are irrigated by the river, and ten major dams have been built along its course in an attempt to control its unpredictable behavior.

So important is this river to residents

## GLOSSARY

**adaptation** — special tools for survival; physical or behavioral characteristics that make an organism more suited to its environment.

**aquifer** — rock or sediment through which groundwater moves easily.

**atmosphere** — the gaseous mass surrounding Earth to a height of 500 miles and held in place by Earth's gravity; provides the gases essential to life: oxygen, carbon dioxide, nitrogen, and water vapor. Water is stored in the atmosphere as clouds.

**cloud** — a visible body of fine droplets of water. May exist up to several miles above Earth's surface.

**condensation** — the process by which water changes from the vapor state to the liquid or solid state. Water vapor stored in clouds condenses to form rain.

**conservation** — the careful use of a specific resource such as water.

**ecosystem** — the interaction of the biological community (all living things) and the physical environment (water, air, minerals).

**evaporation** — the process by which water changes into a vapor.

**glacier** — a thick mass of ice originating on land from the compacting and recrystallization of snow that shows evidence of past or present flow.

**groundwater** — water stored beneath the surface of the ground, coming from *precipitation* and surface water that has percolated down. Water that supplies wells and *springs*.

**habitat** — the place where a plant or animal lives, an organism's home. Provides food, water, shelter, and space in a *suitable arrangement*.

**icecap** — a covering of ice and snow permanently overlying an extensive tract of land and moving in all directions from a center.

**oasis** — a fertile or green spot with water in a desert. Palms, mesquite, willows, and cottonwood trees may grow there.

**Pleistocene Epoch** — an epoch beginning about 2.5 million years ago and ending about 10,000 years ago. Best known as a time of extensive continental glaciation.

**precipitation** — water received directly from clouds as rain, hail, sleet, or snow.

**riparian** — located or living along or near a stream, river, or body of water.

**spring** — a natural flow of *groundwater* that reaches the surface.

**suitable arrangement** — when those things necessary for survival (food, water, shelter, space) are adequate in quantity, accessible, and in keeping with the biological lifestyle of a species.

**transpiration** — a process by which plants evaporate moisture through the surfaces of their leaves.

of the Southwest that some have called it "the most legislated, litigated, and debated river in the world." All the water in the Colorado River was legally allocated among the seven contiguous states with the signing of the Colorado River Compact in 1922. Through this compact, 16.9 million acre-feet were given away, two million acre-feet more than existed in the entire system (one acre-foot of water equals 325,000 gallons or the amount an average family of four uses in one year). An additional 1.5 million acre-feet were promised to Mexico annually with the signing of a 1944 agreement. Today, because of an extended drought, it is estimated that less than nine million acre-feet flow down the river each year. Of that, only a trickle finally finds it way to the Gulf of California.

The river has also been described as "a finite resource with an infinite demand." Most years it never reaches the ocean. Because of this demand, in 1991 the Colorado River was declared the most endangered river in the United States by American Rivers, a conservation society.

## What Good Is A Fish?

Much of the native life that exists in or along the Colorado River is endangered. Construction of dams forever changed the character of the river. Once warm, silty, swift, and shallow, the river is now cold, clear, deep, and virtually stagnant along much of its route.

Fish, in particular, cannot tolerate these changes. Seventy percent of the fish population of the Colorado River exists nowhere else in the world. Four species of fish native to the river are endangered — the razorback (or humpback) sucker, the humpback chub, the bonytail chub, and the Colorado squawfish. All have developed specific structures to survive the extreme environmental conditions of their turbulent, silty habitat, the most common adaptation being a large hump behind the head. This hump allows the fish to stay on the bottom of the stream where currents are not so strong.

These fish depend upon tributary canyons that provide shallow spawning areas and protected back bays for juveniles. Most of the traditional spawning areas have been flooded with the rising waters of human-made lakes. While rivers change almost overnight with the completion of dams, native life adapts much more slowly, if at all.

Up to sixty thousand razorback suckers still exist in Lake Mohave, a remnant population that was there before the construction of Davis Dam. Most of these fish are twenty-five to sixty years old and are not reproducing successfully. If no effort is made to assist them, it is likely they will become extinct within the next ten years. A recovery effort is now underway in Lake Mohave. A back bay has been separated by a barrier from the main river channel in order to provide a spawning area for eighty adult fish. The young will be protected there until they are at least ten inches long and better able to compete with predatory fish such as carp and largemouth bass. If this project is successful, similar attempts may be made to reestablish the bonytail chub and the Colorado squawfish.

Nevada has eighty-two known native species of fish. Of these, seventeen are listed as endangered and four are listed as threatened. Thirty-one species are being considered for listing. Thirteen species have become extinct. The primary reason for this decline is *groundwater* pumping for irrigation and other water needs, drying many of the natural *springs* where native fish thrive.

The Devil's Hole pupfish was declared an endangered species in 1967 and its survival is still uncertain. This two-inch fish is one of five species of pupfish that are found in Death Valley springs. Its entire population is restricted to one small pool. Pupfish have survived from the *Pleistocene Epoch* when large inland seas covered much of the Southwest. As climates changed and the waters receded, the fish gradually adapted to smaller pools that have large concentrations of salts and other minerals toxic to most fish. Their ability to tolerate these saline conditions could one day be very valuable in researching human kidney diseases.

Southern Nevada's needs for new sources of water could have a direct impact on the fishes of Death Valley National Park. The Las Vegas Valley Water District has applied for permits to withdraw water from the groundwater supply underlying central Nevada, the same *aquifer* that feeds many springs in Death Valley as well as springs throughout Nevada.

Much attention has been paid to conserving "likeable" species such as the desert tortoise and the bighorn sheep. Insects, fishes, and other smaller organisms are often ignored. The National Park Service is legally obligated to protect all species found in national parks, both for the enjoyment of future generations and for the irreplaceable roles species play in the ecology of our planet. However, the National Park Service cannot defend wildlife, from shrimp to lizards to bats to bears, without the cooperation and commitment of all Americans. The survival of the human species depends upon our ability to protect the ecology of our planet, including the fish.

## Water Conservation

At first glance the water supply seems limitless. Lakes Mead and Mohave have over seven hundred miles of shoreline. Lake Mohave extends sixty-seven miles upstream from Davis Dam, and Lake Mead backs up 110 miles behind Hoover Dam, before it meets the Grand Canyon. When completely full, Lake Mead could supply every person in the world with 2,200 gallons of water or enough water to cover the state of New York to a depth of one foot. Lake Powell, formed by Glen Canyon Dam in 1963, has over 1900 miles of shoreline. Lake Mead, with its capacity of 28.5 million acre-feet, and Lake Powell, with its capacity of twenty-seven million acre-feet, can each hold over two year's worth of runoff from the Colorado River.

Why should we be concerned about conserving this vast resource? Construction of human-made reservoirs has given us a false sense of security. Inaccurate measurements led us to believe more water was available than existed. The large lakes allow tremendous amounts of water to evaporate — two million acre-feet evaporate from these surfaces each year, thirty million gallons of water evaporate from Lake Mead every hour. In fact, more water evaporates off the surface of Lake Mead every day than is used by the entire state of Nevada.

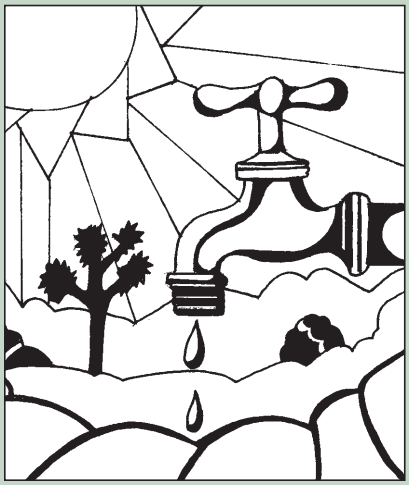
Much of the remaining water is used unwisely. More than sixty percent is sprayed over household lawns and gardens or used to irrigate farmlands in the valleys of Southern California, often with inefficient systems. So much water is used that the mighty Colorado rarely reaches the ocean anymore.

As the river approaches its destination, what water there is has such a high concentration of salts, pesticides, and fertilizers from agricultural lands that it is unsafe to drink. Water delivered to Mexico must first go through a desalination plant in Yuma, but desalination plants are expensive to build and expensive to use. Water produced at a desalination plant built in Santa Barbara, California, may cost up to $1,900 an acre-foot, or more than nine times the normal cost. How much will we be willing to pay for water in the future?

The Colorado River system continues to work only because some states are using less than their allocated share. Nevada will soon be consuming all of its allotment and will need to come to terms with the fact that there is no more water. As populations expand and demands continue to rise, something will have to change. Conservation must play a vital role in adapting to modern-day use of water in the desert.

## Fun Facts — WATER WONDERS

- Nearly 80% of Earth's surface is covered with water. This is the same amount of water that was here billions of years ago. Water cannot be created or destroyed.
- 97% of all the water on Earth is salt water.
- 3% of Earth's water is fresh water.
- 2% of Earth's water is glacial ice at the North and South poles.
- Only 1% of the world's water is fresh water available for us to use.
- The Great Lakes contain 20% of the world's fresh water.
- A person's body is about 70% water.
- A person can live only two to three days without water.



- An average person in the United States uses 77 gallons of water per day.
- Groundwater supplies 50% of the drinking water in the United States.
- About half of the fresh water used in the United States is for irrigation.
- 60% of domestic water is used to water gardens and lawns.
- A gallon of water weighs 8.34 pounds.
- It takes about 120 gallons of water to produce an egg. This includes water to raise the grain to feed the chicken. It takes 100 times more water to produce a pound of meat than a pound of wheat.

## Activity 1

# Creature Feature

OBJECTIVE: Create a creature with *adaptations* for living in a *riparian* area.

MATERIALS: Crayons, drawing paper.

SUBJECTS: Art, language arts, science.

SKILLS: Analysis, classification, drawing, problem solving, public speaking, reporting, small group work.

METHOD:

***1.*** Introduce students to the term riparian zone. This is an area that includes not only the water, but the vegetation associated with the water. Riparian zones are areas that surround fresh water springs and that line riverbanks and lakeshores. Many animals living in this area could not survive without the special conditions that the riparian zone provides. Riparian areas often provide different and more abundant vegetation than surrounding areas, a higher percentage of shade, trees for nesting or shelter, higher humidity, and more diverse plant and animal life. Riparian areas are easily affected by natural and man-made changes.

***2.*** Have each student design a creature adapted to living in a riparian area. This activity can be done individually or in small groups. While they are designing the creature, have them consider the following questions. Put the questions on a chalkboard or chart paper for easy reference. How are its feet adapted to the environment? What kind of body covering does it have that makes it well suited for living in an aquatic area (scales, feathers, shell)? Where are its eyes? How can it see what's above, what's below? How does it move (swim, fly, carried on current)? What does it eat? How is its mouth adapted to this kind of food? What kind of limbs does it have (arms, legs, flippers, gills, wings, tail)? Did you invent anything special which will help it adapt to living in a desert region (surviving flash floods, drought)? An example of an invented creature is below.

***3.*** Have students (or groups) share their creatures with the class, discussing ways each animal has adapted to an aquatic *habitat*.

EXTENDING THE EXPERIENCE:
Talk about threats to aquatic habitats, such as construction of dams along the Colorado River or draining a spring for irrigation. How would this creature adapt to these and other man-made changes? Would this creature disappear or would it adapt?

What could be done to protect this animal and still satisfy our water needs?

EXAMPLE:
**DOUBLE-CRESTED CREVICE CREEPER**

WHAT DOES IT LOOK LIKE? — This is a scaly-fleshed, bird-like creature. It has no feathers. The scales and flesh on its head, body, and legs have a rosy, golden hue. The creeper is the size of a sparrow.

WHERE DOES IT LIVE? — It lives near rocky stream bottoms, along muddy banks, and in areas of calm, deep pools for diving. This creature is mainly a wader, but it can submerge for up to three minutes in search of food. It is a non-migratory bird that lives in the southern part of the United States where the climate is mild all year long.

WHAT DOES IT EAT? — It feeds on insects, worms, animal carcasses, and discarded human food.

WHO EATS IT? — The creeper can be attacked by snakes and raccoons. It uses its long, pointed beak in defense against predators, goring them and then feeding on their carcasses. It shares the carcasses with other water and land animals, using the carcasses as bait to prey upon any insect, small creature, or fish that looks delectable.

WHAT ARE ITS ADAPTATIONS? —

1. It has a long bill for finding food in cracks and crevices of rocks and in mud. The creeper also uses its bill for snatching curious insects out of the air and small fish that may get too close.
2. Double crested, it has two colorful (red with yellow spots) bony ridges on top of its head. In and out of water, it has the look of a small blossom, helping to attract insects.
3. Its eyes have top and bottom lids for protection from darting prey and sun.
4. The coiled tail twists for propulsion under water.
5. Its webbed feet are for balance and propulsion through water.
6. Webbed, bat-like wings allow for low, short distance flight and underwater movement.

## Activity 2
# Water, Water Everywhere

OBJECTIVES: Explain why water is a limited resource. Name at least three ways you can conserve water in your daily life. Recite some simple statistics regarding water consumption in a typical household.

MATERIALS: Drinking glass with water, eye dropper, five gallons of water, five-gallon aquarium or clear plastic container, four jars of equal size (at least 2 ½ cups), map of the world, measuring cup, paper, salt, tape.

SUBJECTS: Language arts, math, science, social studies.

SKILLS: Application, computation, discussion, observation, research.

METHOD: There is a limited amount of usable water in the world. Therefore, it is important for people to conserve water in their daily lives. This activity demonstrates that our water resources are limited, shows how much water can be wasted by a typical family, and presents ways students and their families can save water. This is a two-part activity, consisting of a class discussion followed by a demonstration.

DISCUSSION:

***1.*** Begin activity with a discussion of the ways we use water each day, including how we use water to make the foods we eat.

***2.*** Ask: "How many of you think there is a lot of water in the world? How many of you think there is not a lot of water in the world?" Explain: "You are all correct. There is a lot of water in the world, however there is not a lot of water we can actually use."

***3.*** Display a world map. Have students read names of oceans from the world map. Ask: "Are our oceans salt water or fresh water?" Point out that there is a lot more salt water than fresh water in the world. Ask students to locate *icecaps* and *glaciers*.

***4.*** Is salt water available to us to drink? Place a tablespoon of salt in a cup of water and have a student take a sip. Explain that if we drink too much salt water we lose water in our body. Salts draw water from body tissues, preventing the body from functioning normally.

***5.*** Explain that fresh water is our main source of water for household uses and for drinking.

## Water Use Chart

- Brushing teeth — 5 gallons per minute (running water)
- Dripping faucet — 10 to 20 gallons per day
- Flushing the toilet — 5 to 7 gallons per flush
- Taking a bath — 30 to 40 gallons
- Taking a shower — 5 to 7 gallons per minute
- Using a dishwasher — 15 to 25 gallons per load
- Washing a car — 30 to 40 gallons
- Washing laundry — 20 to 40 gallons per loa
- Watering the lawn — 5 to 10 gallons per minute

DEMONSTRATION:

***1.*** Fill an aquarium with five gallons of water. Tell students this will represent the total amount of water in our *ecosystem*. Label this container "total water on the Earth."

***2.*** Remove 2 ¼ cups of water from the large container. Tell students this represents the total supply of fresh water in the system. Put this into one of the jars next to the aquarium. Label this jar "total fresh water on Earth." The remaining water in the aquarium represents salt water.

***3.*** Ask students to define/describe a glacier. Ask the students to predict the amount of fresh water locked up in glaciers on our planet. Take 1 ½ cups from the "total fresh water" jar. Put this in another jar and label "fresh water in polar icecaps and glaciers." Advise the class that this water is not available for use.

***4.*** Discuss briefly that the *atmosphere* also contains moisture, which we can sometimes see in the form of clouds and which can fall to earth as rain, snow, etc. Ask students to describe what happens to rain after it reaches the ground. Remind students that water runs into streams, lakes, ponds, and oceans; is used by plants and animals; and evaporates back into the atmosphere. Be sure to discuss the fact that some water falls onto soil and soaks in to become *groundwater*. Ask students to predict how much of the remaining fresh water is atmospheric or groundwater. Take ¼ cup from the "total fresh water" jar. Put this in a jar and label "atmospheric and ground water." Discuss why most of this fresh water is not available for use — because it is in the clouds or under a thick rock layer.

***5.*** There should be ½ cup water remaining in the "total fresh water" jar. Take five drops out with an eyedropper. These five drops represent the amount of fresh water available to humans. The ½ cup, less five drops, represents surface and groundwater that is either technologically or economically unfeasible to make available for human use — including polluted water. Put the five drops in a jar and label "fresh water available to humans." You may wish to place a few drops of food coloring in this jar so that students can see it easier. Relabel the "total fresh water" jar "polluted or too costly to use."

***6.*** Conclude this activity by discussing how we can ensure that this limited amount of fresh water is not polluted or lost in some way. What are some ways to conserve water?

EXTENDING THE EXPERIENCE: Reproduce the water use chart in a larger format. Have students keep track for one week of how much water they use. Multiply this by the number of people in the family. Add the amount of water used for watering the lawn and garden, washing the car, etc. How could some of this water be conserved?

## Activity 3
## Water Words

OBJECTIVES: Describe the water cycle. Describe one feeling they have about water.

MATERIALS: Bulletin board, crayons, Discovery Activity Pages #1 and #2, paint brushes, magazines, paper, pencils, scissors, watercolors.

SUBJECTS: Art, language arts, science.

SKILLS: Analysis, discussion, listing, mapping, research, writing.

METHOD:

***1.*** Ask students to cut photographs from magazines showing water. Display these on a classroom bulletin board.

***2.*** Ask students to list words connected to water, including ways they feel about the water in the photographs and its importance to plants and animals.

***3.*** Pass out copies of the two activity pages. Referring to the list at the end of this activity, write the word search vocabulary on the board. Introduce the words and use some of them to describe the water cycle. Have the students try to use these words in sentences. Have students complete the word search.

***4.*** Brainstorm adjectives for water, actions for water, words that describe feelings about water, and synonyms for water.

***5.*** Have students write short poems to describe their feelings about water or have them paint a water scene. One possible poetic form to use is this version of a cinquain. This is a five-line poem that contains the following format: The first line consists of one word, the subject of the poem. The second line consists of two words, adjectives describing the subject. The third line contains three words which express the subject's action (past, present, or future). On the fourth line the author writes four words describing his/her feelings about the subject. The final line is a synonym for the subject.

EXAMPLE:

Ocean
Gray, rough
Smashing, crashing, roaring
I'm half afraid, you
Sea

After the cinquains are complete, they can be shared by reading them aloud or displaying them with art.

EXTENDING THE EXPERIENCE: Research where your water comes from. Does your water come from a well or from a central delivery system? Visit your local water treatment plant and learn step-by-step how water gets to your area. Using a map of your local water system trace the water to its source.

### Word search vocabulary

*atmosphere*
bighorn
cactus
*cloud*
*condensation*
*conservation*
creosote
cycle
desert
drink
drip
*evaporation*
fish
*groundwater*
lake
mesquite
*oasis*
palm
*precipitation*
rain
*riparian*
river
*spring*
*transpiration*
water
willow

# Discovery Activity Page #1

C O N S E R V A T I O N C P W R
O L C R I W H E L C Y C R I V I
N B Y K B S W G J C B E L Q R P
D L E V I X A U L J C L V N E A
E A T F M O T O X I O N O V V R
N P I R D W U S P W P I A A I I
S X U D H D R I A I T P U T R A
A F Q N M Q T T D A O A Y M C N
T R S R S A E C R R M L H O E I
I A E Z T R N I A P I M A S K G
O I M I G R P T E C O N D P O N
N N O A O S I E Y H T L K H A I
I N T H N O J D T P G U S E N R
S F G A N K E K A L Z F S R Q P
U I R V G R O U N D W A T E R S
B T E T O S O E R C D E S E R T

# Discovery Activity Page #2

## The Water Cycle

All the water that exists on the Earth today was created billions of years ago. The amount remains exactly the same. Water changes form from solid to liquid to gas (vapor), but it can never be destroyed. As water changes form it travels through a never ending cycle — from rainfall to rivers, lakes, and oceans, then stored as groundwater or returned to the atmosphere by evaporation or transpiration. This cycle connects the world's water as one body, but only 1% of it is available as fresh water for humans to use. We must be careful to protect the quality of this water as it can become contaminated easily. All life depends upon water in order to survive.