Water Here, Water There

MOVING WATER THROUGH CALIFORNIA

Respect Rule: Look, Listen, Learn, and Leave Alone (until instructed).

Objectives
The student will gain a greater appreciation of the unique and often times complex job of water distribution throughout California.

Grade Levels
4–8

Adult/Student Ratio
Whole class

Where
Major reservoir site

Skills
Analyzing, discussing, comparing, researching, interpreting, mapping

Key Words
Aqueduct
Hydroelectricity
Irrigation
Reservoir

Overview

In California most of the rain and snow falls in the northern third of the state; most of the people live in the southern two-thirds of the state. The water industry is key in serving the southern two-thirds of California.

Background

See information in After-the-Field-Trip Activity 1.

Before-the-Field-Trip Activities

Activity 1: Conduct Water Transfer
Time: 45 minutes
Materials: 2 clear-plastic water bottles, 3 to 4 feet of flexible plastic tubing or several plastic "flex" straws, nail (or other device to punch a hole), packing tape, cloth or paper towels, water

1. Set up the demonstration: Fill one bottle about ¾ full and set it on a table. Fill the other bottle less than ¼ full and set it on a chair beside the table. If using plastic straws, insert one into the other and tape together to form enough tubing to reach from one bottle to the other.
2. Point out to students the full bottle of water on the table and the almost empty bottle on the chair. Tell students to imagine that the bottle on the table supplies water to "Table Town" and that the bottle on the chair supplies water to "Chair City." Explain that "Table Town" has more water than it needs, whereas "Chair City" does not have enough water.
3. Ask students how they could get some water from the supply in "Table Town" to the container in "Chair City." Discuss all suggestions.
4. Demonstrate one way to move the water. Cap the "Table Town" bottle, turn it up side down, and poke a hole in the side near the bottom. Put into the hole the flexible plastic tubing or the straws that have been taped together. Tape the tubing to the bottle to avoid leakage. Insert the other end of the tubing into the "Chair City" bottle. Put a towel on the table and then turn the "Table Town" bottle upright and set it back on the table. Remove the cap from the bottle.
5. Ask students what is happening and why. The water is flowing by gravity through the tube down into the container in "Chair City."
6. Ask students to imagine that it is "Chair City" that has more water and that "Table Town" needs water. Ask how they could get the water from "Chair City" to "Table Town." Discuss all suggestions and perhaps even try some ideas (e.g., using a pump spray bottle for the container in "Chair City" or blowing into the tube once part of it is filled with water).
7. Explain to students that sometimes water cannot travel by gravity to where it is needed; it must be pumped over mountains or across flat land.

Activity 2: Water Distribution: Problem and Solution
Time: 45 minutes
Materials: Water Here, Water There Fact Sheet

1. Give each student a copy of the fact sheet.
2. Ask individual students to read aloud the text and then use the questions below to discuss with the class what was read. Or, write the questions on the chalkboard; divide students into cooperative groups; have groups read the text and write their answers to the questions; and then discuss the reading together as a class.

   Why is supplying water to people throughout California a problem? Most of California's water, 75%, is in the north, but 75% of the people are in the south.

   How is water moved to where it is needed

> **Our children no longer learn how to read the great Book of Nature from their own direct experience or how to interact creatively with the seasonal transformations of the planet. They seldom learn where their water comes from or where it goes. We no longer coordinate our human celebration with the great liturgy of the heavens.**
>
> —Wendell Berry

in the state? Water travels through aqueducts, which are canals, pipelines, and tunnels. Sometimes the water must be pumped up and over mountains.

Which is the longest aqueduct in California? Where does it start and where does it end? The California Aqueduct is the longest at 444 miles long. It begins at the Delta where the Sacramento and San Joaquin Rivers come together in northern California. It ends in southern California.

Which aqueduct supplies San Francisco with water? The Hetch Hetchy Aqueduct supplies San Francisco with water.

Which aqueducts supply Los Angeles and other cities in southern California with water? The Los Angeles Aqueduct provides the city of Los Angeles with water. The Colorado River Aqueduct and the California Aqueduct supply water to other cities in southern California.

Which aqueducts provide water for farms in the Central Valley? The Fraint-Kern Canal and the Delta-Mendota Canal

Which aqueduct provides water to counties in northern California? The Tehama-Colusa Canal

What are reservoirs mainly used for? Reservoirs are mainly used to store water so that is can be supplied to farms, homes, and businesses when it is needed.

How are reservoirs usually formed? Dams are built on rivers to hold back water and form lakes.

What else are reservoirs and the dams that create them used for? They are used to generate hydroelectricity, to control flooding, and to provide recreation, such as swimming, boating, and fishing.

Field Trip Activity

Activity: Tour a Reservoir Site and/or Hydroelectric Plant

Time: Depends on choice of Field Trip

After-the-Field-Trip Activities

Activity 1: Search and Find the Aqueducts

Time: 45 minutes

Materials: *California Waterways* poster (in pocket of Guide)

1. Have the students read the text on the poster. Ask students to identify the aqueducts mentioned in the fact sheet. Have them identify other aqueducts as well.
2. Explain that the aqueducts are shown in different colors on the map to indicate how they are funded. Point out that the Federal government has joined with local agencies and with the State to build and maintain many of the aqueducts.
3. Supplement what students read about the aqueducts with information below, especially for any aqueducts that supply the local area with water.
   - The California Aqueduct is part of the State Water Project, which includes dams, reservoirs, and aqueducts. Some of the water from the California Aqueduct is used in the San Joaquin Valley, mostly for irrigation. To get the remaining water into southern California, the Edmonston Pumping Plant lifts the water nearly 2000 feet over the Tehachapi Mountains. This pumping plant lifts more water higher that anywhere else in the world. In southern California, the California Aqueduct splits into two branches. The West Branch primarily supplies Los Angeles County, Orange County, and parts of Ventura County. The East Branch supplies parts of Riverside and San Bernardino and San Diego Counties. The California Aqueduct began delivering water to southern California in 1972.
   - The Colorado River Aqueduct begins at the Colorado River, which runs between Arizona and California. The water flows from Lade Havasu across the desert to Lake Mathews. From here, it is distributed to businesses and more than 17 million people. Water from this aqueduct also flows into the San Diego Aqueducts, which supply the city and county of San Diego with water. The Colorado River Aqueduct has 9 tunnels and 5 pumping plants. It began delivering water in 1941.
   - The Delta-Mendota Canal is part of the Central Valley Project, a federal project that includes reservoirs, dams, power plants, aqueducts, and fish

hatcheries. The canal was completed in 1951. It supplies water to the San Joaquin Valley for irrigation and it replaces San Joaquin River water that is stored at Friant Dam and used in the Friant-Kern Canal. It is the largest concrete-lined canal in the West.

- The Friant-Kern Canal is part of the Central Valley Project, a federal project that includes reservoirs, dams, power plants, aqueducts, and fish hatcheries. The canal was begun in 1945 and began delivering water in 1949. It has been claimed, "no other canal in history has been built through such a highly developed area." More than 500 different structures—including over chutes, drainage inlets, irrigation crossings, and turnouts—were built. Almost 85% of the canal is concrete-lined. Except for the Delta-Mendota Canal, the Friant-Kern Canal is the largest lined canal in the West.
- The Hetch Hetchy Aqueduct is supplied by the Tuolumne River, which flows through the western slopes of the Sierra Nevada Mountains. In 1913, Congress authorized the Hetch Hetchy project, and in 1923, O'Saughnessy Dam was completed, creating the Hetch Hetchy Reservoir.
- The Los Angeles Aqueduct began delivering water to Los Angeles in 1913. The Mokelumne Aqueduct is supplied by the Mokelumne River. The water is collected at Pardee Dam and Reservoir, 38 miles northeast of Stockton, and at the Comanche Dam and Reservoir, 10 miles downstream from Pardee Dam. The aqueduct is constructed of steel and concrete pipelines that get progressively larger in diameter—from 5 feet 5 inches to 9 feet. The water flows by gravity through several tunnels to supply the East Bay.
- The Tehama-Colusa Canal receives water from the settling basin at Red Bluff Diversion Dam. A screen at the dam keeps fish out of the canal and diverts them into a channel that parallels the main canal for a short distance. The fish facilities provide a special gravel-bottomed canal as a spawning area for salmon. These facilities are the largest of their kind in the world.

4. Have students find the following major reservoirs on the poster. Divide students into about four teams. Have one student from each team come up to the poster and together look for a reservoir that is named. Give a point to the team that first finds the reservoir.
   - Comanche Reservoir (feeds the Mokelumne Aqueduct)
   - Diamond Valley Lake Reservoir (in Southern California)
   - Folsom Lake (on the American River)
   - Hetch Hetchy Reservoir (feeds the Hetch Hetchy Aqueduct)
   - Lake Crowley (on the Owens River)
   - Lake Mathews (at the end of the Colorado River Aqueduct)
   - Lake Perris (at the end of the California Aqueduct)
   - Millerton Lake (feeds the Friant-Kern Canal)
   - New Melones Reservoir (on the Stanislaus River)
   - Pardee Reservoir (feeds the Mokelumne Aqueduct)
   - San Luis Reservoir (on the California Aqueduct)
   - Shasta Lake (on the Sacramento River)
   - Clair Engle Lake (on the Trinity River)

Activity 2: Individual Aqueduct Maps
Time: 45 minutes
Materials: Water Here, Water There Student Worksheet and Answer Key, California Template Map Student Worksheet

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1. Give each student a copy of Water Here, Water There Student Worksheet.
2. Read the directions aloud and then allow students time to complete the sheet on their own. Ask them to identify the aqueducts without looking back at their worksheet.
3. Correct the worksheet as a class using the answer key below. Be sure students with incorrect answers erase or cross out their answers and write in the correct answers.
4. With the California Template Map Student Worksheet, have students draw in the major aqueducts and major reservoirs throughout the state.

5. Have students indicate on their maps the sources of water for their community. Contact the local water agency to discover where the water comes from. If not already done, have students draw in the aqueduct or reservoir that supplies their water. If their community uses groundwater, have them draw a well on their maps by their town. Have students create a box beside their maps titled "Water Supply for (their town)." Under the title, have them list the sources for their water.

Source

Adapted with permission from:

California Water Awareness Campaign, 910 K Street, Suite 340, Sacramento, CA 95814-3577 Posters come from this agency.

Name Date

Water Here, Water There

Fact Sheet

The Problem: In California, about 75% of the rain and snow falls in the northern third of the state. But about 75% of the people live in the southern two-thirds of the state, below Sacramento. The highest demand for water is during the summer months when it rains very little. So getting the water to where it is needed, when it is needed, is a problem.

The Solution: To solve the problem, water must be moved. People have been moving water since they came to California. In the late 1700s, the Spanish missionaries dug ditches to carry water from nearby streams to their crops. In the 1850s, gold miners used miles and miles of ditches to get the water where they needed it for mining. Today water is moved to where it is needed through aqueducts, and it is stored in reservoirs so that it is available when it is needed.

Aqueducts are canals, pipelines, and tunnels that carry water across land and over or through mountains. The system of aqueducts in California moves more water farther than anywhere else in the world.

Aqueducts bring water to the farms and cities that need it. For example:

- The Tehama-Colusa Canal is almost 11 miles long, supplying Tehama, Glenn, Colusa, and Yolo Counties with water.
- The Mokelumne Aqueduct—about 100 miles long—supplies water to the city of Oakland and surrounding areas.
- The Hetch Hetchy Aqueduct was built to bring water 156 miles from the Tuolumne River to the San Francisco area.
- The Delta-Mendota Canal, about 117 miles long, carries water for irrigation along the west side of the San Joaquin Valley.
- The Los Angeles aqueduct delivers water 233 miles from the Owens River in the southern Sierra Nevada Mountains to Los Angeles.
- The Friant-Kern Canal runs 152 miles through the Central Valley, providing irrigation water for farms in the south San Joaquin Valley.
- The Colorado River Aqueduct, 242 miles long, transports water to farmers in the Imperial and Coachella Valleys and to many people across southern California.
- The California Aqueduct is the longest aqueduct in California. It begins at the Delta, where the Sacramento and San Joaquin Rivers come together and flow into the San Francisco Bay. This aqueduct stretches 444 miles to southern California. It provides water to cities in southern California and in the San Francisco Bay area. And it provides water to farms in the central and southern parts of the state.

Name Date

Water Here, Water There

Fact Sheet (continued)

Reservoirs are used to store water. They are at the beginning and end of rivers and aqueducts and at several points along the way. Reservoirs are usually lakes formed by dams. We have more than 1,300 reservoirs in California.

Reservoirs do more than store water. Many have power plants. The force of the water as it flows out from behind the dam is used to turn generators that produce electricity. This electricity, called hydroelectricity, is a clean, inexpensive source of energy. The power from hydroelectric plants is often used at pumping plants along the aqueducts to pump water over mountains.

The dams on many reservoirs also keep large amounts of water from rushing down rivers all at once and causing a flood. Most reservoirs are used for recreations—like fishing, boating, and swimming. But mainly, our reservoirs supply billions of gallons of water a day to farms, homes, and businesses—when and where it is needed.

While reservoirs and aqueducts provide much water to Californians, in much of the state, people get their water from right beneath their feet! Wells are drilled into the ground to collect the water that seeps into the spaces between underground rocks and soil particles. Some wells are hundreds of feet deep and can provide thousands of gallons of water per minute.

About 15,000 public drinking water systems use groundwater. Many homeowners in rural areas use groundwater right below their property to meet their water needs.

Both surface and groundwater are moved around California in aqueducts. Aqueducts can be pipes or ditches or concrete-lined canals.

Name Date

Water Here, Water There

Student Worksheet

Directions: Several major aqueducts in California are shown on the map. Match each aqueduct with its name.

a. California Aqueduct
b. Colorado River Aqueduct
c. Delta-Mendota Canal
d. Friant-Kern Canal
e. Hetch Hetchy Aqueduct
f. Los Angeles Aqueduct
g. Mokelumne Aqueduct
h. Tehama-Colusa

Directions: Circle the letter of the word or phrase that best completes each sentence.

1. In California, 75% of the population is in the north:
   a. north
   b. south
   c. central region

2. Aqueducts are:
   a. canals
   b. pipelines
   c. tunnels
   d. all of the above

3. Dams and the reservoirs they form are used to:
   a. store water
   b. produce electricity
   c. prevent floods
   d. all of the above

4. Most reservoirs can be used for:
   a. fishing
   b. boating
   c. swimming
   d. all of the above

5. Water in aqueducts:
   a. is pumped over mountains
   b. goes through mountains
   c. goes both over and through mountains

6. The longest aqueduct in California is:
   a. California Aqueduct
   b. Colorado Aqueduct
   c. Hetch-Hetchy
   d. Los Angeles

7. Aqueducts deliver water to:
   a. farms
   b. cities
   c. both farms and cities

8. The highest demand for water is during the:
   a. winter
   b. spring
   c. summer
   d. fall

Water Here, Water There

Answer Key

Map:

1. h
2. g
3. e
4. c
5. d
6. a
7. f
8. b

Questions:

1. b
2. d
3. d
4. d
5. c
6. a
7. c
8. c

Name Date

California Template Map

Student Worksheet