

Water Water Everywhere...Not

The Competition for California's Water Supply



Overview

This activity takes students from a general understanding of the history behind water allocation decisions to the specific case of the decline of San Francisco Bay's fisheries. Students take part in a simulation activity about water allocation and then read articles and complete a worksheet to identify water rights issues.

Estimated Time

Pass the Jug: 1 hour

Issue Identification: 3 hours

Objectives

Students will be able to:

- describe how water is allocated in California.
- discuss the various issues that water allocation raises when competing interests need the same resource.
- recognize the complexities of California's plumbing and understand historical actions that have led to current issues affecting San Francisco Bay.

Materials

Part I: Pass the Jug: 1 paper cup or glass per student, 1 gallon water jug, photocopy of Water Users descriptions (cut into strips)

Part II: Issue Identification: Photocopies of articles for each small group of students and one copy of the student page for each student.

California Science Content Standards

Grades 9-12

Earth Sciences Standard Set 9.a: the resources of major economic importance in California and their relation to California's geology.

Earth Sciences Standard Set 9.c: the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.

California History/Social Science Standards

Grade 8

Standard 8.8.4: the role of great rivers and the struggle over water rights.

Standard 8.12.1: patterns of agricultural and industrial development as they relate to climate, natural resource use, markets, and trade, including their location on a map.

Grades 9-12

Historical and Social Sciences Analysis Skills Chronological Thinking

1. Students compare the present with the past, evaluating the consequences of past events and decisions and determining the lessons that were learned.

Historical Interpretation

5. Students analyze human modifications of landscapes and examine the resulting environmental policy issues.

Grade 11

Standard 11.8.6: the diverse environmental regions in North America, their relation to particular forms of economic life, and the origins and prospects of environmental problems in those regions.

Standard 11.8.7: the effects on society and the economy of technological developments since 1945, including the computer revolution, changes in communication, advances in medicine, and improvements in agricultural technology.

Standard 11.11.5: the impact, need and controversies associated with environmental conservation, expansion of the national park system, and the development of environmental protection laws, with particular attention to the interaction between environmental protection and property rights.

English/Language Arts Content Standards

Grades 8-12

Reading Comprehension

2.0 Students read and understand grade-level appropriate material.

Background

California's current water issues reflect the historical settlement of European Americans during the Gold Rush. The miners of the Gold Rush used water to mine the gold that was in the Sierra Nevada's through hydraulic mining – high pressure hoses directing water at hillsides. Mining required strong water rights that protected earlier water claims from claims that came later.

In order to protect their water claims from subsequent miners, California instituted a “first in time, first in right” water allocation system. This system is in use throughout the arid western states. In general it means that water is allocated based on who has the oldest claim. This water allocation system insured that the first miners were given precedence over later miner's water claims.

This system continued to shape water allocation decisions as agriculture replaced mining as the economic base. The earliest farmers received water rights that later farmers, cities, and environmentalists could not threaten.

Dividing up the freshwater of the state is complicated and difficult because each interest group has compelling reasons for needing more water. The problems of water allocation are worsened by never knowing how much water California will receive in any year. The late 1990s saw improved conditions due to increased rainfall, but it is only a matter of time until droughts return and conditions worsen. This activity asks your students to understand the issues surrounding water allocation and the forces shaping the future of San Francisco Bay and California. How much water should the farmers, the cities and the fish receive?

The Delta is the meeting place of three distinct interests all working towards their own vision of how the water of California should be spent. The farmers of the Central Valley need water in order to continue producing high quality food.

Cities and counties need clean drinking water free of pollutants and salts. Environmentalists see the steady decline of both the water quality and the historic fisheries in the San Francisco Bay and Delta.

“The Sacramento-San Joaquin Delta is a 1,153-square-mile region located where California's two greatest rivers – the Sacramento and San Joaquin – converge and flow into San Francisco Bay. The Delta is a vital link for the state's water supply. Forty-two percent of the state's annual runoff flows through this maze of islands, marshes and sloughs. State and federal water facilities located in the south Delta pump water to supply farms and cities in central and southern California, providing water to about two-thirds of the state's population.” (From the Water Education Foundation)

Teacher Procedure

Part I: Pass the Jug

1. Arrange students' seats in a row or around a table and give each student a cup. Starting at one end, have the first student pour out as much water as she or he wants/needs from the jug and pass the jug to the next student in line. Because of the limited amount of water in the jug, there might not be enough to go around.
2. Ask students to express how they feel about either receiving enough water or receiving no water. Explain that there is not always enough water available to meet everyone's needs.
3. Ask students what they could do as a group to make sure they all get water. Have them repeat the activity and put their plan into action.
4. Briefly explain riparian water rights. The Riparian Rights Doctrine gives people who own land bordering a water source the right to use that water however they choose. A more recent version of the doctrine requires people to justify their uses as reasonable.

- They must also ensure that landowners downstream have their fair share of water.
5. Ask the students to explain how passing the jug relates to riparian rights.
 6. After students have emptied their cups and the jug has been refilled, inform them that they will now simulate the allocation of water rights in the West. Explain how Prior Appropriation Doctrine gives people who originally moved into an area and started using water the right to use their water first, whether or not their land borders the water source.
 7. Have students form a line according to their birthdays (from January to December). Divide the students into 10 groups, with group 1 being the first 2 or 3 students in line, group 2 being the next 2 or 3, etc. Explain that this represents the concept of first in time, first in right.
 8. Pass out the Water User Cards in order (Group 1 gets #1, etc.). Explain to the students that the descriptions are numbered according to who moved into the area first. Along with the right to use water, each description also states how the water is used and how much is needed.
 9. Pass around the jug of water in the order of the numbered cards. Have students read aloud how they use water. Each group takes the amount of water indicated on their card. Some water users, such as fisheries and hydroelectric power plants, utilize water without reducing water quantity; water managers call these users nonconsumptive (however, reservoirs associated with hydroelectric power plants do lose some water to evaporation.) Students who represent these water users should pour water into their cups and then pour most of it back into the jug, using the funnel.
 10. When water runs out, have students express their opinions about this system. What are the benefits and the shortcomings? How does this compare to Riparian Water Rights? Why would Eastern states use Riparian Water Rights while Western States use Prior Appropriations Doctrine? What is the major difference between the East and the West (amount and availability of water).
 11. Explain that California uses a combination of Riparian and Prior Appropriation Doctrine, but there are still major debates over the uses of California's limited water supply. How or why would students change these systems? How should water be divided among water users in the West?

From *Project WET*, by The Watercourse and the Council for Environmental Education, 1995, pp. 392-396.

Part II: Issues Investigation

1. Divide Students into groups of four.
2. Distribute one set of articles for each group and one copy of the student pages to each student. Assist students as needed to complete the worksheet. (This activity can also be assigned for homework for each student to complete on their own.)

Additional Resources

Water Education Foundation: <http://www.watereducation.org/>

Cadillac Desert. Order from PMI/Home Vision Select. Phone: 1-800-343-4727. Or check your local library.

Water Users (Descriptions)

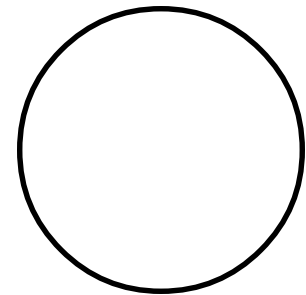
Number 1	You are a descendent of the first homesteader that moved into the area. You grow alfalfa and corn.	use 2 cups
Number 2	Your ancestor came to California during the Gold Rush and starting a Gold mining company. Your family runs this small, but lucrative, operation	use 2 cups
Number 3	Your great-great-grandmother came out to teach the children of the gold miners. You still live on the property she bought and need water for personal use and crop irrigation.	use 1 cup
Number 4	Your grandparents left their farm in the midwest to start a farm here. You help meet the needs of the growing community by growing walnuts and almonds.	use 2 cups
Number 5	You represent San Francisco, a town that grew into a city after the Gold Rush. You use water for homes and businesses in your city.	use 3 cups
Number 6	You represent a hydroelectric company with a dam upstream of town. The water you use passes through the dam to generate electricity. Show this by pouring most of your three cups of water back into the jug.	use 3 cups
Number 7	You are a high-tech farmer that grows a variety of crops on a large plot of land in the Central Valley.	use 5 cups
Number 8	You represent the suburbs that grew as people moved out of the city to find housing. You use water for homes and lawns.	use 2 cups
Number 9	You represent a computer company that uses water for industrial purposes.	use 2 cups
Number 10	You are an environmentalist that is fighting for water for the Bay's fisheries, especially for salmon.	use 2 cups

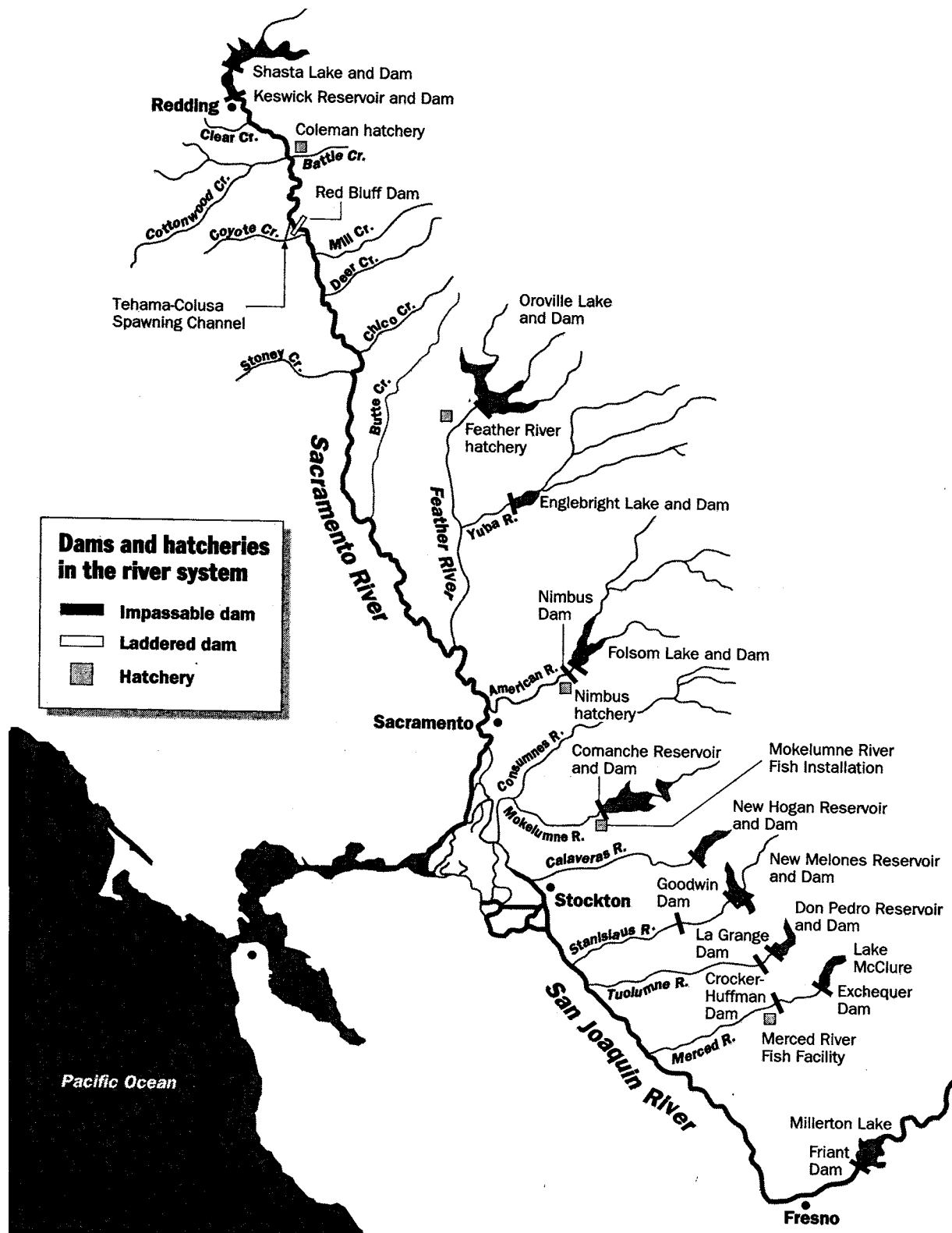
Water Water Everywhere... Not.



1. Look at the watershed map of California. How many creeks and rivers eventually flow into the Sacramento/San Joaquin River Delta and then to the San Francisco Bay?
2. Name at least five of the rivers that make up the San Francisco Bay's Watershed. Which of these rivers are dammed? Put a star next to the rivers that have at least 1 dam.
3. Read the article "How We Use the Estuary's Water." What groups are competing for the water in these rivers?
4. From the article, describe some of the benefits that dams and canals provide to California.
5. Describe some of the environmental impacts of such intensive use of the Bay's water.
6. The pie is only so big (there is a limited amount of water in California). Create a pie graph in the circle showing the percent used for agriculture, cities (municipalities) and environment in a sample year, using the following amounts of acre feet (one acre foot of water covers one acre of land one foot deep).

Total amount of water: 20 million acre feet
Amount of water diverted for agriculture: 9 million acre feet
Amount diverted for use in cities: 2 million acre feet
Amount that flows to the Bay: 8.5 million acre feet
Other: .5 million acre feet
7. Read "Dying Fishery: Sign of Nature in Trouble" by Jane Kay in the San Francisco Examiner. From the article, list five historical reasons for the decline of the fisheries in San Francisco Bay.
8. Read the article "California's Big Water Plan" from the San Francisco Chronicle. What is the mission of the CalFed Bay-Delta Program?
9. What solutions can you think of to save the fisheries, while providing water for farms and cities?





from the San Francisco Examiner, Bay in Peril

SAN FRANCISCO ESTUARY PROJECT

How We Use the Estuary's Water

The Estuary and its watershed provide waterways for shipping and recreation, as well as vital fresh water to farms, cities, industries and other users throughout California. Such uses, combined with increasing pollution and human development, have placed significant stresses on the Estuary's fish and wildlife. The need to balance competing uses and ensure adequate protection for the estuarine ecosystem has never been more urgent. The San Francisco Estuary Project is working with public interest groups, elected officials and government agencies to promote environmentally sound management of the Bay and Delta.

History

Use of the Estuary's resources began with Native Americans, who found food and construction materials in its waters and wetlands. With the Gold Rush, hordes of newcomers began to take fish and wildlife in large numbers. Hydraulic mining operations striped away entire hillsides of gold-bearing gravel, causing enormous amounts of silt and sand to wash down the Sacramento River and into the Estuary. Most of the Estuary's wetlands were diked and converted to farming or urban uses.

Over the turn of the century, increasing amounts of Central Valley land were converted from cattle ranches and dry-farmed grain to irrigated agriculture. At the same time, Bay cities began diverting water from the Tuolumne and Mokelumne Rivers for municipal use.

Between 1950 and 1970, major physical alterations were made to the Estuary and its watershed in the form of dams, canals, pumping stations and other freshwater development and flood control facilities. Construction of the Central Valley and State Water Projects provided enormous benefits—fueling economic growth in agriculture, providing municipal and industrial water supplies, and enhancing the quality of life in California.

In time, however, such intensive use of the Estuary's waters had major environmental impacts including: the visible shrinking of the Bay's surface area, the elimination or alteration of over 88% of the Estuary's wetlands, the concentration of pollutants, the decline of fisheries, non-native species growth, and dramatic changes to the Estuary's flow regime.

Vital Fresh Water

Californians use almost 25 percent (21.1 billion gallons a day) of the fresh water consumed (water not returned to the system) in the United States. Two-thirds of the State's present demand for fresh water originates in the San Joaquin Valley and south of the Tehachapi Mountains. Two-thirds of the available supply is carried by Northern California rivers and streams. The Estuary's Sacramento–San Joaquin Delta is the important link between supply and demand. In recent years, more than half of the Estuary's natural river flow has been diverted for human and natural uses. Beneficial uses—uses with legal protection against degradation in water quality—include domestic, municipal, agricultural and industrial supply, recreation and navigation, and fish and wildlife habitat. With demand for the Estuary's limited freshwater supply increasing on all sides, California is now struggling to provide for all beneficial uses while protecting the health of the estuarine ecosystem.

The Estuary

San Francisco Bay and the Delta combine to form the West Coast's largest estuary. The estuary's watershed drains approximately 60,000 square miles, over 40 percent of the state. The Bay-Delta Estuary encompasses roughly 1600 square miles, contains about 5 million acre-feet of water at mean tide, and circulates 80-280 million cubic yards of sediment every year. More important, the Estuary is the location where the Sacramento and San Joaquin Rivers meet and flow into the Pacific Ocean. The mingling of fresh and salt water in this zone of tidal ebb and flow supports more biological diversity than is found in either salt water or fresh water alone.

California's Big Water Plan

Monday, July 5, 1999
San Francisco Chronicle

IT'S THE LIFEBLOOD of California and we're always in short supply.

More than any other element — more than gold or silicon — water has shaped the state's commerce, development, natural environment and quality of life.

For generations, farmers and cities from Sacramento to Los Angeles fought bitter water wars for their share of the precious fluid flowing from the western watershed of the Sierra Nevada.

In recent years, environmentalists joined the battle on behalf of wildlife, rivers and wetlands. If water is the state's blood, the San Francisco Bay and the Delta form the circulatory system of a fragile ecosystem that pumps 24 million acre-feet a year through the Sacramento and San Joaquin Rivers. (An acre-foot is 325,803 gallons, what an average family of five uses in a year.)

The flow through the Delta's vast network of waterways provides drinking water to 22 million, two-thirds of the state's residents, and irrigates 4 million acres of crops, including 45 percent of the nation's produce.

The Delta also supports more than 750 wildlife species on 738,000 acres of wetlands.

In 1995 the state and federal governments launched the CalFed Bay-Delta Program to fairly divide the water among the many claimants while protecting the Bay and restoring the vital but battered Delta. After four years of collaborative studies, hearings and important but piecemeal restoration projects, CalFed recently unveiled its grand blueprint to overhaul the system in the next 30 years at a cost of \$10 billion.

The ambitious plan describes a delicate balance of conflicting interests of "stakeholders" representing agriculture, municipalities and environmentalists. At the June 25 unveiling, few were completely satisfied, but to their credit the stakeholders are staying with the evolving process.

"Even though nobody is getting everything they want, the plan has something for all the affected groups," says State Resources Secretary Mary Nichols.

Farmers and cities fear they will not get enough. Enviro-worry that without more fresh water the fragile Bay and Delta ecosystems may be damaged beyond recovery.

Everyone is aware of the harsh dilemma of a limited water supply. If enough water is diverted to preserve the Bay-Delta system and satisfy municipalities, the state's vast agriculture industry is likely to go thirsty.

To satisfy competing interests, CalFed's plan offers an array of options and compromises, including aggressive conservation, recharging underground aquifers, streamlining water transfers and creating "environmental water accounts" for endangered wildlife during critical dry times.

The CalFed proposal is a work in progress, but it's a good beginning to deal with the state's expanding water needs as the population swells to 52 million by the year 2030.

However, any long-term strategy must maintain the freshwater flow into the Bay and Delta, the vital core of the ecosystem.

It also must seek alternatives to building dams, which are expensive, threaten the environment and should be considered only as a last resort.