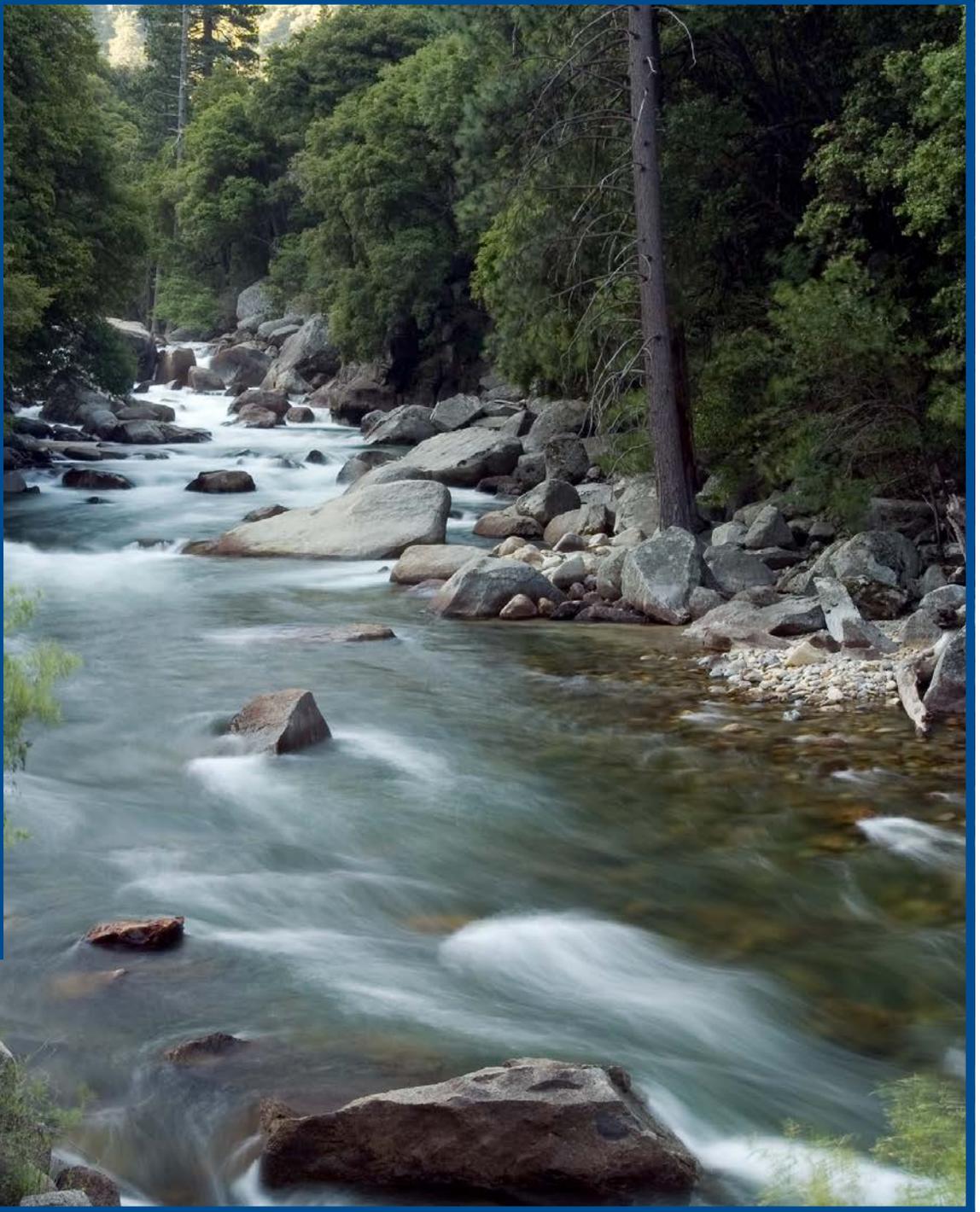


6

Science Standard
6.2.b.



The Dynamic Nature of Rivers

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Initiative Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency
California Natural Resources Agency
California State Board of Education
California Department of Education
Department of Resources Recycling and Recovery (CalRecycle)

Key Partners:

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None required for this lesson.

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The Sacramento-San Joaquin River Delta

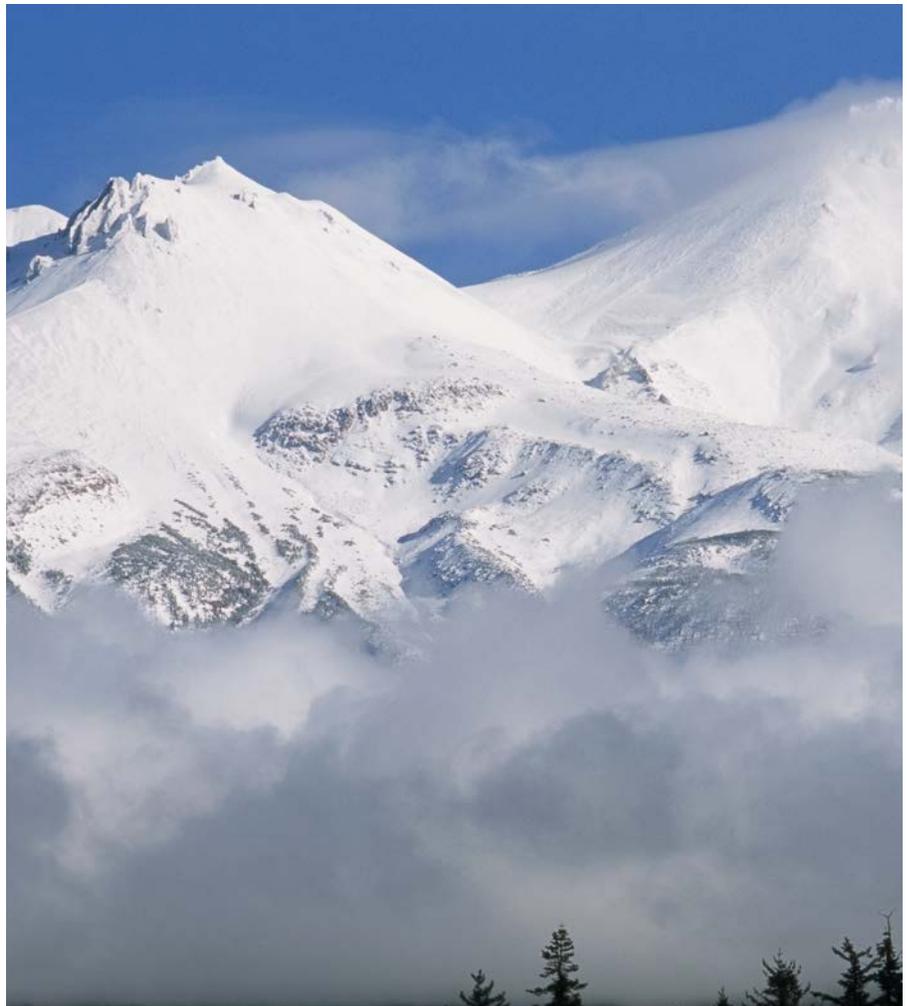


Near Mount Shasta in Northern California, the headwaters of the Sacramento River begin their journey southward. The San Joaquin River begins high on the western slope of the Sierras, where it runs west and then north. In the Great Central Valley, these great rivers meet. On the way, they collect water from other streams and rivers.

The Pit and McCloud rivers, near Mount Shasta, and the Feather, American, and Yuba rivers all flow into the Sacramento River. The San Joaquin River gathers water from the Merced, Tuolumne, Stanislaus, Mokelumne, and Cosumnes rivers. The two great rivers come together before entering Honker Bay near the city of Antioch. Then they continue as one waterway, eventually emptying into San Francisco Bay and the Pacific Ocean.

An Ancient Landform

A fertile triangle of land formed thousands of years ago where the Sacramento and San Joaquin rivers spread out before entering the San Francisco Bay. This 1,100-square-mile landform is



Mount Shasta, California

called the Sacramento-San Joaquin River Delta (Bay Delta).

A delta is created where a river deposits sediment at the location where it flows into an ocean, a lake, a desert, or a valley. Herodotus, the Greek Historian, named this formation “delta” because it frequently looks like the Greek letter delta, which is the shape of a triangle (Δ).

The Bay Delta is an inverted river delta. Most river deltas are narrow where the river enters the plain, and then “fan out” as the water moves toward the ocean, lake, or bay. A good example of this is the delta that the Mississippi River forms as it flows out to the ocean, near the city of New Orleans in Louisiana. Another example, far away, is the Nile Delta in Egypt. Before reaching the Mediterranean Sea, the Nile Delta spreads like a fan in a triangle shape.

Unlike the Nile, the Sacramento and San Joaquin rivers fan out and then rejoin, passing through a narrow gap in the coastal range mountains before flowing into the San Francisco Bay. This gap is called the Carquinez Strait. It connects

Suisun Bay with San Pablo Bay (the northern part of San Francisco Bay). This geological constraint gives the Sacramento-San Joaquin Delta a shape that makes it unique among most of the world’s deltas.

California’s Largest Bay

Twenty thousand years ago, there was no San Francisco Bay. Most of Earth’s water was frozen in glaciers. This made the sea level 400 feet lower than it is today. The California coastline lay 20 miles west of its current location. San Francisco Bay

was just a flat plain, and water from the rivers flowed across it to the sea. As the glaciers melted, the sea level rose. The coastline moved east, and the ocean finally found its way through the Carquinez Strait. Water began to fill the San Francisco Bay.

San Francisco Bay is part of a series of bays that receive water from the Sacramento and San Joaquin rivers. The bay is a partly closed body of water that includes several estuaries. Salt water from the sea and fresh water from rivers and streams combine in



Carquinez Strait, California



San Francisco Bay, California

estuaries. These waterways provide rich habitats for life of all kinds. Estuary ecosystems can contain more life per square inch than the richest Midwest farmland.

Rivers, Islands, and Farms

When the Sacramento and San Joaquin rivers join and move through the low-lying Central Valley, the rivers deposit rock fragments and mud (sediment) that they have carried from the Sierra Nevada and Coast Ranges. This sediment has built up over time, creating a floodplain and other features, such as islands that divide the waterway into

many smaller streams. The streams continue to shift, eroding the floodplain, creating new channels and islands, and leaving behind abandoned channels called sloughs (slews). Today, the Bay Delta is a network of many islands connected by 700 miles of waterways.

Dense wetland vegetation grows on the islands. When it dies, the partially decayed plant matter builds up, forming peat soil. As a result, the islands of the Bay Delta are used for agriculture. The Bay Delta contains some of the richest peat soil in the region, the best type of soil

for growing crops. In the past, the channels, islands, and natural levees of the delta would change form during the winter flood cycle. Natural levees formed on either side of a stream and developed as a result of the accumulation of sediment deposited naturally during winter flooding. The light peat soil would erode during high flows, channels would widen, and natural levees would be overtopped. Agricultural land would instantly disappear and become a vast inland “lake” that would not dry out until early summer. Then the delta became a vast swamp.



Flooding in the Sacramento-San Joaquin River Delta, 1980

It's Not Just the Water

In the mountains, when it rains or snows, water swells the streams and drains into rivers. Most of the water finds its way through the series of sloughs and bays where it mixes with salt water from the ocean. Because seawater is heavier than fresh water, it sinks to the bottom. The churning salt water pushes up the fresh water, which rises to the top.

The flow of the rivers and tides and the mixing of salt water and fresh water keep the sediment, plankton, and nutrients suspended in the water. This provides a nutritious food source

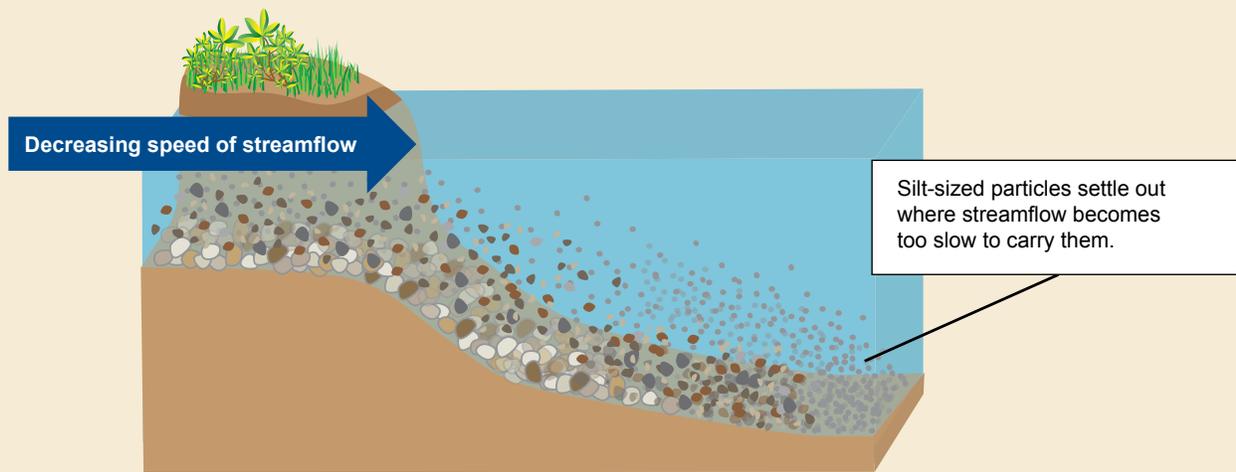
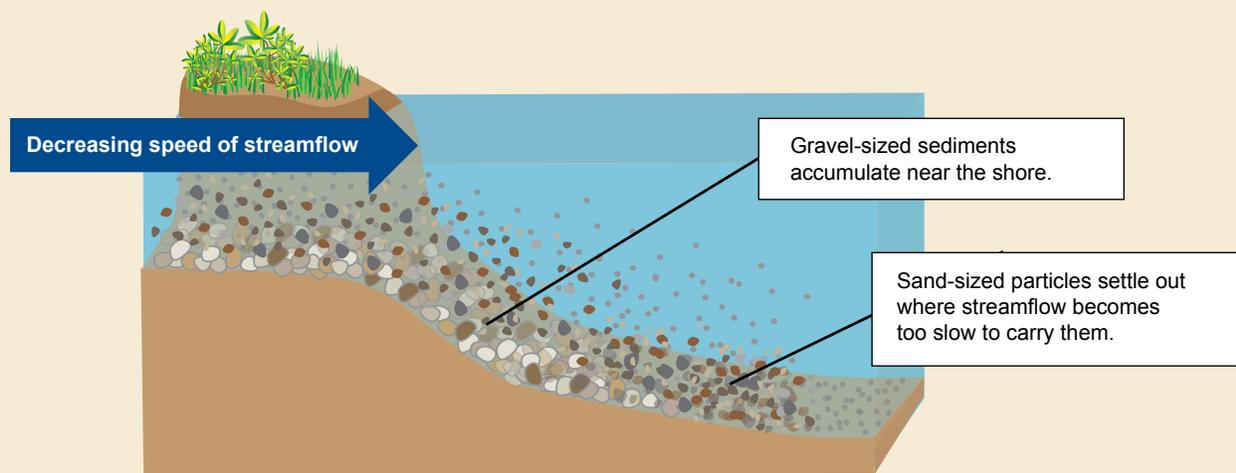
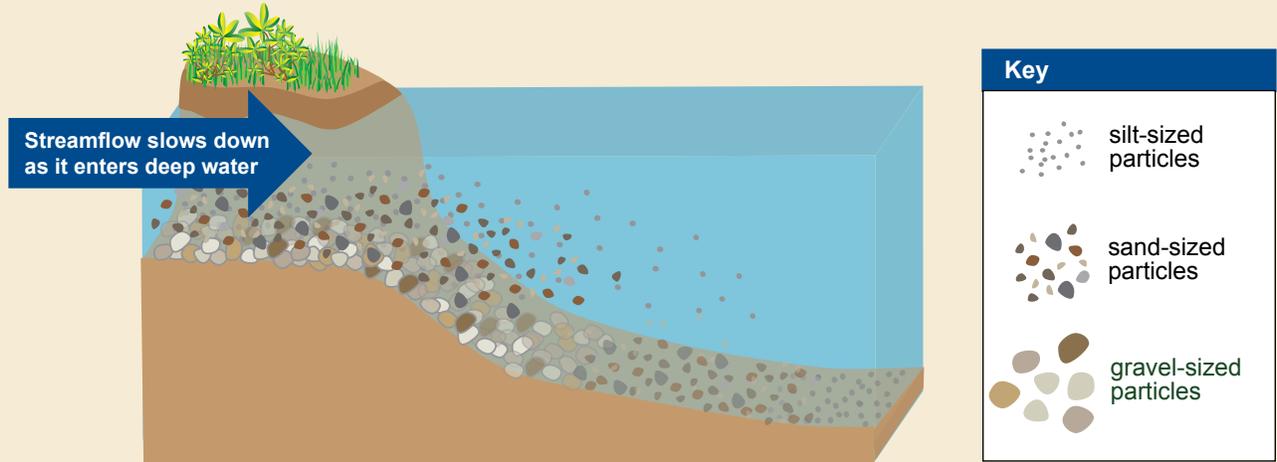
for animals and plants that live both on land and in the water. If the flow of fresh water changes, as in times of drought or flood, this diverse food web can shrink or even disappear. Many species of mammals, birds, and fish depend on the healthy food source to survive.

The area of the Sacramento-San Joaquin Delta is home to more than 750 species of plants and animals, including some found nowhere else on Earth. The rivers provide a favorite habitat for migratory birds, and are spawning grounds for more than a hundred species of fish. Water has always

been the magnet drawing living things to the Bay-Delta. Once a vast floodplain, today the delta is one of the most productive regions in the world, and government officials are working on many efforts to protect it. For example, earthquakes could threaten the Bay Delta's levee system. Fish populations like the Delta smelt, Chinook salmon, and longfin smelt are dropping. Plants that are not native to the delta are also invading this estuary region. More homes and buildings are being built closer to the delta floodplains, which can interfere with the delta's natural way of dealing with seasonal flooding.

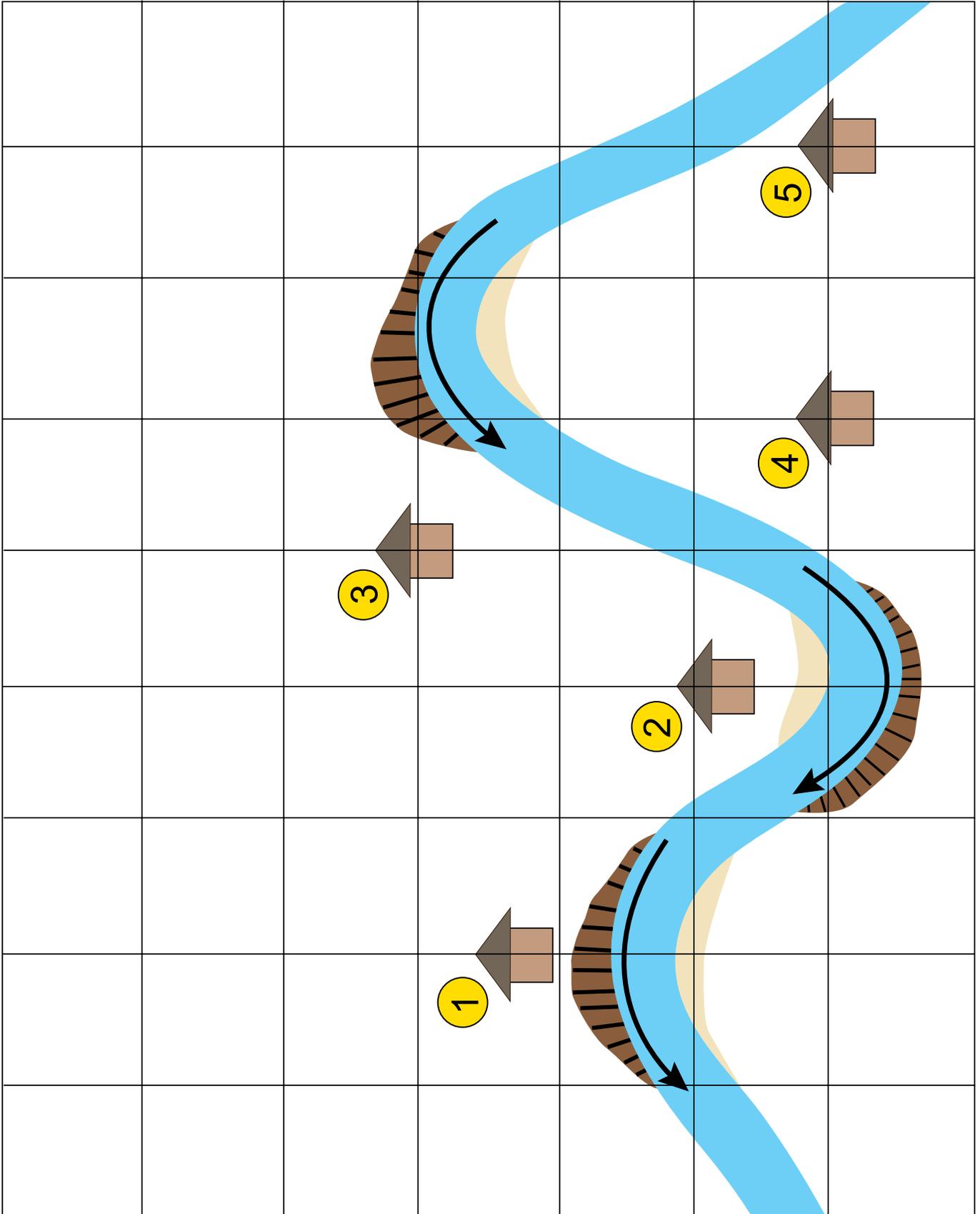
Protecting the Bay Delta for the future is very important for many reasons. It is also the single-largest, most important source of water for California. Though the delta is located in the north part of the state between Sacramento and San Francisco, approximately 25 million people from as far away as Los Angeles and San Diego rely on the Bay Delta, at least in part, for their water.

Sedimentation in a Stream



Houses on the Floodplain

Lesson 4



In 1781, we established a village called Los Angeles. We settled along the shores of a beautiful river. Dry riverbeds called *arroyos* (ah-ROY-yos) crossed the flat land. Every time there was a heavy rain these areas became raging rivers. In 1815, the river flooded and destroyed our town's central plaza. The massive rains in 1835 caused the river to change its course completely. It once emptied into the ocean just south of what you now call Santa Monica. After another flood in 1938, the river changed course again and now empties into the ocean at Long Beach. It is impossible to build a city when you never know whose backyard the river will flow through next.

What should we do? Here are some solutions we have come up with:

1. Build concrete river channels to force the water to flow in the same place all the time.
2. Build dams across the river as it comes down from the mountains. This will allow us to control the water flow and prevent flooding.
3. Build aqueducts on the floodplain to take water from the river to storage tanks along the coast. Divert water into storage tanks so we can use it during droughts.

Which of these solutions would you choose? To help make your selection, discuss these questions as a group.

How does each solution support human needs?

How will each solution change the river?

How would each solution change the riparian habitats in and around the river?

Which solution does your group choose?

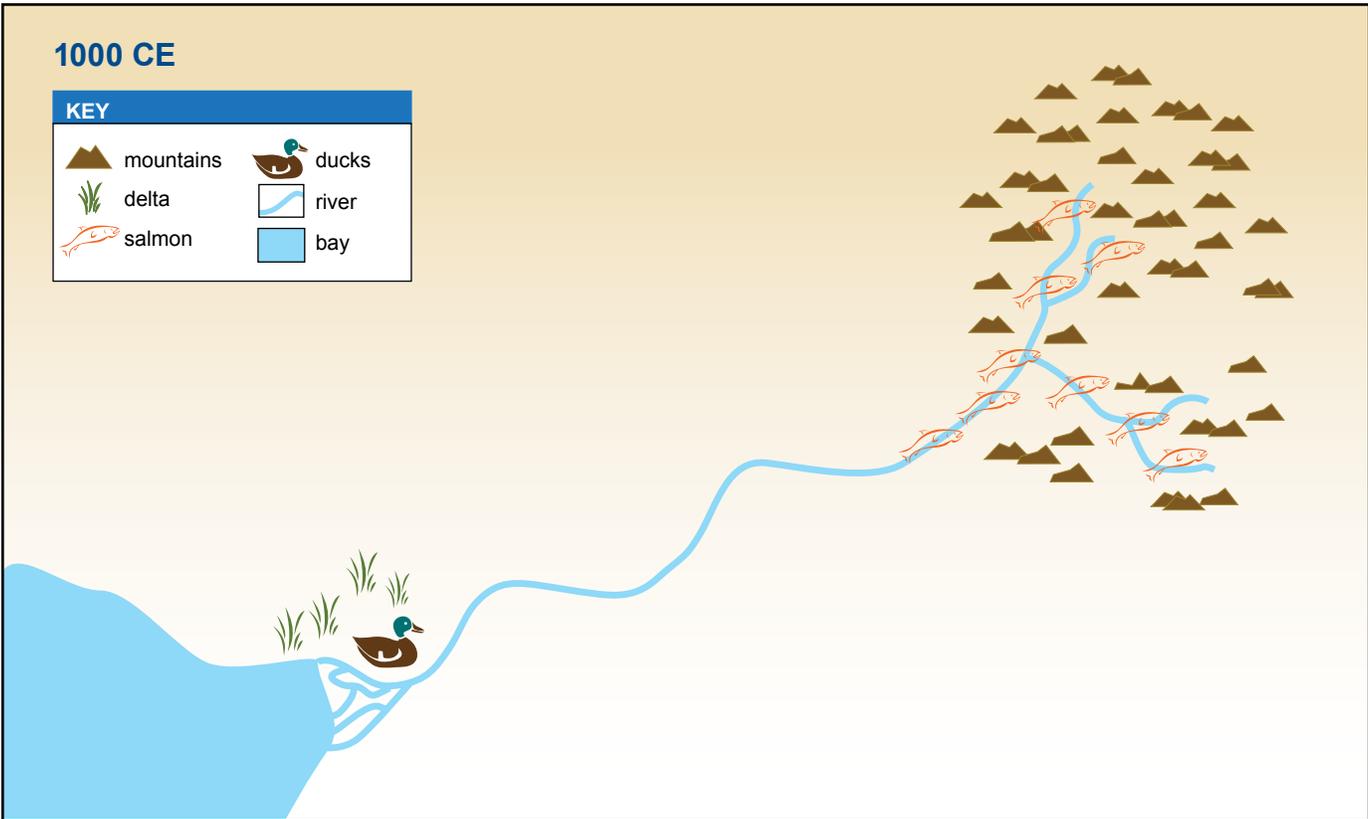
Why?

Maps of the Frontier River

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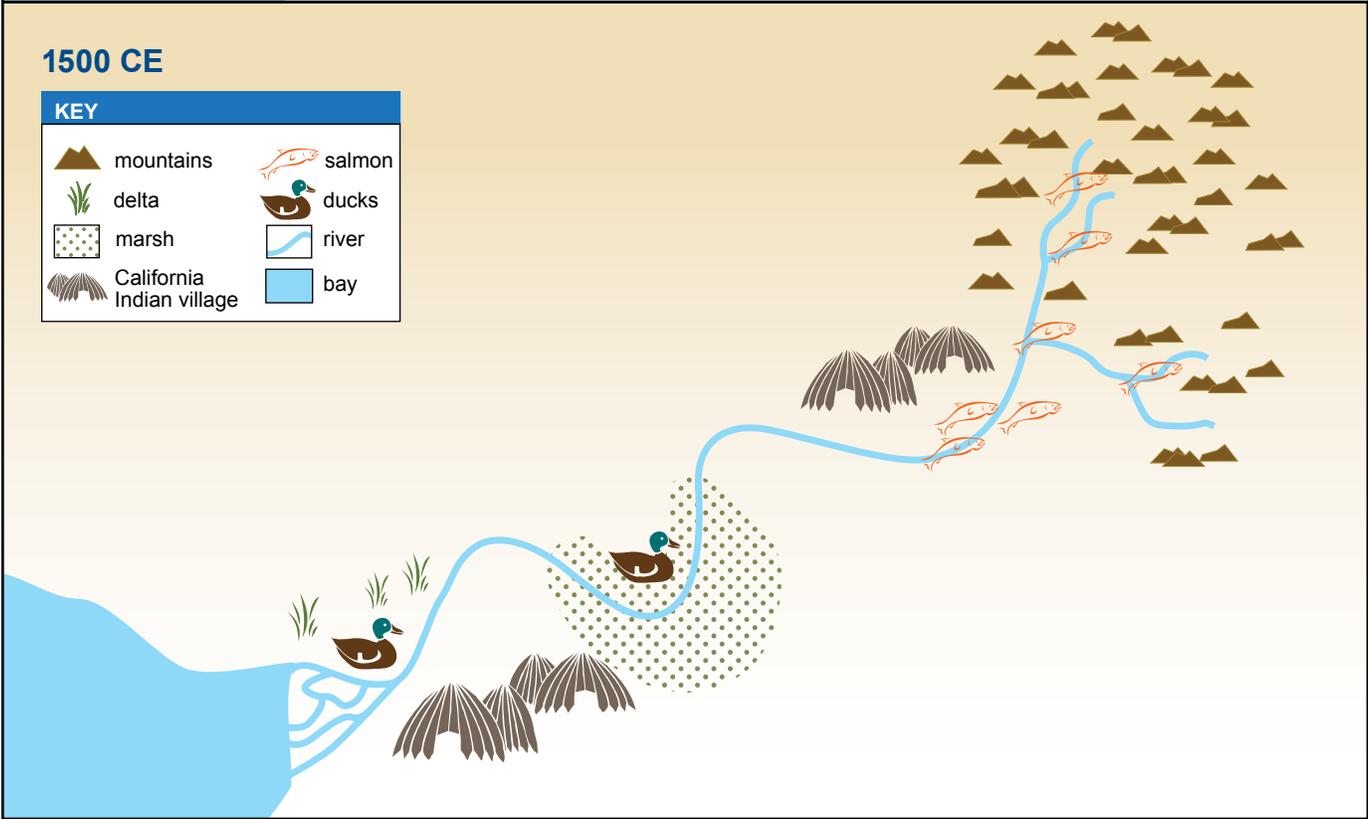
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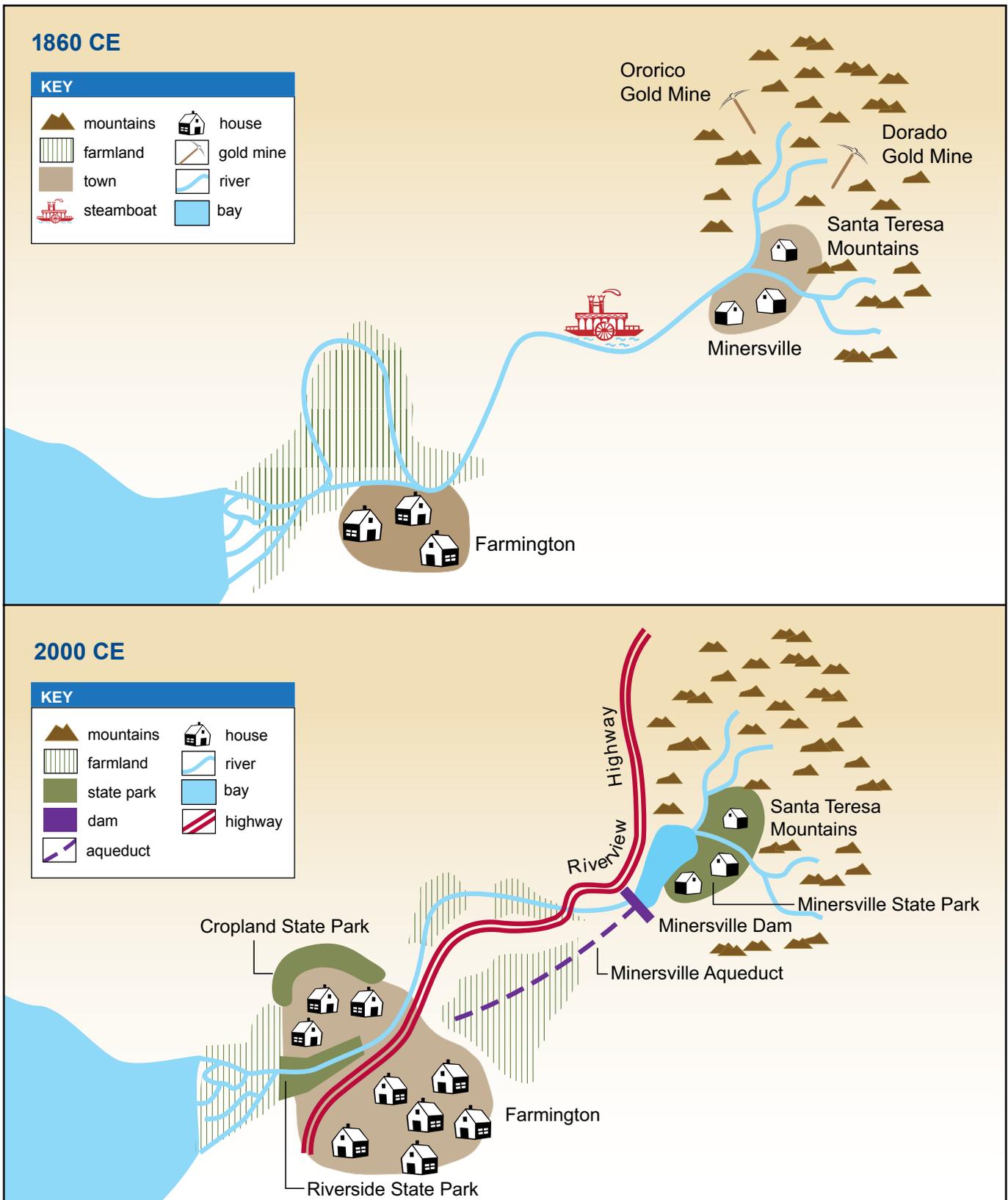
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|  mountains |  salmon |
|  delta |  ducks |
|  marsh |  river |
|  California Indian village |  bay |



Maps of the Frontier River





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