

## The Formation of San Francisco Bay

Watch the segment online at <http://education.savingthebay.org/the-formation-of-san-francisco-bay>

Watch the segment on DVD: Episode 1, 14:19–17:33

Video length: 3 minutes 33 seconds

### SUBJECT/S

Science

History

### GRADE LEVELS

6–8

### CA CONTENT STANDARDS

#### Grade 4

##### *Earth Sciences*

5.a. Students know some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

#### Grade 7

##### *Life Sciences—Earth and Life History*

4.a. Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.

### VIDEO OVERVIEW

The west coast of North America once extended 27 miles west of the Golden Gate. The San Francisco Bay as we know it is a very young landform in geologic time.



In this segment you'll learn that:

- the west coast of North America has changed dramatically over time.
- the Bay with which we are familiar was created just 10,000 years ago.
- San Francisco Bay is a flooded river canyon that formed as a result of rising sea levels at the end of the last ice age.

### TOPIC BACKGROUND

There is a sense of permanence in the Bay Area landscape. Yet the familiar three-bay formation is very young on a geologic time scale—just 10,000 or so years old. A million years ago, there were rolling grasslands in the region where today lies the San Francisco Bay. An enormous inland sea called Corcoran Lake covered what is now the Central Valley. Over time, geologic processes slowly transformed the land into the now familiar landscape.

About 560,000 years ago, as the earth's huge tectonic plates slowly shifted, the land sank and the southern end of Lake Corcoran rose. Water spilled over the western edge, and the lake drained completely. This action carved out what we know today as the Carquinez Strait and began to shape the basin that would become San Francisco Bay.

Twenty thousand years ago, the Pacific coastline was 27 miles west of the Golden Gate, with coastal hills whose tops are now the Farallon Islands. The world was in the last ice age. With much of Earth's water frozen in glaciers, the sea level was much lower than it is today and more land was exposed. Today's San Francisco Bay was a series of broad, dry valleys within the Coast Ranges.

As the ice age ended about 10,000 years ago, the glaciers began to melt and the Sacramento and San Joaquin rivers carried huge flows of water and sediment down from the Sierra Nevada Mountains. Sea levels began to rise, and water entered the Coast Ranges through the Golden Gate. San Francisco Bay began to fill with seawater at the rate of about one inch per year, a rapid fill in a geologic time frame. And on the gentle slopes of the South Bay, the seawater advanced southward by several inches each day.

After a few thousand years, the rate of rising sea levels began to slow. Sediments from area rivers (the San Joaquin and the Sacramento in the north and Alameda Creek in the south) began to accumulate along the shallow shores of the new bay, creating marshes and mudflats that supported plant and animal life.

## VOCABULARY

**bay**

an inlet of the sea, an area of water mostly surrounded by land

**estuary**

a semi-enclosed body of water where fresh water and saltwater mix

**ice age**

a time of widespread glaciation

**glacier**

a large body of slow-moving ice

**plain**

a large area of flat land with few trees

## PRE-VIEWING ACTIVITY

- Review the water cycle. Explain that water from the mountains, including glacial melt, works its way to the sea. Ask students to describe the relationship between glaciers and sea levels during an ice age. What would sea levels be like during periods of maximum glaciation? (*If more water is tied up in glaciers, sea levels will be lower.*) How would sea levels change during interglacial periods when the glaciers melt?

## VIEWING ACTIVITY

- Distribute copies of the student worksheet that contains the map of San Francisco Bay. As students watch the video, ask them to:
  1. label the three bays and the delta that make up the present-day San Francisco Bay Area.
  2. draw the coastline of California as it appeared 14,000 years ago.
  3. draw a star to indicate the location of the Golden Gate.

## POST-VIEWING ACTIVITY

- In small groups, discuss how changes in sea level at the end of the Wisconsin Ice Age might have affected the human inhabitants and wildlife living in and around the hills that are now the Farallon Islands. How might their lives have changed? their food sources? Were the changes fast or slow?

## ABOUT THE AUTHOR

**Lori Mann** is an environmental education consultant with 30 years' experience at the local, state, and national levels. She has worked extensively with curriculum development and review, has taught numerous environmental education courses and workshops, and served for 15 years as education director at Coyote Point Museum for Environmental Education in San Mateo, California.

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## ADDITIONAL RESOURCES

**Beyond the Golden Gate—Oceanography, Geology, Biology, and Environmental Issues in the Gulf of the Farallones**, U.S. Geological Survey, U.S. Department of the Interior

[http://pubs.usgs.gov/circ/c1198/c1198\\_short.pdf](http://pubs.usgs.gov/circ/c1198/c1198_short.pdf)

This 80-page publication discusses the oceanography, geology, biology, ecological niches, and issues of environmental management in the Gulf of the Farallones. The chapter titled "Regional Setting" includes an overview of the development of the landscape features of the Bay Area.

**Geology of the Bay Area**, Doris Sloan, Internet Archive

[http://www.archive.org/details/Cal\\_Day\\_2007\\_04\\_21\\_Doris\\_Sloan](http://www.archive.org/details/Cal_Day_2007_04_21_Doris_Sloan)

Hear Doris Sloan, the author of *Geology of the San Francisco Bay Region*, lecture about geological features of the San Francisco Bay Area and share her favorite discoveries.

**San Francisco Bay**, Playing with Time

<http://www.playingwithtime.org/cgi-bin/browser/gallerydisplay.pl?clipID=0132&page=1&sort=clipName&searchCriteria=san%20francisco%20bay>

View an animation showing how San Francisco Bay formed more than 10,000 years ago.

**An "Unvanishing" Story: 5,500 Years of History in the Vicinity of Seventh & Mission Streets, San Francisco**, National Park Service

<http://www.nps.gov/history/seac/sfprehis.htm>

Read a description of the formation of San Francisco Bay, its natural history, and the early settlement of the area.

## CREDITS

***Saving the Bay*** is produced by Ron Blatman and KQED/KTEH Public Television. Production funding is provided by the Bay Area Toll Authority; the California State Coastal Conservancy; the Richard and Rhoda Goldman Foundation; the Ambassador Bill and Jean Lane Fund; the David and Lucile Packard Foundation; the Sonoma County Water Agency; the Wallace Alexander Gerbode Foundation; the Columbia Foundation; the Melvin B. and Joan F. Lane Fund; the Dirk and Charlene Kabcenell Foundation; the Morgan Family Foundation; the Association of Bay Area Governments and the Bay Trail Project; the San Francisco Bay Conservation and Development Commission; and the Environmental Science Associates.

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## STUDENT WORKSHEET

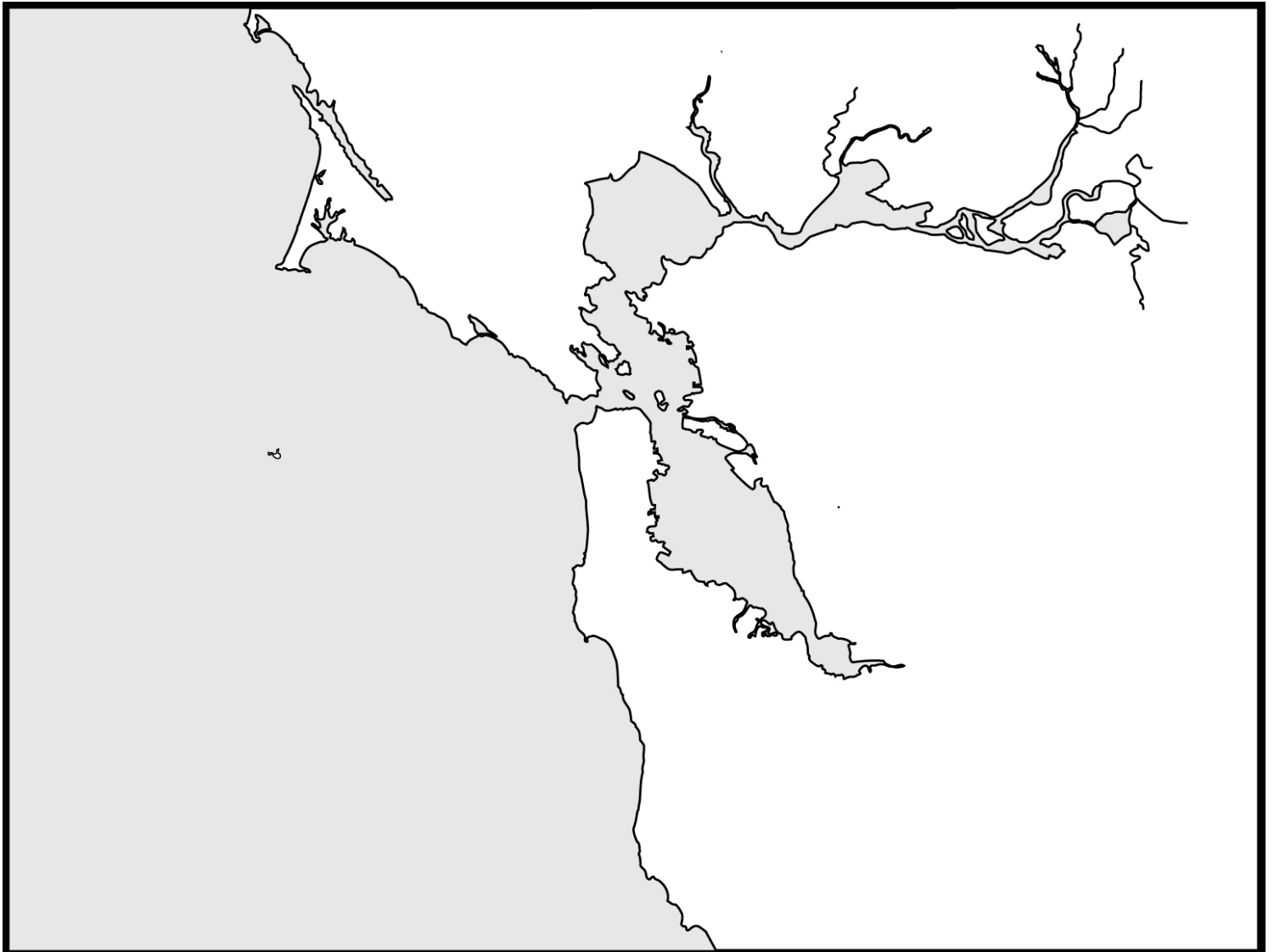
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1. Label the three bays and the delta that make up the present-day San Francisco Bay Area.
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## VIDEO TRANSCRIPT

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**NARRATOR:** The estuary the world came to call San Francisco Bay is actually three bays and a vast inland river delta. San Francisco Bay proper is the most well known, with its ever-spectacular dance of air, wind, and water. To the north lies San Pablo Bay, nearly round in shape and exceedingly shallow. East, through a second break in the coastal mountain ranges, called Carquinez Strait, is a third bay, Suisun Bay. Beyond, a network of rivers and channels—the highly altered river delta formed by the Sacramento and San Joaquin rivers—provides the Bay with its freshwater inflow.

In the long history of the planet, today's San Francisco Bay is a relative newcomer.

**DORIS SLOAN:** We know there have been at least four bays, at least four times when this valley was filled with water and there was a San Francisco Bay; and there may have been as many as seven.

**NARRATOR:** Twenty-seven miles west of the Golden Gate lie the Farallon Islands. Fourteen thousand years ago, the Farallones were hills within a vast river plain extending west to the continental shelf a few miles beyond. This once was the west coast of North America.

**KEN LAJOIE:** During the height of the last ice age, we tend to think the world was frozen over with woolly mammoths running around in snowy areas with glaciers on all the peaks. And actually, the geological and paleontological information tells us that the environment, the climate here in the San Francisco Bay region, was not much different than it is today.

**NARRATOR:** As the last ice age ended, today's Gulf of the Farallones was a vast plain over which a great river flowed. It was here that the first human inhabitants of the region likely lived, drawn by the abundant water, fish, and wildlife. But soon the ocean began to rise.

**JOSH COLLINS:** Some eight or nine thousand years ago, as the glaciers of the Wisconsin Ice Age began to melt, the seas rose and they came across the previous shoreline—which is out there just on the other side of the Farallon Islands—came across the plain we now call the Gulf of the Farallones and began to enter San Francisco Bay through the Golden Gate.

**NARRATOR:** As the sea level rose, the great river that flowed out through a low point in the coastal range flooded. The river canyon now called the Golden Gate began to take on its present form. As water continued to rise, vast river valleys inland filled as well. Seven thousand years ago, the dramatic shift in sea level slowed. Sediment flowing in from the surrounding hills and the great valley inland settled around the edges of the new estuary. Plant and animal life began to flourish. The San Francisco Bay we know today was born.