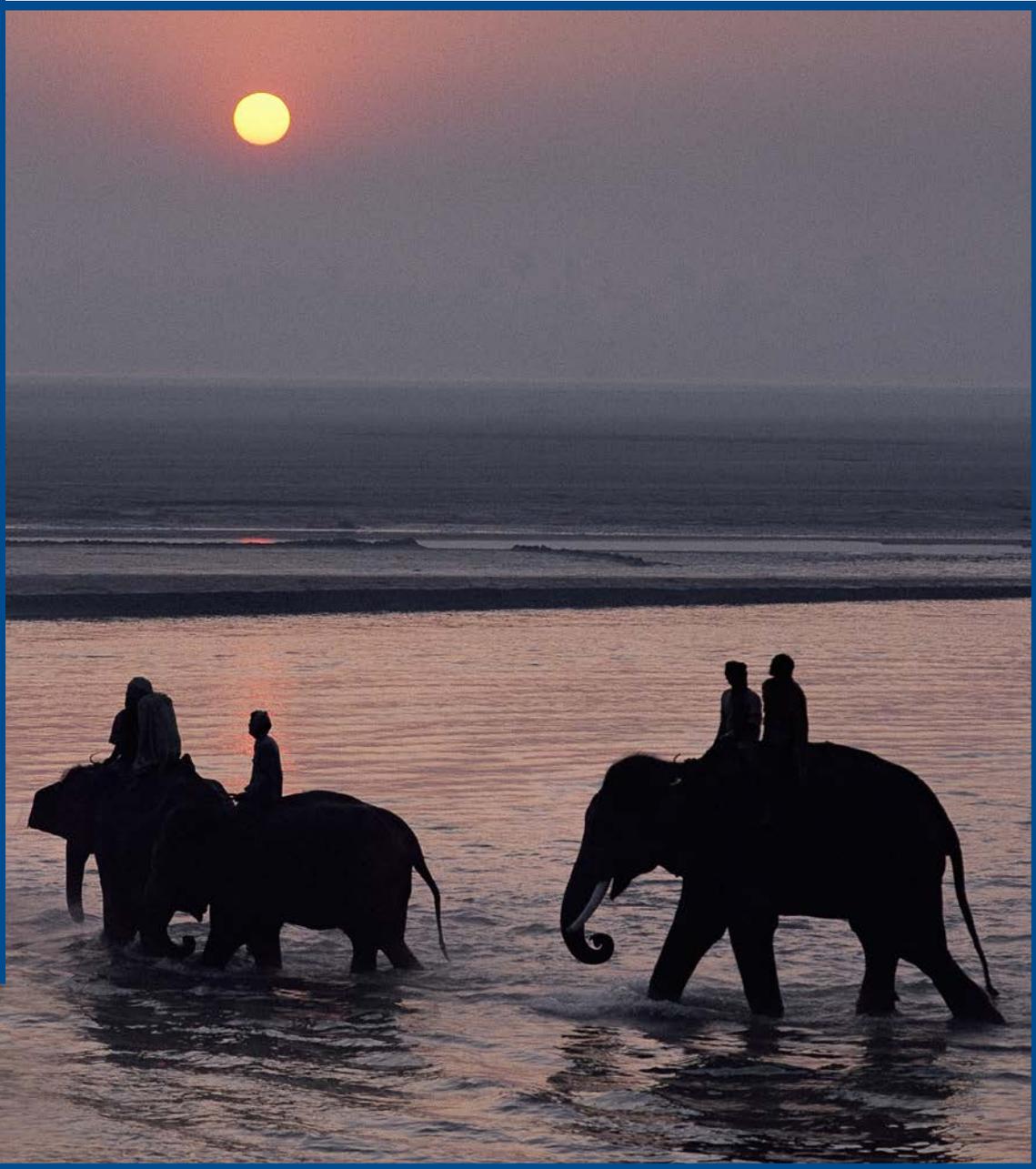


**Student Edition**

California Education and the Environment Initiative

**6**

**History-Social  
Science Standards  
6.5.1. and 6.6.1.**



# The Rivers and Ancient Empires of China and India

## 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:

Special thanks to **Heal the Bay**, sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

### Office of Education and the Environment

1001 I Street • Sacramento, California 95814 • (916) 341-6769

<http://www.CaliforniaEEI.org>

© Copyright 2011 by the California Environmental Protection Agency

© 2013 Second Edition

All rights reserved.

This publication, or parts thereof, may not be used or reproduced without permission from the Office of Education and the Environment.

These materials may be reproduced by teachers for educational purposes.



## Lesson 1 The Fertile Fields of Asia

None required for this lesson.

## Lesson 2 Rivers and Monsoons

Monsoon Song .....	2
Asian Monsoons .....	3

## Lesson 3 Goods to Grow Civilizations

None required for this lesson.

## Lesson 4 Ancient River Settlements of Northern India

The Indus River Valley .....	5
The Ganges River Valley .....	6

## Lesson 5 The Huang He and the Shang Dynasty

Natural Resources of the Huang He .....	7
---	---

## Lesson 6 Our Use of Rivers Today

<i>California Connections: Changing the Bay Delta to Meet Our Needs</i> .....	8
---	---

## Science Background Introducing a River System

River Systems Vocabulary .....	12
<i>California Connections: The Sacramento-San Joaquin River Delta</i> .....	13

## Monsoon Song

### Lesson 2

A *barahmasa* is an Indian folk song about the seasons. There are thousands of barahmasas from all parts of India. One of the most famous is the **Monsoon Song**, written by Rabindranath Tagore, a prominent Indian nationalist.

### Monsoon Song

by Guru Dev Rabindranath Tagore



After the long hot burning tropical summer,  
When the dark clouds of rain make the first appearance on the  
far side of the horizon,  
One's heart is at once filled with joy and hope.  
And then comes the rains, soaking the earth and the human soul.

My mind flies with the clouds in infinite space  
To the musical accompaniment of Shravana rains.  
It takes wings and flies with the wild ducks  
And loses itself in the ecstasy of turbulent nature.

### Mon Mor Megher Sangi

mon more meghero sangee,  
ude chale dig digantero pane  
nishimo shunne shrabano barshano sangeete  
rimijhim rimijhim rimijhim.

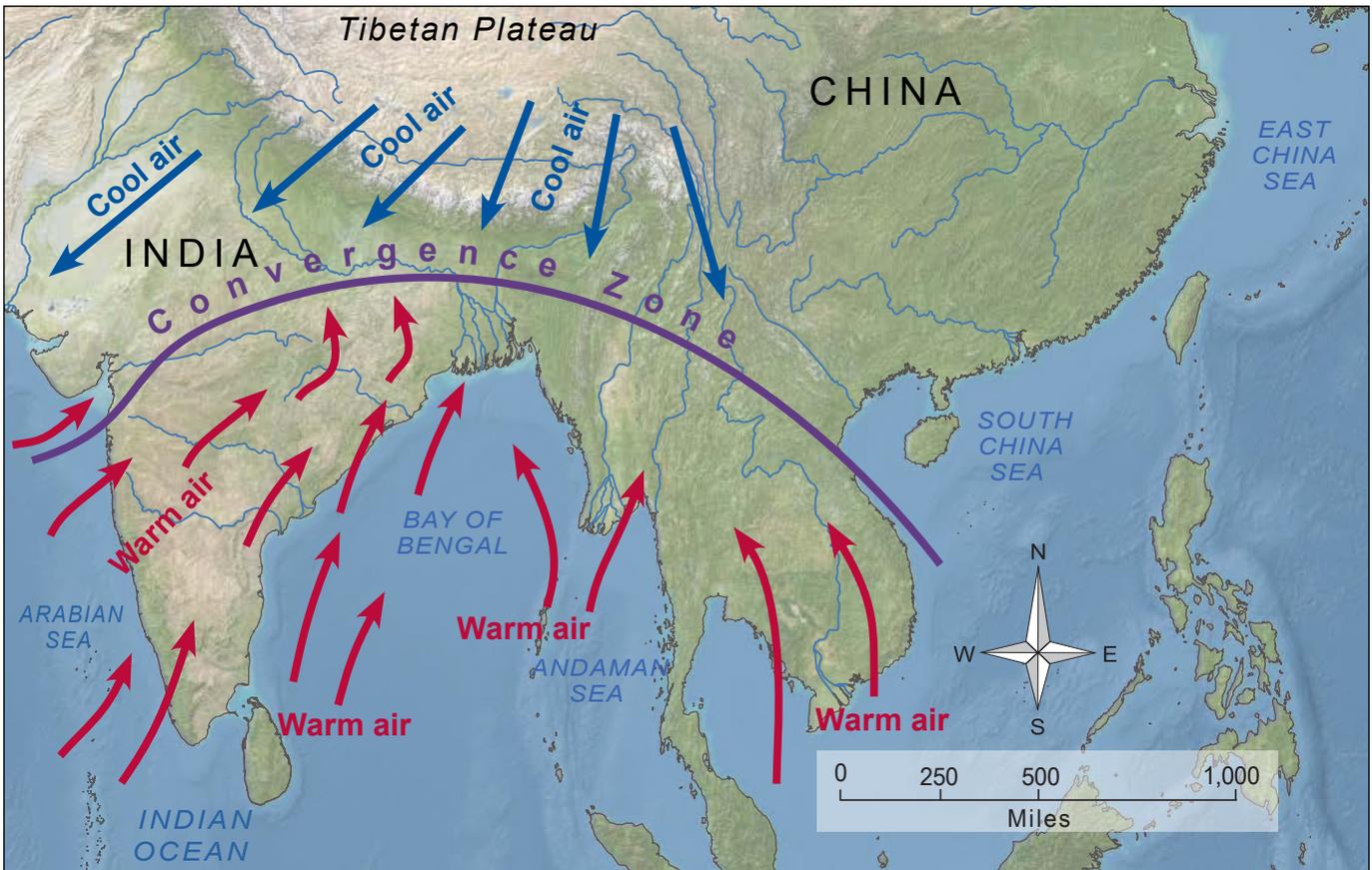
mon more hansha balakar pakhay jaye ude  
kachito kachito chakito tarito – aaloke.  
jhanjhano manjeero bajay jhanjha rudra anande.

kolo – kolo kolo mondire  
nirjharinee dak dyay pralaya aabthane.  
bayu bahe purba samudra hote  
uchchhala chhalo chhalo tatinee tarange.

mon more dhaye tari matto prabahe  
tal – tamalo – aranney  
khubdha shakhar andolaney.

(Song sung by Hemanta Mukherjee available at:  
[http://shamoli-sarkar.sulekha.com/blog/post/2007/06/  
monsoon-song-by-guru-dev-rabindranath-tagore.htm](http://shamoli-sarkar.sulekha.com/blog/post/2007/06/monsoon-song-by-guru-dev-rabindranath-tagore.htm))

# Asian Monsoons



## What Is a Monsoon?

A monsoon is a change in the direction of the usual wind pattern. Monsoons happen every year. These wind shifts change the weather. Monsoons bring rain to many dry, hot regions. Many parts of the world experience monsoons. The most famous are the Asian monsoons, which affect India, China, Japan, and Southeast Asia. Monsoons also affect parts of Africa and the United States.

Monsoon rains are very important to the people of Asia. A weak monsoon season causes drought, crop failures, and hardship for people and animals. However, when

monsoon rains are too heavy, they can cause huge floods and kill thousands of people. The people who first settled along the Indus, Ganges, and Huang He river valleys depended on the yearly monsoon cycle for survival.

## The Monsoon Cycle

Monsoons usually form where a large landmass meets the ocean. Monsoons, like most other winds, form when the Sun heats up the air over the land. The land becomes hotter than the ocean. The air over the land heats up, too. The hot air rises and creates low pressure over the land. (Cool air does

## Asian Monsoons

Lesson 2 | page 2 of 2

the opposite, creating high pressure.) The atmosphere tries to keep the pressure in balance. The atmosphere uses wind to do this. Cooler, humid, heavier air from the ocean rushes in to cover the land. The rush of air starts a cycle. Warm, dry air flows toward the ocean to replace the cooler ocean air moving toward the land. A constant wind starts blowing from the ocean to the land.

### Bring on the Rain

The humid ocean air rises as it flows onto the land. That air starts to lose some of its moisture in the form of rain. The largest rain clouds form over mountains. As the humid air is forced over high elevations, heavy rains begin. This is the reason why the summer monsoon forms the rainy season in many tropical areas.

In the late fall and early winter, the situation is reversed. Land surfaces cool off quickly in response to cooler weather. The land becomes cooler than the ocean during the winter. The air over the ocean, now warmer than the air over the land, rises and is replaced by the cooler land air. The winds blow from land to sea during the winter. The land is very dry during this time of year because sinking air does not make rain clouds.

### The Monsoon in India

The world's biggest monsoon occurs in India. During the early summer months, the Sun begins to heat the land of India. Usually this sets up a pattern of sea-to-land winds. However, in India, the rains come later because of the jet stream. The jet stream is a great "river" of air that constantly blows west to east around Earth.



Fishing after a flood

The jet stream over the Indian Ocean moves around with the seasons, traveling north in the summer and south in the winter.

During the summer, the jet stream moves north and bumps into the Himalayas. The air is forced to rise quickly over the mountains. This air collision creates a monsoon cycle. As a result, towns in the foothills of the Himalayas receive more rainfall than almost anywhere on Earth.

India's seasonal cycle includes three main seasons of four months each: the cold, dry winter from November to February; the hot, dry summer from March to June; and the rainy monsoon season from July to October. Each season has its own crops, too. Rice and corn are harvested in the winter. Wheat and barley are harvested in the following months. Melons and cucumbers are picked during late summer.

### The Monsoon in China

The same cycle takes place in China. However, China receives monsoon winds from both the Indian and Pacific oceans. From May to September, humid, cool winds blow south to north from the oceans, creating heavy rains. This is China's warm, wet period of the year. From October to April, the winds reverse direction. Winds from the north bring a cold, dry winter to China.

# The Indus River Valley

Two great civilizations, the Harappan and the Aryans, began in the valley of the Indus over 4,000 years ago. The Indus River begins in the Himalaya Mountains and empties into the Arabian Sea. The Indus is one of the world's longest rivers. Today, the Indus River runs through the modern-day nations of India and Pakistan.

## The Harappans (2600 BCE–1900 BCE)

The first civilization along the Indus was the Harappan civilization. The Harappans established two large cities, Harappa and Mohenjo Daro, and many smaller towns. The Harappans lived next to the Indus River. They used the river's resources: fresh water for drinking, bathing, watering crops and animals, trade, and fishing. Each year, the monsoon rains caused the river to flood and create fertile soil. The Harappans were excellent farmers. They grew wheat, barley, cotton, dates, and melons. These were the first people in the world to make cotton cloth, too.

The Harappans built their houses and other buildings out of bricks made from river clay. Clay pipes brought clean water to their houses. Their cities were very clean. The Harappans

used wood from the nearby mountains to build ships for trade. The Harappans burned wood in ovens for warmth and cooking. The people of this early civilization used flint to create blades and other tools. The people mined for gemstones, such as lapis lazuli and turquoise, in the Thar Desert. The Harappans traded goods with nearby peoples.

The Harappans were very organized and had the first planned cities in world history. They even created a writing system, but no one alive today can read it. The people of this civilization worshipped river spirits. The Harappans buried food with the dead so the dead could have something to eat in the afterlife.

Harappan civilization ended around 1700 BCE. Nobody knows why, but many think changes in nature played a part. There is evidence of a big earthquake.

The Saraswati, which ran parallel to the Indus River, dried up. People could no longer grow crops in this area and they had to move. Around this same time, people called the Aryans started coming to the valley from the north. Some of them settled along the Indus River.



Harappan seal

# The Ganges River Valley

The Ganges River is the longest river in India. It runs through the nations of India and Bangladesh. About 10% of the world's population lives in the valley of the Ganges—that's 600 million people! The Ganges begins in the Himalaya Mountains. Several other rivers join the Ganges in the middle of its course.

## The Aryans (1500 BCE–800 BCE)

At first, only small nomadic groups lived by the Ganges River. People fished and brought their animals to drink the water. Around 1500 BCE, a group from the north called the Aryans started moving to the Ganges River from the Indus River. The people wanted to settle by the Ganges, but jungles were growing by the river. Aryan farmers had to clear jungle first so they could plant crops, such as wheat, rice, and cotton. The climate was warm, and the soil was fertile.

The Vedas were the holy books of the Aryans. These writings formed the beginnings of Hinduism, the main religion of India. Many verses in the Vedas celebrate the natural resources of the Ganges River. The Aryans believed that the Ganges was a goddess sent from Heaven. Even today people in India believe the Ganges is sacred. They travel far to bathe in the river and drink its water. Aryans worshipped other nature gods, too. The Aryans believed the monsoon rains would not come unless Varuna, the sky god, had defeated a great dragon. Aryans believed the gods controlled natural forces.

Prayaga was one of the earliest cities established on the Ganges. Aryans built this city where the Ganges and Yamuna rivers meet. Aryans brought a new language, known

as Sanskrit, to India. They also brought horses and horse-drawn chariots, cattle, and pottery. The Aryans studied the stars to find the best

time to plant crops, such as wheat and barley. Prayaga was later renamed Allahabad.

Varanasi was another important city established by the Aryans. At Varanasi the Ganges flows north rather than south. Because of this, people thought it must be a sacred spot. Varanasi became a silk capital after traders brought silkworms to the city several thousand years ago.

Yet another important city was Pataliputra, now Patna. It became the capital of the Mauryan Empire. Patna became famous for its rice. The Mauryan Empire controlled almost all of India. Their control started with the river.

The Mauryan leaders knew they had to have power over trade and water. The first Mauryan emperor, Chandragupta Maurya, bought the whole Indus Valley from the Macedonian general Seleucus for 500 elephants! Is that a good deal?



Taj Mahal, Agra, India

## Natural Resources of the Huang He

### Lesson 5

#### Forests

Many trees grow in the valley of the Huang He. The trees are mainly pine. Many things are built from pine, including buildings and boats. Some people wrote on bamboo wood. (They also wrote on silk.)

#### Turtle Shells and Bones

People wrote on turtle shells and the large bones of sheep. These artifacts were called “oracle bones.” In China, people used oracle bones to ask questions about the future.

#### Loess Soil and Crops

The valley of the Huang He was very fertile. Many crops are grown there. Loess soil is close to the river. Trees do not grow well in the loess soil. Yet, the soil is good for crops. The most important crops grown were rice, wheat, and millet. Wheat grew best in northern China, and rice and millet grew best in the south. The thick soil along the river is called clay and was used to build houses.



Pine trees



Bronze spear head

#### Bronze

The Shang Dynasty began during the Bronze Age. Bronze could be used to make bowls and vases. Bronze objects were used in special ceremonies. Bronze, because it is an alloy (a mixture of two metals), made weapons stronger than iron weapons, too. It was used to make arrowheads, knife blades, and axes.

#### Cowry Shells

People got cowry shells from the Huang He Delta. Cowry shells were often used as money in ancient China.

#### Silk

People in China were the first to figure out how to make silk. They hid their knowledge for a long time. The Chinese knew the cocoons of silkworms are made of silk thread. The silk thread was woven into fabric. Silk fabric was traded to faraway places as a way to build riches. The fabric was expensive.

#### The Huang He

The Huang He was the most important resource for early Chinese civilization. The river provided water for people, crops, and animals. Cities built on the curves of the river were easier to defend because people could see their enemies coming. The river also was used for trade. Whoever controlled the water and trade became powerful. The Huang He also influenced religious beliefs. People in Ancient China believed in gods of rain, thunder, and the river.

# Changing the Bay Delta to Meet Our Needs



On June 3, 2004, a levee that protected farmlands from flooding in the Sacramento-San Joaquin River Delta (Bay Delta) gave way. Water poured through the 200-foot opening (called a “breach”) and sent more than 250 people running for their lives. Crops were covered with water in an instant. Twenty houses and 50 barns were under water by the end of the day. Roads washed out, train tracks were flooded, and fuel lines were cut off. One farmer said that he lost \$500,000 worth of corn in only a few hours.

Acres of rich farmland dot the Sacramento-San Joaquin River Delta. Today, more than 1,000 miles of levees protect the islands from the river that flows between them. The levees need to be constantly maintained. They are just one of many ways people have changed the Bay Delta in the past 200 years.

## Human Designs and Nature

The Bay Delta did not always have this system of human-designed waterways, levees, and islands. The region was not developed before the 1830s. It did not have railroad tracks, homes, power lines, and gas lines, which all need



Flooding of Sacramento River

protection from floodwaters. The region also did not have the pipes and aqueducts that now carry valuable fresh water to other parts of the state.

For more than 150 years, people have altered the courses of the Sacramento and San Joaquin rivers. Parts of these rivers were made straighter, deeper, and wider so people and goods can travel more easily. People made areas for fishing, hunting, and water sports. They also built a network of dams, pipes, and canals to carry water to farms and communities.

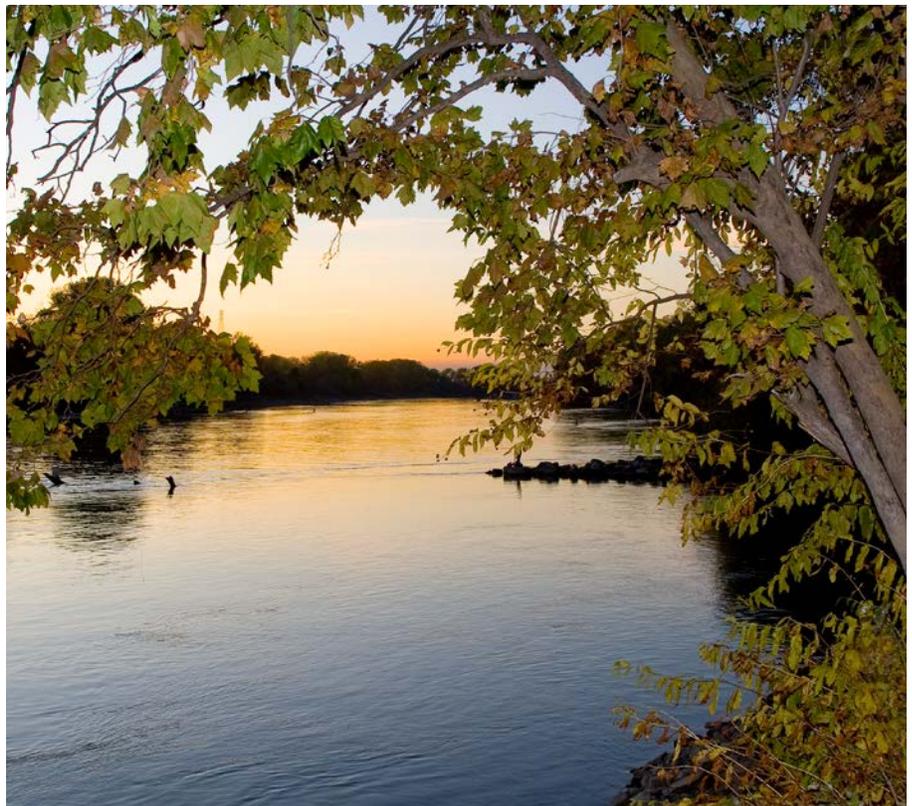
The rivers that flow into the Bay Delta pass thousands of people who depend on them. The water rushes under rafts and through strawberry fields. The rivers run past towering buildings and beneath cargo ships filled with goods.

Sacramento and Stockton are major inland ports. Sacramento is the shipping and rail center for the Sacramento Valley. Stockton ships goods and agricultural products from the San Joaquin Valley. Fruit, vegetables, grains, dairy goods, and beef pass through these inland port cities to the coast,

where they are exported to other cities and countries. In the past, the Bay Delta's natural waterways were too shallow to allow heavy ships to pass through and transport goods. People scooped out thousands of tons of the river bottom sediments to make the waterways deeper so ships could reach these ports. This process is called dredging and, with certain restrictions, the practice continues today. Dredging can make the water cloudy, affecting the lives of river animals and plants.

The process can also stir up materials that have settled onto the river bottom. These materials can pollute the flowing river water.

In addition to dredging shipping lanes and constructing levees, people have built canals and channels in the delta to provide water to farms and homes. This construction has changed how the rivers flow. These changes have affected the animals and plants that depend on the Bay Delta's rich resources.



Sacramento River Delta



California crops being watered

### Changes in the System

Scientists estimate that about five of the 29 native fish species in the Bay Delta are in danger of going extinct or have disappeared forever. This is just one of the many visible signs of change in the Bay Delta's ecosystems. As with many ecological changes, it is hard to know the exact cause. Today, water flows at different speeds, during different times of the year, and in different places than it did in the 1800s. These alterations have caused big changes in the environments where fish and other animals live. The temperature, speed, and clarity of the water may have changed. In some places

the water is even flowing in a different direction.

Fish and other species are not the only living things that depend upon the delta, though. Twenty-five million Californians drink at least some water from this system. Dozens of crops, from apricots to zucchini, use water drawn from the Bay Delta. Maybe you are wearing a T-shirt woven from cotton grown with water from the delta. You have probably eaten cereal or cookies that have ingredients grown with this water. Water from the delta produces a bounty of crops that include almonds, figs, and pistachios. Other vegetables, fruits, and nuts, such as walnuts, melons, lettuce,

plums, and tomatoes, are also grown here. You may drink milk from cattle raised here.

Almost one-third of the water in this system no longer flows into the San Francisco Bay. In the year 2000, nearly 2 trillion gallons of water were taken out of the Bay Delta system. That's more than enough to give a gallon of water to every single person on Earth every day for a year! Most of the water ended up irrigating farms in the Central Valley. About 410 billion gallons went to homes.

It is a natural process for saltwater to flow inland and move upstream, especially in years with little rainfall. However, so much fresh water

is removed from the river upstream that salt water from San Francisco Bay sometimes flows inland during high tide. This affects farms and wildlife that depend on fresh water.

### Human Impact

Channels, levees, and dredging have changed patterns of erosion and sedimentation in the valley. Much of the land around the river used to receive a coating of rich soil during yearly floods. The river is no longer

allowed to flood—unless a levee breaks, as in 2004.

One way that human use has changed the delta is that dams upstream from the Bay-Delta control the amount of water flowing in the system. People operating the dams release the water at different times of year. The dams also act as barriers to fish movement, except where there are “fish ladders” or similar structures. Dams may make less water available in a river environment. This

can make a big difference to various species in the river. For example, populations of animals that depend on natural river flow and plenty of cold water, such as salmon, have decreased.

As California’s population grows, we will depend more on the Sacramento-San Joaquin River Delta system. We will need to continue to find new ways to manage precious water supplies while protecting the state’s natural resources and wildlife.



Hetch Hetchy Dam, California

## River Systems Vocabulary

Science Background

---

**Cataract:** A series of steep rapids or a waterfall in a river.

**Channel:** The bed of a stream, river, or other waterway.

**Delta:** A large, usually triangle-shaped area at the mouth of a river that gradually builds up as the river deposits sediments.

**Deposition:** The depositing or settling of rock or soil from one place to another.

**Erosion:** The moving of rock and soil from place to place by wind, water, or ice.

**Flood cycle:** The periodic seasonal pattern of flooding in a river system.

**Floodplain:** A flat area along a river that floods when water flows outside of a river's banks.

**Headwaters:** The springs or small streams that supply water where a river first starts.

**Meander:** A winding section of a river or stream.

**Sediment:** Stones, sand, and soil carried by water, wind, or glaciers.

**Tributary:** A small river or stream that flows into a larger one.

**Watershed:** The land area that drains water into a particular body of water, such as a stream, river, lake, or ocean.

# 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 ( $\Delta$ ).

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.





California STATE BOARD OF  
**EDUCATION**

---

## California Education and the Environment Initiative