GRAB-AND-GO WATER ACTIVITIES

for Orange County K-12 students



WHAT'S INCLUDED

- ✓ Activity Background
- ✓ Learning Objectives
- ✓ Activity Procedure
- ✓ List of Materials
- ✓ Advanced Resources Section*
- ✓ Engineering Design Process Worksheet
- ✓ Natural and Human Social Systems Venn Diagram
- ✓ Key Terms and Definitions
- ✓ Video Link and Sample Q & A
- ✓ Organisms Game Card Pack
- ✓ Advanced Game Card Pack

**Younger students can explore the basic ecosystem structure, while older students use the advanced resources to further investigate the web of life.*

Explore the Web of Life

Students engage in the steps of the engineering design process as they investigate and develop solutions to a real-world problem. Working alone, or together in small groups, students examine natural and human social systems in the Sacramento-San Joaquin Bay Delta and discover why healthy systems in the northern part of California are so important to Orange County water supply.

California's water supply resources, combined with the landscape and climate of a region, cultivate rich habitats with diverse ecosystems of plants, animals, and more. The health of these ecosystems can impact the quality and reliability of the state's water supply, infrastructure, human societies, and economy. Through construction of a model web of life, students will explore, compare, and contrast a human social system with a natural one, and will develop an awareness of how they are a part of, and not separate from, the environment around them.

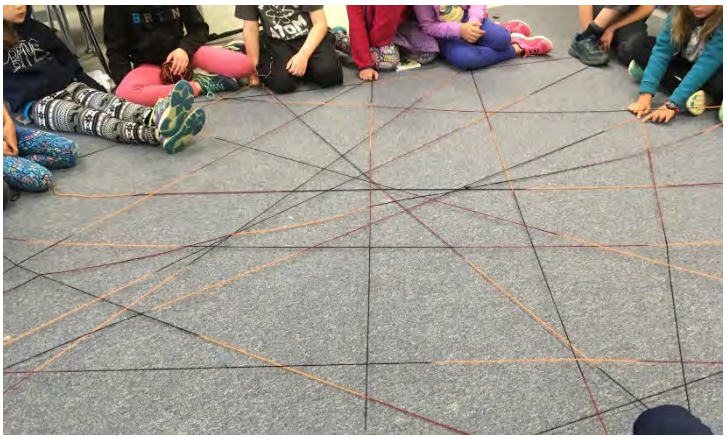
Activity Background

In this activity, students investigate the importance of healthy ecosystems. An ecosystem is made up of different types of living things and their environment which includes water, sunlight, air, soil, and more. The organisms in an ecosystem interact with each other, and each organism has a role in the ecosystem. Human activities can alter natural systems which may be beneficial, neutral, or detrimental in their effect.

Through active participation, students are introduced to the Sacramento-San Joaquin Delta (Delta), a critical hub for California's water supply from the north. Water from lakes and rivers in Northern California move through the Delta to the San Francisco Bay Area, through the Central Valley, and down to Southern California via the State Water Project (SWP). This system provides water to nearly 30 million Californians and 750,000 acres of farmland. Nearly all Californians rely on resources from the Delta, whether they know it or not, and the SWP is a critical piece of infrastructure for the state.
Learn more:
https://www.mwdoc.com/statewaterproject

The Delta also provides crucial habitat for both land and water species. Seawater from the San Francisco Bay mixes with fresh water from the Sacramento and San Joaquin Rivers - along with others - to create the largest estuary on the West Coast. The threat of rising sea levels, earthquake damage, floods, aging levees, invasive species, and more, impact the long-term sustainability of the Delta.

To learn more, have students watch this video from the Metropolitan Water District of Southern California. Sample Q & A provided on page 7:
https://youtu.be/bv0pbTpU800





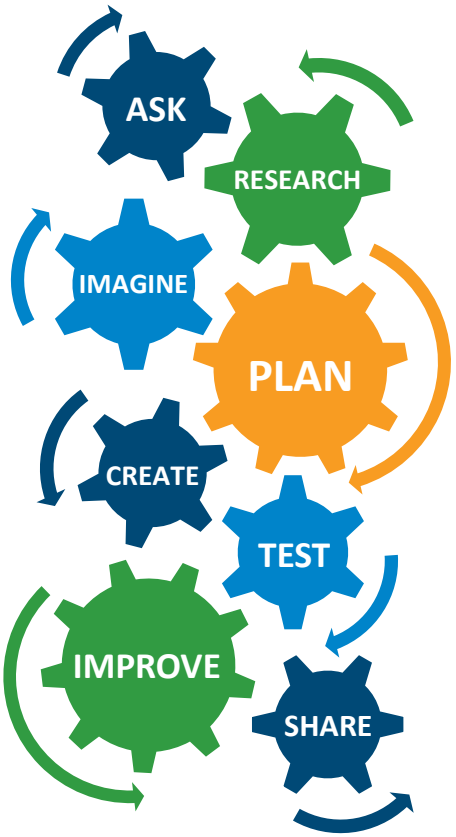
Learning Objectives

Through this activity, students should be able to:

- Observe that all living things have needs that must be met for survival
- Identify that humans are living things, and therefore depend on natural systems for both their survival and the survival of societies
- Discover that human activities can influence natural systems
- Explain potential consequences to an ecosystem when a component is changed or eliminated
- Recognize that nearly half of all Orange County water supply needs are met with imported water, and the water supply delivery from Northern California is complex and challenged

Introduce the Web of Life

Nearly **half** of Orange County's water supply is imported either from Northern California or the Colorado River. The challenge is for students to develop solutions to ecosystem problems in the Delta that will protect, preserve, or effectively alter the web of life, ensuring clean, healthy drinking water for Southern California residents and businesses who rely on it. Be sure to guide students to connect, reflect, and communicate their solutions.



PROCEDURE:

- Print and cut out attached Game Cards.
- Place students in a circle and give them each a Game Card and the attached engineering design worksheet. NOTE: *If working alone, identify points in the room to tape Game Cards to.*
- Cut yarn or string into pieces long enough so connections between Game Cards can easily be made.
- Start with the SUN. Ask "Which organisms rely on the sun for food? These are PRODUCERS." Tape one end of a piece of string to the sun, and connect the opposite end to an organism that relies on the sun for food. Continue making these connections using multiple pieces of string.
- **One-by-one**, ask the question for other Game Cards, "Which organisms rely directly on PLANTS (PRIMARY CONSUMERS), INSECTS and ANIMALS (SECONDARY CONSUMERS), or FUNGI (DECOMPOSERS) for food, shelter, or protection?" Use tape and pieces of string to make connections.
- Using tape and pieces of string, start a NEW connection with WATER. Ask students, "What organisms need WATER for survival?" Continue the process above.
- Draw students attention to the complex web that has been created and begin asking **one-by-one**, "What would happen if the X (organism) in the ecosystem disappeared?" If impacted, have the students drop, cut, or remove the string of the organism that makes any connection to others.
- Begin guiding students to offer potential solutions to breakdowns in the web.

LIST OF MATERIALS

- ✓ Engineering design worksheet
- ✓ Organisms Game Card Pack
- ✓ *Advanced Game Card Pack
- ✓ Yarn or String
- ✓ Tape and Scissors

***Note:** *You can continue this activity by adding other connections in the web of life to COMMUNITY, INFRASTRUCTURE, ECONOMY, and POLICY Game Cards. Ask the guiding question, "How are these activities impacted by changes in the web?"*

ADVANCED RESOURCES

- ✓ www.MWDOC.com/your-water/
- ✓ www.MWDOC.com/deltaconveyance
- ✓ www.watereducation.org/aquapedia/sacramento-san-joaquin-delta

The Web of Life

Engineering Design Process Worksheet

NAME: _____

DATE: _____

ASK

What is an ecosystem? Why are healthy ecosystems in the Delta important? Identify an example of an ecosystem in your community. How is it similar to a Delta ecosystem?

RESEARCH

Use books, technology, or human resources to research life cycles and systems in the Delta, and identify examples of breakdowns in the web of life there.

IMAGINE

Who are the Producers, Primary and Secondary Consumers, and Decomposers in the Delta? What can be done to protect, preserve, or effectively alter organisms or cycles in the ecosystem?

PLAN AND CREATE

Identify three (3) ecosystem problems in the Delta, and develop solutions to those problems.

TEST

Discuss solutions with family members or classmates. Were your solutions met with questions or overwhelming approval? How else might you be able to test your theories?

IMPROVE

What solutions might work better? How can you improve your original ideas? Present and discuss improvements.

The Web of Life

Natural Systems and Human Social Systems

NAME: _____

DATE: _____

System: When different parts or components connect to form a whole. Example: Pedals, handlebars, and wheels are different parts or components that connect to form a bicycle.

Natural Systems: Systems that occur in nature without any human influence like weather, rivers, or trees.

Human Social Systems (man-made): Systems that are created by humans like water delivery, schools, and parks.

STEP 1

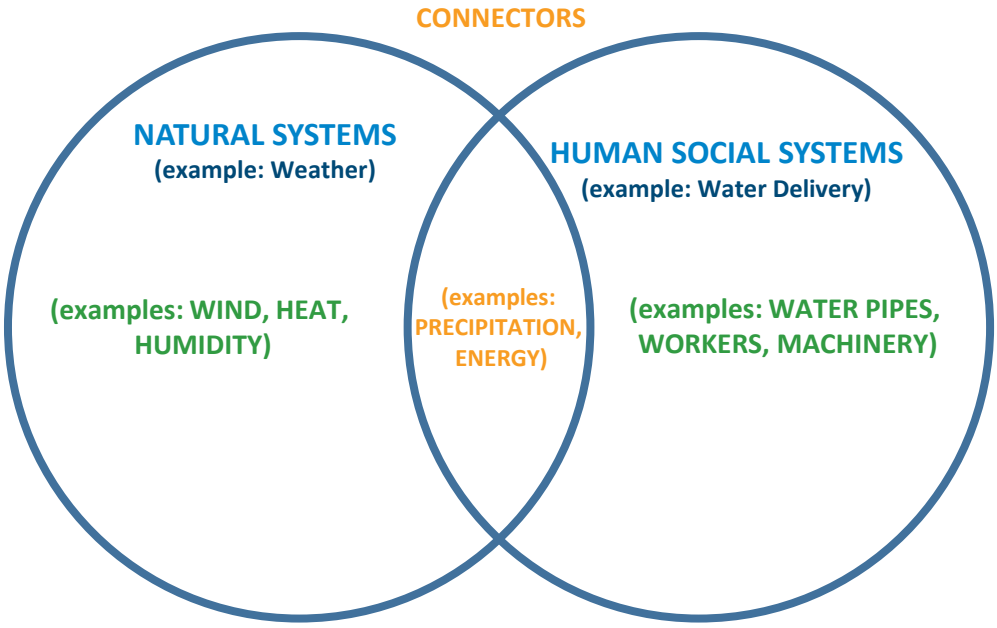
Spend some time observing and learning about the systems and cycles that exist in your own community. On a separate sheet of paper, write down examples of natural systems and human social systems in your community. Pick one example of each to use in the diagram below. We know that water is essential to all life, as well as to the health and prosperity of societies, so water will be one of your connectors.

STEP 2

A community is a human social system made up of many other systems. Using the examples of natural and human social systems identified in Step 1, examine how these systems in your neighborhood depend on water. What would happen if any of these systems no longer existed? From your conclusions, decide if you want to change your examples in the diagram below.

STEP 3

Using the diagram below, uncover connections that can be made between the natural and human social systems you've decided to explore in Step 1. Where do these two systems connect? What would happen if the any of the connections between the two were altered or no longer existed?



STEP 4

Specify problems that were uncovered when connections between systems above were lost or altered. Propose solutions to those problems and engage others in your findings. What actions could you take individually or in groups to make changes needed to protect those systems?

Consider how human activities cause changes to water or water sources near your home or school, as well as globally. Are there ways that you can help protect and save water in your community, as well as on a larger scale?

The Web of Life

Key Terms and Definitions

01 **Connection:** A relationship, link, or association.

02 **Consumer:** An organism that feeds on other plants (PRIMARY) or animals (SECONDARY) for energy.

03 **Decomposer:** An organism that breaks down the cells of dead plants and animals into simpler materials, returning nutrients to the soil.

04 **Ecosystem:** A combination of living things in a community and the non-living things in the physical environment surrounding them.

05 **Engineering Design Process:** A series of steps used to solve a problem. In this activity, the steps are Ask, Research, Imagine, Plan, Create, Test, Improve, and Share.

06 **Estuary:** A partially enclosed body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea.

07 **Habitat:** The natural home or environment of an animal, plant, or other organism.

08 **Organism:** An individual plant, animal, or single-celled life form.

09 **Producer:** An organism, either green plant or bacterium, which takes energy from the sun to produce its own food.

10 **Reliability:** Someone or something to be trusted or relied upon. You can trust that Orange County's water is clean and safe, and there is plenty of it.

11 **Water Quality:** The measurement of how clean and healthy your water is to drink and use.

Sample Q &A Video:
The Heart of California's Water Supply

https://youtu.be/bv0pbTpU800

Q: In what ways is the Delta important to California?
A: The Delta is integral to California's water supply, economy, and quality of life.

Q: What waters come together to form the Delta?
A: The Sacramento River and San-Joaquin River meet to form the Delta. These waters mix with salt water from the San Francisco Bay and the Pacific Ocean to create the largest estuary on the West Coast.

Q: The Delta has roughly _____ miles of levees, _____ miles of sloughs and channels, and _____ islands.
A: 1,100 miles of levees, 700 miles of sloughs and channels, 57 islands
BONUS: Describe what a levee, slough, channel, and island are. Why are they important to the Delta?

Q: Approximately how many people are served by the Delta watershed, and in what geographical regions of the state do they live in?
A: 30 million people in the Bay Area, Central Valley, Central Coast, and Southern California are served by water in the Delta watershed.
BONUS: List three (3) things you know about each of these regions and what resources they provide to the state.

Q: Approximately how much of Southern California's water supply comes from the Delta?
A: One-third
BONUS: What percent of your city's water supply is imported?
https://www.mwdoc.com/orange-county-water-supply-sources/

Q: Approximately how many acres of California farmland are irrigated with water from the Delta, and what percentage of fruits and vegetables grown here feed the United States?
A: Six (6) million acres of farmland are irrigated here, producing nearly half of the fruits and vegetables in the United States.
BONUS: List some of the crops.

Q: What percent of U.S. salmon fisheries are supported by the Delta?
A: 80 percent

Sample Q &A Video: *Continued…*

https://youtu.be/bv0pbTpU800

Q: What are some of the challenges the Delta faces?
A: How to balance the needs of local Delta communities, the state's economy, a reliable water supply for two-thirds of Californians, and a healthy ecosystem.

Q: What are some of the recommended solutions to Delta challenges?
A: Diversifying the state's water portfolio, and updating Delta water infrastructure while balancing the interests of local Delta communities.

Q: Why were levees in the Delta built originally? What are they used for today?
A: Levees were first built to protect agriculture. Today, levees also protect highways, towns, infrastructure, and water supply reliability.
BONUS: Describe a levee, slough, channel, and island. Why are they important to the Delta?

Q: What percentage of wetlands and riparian forest has been removed from the Delta? How has this altered the area?
A: 98% of wetlands and riparian forest has been removed. This action has taken its toll on the ecosystem, devastating the robust habitat and food web that native species evolved in, resulting in the decline of many fish species here.

Q: What are the three (3) key risks to the Delta? Describe them.
A: **Subsidence** – dropping land surface, **sea level rise** – increasing levels of sea and ocean water due to factors like global warming, land subsidence, and withdrawal of groundwater, and **seismic** – earthquakes.
BONUS 1: How does peat soil play a role, and how much dirt is lost daily to subsidence?
BONUS 2: Name the potential sea level rise impacts to the Delta?
BONUS 3: Name the potential seismic impacts to the Delta?

Q: What type of restorative projects are being done in the Delta today? What are their benefits?
A: Innovative and science-based projects are underway to restore some historic Delta habitat and ecosystem processes. Benefits include reversing the decline of the ecosystem and providing a more robust food web to boost endangered fish populations.

Sample Q &A Video:
Continued again…

https://youtu.be/bv0pbTpU800

Q: What role do tides play in the Delta ecosystem?
A: Tides move in and out, bringing food to life that exists here.

Q: Who is funding the projects that aid the discovery of new ways to update aging infrastructure in the Delta?
A: Public water agencies, the state, and conservation organizations.

Q: How much has California's population grown since 1960?
A: California's population has more than doubled since 1960.

Q: What is the State Water Project, and who approved it?
A: The California State Water Project is the nation's largest state-built water and power development and conveyance system, and was approved by voters in 1933.

Q: How many long-term water supply contractors receive water from the Delta, and who do they distribute the water to?
A: 29 long-term water supply contractors distribute water from the State Water Project to farms, homes, and industry for daily use.

Q: Who is the largest water supply contractor on the State Water Project, and how much water do they supply to Southern California?
A: The Metropolitan Water District of Southern California (Metropolitan) supplies about 30% of the water used in Southern California.
BONUS: How does Orange County receive water from Metropolitan?
https://www.mwdoc.com/about-us/about-mwdoc/what-we-do/

Q: What are the benefits of modernizing the Delta conveyance system?
A: Ensure reliable water deliveries, restore ecosystem functions for native fish species, guard against climate change impacts, improve export water quality, and protect billions of dollars of investments.



The **SUN** provides energy in the form of light.



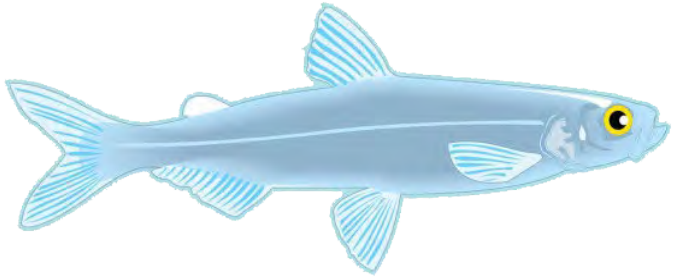
All living organisms need **WATER** to grow and survive.



PLANTS make their own food using energy from the sun. They get things they need to grow from the soil.



CHINOOK SALMON eats insects, amphipods, and other crustaceans when young, and primarily other fish when older.

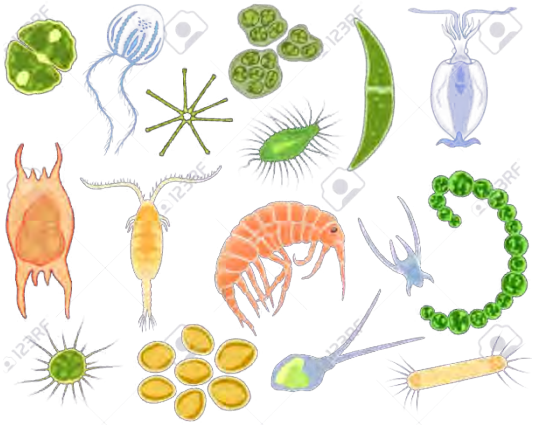


DELTA SMELT primarily eat planktonic copepods, cladocerans, and amphipods.

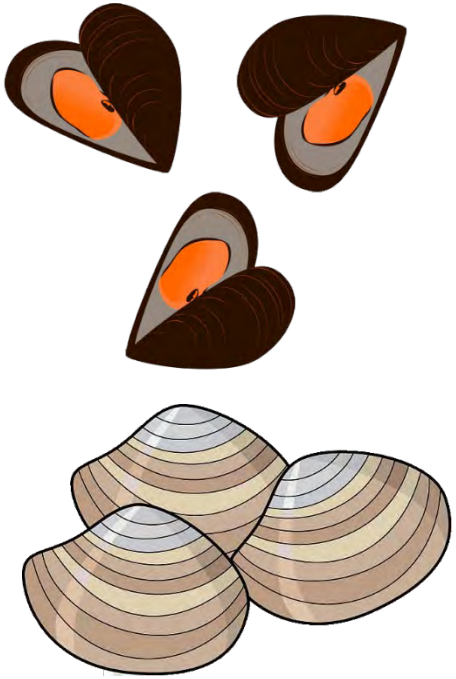
NOTE: *Delta Smelt are listed as a threatened species and at the heart of a long-time war over California's water. This tiny fish is worth further investigation!*



PHYTOPLANKTON are communities of microscopic free-floating algae that make their own food using energy from the sun. Phytoplankton are the foundation of the aquatic food web.



ZOOPLANKTON are small aquatic microorganisms that are composed of both primary and secondary consumers that eat algae and other zooplankton.



CLAMS AND MUSSELS are filter feeders, feeding on plankton and other microscopic sea creatures.



The **CALIFORNIA RED LEGGED FROG** is the largest native frog in the western U.S. Larvae eat algae, adults eat insects and earthworms, and larger frogs eat other frogs and mice!



The **SALT MARSH HARVEST MOUSE** is only found in the California Delta. They eat leaves, seeds, and fresh green grasses.



OWLS *(Spotted, Great Horned, Barn and more!)* eat squirrels, mice, rabbits, frogs, snakes, and sometimes other birds.



HAWKS AND FALCONS are predatory birds that eat shorebirds, songbirds, bats, fish, rabbits, mice, snakes, lizards, frogs, and insects.



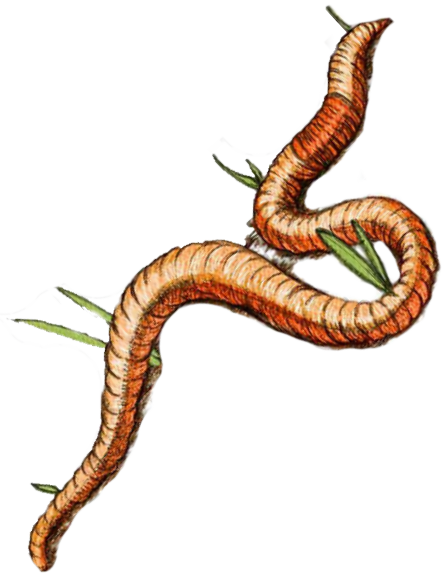
The **GIANT GARTER SNAKE** is at least 64 inches long, but is not dangerous. Giant Garter Snakes primarily feed on fish, tadpoles, and frogs.



INSECTS *(Delta Green Ground Beetle, Valley Elderberry Longhorn Beetle, and more!) eat plants and other insects.*



FUNGI cannot make its own food. It gets energy by breaking down dead matter. Fungi includes molds, yeast, mushrooms, and toadstools.



EARTHWORMS feed on soil nutrients and decaying organic matter like dead or dying plants, insects, and animals. Earthworms are very important for aerating and fertilizing the soil.



TULE ELK, a subspecies of elk found only in California, eat grasses, leaves, twigs, and aquatic vegetation found near streams and freshwater marshes.



RIPARIAN BRUSH RABBITS live in thickets by rivers. They eat green clover, bark and leaves, grasses and vines.



CALIFORNIA TIGER SALAMANDERS eat earthworms, snails, insects, fish, and even small mammals. They live in wetland areas that have seasonal, fishless pools or similar bodies of water.



NORTH AMERICAN RIVER OTTERS live in and along waterways and coasts, feeding on fish, amphibians, clams, mussels, snails, small turtles, and crayfish.



STURGEON *(White and Green)* are prehistoric fish that typically range in size from four to seven feet long. Sturgeon feed on shells, crustaceans, and small fish at river bottoms.



The **SAN PABLO VOLE** is a small rodent that feeds primarily on grasses in their coastal marshland and rolling hills habitat.



SHREWS *(Salt-Marsh Wandering and Suisun)* are small, mole-like animals that live in tidal marshes and live off small insects and other invertebrates.



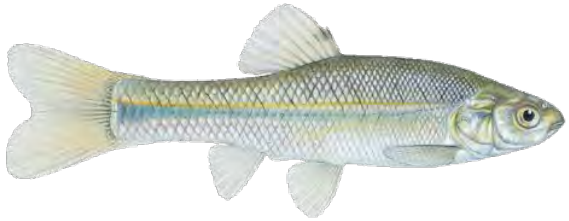
The **SAN JOAQUIN KIT FOX** is a small, large-eared member of the wild dog family that lives in grasslands. Their preferred prey is the kangaroo rat.



SEA LIONS are large, coastal-dwelling mammals that feed on a variety of seafood mainly consisting of squid and fish, and sometimes clams.



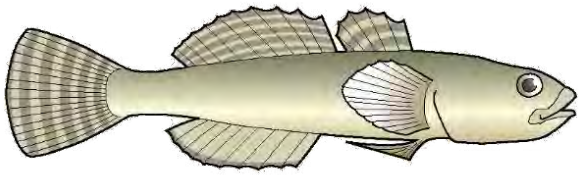
CALIFORNIA GOLDEN BEAVERS are large, semi-aquatic rodents known for building their river dwelling out of wood, which is also their main food source.



MINNOWS *(numerous native and non-native species)* are small, silvery fish that are important to an ecosystem, serving as food for most other animals.



STRIPED BASS are large, voracious predators introduced for sports fishing. They compete with native fish for limited food sources.



TIDEWATER GOBY

are small, bottom-dwelling fish that live in brackish water and feed on tiny animals like shrimp, amphipods, and insect larvae.



KANGAROO RATS

(California and Fresno) are small, seed-eating rodents that move by hopping on their hind legs.



FISHERMEN are people who catch fish either for a living, for sport, or for food. Both native and non-native fish species live in the Delta.



FARMERS grow food for people and animals. There are over 90 agricultural products in the Delta including a variety of animals, grains, fruits, nuts, and vegetables.



A **RESIDENT** is a person who lives someplace on a permanent basis, usually in a community with homes, grocery stores, schools, and other businesses.



A **BUSINESS** is a place where people work that sells products or services for money. Businesses help support communities.



The Delta is the hub of California's **WATER SUPPLY**. Water travels through the State Water Project and Central Valley Project to two-thirds of the state's population and millions of acres of farmland.



TRANSPORTATION infrastructure in the Delta includes three major railways, two deep water shipping channels, and five highways carrying people, goods, and supplies.

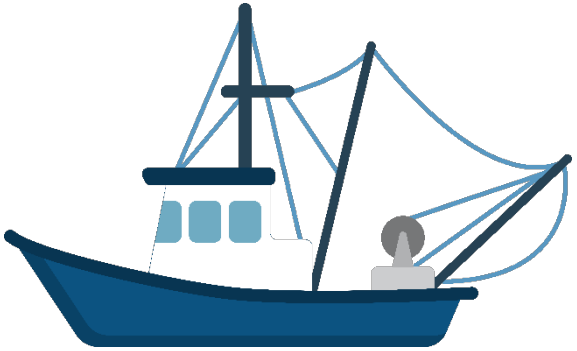


Electrical lines cross the Delta, bringing **POWER** to the Bay Area, and southward to cities and farms in Central and Southern California.

The Delta serves as an important source of **NATURAL GAS** for the state, and underground natural gas storage area.



INDUSTRY produces goods and services people use all over the world.



COMMERCIAL FISHING provides fresh fish to many communities.



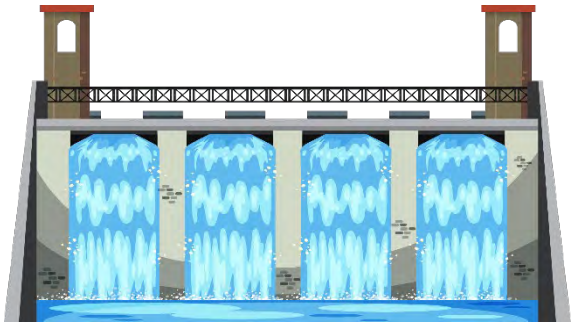
FARMS grow crops for much of the country, making California an agricultural powerhouse.



TOURISM attracts people seeking to enjoy the activities and natural wonders of California.



WILDLIFE PROTECTIONS keep threatened and endangered from becoming extinct.



WATER USE policies regulate how much water is taken is used by communities.



WATER QUALITY RESTRICTIONS protect humans, plants, and animals from contaminated water.



LAND USE policies prevent development or destruction of ecologically sensitive lands.