3RD GRADE

TEACHER RESOURCE GUIDE

THEME:

Salmon are extraordinary animals that both depend on and help create healthy freshwater ecosystems.

CRITICAL ISSUE:

Freshwater Flows

CONTENTS:

Aquarium of the Bay
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MISSION STATEMENT:

Aquarium of the Bay's Education and Conservation Department's mission is to promote literacy in ocean and watershed health, climate change issues, and science career development through the lens of critical issues such as sustainable seafood, marine protected areas, marine debris and plastics, climate change and fresh water flows.

ACKNOWLEDGEMENTS:

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S. D. BECHTEL, JR. FOUNDATION
STEPHEN BECHTEL FUND

LESSON 1

COMING HOME

Enduring Understanding: Salmon have extraordinary adaptations that help them to return to their home stream in order to spawn.

Materials

• "A Salmon's Journey" handout

• "Building a Redd" materials
- Wide-bottomed bins or Tupperware containers (at least two quarts each)
- Blocks or similar items (to prop up bins)
- Watering can or other container (to hold and pour water)
- Gravel or other appropriate substrate
- Large beads or other small objects (about 6 mm by 8 mm; about 30 beads per group) NOTE: Orange, red, or pink beads will better approximate the look and color of salmon eggs.
- Rulers (for measuring redds)
- Stopwatches (optional)
- Towels (for clean up)

SETUP:

1. Make copies of "A Salmon's Journey" handout.
2. Prepare a set of "Building a Redd" materials for each group of three to five students.

PROGRAM OUTLINE:

Introduction

- Review the concept of adaptations.
  - An adaptation is a body part or behavior that helps an organism survive or reproduce, or in other words, something an animal has or does that helps it live or have babies.
  - Salmon have many extraordinary adaptations that help them survive.Some of the salmon's most impressive adaptations are those they need in order to return to their home stream to reproduce.

Migration overview

- Have students read the "A Salmon's Journey" handout.
- Review the salmon life cycle to check for understanding.
  - Salmon start out as eggs in freshwater streams.
  - After they hatch, they live in their home stream for a while.
  - They swim downstream to an estuary or other body of brackish water.
  - They mature in the brackish water, then move into the ocean, where they spend their adulthood.
  - When it is time for the salmon to have babies of their own, they swim upstream to their home stream. The journey from the ocean to their home stream is difficult. It is one of the wonders of nature.
- Discuss why the salmon's journey is important.

PROGRAM OUTLINE CONTINUED:

Building a redd

- When salmon reach their home stream and are ready to lay their eggs, their challenge is to protect their eggs from predators and from being washed away if they aren't around to protect the eggs.
- If you were a salmon, what would you do to protect your eggs?
  - In their reading, students learned that salmon build special nests, called redds, to protect their eggs.
- Students now have the opportunity to build their own redds.
  - Break the students into small groups of about three to five.
  - Each group gets a bin, a block to prop up the bin, watering can, gravel or similar substrate, and beads.
  - Each group props up their bin on the block it's slightly inclined, just like a salmon stream.
  - Their goal is to use the given materials to figure out how to keep as many of their "eggs" as possible from washing away when watered with the watering can.
- Testing the designs
  - Students should complete at least three separate trials of different nest designs, but they may complete as many different trials as time allows.
    - Each trial should be a fair test. Students should pour water for the same amount of time in each test, by counting or using a stopwatch.
  - Students record data for each trial (see sample data chart below).

Trial	Redd Description	Eggs Washed Away	Eggs Left
1	Place eggs on flat gravel	29	1
2	Build redd 1 inch deep and 1 inch wide	15	15
3	Build redd 1 inch deep and 3 inches wide	7	23

    - Let the students try different designs and figure it out on their own. The goal of this activity is for them to experiment with their own ideas, work collaboratively, and otherwise engage in scientific practices.
- Sharing the results
  - Gather the group together when the students have finished their trials.
  - Have each group share their findings with the class or another group. Have them discuss their process, successes and failures, and best designs.
- Conclusions
  - Why is it important to build a good redd?
    - Discuss as a group why building a good redd is important for a mother salmon.
    - Building a good redd will help protect the eggs so they can survive.

TEACHER BACKGROUND:

Pacific Salmon

The name “Pacific salmon” refers not to one species but to seven closely related species of the genus Oncorhynchus that are found along the Pacific coast of the Americas. These species all have similar life histories, ecologies, and threats, but there is also great diversity both between and within species. Because salmon return to their home streams to spawn instead of genetically mixing with other populations, the salmon populations of each stream have distinct and evolutionarily significant differences from the populations of other streams. Each population has the adaptations needed to survive under the specific conditions found in and around their home stream. This genetic diversity makes salmon extremely resilient.

The Salmon Life Cycle

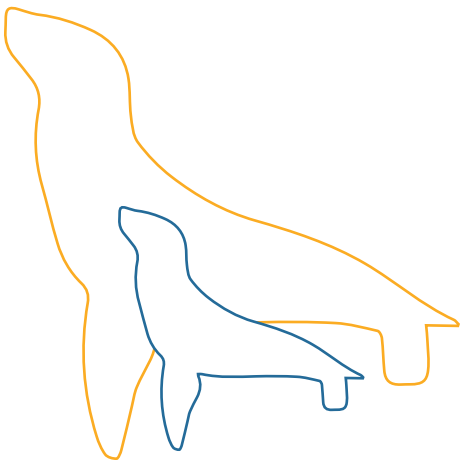
As with many plant and animal life cycles, there is some debate about where to draw the line between different stages of the salmon life cycle and which phases of life truly qualify as stages. In one classification system the salmon life cycle contains six distinct stages: egg, alevin, fry, smolt, oceanic adult, and spawning adult.

Salmon lay their eggs in nests, called “redds,” in freshwater streams, where the eggs develop without parental care for two to three months. Compared to many species of fish, salmon eggs are large, with a large yolk. This yolk remains attached to their bodies after they hatch. For the few weeks that the young salmon have these yolks attached they are known as “alevin” and generally remain in or near the redd. Once the yolk has been absorbed, the young salmon are called “fry” and must begin to hunt for food. The young salmon stay in their home stream during this stage.

After several months the young salmon begin to move downstream toward an estuary, such as the San Francisco Bay Delta. In the estuary the salmon undergo the process of smoltification and are known as “smolts.” Smoltification, a transformation akin to metamorphosis in insects, is the process by which salmon physiologically transform from a fish adapted to life in freshwater to one adapted to life in saltwater. Spending time in the estuary’s brackish water is an important step in this process. The salmon must undergo smoltification before they can enter the ocean, where they will spend most of their life.

Once the salmon have transformed and acclimated to saltier water, they leave the estuary and enter the Pacific Ocean as adults. Depending on the species, they will live and hunt in the ocean for anywhere from one to five years. During this time salmon grow dramatically and accumulate omega-3 fatty acids throughout their tissue.

Salmon transform again when preparing to return home to spawn. They change color and develop humped backs. The males develop a hooked rostrum, or beaklike snout. These changes attract mates. Salmon sometimes travel 1,000 miles and as much as 7,000 vertical feet to reach their home spawning grounds. During this time they stop eating and devote all of their energy to getting upstream. Most salmon return to their home streams, although a small percentage may end up in a different spawning ground.



TEACHER BACKGROUND CONTINUED:

In the spawning ground the females build their first redd with their caudal, or tail, fins. After the females deposit the eggs, one or more males will fertilize them. The female then moves upstream, covering her first redd with the pebbles removed from the next. They continue this process until they have no more eggs. The salmon die shortly after mating. Their carcasses feed many animals and fertilize plants.

Salmon Ecology

Salmon are extremely ecologically important. At each stage of their life cycle they provide food for a wide range of animals, including humans. They are particularly important because their return upstream represents one of the few instances in nature where nutrients from the ocean are brought to terrestrial communities. This exchange of nutrients is believed to be vital in maintaining the biomass and biodiversity in several ecosystems along the Pacific coast, including the large coniferous forests in Northern California and the Pacific Northwest. It also plays a role in the productivity of agriculture in the Bay's watershed.

While salmon are impacted by unsustainable fishing practices, habitat degradation, deforestation, marine debris, and a wide range of ecological issues, the primary threats to salmon arise from freshwater diversions. Diversions affect salmon in two key ways: When water is diverted to the point where the streams in which salmon spawn are too shallow or no longer run, it prevents them from reproducing. Additionally, the infrastructure used to siphon the water off causes problems for salmon. Dams often block the routes back to spawning grounds, and the pumps that move water catch young fish on their downstream migration.

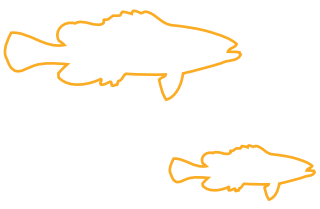
GLOSSARY:

Estuary: Partially enclosed coastal body of water where freshwater from rivers or streams mixes with saltwater from the open ocean

Redd: Salmon nest, usually made of pebbles or gravel; protects eggs from predators or from being washed away in a current

Salmon: Type of fish known for being born in freshwater, spending most of its life in the ocean, and returning to its birth stream to spawn; considered one of the main keystone species on the western coast of North America

Stream: Body of water with a current; includes rivers and creeks



3RD GRADE STANDARDS:

California Science Content Standards

- 3.b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
- 3.c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
- 5.e. Collect data in an investigation and analyze those data to develop a logical conclusion.

California Next Generation Science Standards

- 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
  - Develop models to describe phenomena.
  - Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.
- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
  - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
  - Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
  - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

California Common Core Standards

ELA/Literacy

- W.3.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area
- L.3.4. Determine or clarify the meaning of unknown and multiple-meaning word and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
  - a. Use sentence-level context as a clue to the meaning of a word or phrase.

Name: _____

Date: _____

A SALMON'S JOURNEY

Salmon go on one of the most amazing journeys in nature. Salmon hatch out of eggs. The eggs are laid by their mothers in freshwater streams, rivers, and creeks in Northern California. When the baby salmon hatch, they stay in their home stream for the first part of their life.

Soon the young salmon begin their journey downstream to the sea. They will spend their adulthood in the sea. But before they reach the sea, the young salmon must live in an estuary. An estuary is a place where freshwater and saltwater mix. The San Francisco Bay is an estuary. Many young salmon stay in the bay. Spending time in an estuary lets the fish get used to being in saltwater instead of freshwater.

When the salmon are ready, they swim into the Pacific Ocean. There they will spend most of their life. In the ocean they find lots of food that helps them grow big and strong. They live in the ocean for a year or two. Then they are ready to begin the hardest part of their journey.

The full-grown salmon are ready to lay eggs of their own. But first they have to swim back to their home stream. Some salmon must swim as much as 1,000 miles—all of it upstream. Sometimes they even have to swim up waterfalls! Without eating and without resting, the salmon make this incredible journey back home so they can lay their eggs.

Not all of them make it. Predators eat some of them. Dams stop some of them. Some aren't strong enough to make the long, hard journey. But enough salmon do make it home.

In their home stream the salmon lay their eggs in special nests, called redds. They dig redds in the gravel at the bottom of the stream. Building the redds for their eggs is the last thing the salmon do. Tired from their long journey, the adults die. But their eggs will live and the journey begins again.

This incredible journey helps make the salmon one of the most important animals in California. Salmon are food for many other animals. Bears, eagles, river otters, herons, sharks, bigger fish, and people eat salmon. Salmon even feed trees. When they return to their home stream, the salmon bring all of the nutrients they got from the food they ate in the ocean. That means that when they die, they help fertilize, or feed, the trees and other plants around the streams. If not for salmon, many animals and plants would not have enough food or nutrients to live. Because of this, each salmon's long, hard journey is important, not just for salmon but also for every living thing in our state.

LESSON 2

SALMON AND BEAVERS

Enduring Understanding: Salmon and beavers are two local keystone species that rely on each other to survive.

Materials

• "Salmon and Beavers" handout

• "Building a Beaver Dam" materials

- Wide-bottomed bins or Tupperware containers (at least two quarts each)
- Blocks or similar items (to prop up bins)
- Watering can or other container (to hold and pour water)
- Modeling clay, sand, or other appropriate substrate
- Twigs, popsicle sticks
- Gravel, small rocks, or other small objects
- Modeling clay, putty, or similar substance (to plug holes in "beaver dams")

- Towels (for clean up)

SETUP:

1. Create boundaries for an area in which the students can run around with plenty of room.

PROGRAM OUTLINE:

The food web

- All plants and animals are part of a delicate food web. When one population is affected by something, it creates a ripple effect and can impact many other species in the food web.
- Food webs contain a variety of organisms belonging to three different categories: producers, consumers, and decomposers.
  - Ask students what they think these various roles play in the food web.
  - Ask them to identify at least three organisms that would belong in each category.

California sea lions are an integral part of the San Francisco Bay food web.

- Anchovies are a large part of the sea lion diet.
  - Plankton are a large part of an anchovy's diet.
- When the level of anchovies fluctuates, it has a big impact on the number of sea lions in the Bay Area.

The Food Web Game

- Students will simulate a small part of the San Francisco Bay food web in this modified tag game.
- 15 students will start as plankton (green bandanas); 10 will start as anchovies (yellow bandanas); 5 will be sea lions (purple bandanas).

PROGRAM OUTLINE CONTINUED:

- Bandanas can be tied around students' arms and must be visible to others.

- All plankton will begin with five poker chips, all anchovies will begin with three, and sea lions will have none.
- Each animal has a different objective:
  - Plankton are trying to avoid being eaten by the anchovies.
  - Anchovies are trying to eat the plankton while avoiding the sea lions.
  - Sea lions are trying to eat the anchovies.
- To "eat" another animal, student must tag them and then play "rock, paper, scissors." If the bigger animal wins, it takes a chip from the smaller animal. If the smaller animal wins, it gets away without giving up a chip.
  - In order to survive, sea lions must end up with at least eight chips, anchovies must have at least five, and plankton must have at least one.
- Once an anchovy or plankton has lost all of his or her chips, they are out of the game.
- Play the first round (one "season) for about five minutes and then call the students back in.
- How many students survived? Were the numbers fairly even or did one group largely outlive the others?
- For the following rounds, change up the numbers by using one of the following scenarios:
  - One year there is a very high level of plastic pollution in the water, causing several sea lions to get sick and die (18 plankton, 10 anchovies, 2 sea lions).
  - The next year anchovy numbers are low due to commercial fishing, so there are fewer fish to go around (12 sea lions, 8 anchovies, 10 plankton).
  - The following year levels have returned to normal, but a great white shark has started hunting the sea lions. Have one student be the shark—each time the shark "eats" a sea lion, they steal one chip. (The shark needs 10 chips to survive.)
- You and the students can create your own scenarios by asking them to think about what other factors might affect the numbers of each animal. Ask them to predict what might happen in the game with each of these changes:
  - What happens when there are too many predators? Not enough predators?
  - Are food webs in the wild completely linear like this, or do they have more components to them?
  - What non-human factors might affect the San Francisco Bay food web?
  - What human factors might affect the San Francisco Bay food web?
  - In what ways might animals have to adapt to changes in their environment?
  - What would happen to an animal if there were a drastic change to the environment and they were unable to adapt?
  - What sorts of events could permanently alter an ecosystem?
  - Can you think of any catastrophic events from the past that have had a huge impact on Earth's ecosystems?

TEACHER BACKGROUND:

Keystone Species

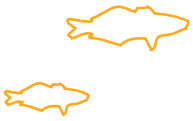
Salmon and beavers are important keystone species in California and beyond. A keystone species is an organism whose presence, abundance, or absence within an ecosystem has a disproportionately high impact on that ecosystem. The term "keystone species" is only used to describe organisms that have a positive impact on their ecosystem and other species.

Salmon

Salmon are keystone species largely because of their role in the food web. At each stage of their life cycle salmon provide food for a wide range of animals, including humans. They are particularly important because their return upstream represents one of the few instances in nature where nutrients from the ocean are brought to communities on land. This exchange of nutrients is believed to be vital in maintaining the biomass and biodiversity in several ecosystems along the Pacific coast, including the large coniferous forests in Northern California and the Pacific Northwest. It also plays a role in the productivity of agriculture in the Bay's watershed.

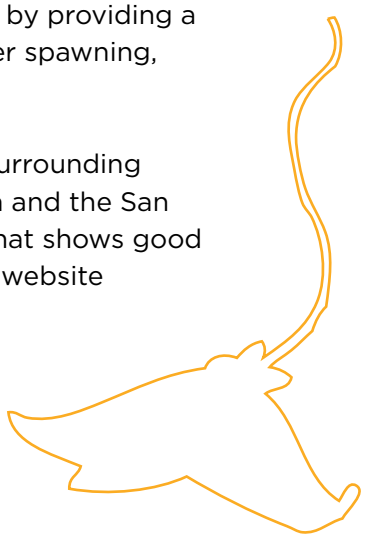
Beavers

Beavers are keystone species because the dams they build create crucial habitat for many organisms. By building dams that block rivers, creeks, and streams, beavers create beaver ponds that provide crucial habitat for many pond-dwelling organisms. This is particularly important in more arid regions or during drought, because beaver ponds store water longer than a free-flowing stream would. This provides more stable habitat in addition to drinking water for other animals. Beaver dams and ponds also promote the growth of wetlands, which provide even more habitat for other organisms. In addition to this, beaver dams and ponds can prevent erosion, allow sediment and pollution to settle out of the water column, keep water at a stable temperature, and control water flow.



Symbiosis

In addition to being keystone species, both salmon and beavers support each other in a mutualistic symbiosis. Beaver ponds offer vital habitat for juvenile salmon by providing a sheltered, cool, clear, food-rich environment. In turn, when salmon die after spawning, their bodies fertilize the trees that beavers need to build their dams.



Both salmon and beavers can be viewed in the wild in the Bay Area and surrounding regions. Salmon can be seen in rivers and creeks throughout the Bay Area and the San Francisco Bay's watershed. The Bay Institute has a salmon-viewing map that shows good locations and times of year for viewing salmon. You can access it on their website (http://www.bay.org/publications/salmon-viewing-map). Beavers can be seen in Alhambra Creek in Martinez, the Guadalupe River in San Jose, Los Gatos Creek in Campbell, and several other locations throughout the Bay Area.

RESOURCES:

- The Bay Institute
www.bay.org

- MartinezBeavers.org, "Our Story," Worth a Dam Website
http://www.martinezbeavers.org/wordpress/about-2/.

- Salmonid Restoration Federation, "A Reassessment of the Historical Range of Beaver in California and Implications for Salmonids," 2010
http://www.calsalmon.org/news/biannual-newsletters/winter-2010-newsletter/reassessment-historical-range-beaver-california-and-implications-for-salmonids.

- Washington Department of Fish and Wildlife, Pacific Salmon and Wildlife: Ecological Context, Relationships, and Implications for Management, Technical Report
http://wdfw.wa.gov/publications/00063/wdfw00063.pdf.

GLOSSARY:

Beaver Dam: Barrier constructed of wood, rocks, mud, and other materials; built by beavers to provide protection against predators

Beaver Pond: Pond of water made by a beaver dam blocking a creek, stream, or river

Keystone Species: Organism whose presence, abundance, and/or absence has a disproportionate effect on the relative abundance of different species and the overall biodiversity of an ecosystem; classic examples include sea otters in kelp forests and sea stars in the California intertidal zone

Mutual Relationship: Type of interaction between two or more organisms in which each benefits; type of symbiotic relationship

Symbiotic Relationship: Any kind of long-term interaction between two or more different kinds of organisms; can be beneficial to both (mutual), beneficial to one but harmful to the other (parasitic), beneficial to one and neither helpful nor harmful to another (commensal), or harmful to both (competition)

Watershed: Area of land that eventually drains its surface water—through rivers, streams, and runoff—and groundwater into a given body of water, such a lake, bay, or ocean

3RD GRADE STANDARDS:

California Science Content Standards

- 3.b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
- 3.c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
- 3.d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.

California Next Generation Science Standards

- 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
  - Develop models to describe phenomena.
- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
  - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
  - Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
  - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

California Common Core Standards

ELA/Literacy

- W.3.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area
- L.3.4. Determine or clarify the meaning of unknown and multiple-meaning word and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
  - a. Use sentence-level context as a clue to the meaning of a word or phrase.
  - d. Use glossaries or beginning dictionaries, both print and digital, to determine or clarify the precise meaning of key words and phrases in all content areas.

Name: _____

Date: _____

SALMON AND BEAVERS

Beaver Pond: Pond of water made by a beaver dam blocking a creek, stream, or river

Dam: Wall in a river or creek that stops some or all of the water from moving downstream; beavers and humans make dams.

Fertilize: To give a plant the nutrients it needs to grow

Habitat: Animal home

Keystone Species: Living thing that is such an important part of its habitat that if it were taken away the habitat would change so much that it would no longer look the same and some animals would no longer be able to live there

Wetland: Land that is sometimes covered by water; special kind of habitat; home to many plants and animals

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Salmon and beavers are two very different animals. But they are both very important animals that live in the San Francisco Bay Area and Northern California. **Salmon** are fish that spend part of their life in freshwater and part in the ocean. **Beavers** are mammals that live in freshwater and on land. Both are keystone species. A **keystone species** is a living thing that is a very important part of its **habitat**. It is so important that if it were taken away the habitat could change so much that it would no longer look the same. Some animals would no longer be able to live there.

What makes salmon and beavers keystone species? There are several reasons salmon are keystone species. One is that they provide food for many different kinds of animals. Great blue herons, rainbow trout, river otters, sevengill sharks, sea lions, bears, and eagles eat salmon. Without salmon, some of these animals would not have enough to eat. A second reason is that when salmon return to the rivers and creeks where they were born, they spawn and die. When they die, they **fertilize**, or give nutrients to, all of the plants around the stream. In fact, some scientists think that the big forests of California and the Pacific Northwest could not survive without the nutrients brought upstream by the salmon.

Beavers are a keystone species for a different reason. They don't provide food for other living things. Beavers create habitat for other animals. They build **dams**—walls of twigs, branches, and mud—in rivers and creeks. These dams create **beaver ponds**. These ponds make good homes for many animals. Beaver dams and beaver ponds also help store water for other animals to drink during summers and droughts. They trap dirt that could make the water too cloudy. And they help create **wetlands**. If beavers didn't build dams and create beaver ponds, some animals would lose their habitat. Some animals might run out of water to drink in the summer. And the water might get too cloudy for some animals to live in. Beaver ponds are very helpful for salmon, too. In fact, having beavers in a young salmon's habitat can increase by 80 times the salmon's chance of survival!

LESSON 3

SALMON COUNTRY

Enduring Understanding: American Indian nations of the Bay Area and its watershed are closely linked to salmon.

Materials

• Appropriate research materials, including books, articles, and the Internet

SETUP:

1. Prepare needed research and writing materials.

PROGRAM OUTLINE:

Introduction

- Many animals, including humans, eat salmon.
  - Today, many Americans eat salmon for its flavor and nutritional value, but we generally don't depend on it as a staple food source.
  - Historically, many American Indian nations, including in the Bay Area and Northern California, depended on salmon as a major source of nutrition.
- Students will learn about the relationship between salmon and California American Indian nations by researching the topic and writing a synthesis, or summary, of what they find and sharing it with the class.
  - The process outlined below is designed to approximate part of the process that scientists and social scientists use when they work collaboratively to write a paper or book.

Research

- Break students into small groups.
  - Each group will use the available resources to research the relationship between salmon and local American Indian nations.
  - Students should work collaboratively to find the needed information.
  - Students should take notes based on their research to help them write their piece.

PROGRAM OUTLINE CONTINUED:

Draft

- After students complete their research, each group should work together to synthesize their research findings into a multi-paragraph piece of writing with an introduction, body with main and supporting ideas, and conclusion.
  - Students should work collaboratively to formulate the main idea of their piece, choose supporting points, craft an outline, and write a draft.
  - You may have students write their pieces individually, but there are benefits to having students write collaboratively, as this is a practice that many researchers, scientists, and social scientists employ.

Review and final edit

- Have student share what they have written with another group.
  - Have each group read the other group's work, ask questions, and discuss the piece with the other group.
  - Based on the discussion of their work, have each group edit their piece a final time.

TEACHER BACKGROUND:

Salmon have been an important staple food for many American Indian nations for thousands of years. Salmon tribes are traditionally associated with the Pacific Northwest, but salmon were once plentiful throughout Northern California. They provided a vital source of protein and healthy fats for tribes along the coast, along inland rivers, and even in arid parts of the state, thanks to trade between tribes. Before European contact, when rivers flowed unhindered by large-scale dams or major water diversions, the San Francisco Bay's watershed (the half of the state whose rivers, streams, and runoff eventually flow into San Francisco Bay) was home to the second-largest salmon run in the world. Historically, tens of millions of salmon swam through the San Francisco Bay every year, returning to their home streams to spawn. Even today, two-thirds of all the salmon in California are born in the Bay's watershed.

California tribes traditionally harvested salmon in sustainable ways, allowing most of the fish to return to their home stream to spawn. Many tribes fished for salmon by constructing temporary fish dams. These dams were built of brush, timber, or other materials stretched across a stream. Migrating salmon would be stopped by and congregate near the dam, making them easy to catch. After a specified period of a few days, the dams would be removed, allowing the salmon to continue their journey upstream. In addition to temporary fish dams, California tribes have used many other fishing techniques, including harpoons, nets, and basket traps similar to eel or crab pots. Spawning salmon are a seasonal food, and so much of the catch was preserved by smoking or drying so that it could be eaten throughout the year and used in trade.

Today, many California tribes continue to rely on salmon both for sustenance and cultural connection. They use both traditional and modern fishing and cooking techniques. California tribes have also taken on a large role in the movement to preserve and restore salmon populations in the state, acting as stewards of salmon runs in their own lands and beyond. Tribes have played a key role in efforts to restore rivers, such as the Klamath River, to make them once again ideal habitat for salmon, and they were instrumental in reintroducing salmon to the McCloud River.

RESOURCES:

- The Bay Institute
www.bay.org.

- Dubin, Margaret and Sara-Larus Tolley. Seaweed, Salmon, and Manzanita Cider: A California Indian Feast. Berkeley, CA: Heyday Books, 2008.

- Klamath River Keeper, "Fish Are Life: Environmental Justice on the Klamath"
http://www.klamathriver.org/environmentaljustice.html.

- U.S. Environmental Protection Agency, "San Francisco Bay Delta: About the Watershed"
http://www2.epa.gov/sfbay-delta/about-watershed.

- Winnemem Wintu Tribe, "Salmon Return: The Story of the New Zealand McCloud Salmon"
http://www.winnememwintu.us/mccloud-salmon-restoration/.

3RD GRADE STANDARDS:

California Science Content Standards

- 3.b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
- 3.c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.

California Next Generation Science Standards

- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
  - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
- 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.
  - Obtain and combine information from books and other reliable media to explain phenomena.

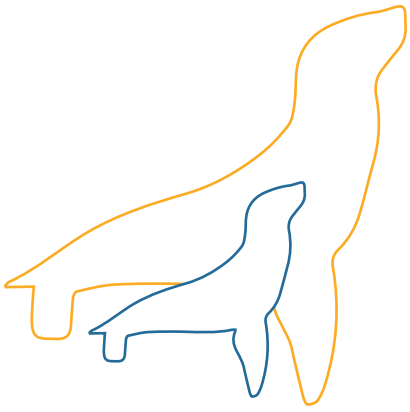
California History and Social Science Standards

- 3.2. Students describe the American Indian nations in their local region long ago and in the recent past.
- 3.2.1. Describe national identities, religious beliefs, customs, and various folklore traditions.

California Common Core Standards

ELA/Literacy

- RI.3.9. Compare and contrast the most important points and key details presented in two texts on the same topic.
- W.3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
- W.3.5. With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.
- W.3.7. Conduct short research projects that build knowledge about a topic.
- W.3.8. Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.



LESSON 4

LIKE WATER FOR SALMON

Enduring Understanding: People can help take care of salmon and the environment not only by using less water directly but also by using less water indirectly through the things they eat.

Materials

- "My Food Journal" worksheet
- "My Food's Water Footprint" worksheet
- Computer and Internet access (optional)

SETUP:

1. Make copies of "My Food Journal" worksheets.
2. Make copies of "My Food's Water Footprint" worksheets.

PROGRAM OUTLINE:

Introduction

- Salmon are amazing animals that undertake one of nature's great migrations.
- Salmon are one of the many animals that live in or otherwise depend on freshwater habitats in order to survive.

What is the problem?

- Unfortunately, about half of the freshwater that is supposed to flow through the San Francisco Bay's watershed (all of the land that drains its rivers, streams, and rain into the bay) is diverted, or taken away, by people before it can reach the bay.
  - Sometimes so much water is diverted that big rivers like the San Joaquin run dry.
- This can be a big problem for salmon. They live in freshwater in the early part of their lives and need the rivers to run so that they can migrate back home to have their young. If there is no water running through the rivers, the salmon can't survive.

Why is this happening?

- People need water to survive, just like any other animal, but people use more water than other animals for many reasons.
  - About 20 percent of the water used by people in California is

for ordinary things at home, school, or work, like drinking, showering, washing dishes, and watering gardens.
- The other 80 percent is used by agriculture to grow food. Agriculture is a big industry in California. We grow half of the country's fruits, nuts, and vegetables! We also farm lots of animals. For example, there are more cows in California than in any other state.
- While saving water at home, school, and work is important, in order to help salmon and our local environment, we also have to think about what we eat. We never even see most of the water we use because it is used to grow our food or make other things we use.

Our food's footprint

- A helpful tool for seeing how much water is used by agriculture or manufacturing is something called a "water footprint." A water footprint is how much water it takes to grow, make, or do something.
  - In order to see how much water it takes to grow and produce our food, students will keep track of everything they eat for one day and then calculate the food's water footprint.
  - Each student will use a food journal as homework to keep track of everything they eat and drink in one day.
  - After completing the food journals, have students research the water footprint of everything they ate and drank that day. You may do this in the classroom or as part of the homework assignment. The Water Footprint Network (waterfootprint.org) and the Waterprint application (http://waterprint.net/app_index.html) are good resources for students to use.

Finding solutions

- Now that students have calculated their daily food water footprint, discuss with them how they can make different choices in order to save water.
  - You can limit this discussion to food, but you may also include home water use and the other hidden water footprints of the things they own, use, and do.
  - Remind students that by using less water—directly and indirectly—they can help take care of salmon and our environment.

TEACHER BACKGROUND:

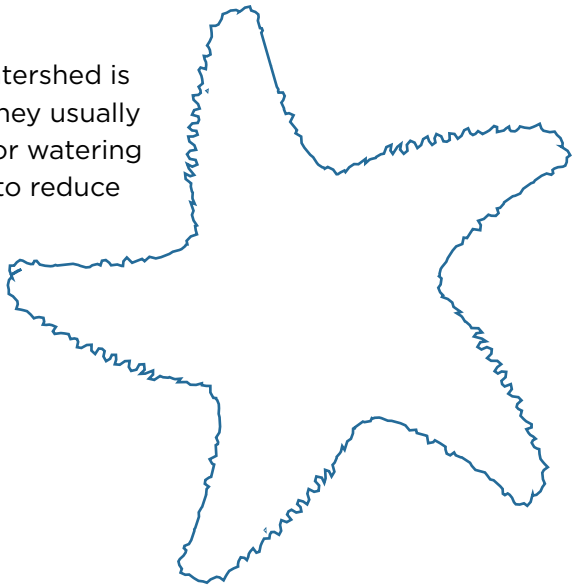
All living things depend upon freshwater, and salmon are no exception. They spend the early part of their lives in freshwater ecosystems. Their ability to reproduce hinges entirely on their ability to swim upstream to spawn. That mean salmon are particularly sensitive to changes in the amount of freshwater that runs through their habitats. Historically, salmon have thrived in California, but that has changed as humans have altered the way that freshwater moves through ecosystems, particularly in the San Francisco Bay's watershed.

The San Francisco Bay's watershed (all the land that eventually drains its rivers, streams, rain, and snowmelt into the Bay) is massive, covering nearly half of the state of California. Millions of people live in this watershed. Many millions who live outside the watershed, particularly in Southern California, also get their drinking water from it. About 20 percent of all the water diverted from the San Francisco Bay's watershed is used for residential and business purposes.

The watershed also provides the freshwater needed to make California an agricultural powerhouse. The state produces roughly half of all the fruits, nuts, and vegetables grown in the United States. Some crops, including almonds, walnuts, olives, grapes, and kiwis, are grown almost exclusively in California. Apart from producing food for millions of people, this agriculture also pumps billions of dollars into the state's economy and provides jobs for many people in rural communities. Despite these important services, California's agriculture comes at a high cost. About 80 percent of the water diverted from the San Francisco Bay's watershed is used for agriculture, making it the biggest user of water in the state.

Between residential, commercial, and agricultural uses, about half of the freshwater that would flow through the San Francisco Bay's watershed is diverted for human use. This means that salmon and all of the other organisms that live in the watershed often do not have enough water to live in or drink. This has been a big problem for salmon in particular. As more and more water has been diverted from the San Francisco Bay's watershed, salmon numbers have declined dramatically. In fact, many populations of salmon are listed as endangered or threatened under the Endangered Species Act.

One way to help salmon and other animals that live in the watershed is to use less water. When many people think of saving water, they usually think of using less water at home by taking shorter showers or watering the garden less often. While these steps are important ways to reduce the amount of water diverted from natural systems, it is also important to think about the indirect ways we use water. The idea of a water footprint is helpful because it makes visible the hidden water used to grow food, make products, create electricity, or do any number of things, even if they are not ways we can see.



RESOURCES:

- The Bay Institute, “Rivers and Delta”
http://www.bay.org/rivers-and-delta

- California Department of Food and Agriculture, “California Agricultural Production Statistics,” 2012
http://www.cdfa.ca.gov/statistics/

- Natural Resources Defense Council, The Green Gate: NRDC’s Environmental Guide to the San Francisco Bay Area
www.nrdc.org/greengate/water/divertedv.asp

- Water Footprint Network, “Water Footprint”
http://www.waterfootprint.org/?page=files/home

GLOSSARY:

Water Footprint: Measure of how much water is used to produce a product, complete an activity, or support a given lifestyle

Watershed: Area of land that eventually drains its surface water, through rivers, streams, and runoff, and groundwater into a given body of water, such a lake, bay, or ocean

3RD GRADE STANDARDS:

California Science Content Standards

- 3.c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
- 3.d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.

California Next Generation Science Standards

- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.
  - Use evidence (e.g., observations, patterns) to support an explanation.
- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
  - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
  - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
- 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
  - Represent data in tables and various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.

California Common Core Standards

Mathematics

- 3.NBT. 2. Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- 3.MD. 2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.

California History and Social Science Standards

- 3.1.2. Trace the ways in which people have used the resources of the local region and modiÐfied the physical environment (e.g., a dam constructed upstream changed a river or coastline).

Name: _____

Date: _____

MY FOOD JOURNAL

In order to discover your food's water footprint for one day, first keep track of what you eat. In this food journal, write down everything you eat and drink today.

Breakfast

_____

_____

_____

_____

_____

Lunch

_____

_____

_____

_____

_____

Dinner

_____

_____

_____

_____

_____

Snacks

_____

_____

_____

_____

_____

Name: _____

Date: _____

MY FOOD'S WATER FOOTPRINT

Refer to your food journal of everything you ate and drank in one day to see how much water it took to grow and make everything you had. Fill out the chart below. Add all the numbers together to see your food's total water footprint. Remember to include units.

Food	Water Footprint

Add all of the numbers in the Water Footprint column to find your daily food's water footprint:_____

Name: _____

Date: _____

MY FOOD'S WATER FOOTPRINT CONTINUED

Is your food's water footprint smaller than you thought it would be? Is it bigger? Why?

Is there anything that surprises you? Why or why not?

What food has the biggest water footprint? Why do you think that it took so much water to grow and make that food?

Now that you know how much water it takes to grow the different foods you eat, are there any different choices you could make that would help save water?

3RD GRADE

RESOURCES

Books

• Dubin, Margaret and Sara-Larus Tolley. Seaweed, Salmon, and Manzanita Cider: A California Indian Feast. Berkeley, CA: Heyday Books, 2008.

Websites

• The Bay Institute
www.thebay.org

• California Department of Fish and Wildlife, "Trout in the Classroom" Program
https://www.wildlife.ca.gov/CAEP/R3

• California Department of Food and Agriculture, "California Agricultural Production Statistics," 2012
http://www.cdfa.ca.gov/statistics/

• Klamath Riverkeeper, "Fish Are Life: Environmental Justice on the Klamath"
http://www.klamathriver.org/environmentaljustice.html.

• MartinezBeavers.org, "Our Story," Worth a Dam Website
http://www.martinezbeavers.org/wordpress/about-2/.

• Natural Resources Defense Council, The Green Gate: NRDC's Environmental Guide to the San Francisco Bay Area
www.nrdc.org/greengate/water/divertedv.asp

• Council for Environmental Education, "Aquatic Wild"
http://www.projectwild.org/projectwildwebsite/aquatic/

• SalmonAid
http://www.salmonaid.org/

• Salmonid Restoration Federation, "A Reassessment of the Historical Range of Beaver in California and Implications for Salmonids," 2010
http://www.calsalmon.org/news/biannual-newsletters/winter-2010-newsletter/reassessment-historical-range-beaver-california-and-implications-for-salmonids.

3RD GRADE

RESOURCES CONTINUED

• Save Our Wild Salmon
http://www.wildsalmon.org/

• Tuolumne River Trust
http://www.tuolumne.org/content/

• Turtle Island Restoration Network, Salmon Protection and Watershed Network (SPAWN)
https://seaturtles.org/programs/

• U.S. EPA, "San Francisco Bay Delta: About the Watershed"
http://www2.epa.gov/sfbay-delta/about-watershed.

• Washington Department of Fish and Wildlife, Pacific Salmon and Wildlife: Ecological Context, Relationships, and Implications for Management, Technical Report
http://wdfw.wa.gov/publications/00063/wdfw00063.pdf.

• Water Footprint Network, "Water Footprint"
http://www.waterfootprint.org/?page=files/home

• Waterprint
http://waterprint.net/app_index.html

• The Watershed Project
http://www.thewatershedproject.org/home.php

• Winnemem Wintu Tribe, "Salmon Return: The Story of the New Zealand McCloud Salmon"
http://www.winnememwintu.us/mccloud-salmon-restoration/.