2ND GRADE

TEACHER RESOURCE GUIDE

THEME: Animals of all kinds depend on clean freshwater habitats during at least some part of their life cycle.

CRITICAL ISSUE: Freshwater Flows, Marine Debris, Plastic Pollution

CONTENTS:

Aquarium of the Bay
a division of bay.org

Embarcadero at Beach St, San Francisco, CA 94133 | 415.623.5300 | aquariumofthebay.org

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:

Aquarium of the Bay thanks the S.D. Bechtel, Jr. Foundation for their generous support for our K-12 programs and development of this Teacher Resource Guide.

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

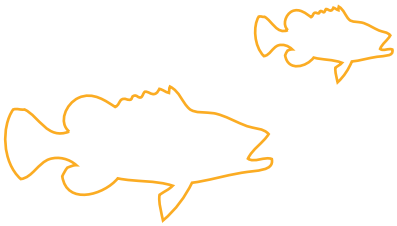
LESSON 1

LIFE CYCLE ART

Enduring Understanding: Frogs, like all animals, have a unique life cycle.

Materials

- Frog life cycle materials for whiteboard, blackboard, or paper chart
- Paper (construction, computer, watercolor, etc.)
- Various media (crayons, colored pencils, watercolor, tempera paint, etc.)



SETUP:

1. Gather frog life cycle materials.
2. Prepare art materials.

PROGRAM OUTLINE:

What is a life cycle?

- All animals have their own life cycle.
  - Some are similar.
  - Some are different.
- Show students one or more examples of life cycles.
  - Humans or other animals students are familiar with are good choices for examples.

What does the frog life cycle look like?

- Frogs, like all animals, have a unique life cycle. Their life cycle has some things in common with those of other animals, but it is also different.
- Using the provided life cycle materials, show students the stages of the frog life cycle. Label each one.
  - Eggs
    - Laid in freshwater and live inside soft shells while they get ready to hatch
  - Tadpoles
    - Live in freshwater, where they breathe water with gills and swim with tails
  - Froglets
    - Changing from tadpole that lives in water to adult frog that can live on land

PROGRAM OUTLINE CONTINUED:

- Adult Frogs
  - Breathe air with lungs and use legs to walk, hop, and swim
- Describe each life cycle stage to whatever depth is appropriate for your students. (For more information on each stage, see the "Instructor Background" section of the lesson.)

Discuss the idea of metamorphosis

- Metamorphosis is when an animal quickly and dramatically changes its body or shape when moving from one life cycle stage to the next.
- Some animals, including many insects, go through metamorphosis.
- Frogs go through metamorphosis.
  - When they are tadpoles, frogs have gills to breathe water, a long tail, and no legs.
  - Adult frogs have lungs to breathe air, no tail, and four legs.
  - Metamorphosis happens when the tadpole grows lungs, loses its gills, shortens its tail, and grows legs.

Create your own artistic representation of the frog life cycle.

- Explain that students will be creating their own frog life cycle art.
  - The art may be creative, but it should include the main characteristics of each life cycle stage.
    - For example, the tadpole should have a long tail and no legs, the froglet should have short legs and a short tail, and the adult frog should have four developed legs and no tail.
    - Have the students do each life cycle stage individually.
    - Once the students have checked the order of the life cycle stages, have the students mount their artwork on a larger piece of paper in the correct order.

Student art show

- Allow students an opportunity to share their artwork with the class.

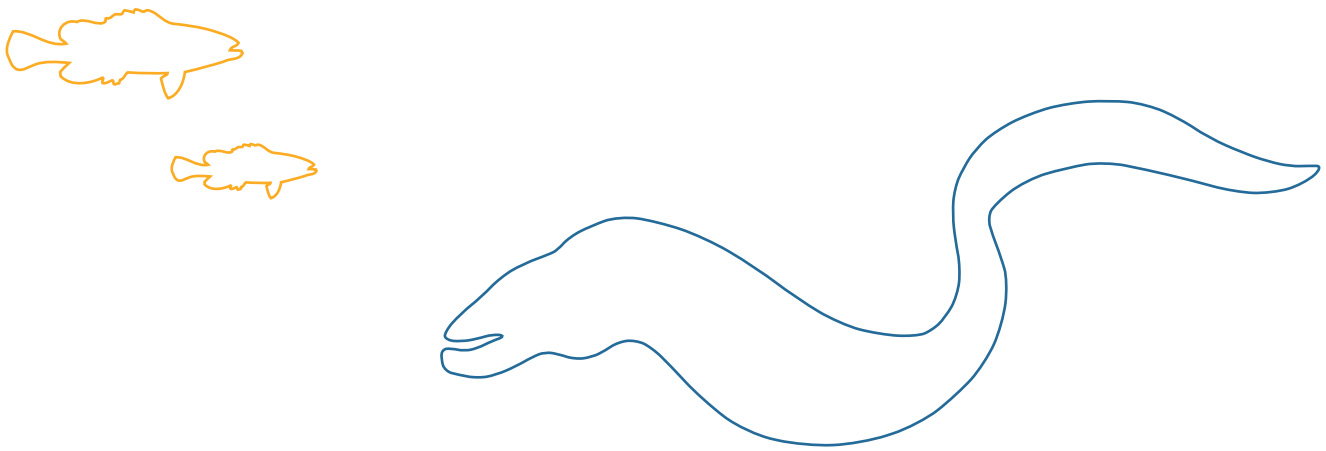
TEACHER BACKGROUND:

Frogs are a large and diverse group of amphibians that live throughout the world, including in the Bay Area and the San Francisco Bay's watershed. Both globally and locally, frogs depend on clean freshwater habitats throughout their life cycle. As eggs, tadpoles, and froglets, frogs live in freshwater. Even as adults they must still have access to freshwater. Frogs are also extremely sensitive to pollution in the water, air, and land.

Frogs start life as eggs, usually laid in ponds, lakes, or slow-moving streams. Frog eggs are made of a soft, gelatinous material that allows water, nutrients, and oxygen to come in. Tadpoles, or larval frogs, emerge from the eggs. Tadpoles are aquatic animals, breathing water with gills and living in freshwater habitats. Most tadpoles are herbivorous, feeding on planktonic algae, such as diatoms, but a few frog species have carnivorous tadpoles.

From the tadpole stage, frogs undergo the process of metamorphosis. During a very short period—only 24 hours in some species—the tadpoles lose their gills and develop lungs with which to breathe air. They also develop legs, lose their tail, and undergo several other changes. The froglets are extremely vulnerable to predation during metamorphosis.

Once metamorphosis is complete, the adult frog is free to move between aquatic and terrestrial environments. However, even adult frogs generally live in or near freshwater habitats because they need to stay moist, need these freshwater habitats to reproduce, and may hunt aquatic animals. Adult frogs play an important role in both freshwater and terrestrial food webs, feeding largely on insects and other invertebrates and serving as a food source for many animals, including herons, raccoons, and snakes.



GLOSSARY:

Adult: Final stage of the frog's life cycle

Egg: First stage of the life cycle of many animals, including frogs

Froglet: Third stage of frog life cycle; frog during metamorphosis, partway between tadpole and adult; has gills, short tail, and small, undeveloped legs

Life Cycle: All the stages of an organism's life

Metamorphosis: Process by which an animal quickly and dramatically changes its body or shape when moving from one life cycle stage to the next

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2ND GRADE STANDARDS:

California Common Core Standards

Visual Arts

- 2.2. Demonstrate beginning skill in the use of art media, such as oil pastels, watercolors, and tempera.

California Science Content Standards

- 2. Plants and animals have predictable life cycles.
- 2.b. Students know the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.

California Next Generation Science Standards

- 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
  - Develop a model to represent patterns in the natural world.

PROGRAM MATERIALS:

- Frog life cycle materials for teachers (to be produced and attached)

LESSON 2

FRESHWATER LIFE CYCLES

Enduring Understanding: Many different kinds of animals live in freshwater during the early part of their life cycle, including frogs, salmon, and dragonflies.

Materials

- Life cycle worksheets
- Pictures of frogs, salmon, and dragonflies during various life cycle stages (optional)

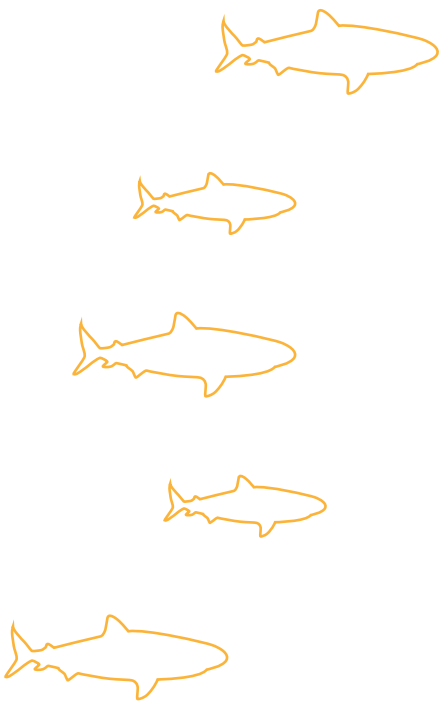
SETUP:

1. Make copies of life cycle worksheets.
2. Find pictures of frogs, salmon, and dragonflies during various life cycle stages (optional).

PROGRAM OUTLINE:

What is a life cycle?

- All animals have a life cycle.
  - Some are similar.
  - Some are different.
- Review the idea of life cycles.
  - Show students one or more examples of life cycles. Humans or other animals students are familiar with are good choices for examples.



How do habitats connect to life cycles?

- A habitat is an animal home. Animals get everything they need—food, water, and shelter—from their habitat.
- Many animals live in the same habitat their whole lives. Some animals live in different habitats during different parts of their life cycle.
- We will be learning about some of the animals that live in fresh water for part of their life cycle and other habitats during other parts of their life cycle.

"Freshwater Life Cycles" activity

- Have students read the narratives about the life cycles of different animals.
- Have students answer the question, "Where do I live?" for each part of the worksheet, using the word bank and narratives to help them.

PROGRAM OUTLINE CONTINUED:

Conclusion

- Did you notice how all of the animals spent a lot of their life cycle in freshwater?
- Even animals we don't necessarily think of as living in freshwater—like dragonflies—live in freshwater habitats during part of their life cycle.
- This is just one of many reasons why it is so important to keep freshwater habitats healthy.

TEACHER BACKGROUND:

The Importance of Freshwater Habitats

Water is essential to all life on Earth, particularly for those animals that live in or depend on freshwater habitats. Freshwater habitats are crucial for many organisms, including many animals people generally don't think of as freshwater animals. Many animals live in freshwater for their whole lives, but others who live on land, in the air, or in the sea as adults, including frogs, salmon, and dragonflies, spend the early parts of their life cycle in freshwater.

Frogs

Frogs are a large and diverse group of amphibians. They live throughout the world, including in the Bay Area and in the San Francisco Bay's watershed. Both globally and locally, frogs depend on clean freshwater habitats throughout their life cycle. As eggs, tadpoles, and froglets, frogs live in freshwater, and even as adults they must still have access to freshwater. In addition to needed access to freshwater habitats, frogs are also extremely sensitive to pollution in the water, air, and land.

Frogs start life as eggs, usually laid in ponds, lakes, or slow-moving streams. Frog eggs are made of a soft, gelatinous material that allows water, nutrients, and oxygen to come in. Tadpoles, or larval frogs, emerge from the eggs. Tadpoles are aquatic animals, breathing water with gills and living in freshwater habitats. Most tadpoles are herbivorous, feeding on planktonic algae like diatoms, but a few frog species have carnivorous tadpoles.

From the tadpole stage, frogs undergo the process of metamorphosis. During a very short period—only 24 hours in some species—the tadpoles lose their gills and develop lungs with which to breathe air. They also develop legs, lose their tail, and undergo several other changes. The froglets are extremely vulnerable to predation during metamorphosis.

Once metamorphosis is complete, the adult frog is free to move between aquatic and terrestrial environments. However, even adult frogs generally live in or near freshwater habitats because they need to stay moist, need freshwater habitats in which to reproduce, and may hunt aquatic animals. Adult frogs play an important role in both freshwater and terrestrial food webs, feeding largely on insects and other invertebrates and serving as a food source for many animals, including herons, raccoons, and snakes.

Salmon

Salmon are considered one of the most ecologically important species in California and the Pacific Northwest. 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 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 San Francisco Bay's watershed.

Salmon lay their eggs in nests, called "redds," in freshwater streams throughout the watershed, 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 body after they hatch. For the few weeks that the young salmon have these yolks attached they're 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 the San Francisco Bay Delta estuary. In the estuary the salmon undergo the process of smoltification and are known as “smolts.” Smoltification, a transformation akin to metamorphosis in frogs and 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 part 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.

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.

Dragonflies

Dragonflies are a large group of predatory insects that depend on freshwater habitats for a large portion of their life cycle. Dragonflies are considered ecological indicators. Because many species of dragonflies are very sensitive to environmental degradation in the form of pollution, water diversion, or other ecological disruption, their presence or abundance is an indication that an ecosystem is healthy.

Dragonflies generally lay their eggs on plants, like reeds, that grow in freshwater. Some female dragonflies submerge completely under the water when laying to ensure their eggs remain covered in water. Depending on the species, the eggs may take several days to several months to hatch. When the young dragonfly, called a “nymph,” emerges from the egg, it begins hunting for anything smaller or the same size as itself, including mosquito larvae and small fish. During the nymph stage, the insects breathe through gills and move using a version of jet propulsion.

TEACHER BACKGROUND CONTINUED:

The dragonflies stay in the nymph stage for as little as three months or as long as a decade, depending on the species, periodically shedding their exoskeletons as they grow. The last time they shed, the nymph climbs out of the water and an adult dragonfly emerges, ready to fly, hunt, and breathe in the air. Even though the adults are no longer bound to freshwater for breathing, living, or hunting, they never stray too far from the freshwater habitats they need for reproducing. In fact, the tendency of dragonflies to stay near freshwater led some America Indian nations of the Southwest to use dragonflies as a symbol denoting pure water.

GLOSSARY:

Adult: Final stage of frog and dragonfly life cycle; the second to last stage of salmon life cycle

Alevin: Second stage of salmon life cycle; baby salmon newly hatched from egg; an attached yolk provides alevin with nutrients and food energy.

Brackish: Water whose salinity is somewhere between that of freshwater and normal ocean water; naturally found in estuaries

Egg: First stage of life cycle of many animals, including frogs, dragonflies, and salmon

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

Froglet: Third stage of frog life cycle; frog during metamorphosis, partway between tadpole and adult; has gills, short tail, and small, undeveloped legs

Fry: Third stage of salmon life cycle; small, free-swimming young salmon that still live in freshwater; sometimes referred to as "parr"

Life Cycle: All stages of an organism's life

Metamorphosis: Process by which an animal quickly and dramatically changes its body or shape when moving from one life cycle stage to the next

Nymph: Second and larval stage of dragonfly life cycle

Smolt: Fourth stage of salmon life cycle; young salmon transitioning both geographically and physiologically from freshwater to saltwater; part of this stage is spent in brackish water in order to change the salmon body chemistry.

Spawner: Sixth and final stage of salmon life cycle, when adult salmon leaves the ocean and swims upstream to reproduce where it was born

Tadpole: Second stage of frog life cycle; frog before beginning metamorphosis; has gills, long tail, and no legs; larval frog

Yolk: Thick, yellowish substance from which salmon and many other egg-born animals derive their nutrition and food energy early in development

2ND GRADE STANDARDS:

California Common Core Standards

ELA/Literacy

- RI 5. Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.

California Science Content Standards

- 2. Plants and animals have predictable life cycles.
- 2.b. Students know the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.

California Next Generation Science Standards

- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
  - There are many different kinds of living things in any area, and they exist in different places on land and in water.
- 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.
  - Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.

Name: _____

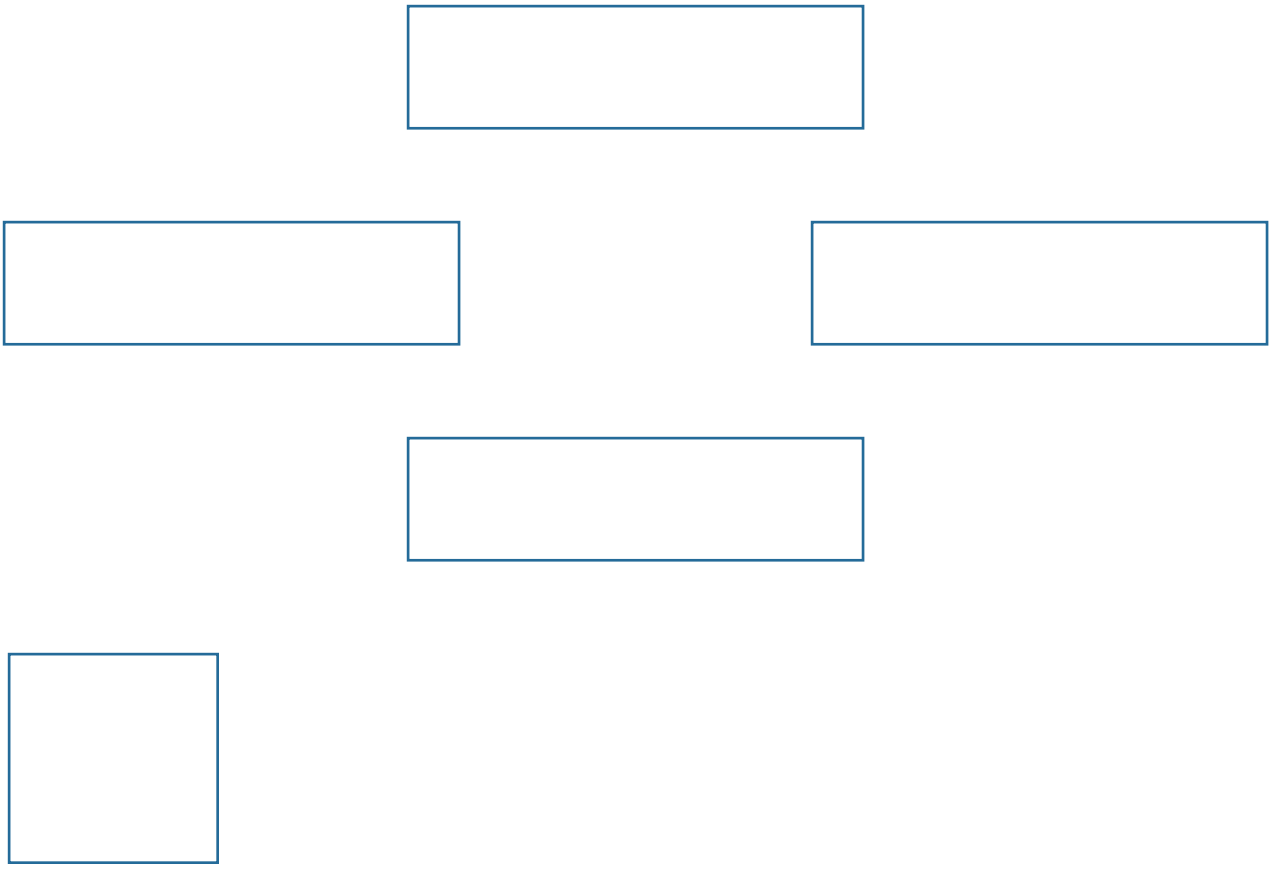
Date: _____

FRESHWATER LIFE CYCLES

Frog

Frogs start out their lives as eggs. Their mothers lay the eggs in freshwater ponds, lakes, or streams. The soft eggs must stay in water or they will dry up. When the eggs hatch, they're called tadpoles. Tadpoles use gills to breathe the water. They swim using their tails. When they get old enough, the tadpoles begin to change. They start to grow legs. First they grow their back legs. Then they grow their front legs. When they have four legs but still have a long tail, they are called froglets. Froglets need to stay in the water because they still have gills. Once they grow lungs and can breathe air, they are called adults. Adults can leave the water and live on land. They never go too far away from the water they came from.

Instructions: Use the information in the paragraph above to answer each question below. Choose the best answer for each question from the "Options" box. Draw an arrow from one box to the next, going in the right direction, to show the frog life cycle.



Name: _____

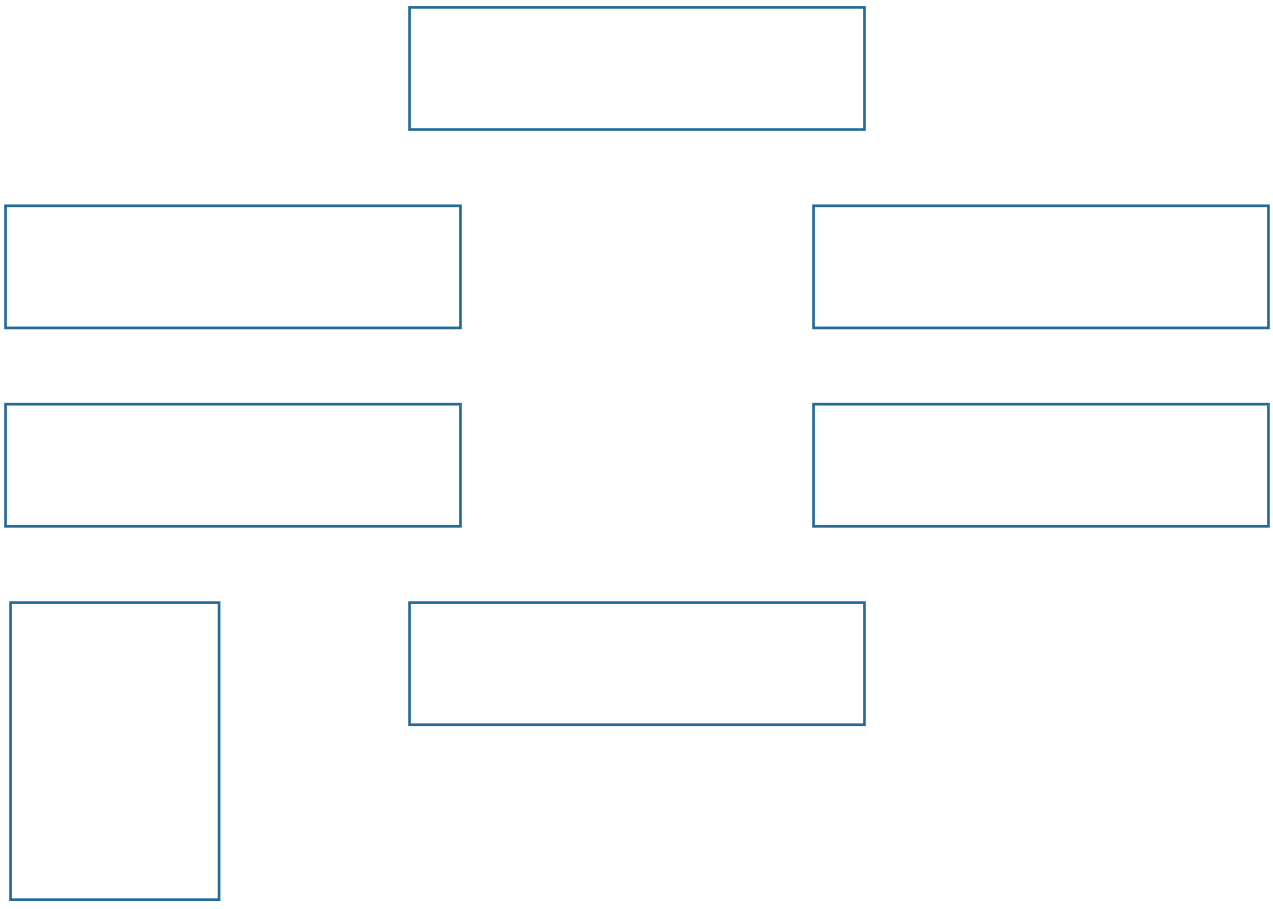
Date: _____

FRESHWATER LIFE CYCLES

Salmon

Salmon start as eggs laid in freshwater rivers and streams. When the eggs hatch, they're called alevin. Alevin still have their yolk attached. They hide near the bottom of the stream. Once the yolk disappears, the young salmon are called fry. Fry still live in their freshwater home, but not for long. Soon they swim downstream to an estuary where freshwater and saltwater mix. The San Francisco Bay is an estuary. This mix of fresh and salty water is called "brackish" water. Salmon growing in brackish water are called smolts. When the smolts become adults they swim to the ocean. Adults live in the ocean for a while. They then return to their freshwater home. They're called spawners when they're ready to swim upstream.They swim to the same place where they hatched. They lay their eggs and the life cycle begins again.

Instructions: Use the information in the paragraph above to answer each question below. Choose the best answer for each question from the "Options" box. Draw an arrow from one box to the next, going in the right direction, to show the salmon life cycle.



Name: _____

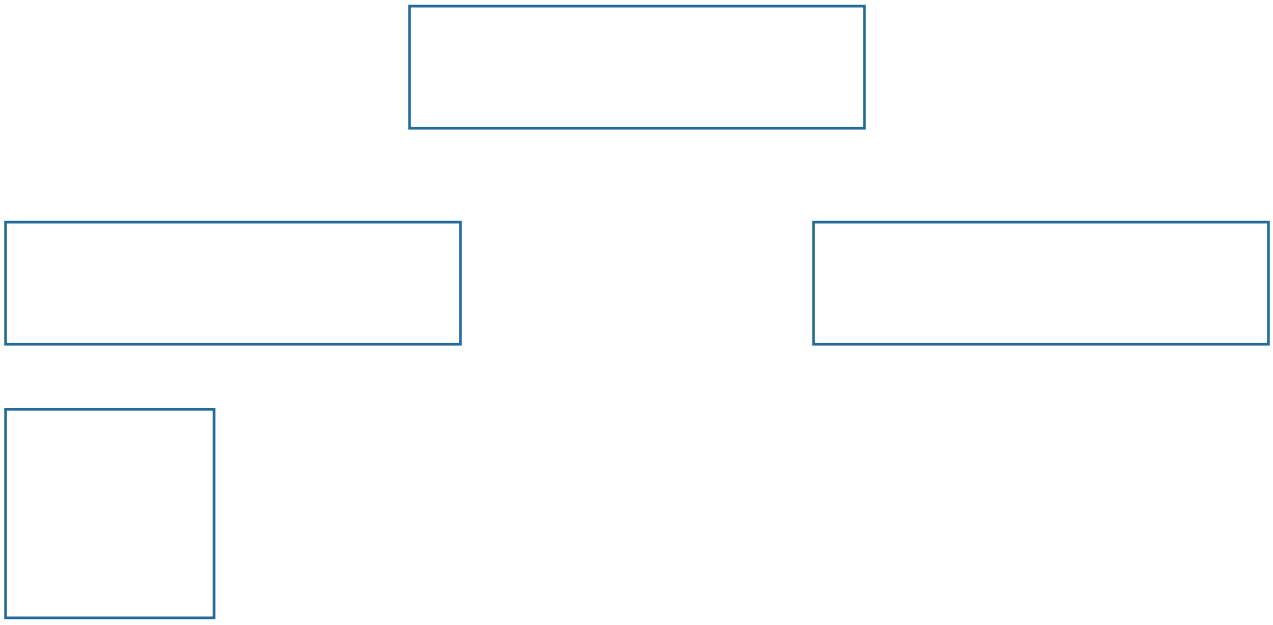
Date: _____

FRESHWATER LIFE CYCLES

Dragonfly

Dragonflies start life as eggs laid in freshwater. When they hatch, they're called nymphs. The nymphs live in freshwater. They hunt and breathe with gills. They shed their skins several times as they grow. The last time they shed their skin they become adult dragonflies. Adult dragonflies live in the air, but they never go too far from their freshwater home.

Instructions: Use the information in the paragraph above to answer each question below. Choose the best answer for each question from the "Options" box. Draw an arrow from one box to the next, going in the right direction, to show the dragonfly life cycle.



Name: TEACHER KEY

Date: _____

FRESHWATER LIFE CYCLES

Frog

Frogs start out their lives as eggs. Their mothers lay the eggs in freshwater ponds, lakes, or streams. The soft eggs must stay in water or they will dry up. When the eggs hatch, they're called tadpoles. Tadpoles use gills to breathe the water. They swim using their tails. When they get old enough, the tadpoles begin to change. They start to grow legs. First they grow their back legs. Then they grow their front legs. When they have four legs but still have a long tail, they are called froglets. Froglets need to stay in the water because they still have gills. Once they grow lungs and can breathe air, they are called adults. Adults can leave the water and live on land. They never go too far away from the water they came from.

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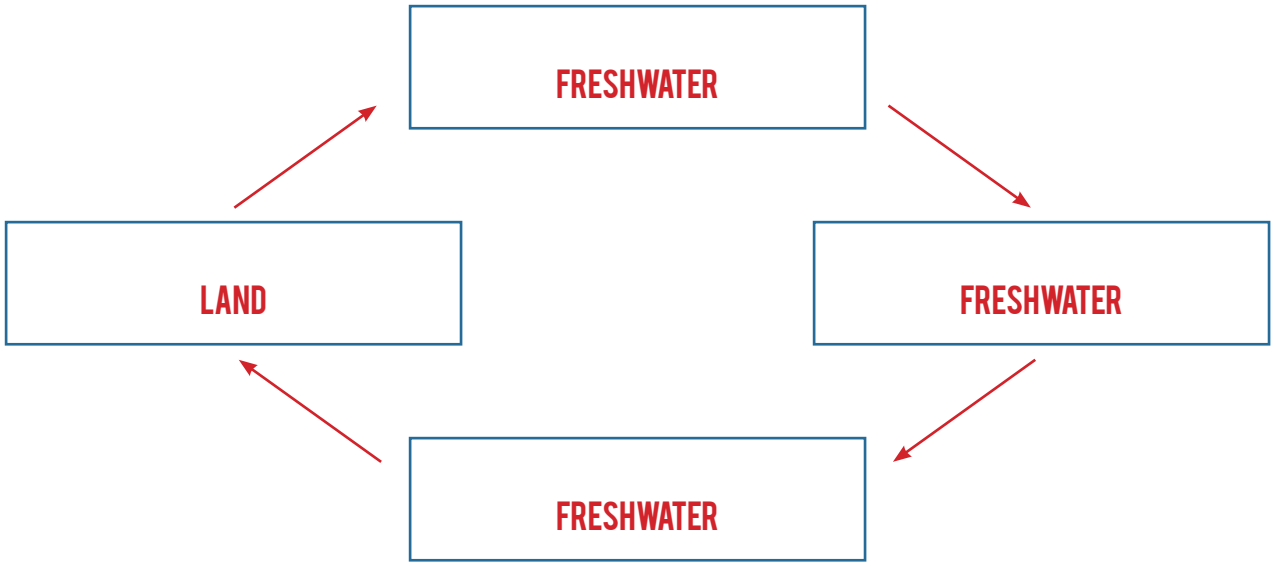

Name: TEACHER KEY

Date: _____

FRESHWATER LIFE CYCLES

Salmon

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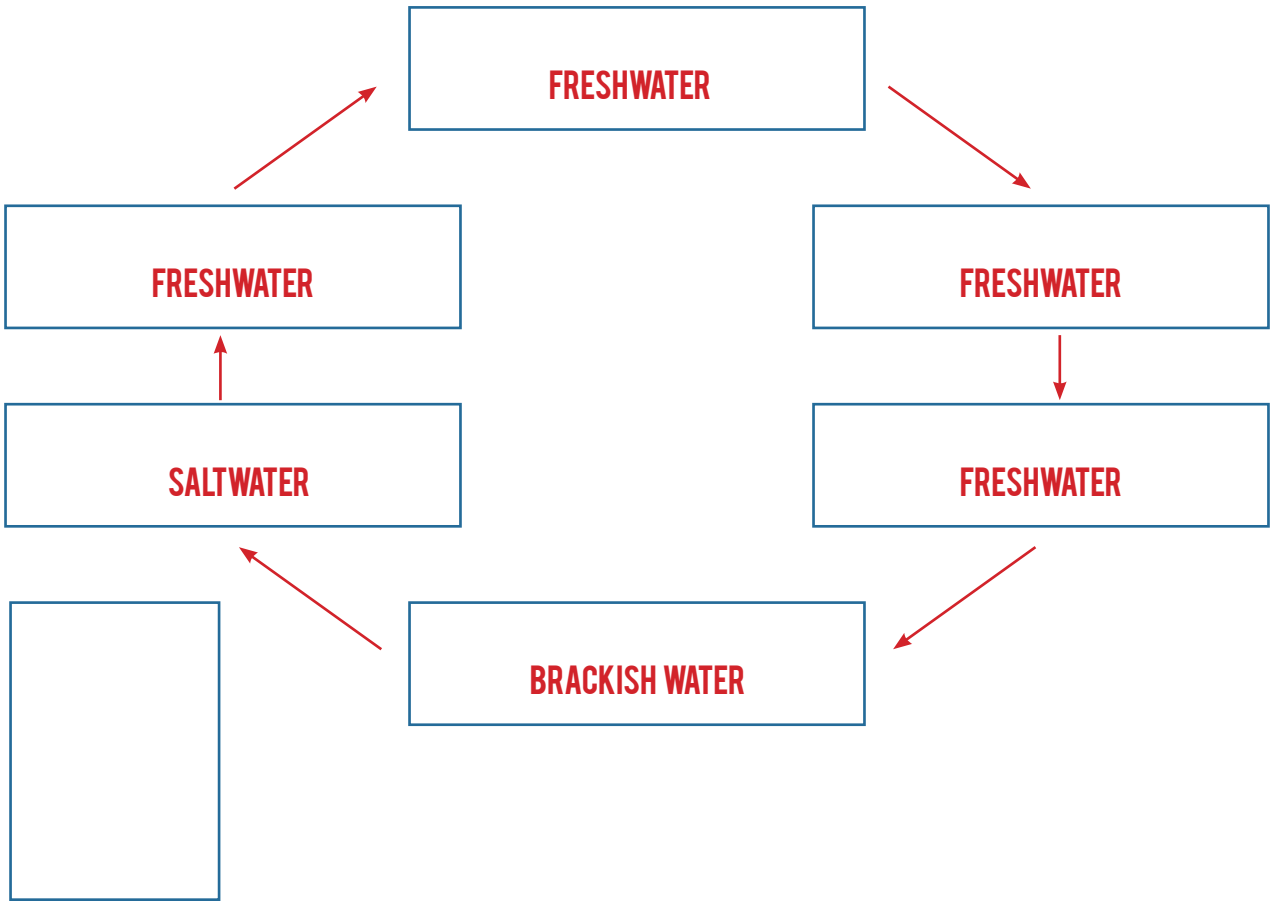

Name: TEACHER KEY

Date: _____

FRESHWATER LIFE CYCLES

Dragonfly

Dragonflies start life as eggs laid in freshwater. When they hatch, they're called nymphs. The nymphs live in freshwater. They hunt and breathe with gills. They shed their skins several times as they grow. The last time they shed their skin they become adult dragonflies. Adult dragonflies live in the air, but they never go too far from their freshwater home.

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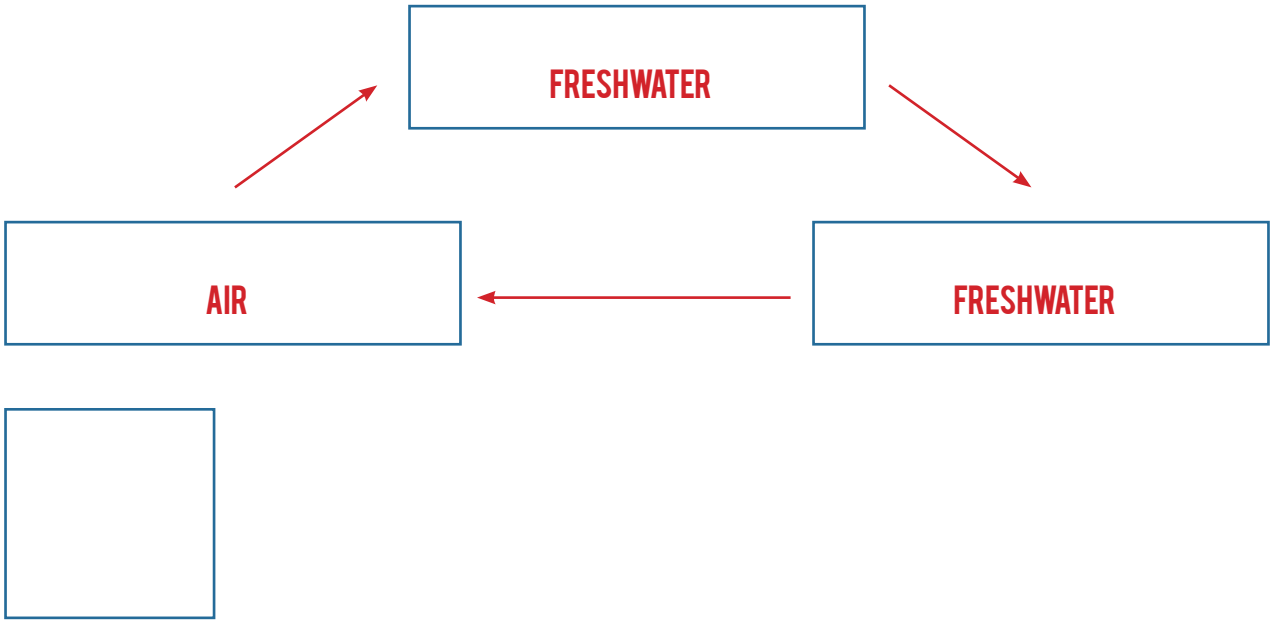


LESSON 3

MY LIFE AS A FROG

Enduring Understanding: How well humans take care of their watershed affects how frogs and other aquatic animals fare in the wild.

Materials

- Large dice (or game dice)
- Frog life cycle game materials
  - Clothespins of three different colors (green, purple, and orange are used in the guide, but you may substitute as needed, or use stickers or something else to signify different results)
  - Cups or containers to hold clothespins
  - Paper, chalkboard, or whiteboard for chart

SETUP:

1. Attach the frog life cycle game cards to the large dice. If using regular game dice, use reference sheets attached.
2. Place dice on four different tables or stations.
3. Place a container each of green and purple clothespins at each station.
4. Place a container of orange clothespins at the adult station.
5. Create a chart on paper, chalkboard, or whiteboard to record data during the game.

PROGRAM OUTLINE:

Introduction

- Review the frog life cycle and where it lives during each stage of the life cycle.
  - Eggs are laid in freshwater; young live inside soft shells before they hatch.
  - Tadpoles live in freshwater; they breathe water with gills and swim with tails.
  - Froglets are changing from tadpoles that live in the water to adult frogs that can live on land.
  - Adult frogs breathe air with lungs and walk, hop, and swim using legs.
- Explain that the class will be playing a game that will show them what it might be like to be a frog and go through its life cycle.

Rules of the game

- Explain the rules of the game. Each student will be a frog, with the goal of making it all the way through their life cycle.
  - In order to move onto the next life cycle stage, they need to

roll a die. If you're using large dice, each side of each die has a different outcome: success, natural challenge (i.e., being eaten), or human-caused challenge (i.e., pollution or other human impact). If using small dice, refer to the key see what each number means.
- When a student rolls a success, that student moves to the next life cycle stage.
- When a student rolls a natural challenge, that student takes a green clothespin and returns to the first stage.
- When a student rolls a human-caused challenge, that student takes a purple clothespin and returns to the first stage.
- When a student rolls a success at the adult stage, that student gets an orange clothespin, signifying survival, and starts again.
- The students play two rounds, each of about the same length, and use their clothespins to tally data as a group.

Round 1

- Break the students into four groups and send each group to one of the life cycle stages.
  - Time the round.
  - When the round is done, make a tally chart for the whole group, showing how many of each color clothespins the class received. See sample chart below.

CLOTHESPIN	ROUND 1	ROUND 2
Green (Nature)	||||	
Purple (Human)	𝍸 ||	
Orange (You made it!)	||	

- Discuss with the students some of the things that made it difficult to survive. Some of these things are human caused. That means that people have the power to make better choices.

Round 2

- Replace the human-caused challenges with "frog friends" options, where students make frog-friendly environmental choices. If using regular playing dice, switch to the keys for Round 2.
  - Play the game for the same length of time as Round 1.
- When Round 2 is done, gather the students and add the data for Round 2 to the chart.

Compare the rounds

- As a group, discuss and compare the two rounds. What difference did the "frog friends" make in the results?
  - You should find that considerably more frogs were able to make it all the way through their life cycle when some people were "frog friends."

How can we help?

- The game demonstrates that more frogs survive when people make good choices that take care of our freshwater resources.
- Have the students discuss what they can do to keep freshwater habitats clean and healthy for frogs.

TEACHER BACKGROUND:

Frog Life Cycle

Frogs are a large and diverse group of amphibians that live throughout the world, including in the Bay Area and the San Francisco Bay's watershed. Both globally and locally, frogs depend on clean freshwater habitats throughout their life cycle. As eggs, tadpoles, and froglets, frogs live in freshwater, and even as adults they must still have access to freshwater. Frogs are also extremely sensitive to pollution in the water, air, and land.

Frogs start life as eggs, usually laid in ponds, lakes, or slow-moving streams. Frog eggs are made of a soft, gelatinous material that allows water, nutrients, and oxygen to come in. Tadpoles, or larval frogs, emerge from the eggs. Tadpoles are aquatic animals, breathing water with gills and living in freshwater habitats. Most tadpoles are herbivorous, feeding on planktonic algae, such as diatoms, but a few frog species have carnivorous tadpoles.

From the tadpole stage, frogs undergo the process of metamorphosis. During a very short period—only 24 hours in some species—the tadpoles lose their gills and develop lungs with which to breathe air. They also develop legs, lose their tail, and undergo several other changes. The froglets are extremely vulnerable to predation during metamorphosis.

Once metamorphosis is complete, the adult frog is free to move between aquatic and terrestrial environments. However, even adult frogs generally live in or near freshwater habitats because they need to stay moist, need freshwater habitats to reproduce, and may hunt aquatic animals. Adult frogs play an important role in both freshwater and terrestrial food webs, feeding largely on insects and other invertebrates and serving as a food source for many animals, including herons, raccoons, and snakes.

Threats to Frogs

Frogs and other amphibians are extremely vulnerable to environmental changes for a variety of reasons. They need clean freshwater habitats for reproduction, and their semi-permeable skin allows pollutants in. Because of this they're considered ecological indicators: their health, presence, and abundance are indications of the overall health of an ecosystem.

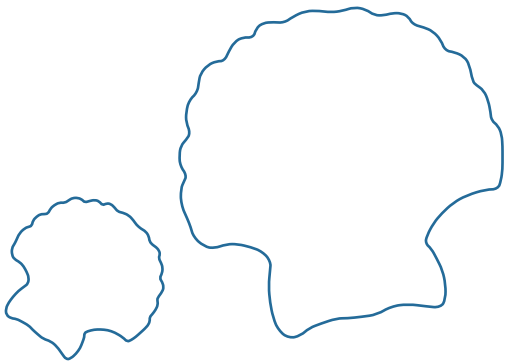
Frogs face a variety of anthropogenic—or human-caused—threats. Three of the main threats are global climate change and its impacts (not addressed in this lesson), freshwater shortages in their habitats, and water-borne pollution. As a result of these and other threats, frogs and other amphibians are currently facing a global extinction crisis. More than a hundred species of frogs have gone extinct in the last few decades, and as many as half of the remaining amphibian species are currently threatened or endangered. Because of the vulnerability of frogs and their relatives, they serve as a particularly strong reminder of why it's so important to take care of habitats, ecosystems, and ecological processes.

Fortunately, there are things that people can do, on our own or working together, to help take care of frogs and the ecosystems they call home. These include the following:

- Save water at home, school, and work.
- Use less energy at home, school, and work (this both saves the water used to produce energy and keeps the greenhouse gases that cause climate change out of the atmosphere).
- Protect and restore wetlands (favorite habitat of frogs and their relatives).
- Dispose of litter properly and pick up litter that other people leave.

TEACHER BACKGROUND CONTINUED:

- Participate in creek, river, or coastal cleanup events.
- Use less single-use plastic like water bottles and plastic shopping bags, which can end up in frog habitats.
- Choose toiletries and household cleaning products made of natural ingredients and don't contain chemicals that can harm frogs (like the triclosan found in many hand sanitizers).
- Eat organic food (frogs are very sensitive to many pesticides, including atrazine, used in conventional agriculture).



GLOSSARY:

Adult: Final stage of the frog's life cycle

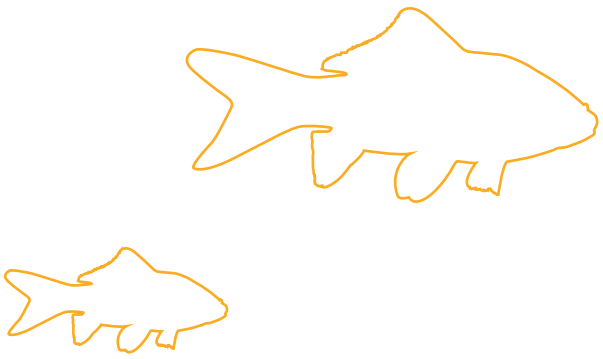
Egg: First stage of the life cycle of many animals, including frogs

Froglet: Third stage of frog life cycle; frog during metamorphosis, partway between tadpole and adult; has gills, short tail, and small, undeveloped legs

Life Cycle: All stages of a living thing's life

Metamorphosis: Process by which an animal quickly and dramatically changes its body or shape when moving from one life cycle stage to the next

Tadpole: Second stage of frog life cycle; frog before beginning metamorphosis; has gills, long tail, and no legs; larval frog



2ND GRADE STANDARDS:

California Common Core Standards

Mathematics

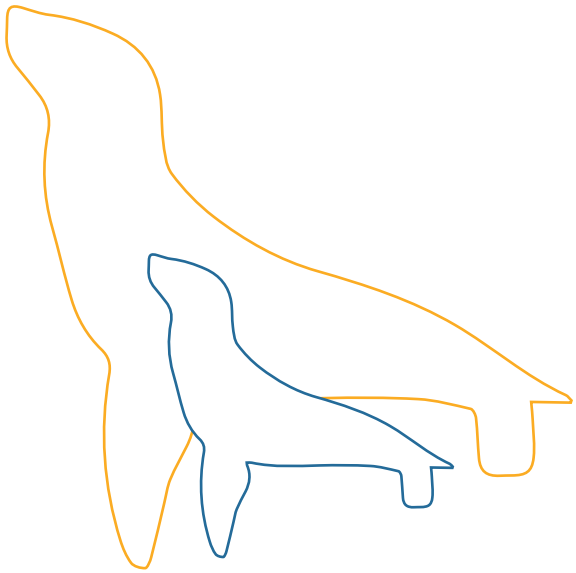
- 2NBT 2. Count within 1000; skip-count by 2s, 5s, 10s, and 100s.

California Science Content Standards

- 2. Plants and animals have predictable life cycles.
- 2.b. Students know the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.

California Next Generation Science Standards

- 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
  - Develop a model to represent patterns in the natural world.
- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
  - Make observations (firsthand or from media) to collect data which can be used to make comparisons.



Name: _____

EGG ROUND 1

You were laid in clear water. Move on to the next stage.	Your pond is surrounded by tall, shady reeds. Move on to the next stage.	Your yolk is giving you all the nutrition you need. Move on to the next stage.
You have been able to stay hidden from predators. Move on to the next stage.	You were gobbled up by a trout. Return to start.	Someone used pesticides to kill insects in their garden and the rain washed them into your pond. Return to start.

TADPOLE ROUND 1

Your water is just the right temperature. Move on to the next stage.	You're able to hide from predators in the water plants growing in your pond. Move on to the next stage.	There are lots of yummy insect larvae for you to eat. Move on to the next stage.
There is lots of oxygen in the water for you to breathe with your gills. Move on to the next stage.	You were eaten by a raccoon. Return to start.	People took too much water from your home and there isn't enough for you. Return to start.

FROGLET ROUND 1

Your home pond is still and quiet. Move on to the next stage.	You grew strong legs. Move on to the next stage.	You grew lungs and can now breathe air. Move on to the next stage.
Your pond is filled with food. Move on to the next stage.	You were eaten by a hungry heron. Return to start.	You got caught in a plastic bag someone left by your pond. Return to start.

Name: _____

ADULT ROUND 1

You found a nice, clear pond to lay your eggs. You made it!	Your home is surrounded by shady trees, keeping you nice and cool. You made it!	There are lots of water bugs for you to eat. You made it!
You successfully completed metamorphosis. You made it!	You were eaten by a San Francisco garter snake. Return to start.	Uh oh! You thought a piece of plastic was food and got sick. Return to start.

FROG FRIENDS ROUND 2

Egg Frog Friend: The people who live near your pond don't pollute. Move on to the next stage.	Tadpole Frog Friend: The city near your pond passed a new law to keep water flowing to your pond. Move on to the next stage.	
Froglet Frog Friend: A school group cleaned up trash from around your pond. Move on to the next stage.	Adult Frog Friend: The people who live near you saved water. You made it!	

Name: _____

Egg Round 1

Roll to find your number.

1. You were laid in clear water. Move on to the next stage.
2. Your pond is surrounded by tall, shady reeds. Move on to the next stage.
3. You were gobbled up by a trout. Return to start.
4. You have been able to stay hidden from predators. Move on to the next stage.
5. Your yolk is giving you all the nutrition you need. Move on to the next stage.
6. Someone used pesticides to kill insects in their garden and the rain washed them into your pond. Return to start.

Tadpole Round 1

Roll to find your number.

1. People took too much water from your home and there isn't enough for you. Return to start.
2. There are lots of yummy insect larvae for you to eat. Move on to the next stage.
3. You were eaten by a raccoon. Return to start.
4. You're able to hide from predators in the water plants growing in your pond. Move on to the next stage.
5. There is lots of oxygen in the water for you to breathe with your gills. Move on to the next stage.
6. Your water is just the right temperature. Move on to the next stage.

Froglet Round 1

Roll to find your number.

1. Your home pond is still and quiet. Move on to the next stage.
2. You got caught in a plastic bag someone left by your pond. Return to start.
3. You grew lungs and can now breathe air. Move on to the next stage.
4. Your pond is filled with food. Move on to the next stage.
5. You grew strong legs. Move on to the next stage.
6. You were eaten by a hungry heron. Return to start.

Adult Round 1

Roll to find your number.

1. There are lots of water bugs for you to eat. You made it!
2. You were eaten by a San Francisco garter snake. Return to start.
3. You found a nice clear pond to lay your eggs. You made it!
4. You successfully completed metamorphosis. You made it!
5. Uh oh! You thought a piece of plastic was food and got sick. Return to start.
6. Your home is surrounded by shady trees, keeping you nice and cool. You made it!

Name: _____

Egg Round 2

Roll to find your number.

1. You were laid in clear water. Move on to the next stage.
2. Your pond is surrounded by tall, shady reeds. Move on to the next stage.
3. You were gobbled up by a trout. Return to start.
4. You have been able to stay hidden from predators. Move on to the next stage.
5. Your yolk is giving you all the nutrition you need. Move on to the next stage.
6. The people who live near your pond don't pollute. Move on to the next stage.

Tadpole Round 2

Roll to find your number.

1. The city near your pond passed a new law to keep water flowing to your pond. Move on to the next stage.
2. There are lots of yummy insect larvae for you to eat. Move on to the next stage.
3. You were eaten by a raccoon. Return to start.
4. You're able to hide from predators in the water plants growing in your pond. Move on to the next stage.
5. There is lots of oxygen in the water for you to breathe with your gills. Move on to the next stage.
6. Your water is just the right temperature. Move on to the next stage.

Froglet Round 2

Roll to find your number.

1. Your home pond is still and quiet. Move on to the next stage.
2. A school group cleaned up trash from around your pond. Move on to the next stage.
3. You grew lungs and can now breathe air. Move on to the next stage.
4. Your pond is filled with food. Move on to the next stage.
5. You grew strong legs. Move on to the next stage.
6. You were eaten by a hungry heron. Return to start.

Adult Round 2

Roll to find your number.

1. There are lots of water bugs for you to eat. You made it!
2. You were eaten by a San Francisco garter snake. Return to start.
3. You found a nice clear pond to lay your eggs. You made it!
4. You successfully completed metamorphosis. You made it!
5. The people who live near you saved water. You made it!
6. Your home is surrounded by shady trees, keeping you nice and cool. You made it!

LESSON 4

IF THE WATER IS CLEAR

Enduring Understanding: Caring for and protecting freshwater habitats is important for plants, animals, and people.

Materials

- Writing materials
- Publishing materials (optional)

SETUP:

1. Review some of the benefits of freshwater habitats in the "Instructor Background" section.
2. Prepare the necessary writing and optional publishing materials.

PROGRAM OUTLINE:

Why is it important to care for our freshwater habitats like rivers, lakes, and creeks?

- Many animals depend on clean freshwater during part or all of their life cycle.
- Most land animals need clean freshwater to drink.
- Other animals live in freshwater. It's their home and they need it to stay clean.
- People need clean freshwater, too, and they like to visit lakes, rivers, and creeks.

Why are freshwater habitats in trouble?

- People leave litter or create other pollution, and that pollution ends up in rivers, creeks, and lakes. It sometimes makes it to the bay or ocean, too.
- People sometimes use more than their fair share of freshwater, which means there is less freshwater to fill rivers, lakes, creeks, and streams.

The good news is that we all have a voice. Why is it important to you to keep our freshwater habitats clean?

- Depending on your students' experience with creative writing,

PROGRAM OUTLINE CONTINUED:

you may do one of the following:

- Have each student write a creative writing piece (poetry or prose) about why taking care of our freshwater habitats is important to the student, animals, and other people.
- Have each student write one sentence or a phrase about why caring for our freshwater habitats is important. Then, each group of four to six students can put their sentences and phrases together to make a group poem.

Sharing work

- You may do this by having students read their work aloud for the whole class, sharing it with a partner, or publishing it so that other students may read it.

What we can do

- Taking care of our freshwater habitats is everyone's responsibility.
- There are choices we can make every day that can help take care of these habitats.
  - Brainstorm ideas with the class.
- Have each child pledge to do one thing to help protect freshwater habitats.

TEACHER BACKGROUND:

Freshwater is essential to life as we know it. It is perhaps the most vital of all resources. It is essential to all different kinds of living things, from the smallest flowers to the tallest trees, from bacteria to salmon. Freshwater is essential to human bodies. It drives all kinds of human endeavors, from agriculture to industry to art. There is a finite amount of water on Earth—the amount of water on our planet has been the same throughout geologic time, and we can't create more of it—and less than 1/100 of 1 percent of that water is available for human use. Because of all these things, protecting our freshwater resources and habitats is one of the most important things that we can all do to care not only for the environment and other animals but also ourselves.

The Importance of Freshwater Habitats to Animals

All freshwater and terrestrial, or land-dwelling, organisms depend on freshwater to meet a variety of needs, including for drinking and habitats. Organisms of all varieties—from algae to fairy shrimp to rainbow trout to beavers—live in freshwater habitats throughout their life cycles, from which they get everything they need to survive. This unit focuses on just three of the many animals that live in freshwater habitats for a portion of their life cycle. Still other animals rely on freshwater habitats for food and drinking water. Even living things in the ocean rely on freshwater, because the water flowing from rivers and streams into the ocean carries important nutrients that provide the basis for coastal food webs.

The Importance of Freshwater Habitats to People

Freshwater habitats provide many ecosystem services for people. Perhaps the most obvious of these is that freshwater habitats provide the water to drink and to use in our homes, schools, and businesses. Freshwater is also integral to growing food, with more than 80 percent of freshwater use in California going to agriculture. Freshwater habitats also feed us by providing much-needed habitat for important fish like salmon, rainbow trout, and sturgeon. In addition to this, healthy freshwater habitats provide refuge for endangered and important animals, create opportunities for recreation, and can even help protect us against flooding.

Protecting Local Freshwater Habitats

A watershed is all of the land where the freshwater drains into the same ocean, bay, river, or lake. The San Francisco Bay has an extraordinary watershed that is home to the animals discussed in this unit, in addition to many more. Freshwater habitats in the San Francisco Bay's watershed face two major threats, one that impacts the quantity of freshwater flowing through our waterways, and another that impacts the quality of that water. These two primary issues are freshwater diversion and freshwater pollution.

Freshwater diversion occurs when people siphon off water from natural systems for human use. This diversion of water is often so large that freshwater ecosystems can't compensate for it. For example, so much water is diverted from the San Joaquin River—the second largest river in California and an important part of the San Francisco Bay's watershed—that it sometimes runs dry or even backward. All told, about half of the freshwater that historically flowed through the watershed is diverted before it reaches San Francisco Bay. This has had huge ecological impacts, including driving some animals to the brink or over the edge of extinction.

Fortunately, we can make many choices in order to keep the water flowing through our freshwater

TEACHER BACKGROUND CONTINUED:

habitats, including the following:

- Support legislation that requires enough water be left in natural freshwater habitats to keep ecosystems healthy.

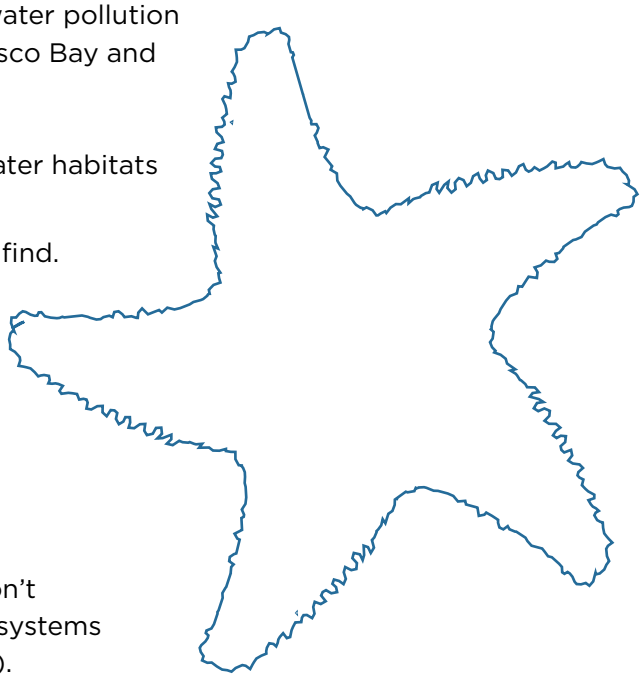
  - Save water at home, work, and school by

    - turning off the water while brushing your teeth, washing your hands, or shaving.
    - taking shorter showers.
    - washing only full loads of laundry.
    - watering the lawn or garden in the evening or morning instead of afternoon.

  - Agriculture uses more than 80 percent of the freshwater used by people in California. Wise food choices include the following:

    - Eat more fruits and vegetables, which take less water to produce than grains, dairy, or meat.
    - Support farmers who use water-saving techniques by choosing dry-farmed or drip-irrigated fruits and vegetables.

Pollution also impacts freshwater ecosystems in a number of ways. Many kinds of pollution find their way into freshwater ecosystems, including litter, household chemicals, and agricultural chemicals (i.e., pesticides and fertilizers). Litter, particularly plastic, can harm animals living in freshwater habitats when they eat it or become entangled in it. Chemical pollution from homes, cities, and agriculture can cause deformations in animals or make them more vulnerable to disease or predation, particularly for amphibians like frogs. Freshwater pollution also often makes its way downstream to the San Francisco Bay and the ocean.



Some things we can do to keep pollution out of freshwater habitats include the following:

- Dispose of litter properly and clean up litter you find.
- Participate in creek and beach cleanup events, such as Coastal Cleanup Day.
- Choose more organic foods and products.
- Support local laws that ban plastic bags and other single-use plastics that often end up polluting our waterways.
- Reduce, reuse, recycle, and compost.
- Choose toiletries and household cleaning products that include natural ingredients and don't contain chemicals that can harm freshwater ecosystems (like the triclosan found in many hand sanitizers).

2ND GRADE STANDARDS:

California Common Core Standards

ELA/Literacy

• W.10. Write routinely over extended timeframes (time for research, reflection, and revision) and shorter timeframes (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

California Science Content Standards

• 3.e. Students know rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.

California Next Generation Science Standards

• 2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
  - Developing and using technology has impacts on the natural world.

2ND GRADE

RESOURCES

• Amphibian Ark
www.amphibianark.org

• Association of Zoos and Aquariums, FrogWatch USA
www.aza.org/frogwatch/

• The Bay Institute
www.bay.org

• California Department of Fish and Wildlife, “Trout in the Classroom” Program
www.wildlife.ca.gov/CAEP

• Council for Environmental Education, Project Wild Aquatic
www.projectwild.org/projectwildwebsite/aquatic/

• Save the Frogs
www.savethefrogs.com

• Tuolumne River Trust
www.tuolumne.org

• Waterfootprint Network
www.Waterfootprint.org

• Watershed Project
www.thewatershedproject.org/home.php