Lesson Plan: Follow Your Nose

By: Patty Malone and Janis Spracher
Inspired By: Trout in the Classroom and The Salmon Source: An Educator's Guide

Target Grade: 4th Grade

Teacher Prep Time: 2 hours

Lesson Time: 5 hours and 20 minutes (We recommend doing this lesson over 6 days, one part per day)

- Part 1: Hooks and Ladders
  - 45 min - Life Cycle Activity
  - 10 min - Discussion and Summary
- Part 2: The Salmonid Life Cycle
  - 20 min - Survival Needs Groups
  - 45 min - Life Cycle Diagrams
- Part 3: Follow Your Nose Home
  - 10 min - Finding Your Way
  - 20 min - "How Salmon Scent Their Way Home Again"
  - 25 min - Structure and Function of Salmonids
- Part 4: Smell Like a Salmonid
  - 20 min - Home Stream Activity
  - 15 min - Revise Life Cycle Diagram
  - 20 min - Constructing an Explanation
- Part 5: Effects of Wildfire on Salmonids
  - 25 min - "Fish and Fire: How Wildfires Affect Salmon and Trout"
  - 20 min - Discussion and Summary
- Part 6: Constructing an Explanation
  - 20 min - Data Analysis
  - 25 min - Constructing an Explanation

Lesson Overview:

Students begin by modeling the salmonid life cycle in a playground activity. They then learn, in a jigsaw activity, salmonids' needs for survival at each stage of the life cycle. They draw a diagram of the life cycle of a local salmonid species. Next, they learn the internal and external structures that function to help the salmonid find its home stream, practice using their sense of smell to find their "home stream," and then write an explanation for how salmonids use their sense of smell to find their home stream. Finally, students construct an explanation for how wildfire affects a salmonid's ability to survive and reproduce.

Learning Objectives:

- Students will be able to use a diagram to explain the salmonid life cycle and its survival needs at each stage.
- Students will be able to construct an explanation for how salmonids use their internal and external structures to find their home stream in order to reproduce.
- Students will be able to construct an explanation for how wildfires affect a salmonid's ability to find its home stream.

NGSS:

- **Performance Expectation:**
  - 4-LS1-1 Construct an argument that plants and animals have internal and external

structures that function to support survival, growth, behavior, and reproduction.

- **Science and Engineering Practice**
  - #6 Constructing Explanations
    - Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
      - Construct an explanation using models or representations.
      - Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- **Disciplinary Core Idea**
  - 4-LS1-1
    - LS1.A **Structure and Function:** Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.
    - LS1.D **Information Processing:** Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.
- **Cross Cutting Concept**
  - #6 Structure and Function
    - The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Where This Lesson Fits in:

Students should have some familiarity with the ecosystem where they live-- if possible, the organisms and geology of the watershed of a creek in their community. If the class is participating in the Trout in the Classroom program, this lesson sequence would ideally begin around the time the salmonid eggs are delivered to the classroom.

Materials Needed (based on class size of 25 to 30)**:**

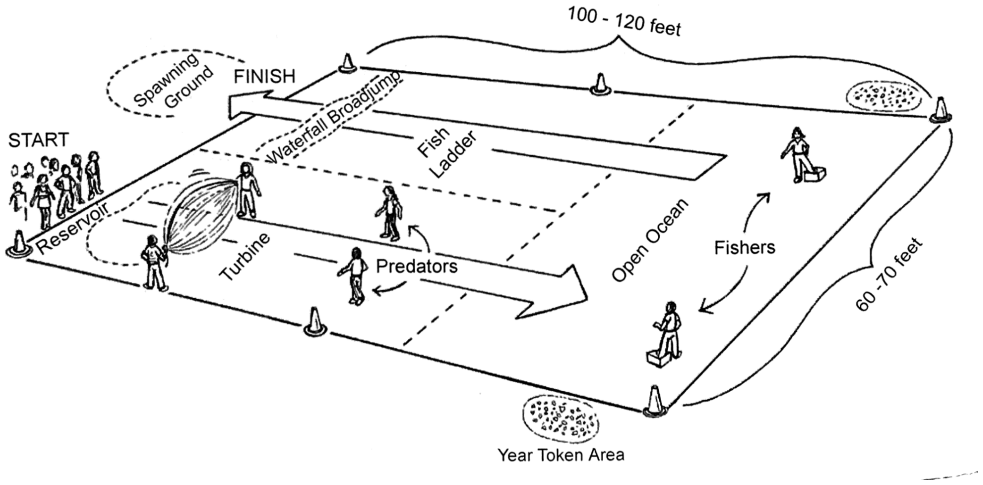
- Large playing area (100 ft x 50 ft)
- About 500 feet of rope or string or six traffic cones (masking tape if indoors)
- Two cardboard boxes or two scooters to sit on
- 100 tokens (3" x 5" cards, poker chips, etc., in four different colors if possible)
- Large jump ropes
- Two pool noodles (optional)
- 1 copy per student of worksheets, templates, articles, and survival needs cards
- 1 brown bag per student, plus 7 brown paper bags for home streams
- Scents: Suggested - garlic powder, dried mint, cocoa powder, oregano, rosemary, lavender, and vanilla and almond extract
- Cotton balls for extracts

Teacher Prep:

- Part 1: Set up Hooks and Ladders activity on the blacktop or field.
- Part 2: Print and copy Smelling the Way Home Student Worksheet, Survival Needs Cards, and Life Cycle Templates.
- Part 3: Print and copy "How Salmon Scent Their Way Home Again" article and Salmonid Cards.
- Part 4: Prepare Scent Bags.

- Part 5: Fish and Fire: Print and copy “How do Wildfires Affect Salmon and Trout”

Lesson Sequence:

Part 1: Hooks and Ladders	
45 mins	**Life Cycle Simulation**  ● Set up a field or blacktop (at least 50 by 100 feet) as depicted above, including spawning grounds, reservoir, downstream, upstream, and ocean. ● In the classroom, ask students where fish live. Do they live in freshwater? Do they live in the ocean? Do any fish live in both freshwater and saltwater? Ask students if they know of any freshwater fish that live nearby. Do those fish spend their whole lives in the river, or do they migrate? Tell students that they are going to study a special type of fish that lives in streams in your area. This type of fish is called a salmonid. Many species of salmonid begin their lives in freshwater, then go to the ocean to grow big, then return to freshwater to reproduce. Tell the class that they are going to role play the life cycle of this special fish called a salmonid. ● Take the class to the activity area. Tell students that this activity is not a competition; it is a learning exercise to see what happens in a population of salmonids, a special kind of fish that live in both freshwater and the ocean. Some students will play the role of salmonids; others will play the part of challenges to salmonids’ survival. Scientists call these challenges “limiting factors.” Explain to students that limiting factors are challenges to an organism’s survival; they limit the population growth of an organism. ● Before beginning the simulation, assign roles to students as follows: ○ 2 students to be the turbines ○ 2 students to be the fish ladder ○ 2 students to be the predatory wildlife ○ 2 students to be the human fishers ○ The remaining students will be salmonids ● Once roles are assigned, walk students through the activity, explaining at each stage what challenges salmonids face in order to survive. ● Begin with all the salmonids as eggs in the spawning ground. The fish hatch,

and the fry swim up to the reservoir and count to 30.

- The salmonids then begin their journey downstream. The first challenge to survival the salmonids encounter is the turbines on the dam. At most dams, escape weirs guide the migrating fish past the turbines. Sometimes, fish become trapped in the turbines. In order to simulate this, two students will swing a jump rope for the salmon to jump through. A salmonid cannot go around the jump ropes, but can swim through as long as the rope doesn't hit them. Any student that "dies" becomes part of the fish ladder. The students who are the fish ladder kneel on the ground with one body space between them. Later, the adult salmon that migrate back to their home stream will use the fish ladder to get around the turbines.
- Once past the turbines, the salmonids face wildlife predators. The predators must catch the fish with their bare hands; tagging is not enough. Dead salmonids are led to the fish ladder by the predator that captures them.
- Once in the open ocean, salmonids can be caught by fishers waiting in fishing boats (cardboard boxes or seated scooters). In order to catch the salmonids, the fishers must tag the fish with both hands (or with pool noodles). They may move about the open ocean as long as they keep a foot in their cardboard box (if using cardboard boxes) or remain seated on their scooters (if using scooters). Since salmonids can spend four years in the ocean, the fish must travel back and forth across the field to collect four tokens (one of each color if using different colored tokens). Each token represents one year of growth.
- When a salmonid has collected four tokens, they can start upstream. The salmonid must walk through the entire pattern of the fish ladder, which is intended to help students recognize how restricting and tedious it is for salmonids to travel upstream this way. Predators may not harm the salmonids while they are in the fish ladder.
- Once through the ladder, the fish face the broad-jump waterfall, which represents one of the natural hazards salmonids face on their way upstream. The jumping distance should be challenging but realistic. The two students who represented the turbine earlier will monitor the jump. The salmonids must jump across the entire waterfall to be able to continue on. If they fail, they must return to the beginning of the fish ladder and try again.

- At the top of the broad-jump waterfall, the two student predators now represent another set of predators-- bears. As before, the predators must capture the salmonids with their bare hands, not just a quick tag. If they catch a salmonid, the bear takes the fish to become part of the fish ladder.
- The activity ends when all the salmonids are gone before the spawning ground is reached -- or when all surviving salmonids reach the spawning ground. Repeat the activity if desired so that all students have a chance to play a

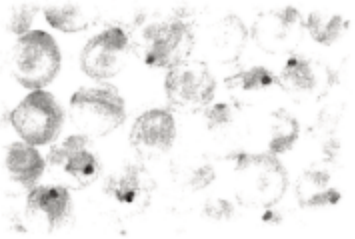
	salmonid.
10 mins	● Once back in the classroom, facilitate a brief discussion with students, touching on the following points: ○ Survival/mortality ratio ○ The role of barriers, including man made, natural, and predatory barriers (wild animals and humans) ○ Where the losses were greatest and where they were the least ○ What the consequences would be if all the eggs survived to maturity and spawning ○ What seemed realistic about the simulation and what did not ● Make sure students understand that limiting factors apply to all living organisms, not just salmonids. Explore other limiting factors, including food scarcity, pollution, loss of habitat.
Part 2: The Salmonid Life Cycle *Before this part of the lesson, decide whether you want to use a local watershed near your school campus that students might be familiar with to model the salmonid life cycle and its survival needs. If so, the template used in this lesson may need to be slightly modified to meet your needs.*	
20 mins	**A. Survival Needs Groups** ● Group the class into groups of six students. Tell them, "Now that we've acted out the salmonid life cycle, we are going to learn about what salmonids need at each stage of their life cycle." ● Tell students, "You are each going to get a 'Survival Needs Card'. Each group has a different stage of the salmonid life cycle. With your group, I want you to read your survival card and talk about what a salmonid needs at your stage of its life cycle. Then, fill out #2 on your worksheet." Direct students to #2 and read the sentence frame.

Egg

Your egg, along with thousands of its brothers and sisters, was deposited and fertilized in a nest (redd) in the gravel of a stream. Your egg was laid in fall or early winter. As your salmon grows and develops within its egg, it has very specific needs for survival.

Your egg needs:

1. Clean, cold water
2. Clean gravel in the bottom of the stream with little or no fine sand in between the gravel
3. Plants growing alongside the stream to shade the water and keep it cool
4. Flowing water to bring oxygen to the egg

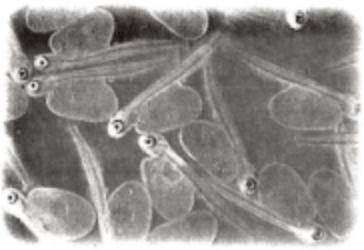


Alevin

Sometime in late winter or early spring, your salmon hatched from its egg as an alevin. Your alevin has a yolk sac still attached to its body. All of the food it needs is absorbed from the yolk sac. Your alevin lives in gravel at the bottom of the stream.

Your alevin needs:

1. Clean, cold water
2. Flowing water to bring oxygen to it
3. Plants growing alongside the stream to shade the water and keep it cool



Fry

In spring, your alevin comes out of the gravel. It is now a fry and is one inch (2.54 cm) long. Your fry hangs out in pools where the water is calm. Watch out! Frogs, birds and other fish want to eat your fry for lunch.

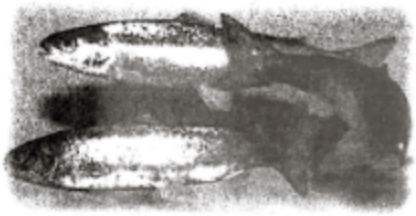
Your fry needs:

1. Clean, cold water
2. Plankton (small floating plants and animals) and small insects to eat
3. Places to rest and hide from predators- especially in pools behind boulders and logs

Smolt

Your salmon is bigger now and has traveled downstream to an estuary (where saltwater and freshwater mix). Your smolt will stay in the estuary until its body gets used to the saltwater of the sea. Watch out! Birds, mammals and other fish want to eat your smolt for lunch.

Your smolt needs:
1. Clean, cold water
2. Plankton (small floating plants and animals) and insects to eat
3. Places to rest and hide from predators- especially in eelgrass
4. Time to adjust to the saltwater



Ocean Adult

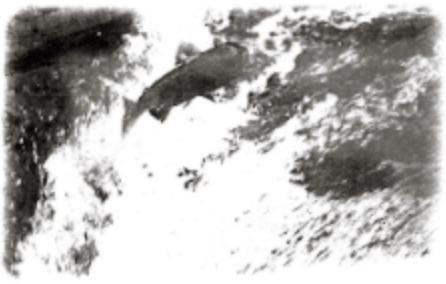
Your salmon has left the estuary for the ocean. Now it's all grown up! Salmon spend one to seven years in the ocean, depending on what kind of salmon they are. During your salmon's time in the ocean, it may swim up to 3,000 miles away from its home stream.

Your ocean adult needs:
1. Clean, cold saltwater
2. Food- smaller fish and shrimp

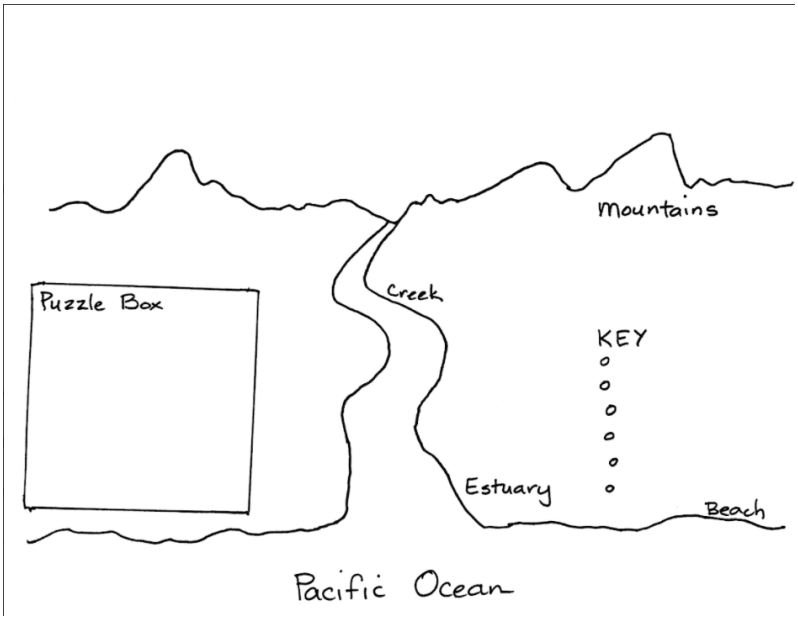
Spawner

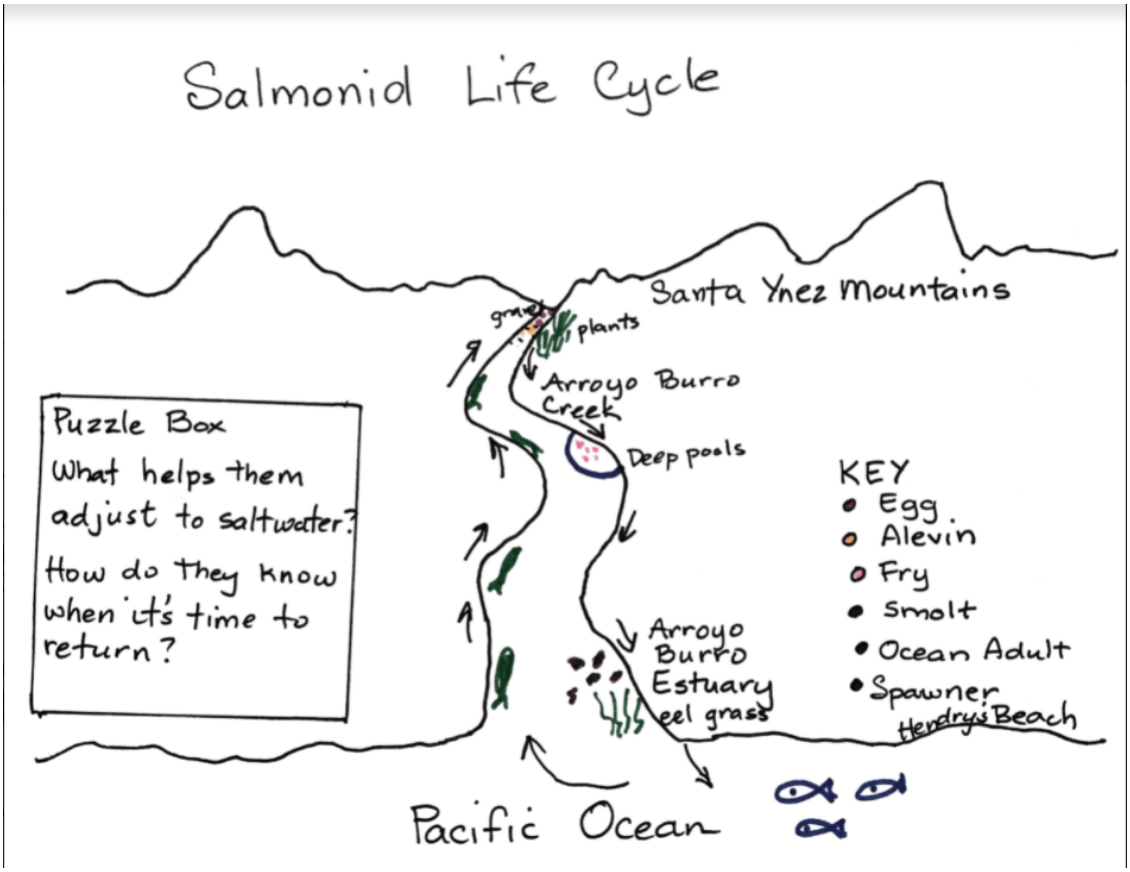
As your salmon returns to its home stream by using its sense of smell, its body changes shape and color. These changes help it find a mate. Once your salmon enters its home stream, it stops eating. It faces many challenges trying to find both a mate and a good place to spawn.

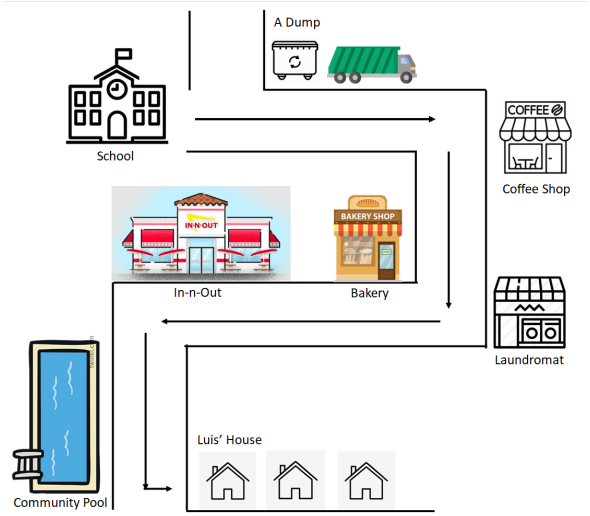
Your spawner needs:
1. Clean, cold water
2. A mate
3. Clean gravel between 6 and 24 inches (15 to 61 cm) deep in which to deposit its eggs
4. Good water flow to bring oxygen to the eggs
5. Deep pools for resting or hiding



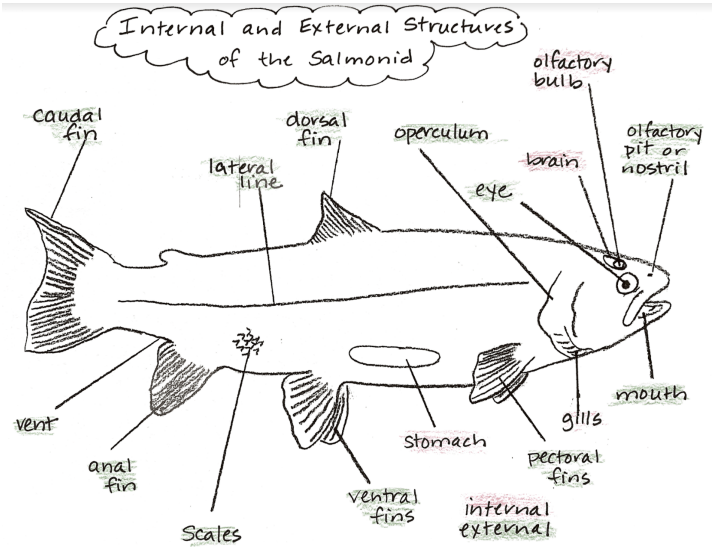
- Give students time to read, discuss, and write down the survival needs of a salmonid at their assigned stage.
- Call for students' attention. Tell students, "Now we are going to get together in a mixed group. Each person in your group will have a different card. With your group, see if you can put the cards in order, beginning with the egg stage. Once you think you have the correct order, check with me before you go on."
- Regroup class into mixed groups. Make sure each of the six stages of the salmonid life cycle are represented in each group.
- As student groups check in, direct them to continue filling in the story of the salmonid's life cycle on page 2 of the Student Worksheet.

	A salmonid begins its life as an egg . Once it hatches, it is called an alevin . It absorbs its yolk sac and becomes a fry . Then, it swims downstream as a smolt . Once it's ready to live in saltwater, it swims into the ocean as an ocean adult . When it is ready to spawn, the salmonid is called a spawner . It returns to its home stream to lay or fertilize eggs. ● Once all groups have finished filling in #3 on page 2 of the Student Worksheet, read through the life cycle together so students can self-correct as necessary. ● Tell students they are going to share the survival needs of their life stage with their group so everyone in the group knows the whole story of the salmonid life cycle. Give students time to do this.
24 mins	**B. Life Cycle Diagrams** ● Tell students, "Our school is very close to a creek/stream/river that has salmonids living in it." Discuss with students and give them time to share their experiences with the creek, organisms that live in and around it, etc. ● Tell students, "We are going to make a diagram to show where the salmonids live at each stage of their life cycle, and to explain what they need in order to survive at each stage of their life cycle." ● Direct students to page 3 of the Student Worksheet. Ask students, "What do you see in this diagram?" Lead students in a discussion in which they recognize each portion of the map template.  ● Tell students, "Before you begin adding to this diagram, talk in your group and agree on some things to include in your drawing. Here are some things you must have in your diagram." Read over the checklist on page 2 of the Student Worksheet with students. ● Circulate as students work and ask questions as necessary. ○ Back Pocket Questions (BPQ's):

	■ What made you include ___ in your diagram? ■ What do you think would happen if you drew (structure) in (location)? ● As students are finishing up, call for the class's attention. Tell students, "Now we are going to add some information to our diagrams. You have already shared what salmonids need at each stage of their life cycle. Now, you are going to add text boxes explaining how the ecosystem meets the needs of salmonids at each stage of their life cycle. Before we do, let's look at some pictures of these places." ● Project Habitat slides. ○ Walk students through the habitat slides to give them more information about salmonids' habitats. ○ As you are going through the slides, ask students questions to deepen their understanding of what a salmonid habitat looks like, and how the environment provides salmonids' survival needs. For example: ■ What do you see in this photo that would help salmonid eggs survive? ● ESR: meandering creek with shallow water, gravel, shade 
Part 3: Follow Your Nose Home	
10 mins	**A. Finding Your Way** ● Ask students, "How do people find their way from one place to another?" ○ ESR: GPS, maps, ask directions

	• Tell students, "Think about how you get to and from school every day. If you had to explain to a friend how to get from school to your house, how would you give directions? Are there any landmarks you would use?" Discuss with students what a landmark is. Then, direct students to tell a partner how to get to their home from school. • Lead students to discuss that their getting home from school relies on their sense of sight. • Read the scenario in question 8 to the students. Go through each of the landmarks with them. Then, have students partner up to discuss how Luis may be able to make it home without his sight. ○ As students are discussing, walk around to listen in on their ideas. If some students bring up relying on a sense of smell, prepare them to share their thoughts with the whole class.  • Have students share their thoughts and lead them to discuss that our sense of smell is a powerful tool that could help guide us home. • Tell students that we are going to apply this idea to salmonids.

20 mins	**B. How Salmon Scent Their Way Home Again**
	• Review the salmonid life cycle with students. Then ask, "How do you think salmonids find their way back to their home stream?" Allow students to come up with some ideas.
	• Tell students that they are going to read about how salmonids find their way home.
	• Pass out copies of "How Salmon Scent Their Way Home Again." Read the article together as a class, annotating according to your classroom ELA practices.
	  ○ We recommend the teacher read the text as students follow along. We like to use annotation techniques and comprehension strategies outlined in Beers and Probst's *Reading Nonfiction: Notice and Note Stances, Signposts, and Strategies*.
	• After reading, direct students' attention to page 5 of the Student Worksheet. Guide students to fill in the blanks for #9 and #10.
	  ○ #9: After spending two to eight years in the ocean, depending on the species, adult salmonids leave the ocean and return to their birthplace

	to spawn. ○ #10: How do adult salmonids find their way to the mouth of their home stream where they hatched? Scientists think salmonids use ocean currents and water temperature to find their way back to the mouth of their home stream.
25 mins	**C. Structure and Function of Salmonids** ● Ask students, "What part of your body do you use to smell odors?" ○ ESR: Our nose. ● Ask students, "What other organ in your body helps you figure out what you're smelling?" ○ ESR: Our brain. ● Tell students that the parts of our body that are on the outside are called our external body parts, or structures, and that the parts of our body that are on the inside are called internal structures. ● Ask students, "Is our nose an internal or external structure?" ESR: external ● Ask students, "Is our brain an internal or external structure?" ESR: internal ● Tell students that the function of a structure is its purpose. Ask students, "What is the function of our nose?" ESR: To smell things. ● Ask students, "What is the function of our brain after our nose smells something?" ESR: To interpret that smell. ● Tell students that they are going to learn some of the external and internal structures that salmonids have, as well as the function of those structures. ● Practice with some human structures. Lead students in a discussion about internal and external body parts we have, and what their function is. For example, ask students, "What is the function of our mouths?" ○ ESR: To eat, breathe, talk. ● Pass out one Salmonid Anatomy diagram to each group and direct students' attention page 5 of the Student Worksheet. Tells students they are going to work together and use the diagram to fill in the chart. Give students time to do this. ● Review answers as a class.  ● Guide students to fill out the sentence frames in #11 on page 5 of the Student Worksheet. (The external structure of its body that a salmonid uses to sense

	odors in its environment are called its olfactory pit or nostrils . The internal structure that a salmonid uses to detect scent is called its olfactory bulb .) ● Then, discuss the question: How do these structures function to help salmon and trout survive to reproduce? Ask students to write a response, then invite students to share. Model a written response for students.
Part 4: Smell Like a Salmonid *Before this part, prepare a set of paper bags for each salmonid type, enough to have one for each student. We recommend distributing the scents as follows: Chinook (garlic powder), Coho Salmon (dried mint), Steelhead Trout (cocoa powder), Sockeye Salmon (oregano), Golden Trout (rosemary), Chum Salmon (lavender). Make one extra set for the home streams. Also make one bag that has a different scent, such as vanilla, if you have time for a second round.*	
20 mins	**A. Home Stream Activity** ● Ask students, "What do you think makes a stream smell a particular way to a salmonid?" ○ ESR: Trees and plants around the stream, the soil and rocks in the stream, other organisms in the stream, pollution. ● Tell students, "We are going to pretend to be salmonids and see if we can find our way home using our sense of smell." Mix up 'Salmonid Cards' and give one to each student. Tell students to put a check next to their salmonid type (#13, page 6 of the Student Worksheet). ● Ask students, "Do you think it will be easy or difficult to find your way home using your sense of smell?" Tell students to make a prediction (#14 on Student Worksheet). ● Group students into home streams based on their salmonid type. Tell students, "You are salmonids about to hatch out of your eggs. When you hatch and grow into fry, you will use your nares to take in the scent of your home stream and then store it as a memory in your olfactory bulb." ● Tell them, "You're hatching!" Then, tell them, "You're in your alevin stage and living off your yolk." Then, "Now you're fry! Swim around!" Pass out a brown paper bag to each as they swim around in their home stream. The brown paper bag is their olfactory bulb. ● Tell students that now that they have grown into smolt, it is time to leave their home stream and swim out to the ocean. ● Tell students that they will spend the next two to ten years, depending on the species, out in the ocean. Students swim around in the ocean area outside the classroom. As students are role playing adult salmonids in the ocean, place six home stream bags around the classroom. These are the home streams students will try to find when it's time to spawn. ● Now tell students, "It's time to spawn!" Tell students that they will need to use the earth's magnetic field and their memory of the ocean currents to find the river they left to enter the ocean. Guide them back into the classroom. ● Tell students, "Now it's time to find your home stream! Use your nares and your olfactory bulbs!" Encourage students to try to find their matching scent among the six stream scents placed around the classroom.

	● Check in with students to confirm they found their home streams. Then, direct them to sit down. ● Remind the class that salmonids use their memory of the scent of their home stream to find it because they know it is a good place to spawn, so they won't have to waste time and energy finding a good place. ● Ask students, "Was your prediction correct? Was it easy or difficult to find your home stream?" Direct students to fill in #15 on the Student Worksheet. ● Time permitting, tell students that they are going to get to try again. This time, make sure to replace one of the home stream bags with the seventh bag, which has a different scent. This is because the environment of the home stream has changed, so the stream no longer smells the same. However, do not tell students this. ● Repeat the activity, but this time, one group will not be able to match the scent in their olfactory bulbs with the scent of the home stream. ● Check in with students to make sure they have found the correct home stream. Check in with the students who were unable to find their home stream, and ask them why they think they were unable to find it. ● Ask students to sit down, then ask students to raise their hands if they were able to find their home stream. Ask students to raise their hands if they were unable to find their home stream. Ask, "How many of you are confident you are in the right place?" Ask, "Were any of you unable to find your home stream? Why might that be?" "Why might the stream smell different than when the fish hatched in that stream?" ○ ESR: Pollution, fire, loss of vegetation. ● Ask students, "What happens to salmonids who can't find their home stream?" ○ ESR: They use up all their energy while they are looking, and die without spawning. Or, they might find other salmonids to spawn with.
15 mins	**B. Revising the Diagram** ● Tell students to look back at their diagrams on p. 3 of the Student Worksheet. Ask, "What details could you add to your diagram now?" ○ ESR: You could add a text box that explains that a change to the scent of the home stream would make it hard for the salmonids to find their way back to spawn.
20 mins	**C. Constructing an Explanation** ● Tell students that they are going to write an explanation for how salmonids find their way back to their home stream. They are going to begin with a claim. Ask, "So how do salmonids find their way back to their home stream?" (Question 20) ○ ESR: When salmonids are fry and smolt, they use their nares to take in the odor of their home stream, and they store a memory of the scent in their olfactory bulb. Then, they use their nares and olfactory bulb to find the scent of their home stream when they are ready to spawn. ● Ask students, "What is one piece of evidence we have from our reading that

	supports this claim?" ○ ESR: In the text we read, it said that scientists plugged salmonids' nostrils and they were unable to find their way back. ● Ask students, "How does this evidence support our claim?" ○ ESR: This evidence shows that salmonids must rely on their sense of smell to find their way back to their home stream, because without their sense of smell, they can't find their way.
Part 5: Effects of Wildfire on Salmonids	
25 mins	**A. Read and Annotate** ● Pass out and introduce informational text "Fish and Fire: How Wildfires Affect Salmon and Trout." Explain to students that they are going to use two different colors to highlight evidence that shows wildfire is helpful to wildlife, including fish, and evidence that wildfire is harmful to wildlife, including fish. ● Tell students to pick two colors and use one to highlight the phrase "wildfire is harmful" and the other color to highlight the phrase "wildfire is helpful" on the bottom of page 7 of the student worksheet. Tell the students that this will be their key as a reminder for how they should annotate the reading. ● Give students instructions on annotating the text as they read together, using the ELA practices you use in your classroom.
20 mins	**B. Discussion and Summary** ● Lead the class in a discussion about the ways wildfire impacts the environment, especially fish. Have the students list 3 ways for each harmful and helpful for questions 21 and 22 on the Student Worksheet.
Part 6: Constructing an Explanation	
20 mins	**Data Analysis** ● Tell students that scientists called biologists keep track of the number of steelhead fry in the local creek. Direct students' attention to the data table on page 8 of the Student Worksheet. Ask students what they notice about the data and record their answers for #23. ○ ESR: The data shows the number of fry counted each year between 2008 and 2018; there were 13 fry counted in 2008; the number of fry dropped to 0 for three years, but then increased slowly.

	<table><tr><th>Year</th><th># of fry counted</th></tr><tr><td>2008</td><td>13</td></tr><tr><td>2009</td><td>17</td></tr><tr><td>2010</td><td>0</td></tr><tr><td>2011</td><td>0</td></tr><tr><td>2012</td><td>0</td></tr><tr><td>2013</td><td>1</td></tr><tr><td>2014</td><td>1</td></tr><tr><td>2015</td><td>3</td></tr><tr><td>2016</td><td>2</td></tr><tr><td>2017</td><td>6</td></tr><tr><td>2018</td><td>9</td></tr></table> ● Ask students why they think the fish population changed and record their answers for #25. ○ ESR: People caught them; predators; fire. ● Tell students that in May 2009, the Jesusita Fire burned 35 square kilometers in Santa Barbara, including areas along the creek where the trout population was being counted. ● Lead students in a discussion about the effect they think the wildfire had on the habitat (#25) and why they think those changes caused the number of fry to decline (#27).
25 mins	**Constructing an Explanation** ● Ask students, "Why do you think the steelhead population increased from 2010-2018?" ○ ESR: A new population of fish came to populate that area after the fire. ○ Note that this answer may vary. You will work with your students to construct an explanation based on their claim and the evidence listed in the table. ● As a class, work together to construct another explanation for how the steelhead population increased from 2010-2018 (#28). ○ ESR: A new population of fish came to populate that area after the fire because in 2012 there were 0 fish present and in 2018 there were 9 fish present. ● Ask students to think, then share with a partner something they wonder now. Invite a few students to share, and then direct students to write down what they wonder (#29).

Thank you to Monte Vista students Abby H., Eliot G., Mia R., Samantha M., and Spencer S. for piloting this lesson with us!

Example Student Work:

Name: Sally

Follow Your Nose

Part I: Hooks and Ladders

1. Thinking back to the Hooks and Ladders activity, what were some of the dangers that threaten a salmonid's survival? List them below:

Turbines, dams, predators, fishers, natural hazards, food scarcity, pollution, loss of habitat

Part 2: The Salmonid Life Cycle

Part 2A - Jigsaw: What Salmonids Need to Survive

2. With your group, read your Survival Needs card. What does a salmonid need in order to survive at the life cycle stage assigned on your card?

A salmonid at the _____ stage needs:

Answers vary based on card.

3. In your mixed group, order the cards with the life cycle stages from first to last. Then check with your teacher to see if you are correct. Once your teacher confirms your answer, use your cards to fill in the blanks below in the correct order.

A salmonid begins its life as an egg. Once it hatches, it is called an alevin. It absorbs its yolk sac and becomes a fry. Then, it swims downstream as a smolt. Once it's ready to live in saltwater, it swims into the ocean as an ocean adult. When it is ready to spawn, the salmonid is called a spawner. It returns to its home stream to lay or fertilize eggs.

Part 2B - Diagram: Life Cycle of the Steelhead Trout

4. Steelhead trout are a species of salmonid that live in Arroyo Burro Creek. With your mixed group, you are going to create a diagram of the steelhead's life cycle.

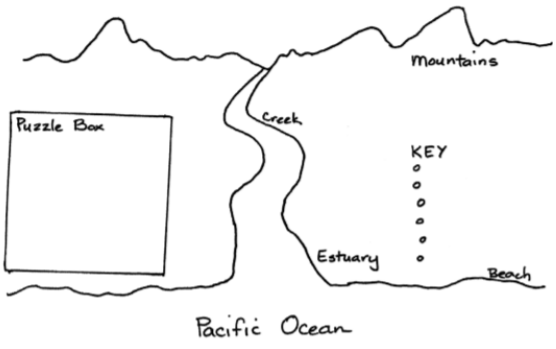
Before you begin:

-- Talk together and agree on some things to include before anyone starts drawing.

-- Your diagram should include the following:

- ☐ A color-coded key with a different colored dot to represent the steelhead at each stage of its life cycle. We will fill in the colors of the key together.
- ☐ Dots showing where the steelhead live at each stage of their life cycle.
- ☐ Arrows to show the movement of the steelhead throughout its life cycle.
- ☐ A title that says what the diagram shows.
- ☐ In the Puzzle Box, write something that still puzzles you.

See lesson plan for example.



5. Take turns with your group sharing the survival needs of a salmonid at each stage of its life cycle. As you share, add text boxes to your diagram to explain how the ecosystem meets the steelhead's needs at each stage of its life cycle.

Part 3: Follow Your Nose Home

Part 3A. Finding Your Way

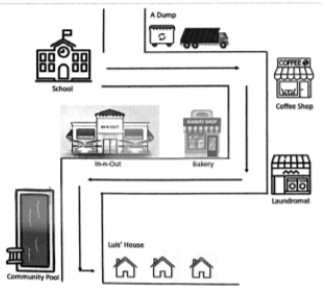
6. How do people find their way from one place to another?

Maps, direction, landmarks, GPS

7. Describe your route from school to home. What landmarks would you use to tell a friend how to get there?

Answers vary

8. Luis walks home from school everyday by following the route below. If Luis were to be blindfolded, could they still find their way home? What would help Luis know they are heading in the right direction?



Luis could smell the dumpster, coffee shop, bakery, In-n-Out, and the pool.

	fish remain stable in the water
10. scales	protect salmonid's skin from predators, parasites, and injuries
11. olfactory pit/nostril	salmonid uses to detect odors in the water
12. vent	opening that releases waste (poop)
Internal Structures	
Structure	Function
13. olfactory bulb	identifies and remembers odors
14. brain	nerve processing center
15. stomach	digests food
16. gills	absorbs oxygen from the water

11. The external structure of its body that a salmonid uses to sense odors in its environment are called its olfactory pit or nostrils. The internal structure that a salmonid uses to detect scent is called its olfactory bulb. How do these structures function to help salmon and trout survive to reproduce?

They help them move, see, eat, breath, smell, digest ...

Part 4: Smell Like a Salmonid

12. What do you think makes a stream smell a particular way to a salmonid?

Trees, plants, soil, rocks, organisms, or pollution in the stream.

13. We are going to do an activity to test whether we can find our way "home" using our sense of smell.

Put a check next to your salmonid type:

- ☐ Chinook
- ☐ Coho Salmon
- ☐ Steelhead Trout
- ☐ Sockeye Salmon
- ☐ Golden Trout
- ☐ Chum Salmon

Answers vary.

14. Make a prediction: (circle one) It will be *easy* / *difficult* to find my "home" using my sense of smell.
    - **Wait for directions from your teacher!**
15. Was your prediction correct? Were you able to find your "home" using your sense of smell?
    Yes / *No* It was *easy* / *difficult* .
16. After the second trial, were you able to find your "home" using your sense of smell?
    Yes / *No* It was *easy* / *difficult* .
17. Was there anything that differed between trial 1 and trial 2?

18. What do you think could have caused this?

19. Look back at your diagram on page 3. After learning about the structure and function of salmonids and after reading the text, what can you add to your diagram? Add to it now.
20. Now write an explanation that answers the question "How do salmonids find their way back to their home stream?"

Claim:
Salmonids store memories of odors from home and use sense of smell to find their way home.

Evidence #1:
In the text, scientists plugged salmonids' nostrils and the weren't able to find their way back.

Answers vary.

Reasoning:
This shows salmonids rely on sense of smell to find their way home.

Evidence #2:

Reasoning:

Part 5: Effects of Wildfire on Salmonids

Together, we are going to read an informational text called *Fish and Fire: How Wildfires Affect Salmon and Trout.*

Wildfire is harmful **Wildfire is helpful**

21. What are some of the ways wildfire can harm salmonids?
Increase water temperature, change water chemistry, create algae blooms that decrease oxygen, erosion, toxins in fire retardant.
22. Give some examples of ways that wildfire might be helpful to organisms in a riparian habitat.
Some plants require fire to reproduce, woody debris creates shelter, more insects for fish to eat.

Part 6: Constructing an Explanation:

23. Fish biologists counted steelhead fry in Arroyo Burro Creek each April over a ten-year period. Here is a table showing the data they collected:

Year	# of fry counted
2008	13
2009	17
2010	0
2011	0
2012	0
2013	1
2014	1
2015	3
2016	2
2017	6
2018	9

24. What do you notice about this data? There were 13 and 17 fish in 2008-9, dropped to 0 for 3 years, then gradually increased
25. What could have caused the change in fish population?
People caught them, predators, pollution, fire
26. In May 2009, the Jesusita Fire burned 35 square kilometers in Santa Barbara, including areas along Arroyo Burro Creek. What changes do you think the fire made to the steelhead's habitat? Water temp or chemistry changes, algae bloom, erosion, toxins

27. How might these changes have caused steelhead fry to disappear from the stream in 2010?
The habitat wasn't good enough for fry to survive.
28. Construct an explanation for how the steelhead population increased from 0 fry after the Jesusita Fire in 2010 to 50 fry in 2018. Remember to include a claim, at least 1 piece of evidence, and reasoning in your explanation.
A new population of fish came to populate the area.
The life cycle of salmonids take place in other areas.
29. What do you wonder now?
Answers vary