



MATH

Catching Pacific Lamprey at Willamette Falls

ESSENTIAL UNDERSTANDINGS

- Since Time Immemorial
- Lifeways

LEARNING OUTCOMES

Students will solve a word problem involving a comparison by using an equation with a symbol for an unknown number.

ESSENTIAL QUESTIONS

How can we determine how many lamprey are in a given river?

LOGISTICS

- Where does the activity take place?
Classroom
- How are the students organized?
 - Whole class
 - Teams: 2 – 4
 - Pairs
 - Individually

TIME REQUIRED

1 – 1.5 hours

Overview

Lamprey were an important food source for many Native American tribes in Oregon, particularly those in coastal areas and along the Columbia River watershed, and they continue to be an important link to traditional cultural practices. Like salmon, lamprey are anadromous, meaning they are born in fresh water, spend most of their life in the ocean, and return to freshwater to spawn.

Sustaining the population of lamprey has always been important to Native people, and one way to do that is by not overharvesting. In previous generations this was not a problem, but hydroelectric dams, pollution, and destruction of habitat have all led to a drastic reduction in the lamprey population over the past century.

Today, tribal biologists use both traditional and Western scientific methods—such as fish tagging—to protect and preserve lamprey, salmon, and other aquatic species. Using this real-world context, this lesson engages students in a mathematical process to determine a lamprey population in a given area. Students work with concrete math manipulatives, develop an abstract single-variable equation, and use ratios and proportions.



Background for teachers

There is a wealth of information available on the Pacific lamprey and its importance to Native American tribes in Oregon. When teaching the lesson, consider including the following key ideas:

- Lamprey were an important food source for many tribes in Oregon and particularly those living along the coast and the Columbia River watershed.
- Lamprey were also important for trade and were used in ceremonies.
- Lamprey are a type of anadromous fish, but are often mistaken for eels because of their long, relatively round shape and sucker-like mouths.
- The oil of these fish was also used by some tribes for medicinal purposes or for hair grease.
- Several tribes in Oregon continue to harvest lamprey for food and for use in traditional ceremonies.

Resources

Brostrom, J. K., Wang Luzier, C., & Thompson, K. (2010). *Best management practices to minimize adverse effects to Pacific lamprey*. U.S. Fish and Wildlife Service. Retrieved from <https://www.fws.gov/oregonfwo/Documents/Lamprey/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf>

Bull, B. (2018, August 24). Tribes and conservation groups study what's leading to low lamprey counts. *Oregon Public Broadcasting*. Retrieved from <https://www.opb.org/news/article/low-lamprey-count-oregon-study/>

STANDARDS

Oregon math standards

4.OA.2 – Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

MATERIALS

What materials are needed for students to engage in this activity?

- Each student group needs: a small bowl, a small paper cup, a cup and a half of cheese-flavored fish crackers, and a cup and a half of pretzels.
- Oregon Lamprey Fishing Regulations
- Student Recording Sheet
- Math Around the Room Questions
- Math Around the Room Student Recording Sheet



Close, D. A., Fitzpatrick, M. A., & Li, H. W. (2002, July). *The ecological and cultural importance of a species of fish in danger of extinction, Pacific lamprey*. Retrieved from <https://ir.library.oregonstate.edu/downloads/44558d67v>

Columbia River Inter-Tribal Fish Commission. (n.d.) *Pacific lamprey: A cultural resource*. Retrieved from <https://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/lamprey/>

Confederated Tribes of Umatilla Indians. (2004). *Species of interest: Pacific and Western brook lamprey and freshwater mussel detailed life history, distribution, abundance, and other information*. Northwest Power and Conservation Council. Retrieved from https://www.nwcouncil.org/sites/default/files/AppE_SpeciesofInterest.pdf

Eastern Oregonian. (2018, June 14). Pacific lamprey swarm Umatilla River in best numbers in years. *Eastern Oregonian*. Retrieved from https://www.eastoregonian.com/sports/outside/pacific-lamprey-swarm-umatilla-river-in-best-numbers-in-years/article_d0353b2f-84ed-55b8-b728-48fb11add776.html

Flatt, C. (2013, July 28). How Pacific lamprey could help nourish streams. *Oregon Public Broadcasting*. Retrieved from <https://www.opb.org/news/article/how-pacific-lamprey-could-help-nourish-streams/>

VOCABULARY

Lamprey – Eel-like fish that are considered a traditional food source by tribes in Oregon.

First food – Traditionally harvested foods that provide sustenance and promote health.

Fish tagging – A form of catch and release in order to provide data about fish in an area.

Bag limits – Law imposed on hunters and fishermen to restrict the number of animals within a specific species or area being harvested.

Equation – A math statement that shows two values are the same using an equal sign.

Variables – A quantity that may change but is represented by a symbol, often a letter.

Flatt, C. (2018, June 15). Record lamprey return a cultural win for Native tribes. *Oregon Public Broadcasting*. Retrieved from <https://www.opb.org/news/article/record-lamprey-umatilla-native-tribes/>

Hilty, I. E., Peters, J. H., Benson, E. M., Edwards, M. A., & Miller, L. T. (1980) *Nutritive values of Native foods of Warm Springs Indians* (Revised ed.). Oregon State University Extension Service. Retrieved from <https://ir.library.oregonstate.edu/downloads/tm70mv51j>

Loew, S. (2018, July 13). Oregon's prehistoric fish making a comeback with Grand Ronde's help. *Salem Statesman Journal*. Retrieved from <https://www.statesmanjournal.com/story/tech/science/environment/2018/07/13/oregons-prehistoric-fish-pacific-lamprey-making-comeback/777520002/>

Oregon Fish and Wildlife Office. *Pacific lamprey* (Fact sheet). Retrieved from <https://www.fws.gov/oregonfwo/articles.cfm?id=149489457>

Oregonian. (2012, July 18). Pacific lamprey harvested at Willamette Falls (YouTube video). *The Oregonian*. Retrieved from <https://www.youtube.com/watch?v=Sc8VGyY5Hf4>

Considerations for teachers

Practices

It may be easier to divide a set of cheese crackers into individual resealable bags for each group. Pretzels may also be pre-portioned in small bags with the possibility that student groups may need additional crackers. If you do not have fish crackers, you can substitute any manipulative that is easily scoopable and can be distinguished as a whole set and a "tagged" set (e.g., counting chips, centimeter cubes).

Learning targets

- I can use ratios to create an equation.
- I can write an equation with a single variable.

Options/extensions

Common Core Standard: Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. 1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that one foot is 12 times as long as one inch. Express the length of a four-foot snake as 48 inches. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36).

Compare caloric and other macro-nutritional values. Pacific lamprey are extraordinarily rich in fats—much richer than salmon. Caloric values for lamprey range from 5.92 to 6.34 kcal/g wet weight; whereas salmon average 1.26 to 2.87 kcal/g wet weight (have students convert caloric value on a chart). Additional first foods and nutritional values may be found in this pamphlet *Nutritive Values of Native Foods of Warm Springs Indians* at <https://ir.library.oregonstate.edu/downloads/tm70mv51j>

Predict and graph the amount of lamprey that have been tagged or counted in the Umatilla River. How many fish would be expected in 2025 if there were 129 in 2011, 2,600 in 2018, and 3,000 in 2019? Students should have conversations about average rate growth, the possibility of overpopulation, and the concept of a natural maximum amount of species in a given area.

Reflection/closure

Have students share their math thinking and strategies and determine which methods are most efficient and effective to solve ratio problems.

Appendix

Materials included in the electronic folder that support this lesson are:

- Oregon Lamprey Fishing Regulations
- Student Recording Sheet
- Math Around the Room Questions
- Math Around the Room Student Recording Sheet

Activity 1

Activate Student Interest in Lamprey

Time: 10 minutes

Students will review a video about the lamprey and tribal connections to it, as well as traditional harvesting techniques. Students are then introduced to the task question.

Say:

The health and well-being of Native American people in Oregon has always been closely tied to the health of the natural environment—the rivers, streams, ocean, mountains, valleys, and plateaus. Fishing for salmon and lamprey, which is a type of fish that looks similar to an eel, has always been an important part of Native culture. Some scientists say the lamprey has been here for 500 million years, which is a long time ago! Native Americans refer to this as “since time immemorial,” which means before recorded history and long predating the arrival of Euro-Americans.

Maintaining a healthy balance between human nutritional needs and the resources of the earth is also important for tribes in Oregon and that includes the harvesting of lamprey. Tribal members only take what they need. Today, we’re going to learn about the lamprey and its place in tribal culture while also practicing our math skills. First, we’re going to watch a short video. I want you to watch closely and to think about questions you might have.

Watch the Pacific Lamprey Harvested at Willamette Falls video: <https://www.youtube.com/watch?v=Sc8VGyY5Hf4>

Say:

There is a lot of documentation that tells us lamprey were once abundant in Oregon. This began to change with the coming of Euro-Americans in the 1850s. Over time, due to the building of hydroelectric dams, pollution, and the destruction of habitat, the lamprey population—like the salmon population—was drastically reduced. This also had a huge impact on the ability of Native people to live in their traditional ways.

Activity 1 *(Continued)*

Over time, several tribes began to work with government agencies and other organizations to restore the lamprey population. In 2011, for example, the Bonneville Power Administration provided funds to support the Confederated Tribes of the Umatilla Indian Reservation and their work to make pathways around the dams for the lamprey. When this work began, a tribal biologist believed that getting 129 fish back in the Umatilla River would be a success. Only seven years later, however, in 2018, there were more than 2,600!

Today, there are regulations that determine when, where, and how many lamprey can be harvested in a given area. This helps protect the lamprey population, which is consistent with traditional Native practices that emphasized sustainability—never take more than you need.

Here are the regulations for one particular area, which is referred to as the Willamette Zone.

Handout Oregon Lamprey Fishing Regulations and have students identify when and how people can fish for lamprey.

Say:

You can see that these regulations mention a harvest record card. That means people who fish for lamprey have to keep track of how many they catch and then report that number to the Oregon Department of Fish and Wildlife, which also has the authority to set “bag limits”—that means restrictions on how many lamprey can be taken from that area. They set bag limits to ensure there are enough lamprey left that can spawn and sustain the population in the future.

To set the bag limits, they have to know not only how many lamprey are taken out, but how many were in the river in the first place. That might make you wonder: How in the world do they count fish?

Solicit ideas from students. They may mention underwater or overhead cameras, actual counts over time, or sample population counts.

Activity 2

Explore the Initial Lamprey Count and Ratio

Time: 30 minutes

Say:

One of the main ways to monitor the fish population in a given area is to actually catch some fish, tag them, release them back into the river, and then repeat that process at different times. In real life, scientists place micro-radio tags on the fish and return them to the river. When they catch them the next time, some have the tags and some don't. By comparing those numbers, they can make an estimate about how many fish, in total, are in the river.

Today, we're going to work in groups to simulate the process of fish tagging. To simulate means to act out—or imitate—the process using different materials. It's a great way to learn. For example, we can't all go out to the river today, catch fish, and put radio tags on them. Instead, we're going to simulate the process using a bowl, some fish-shaped cheese crackers, some pretzels, and a cup.

OK, here's what we're going to do. Each bowl represents a section of the Willamette River, and the crackers represent the fish (or lamprey) in that section of the river. We will scoop out one cup of the fish crackers. We will then exchange the crackers in the cup with pretzels. The pretzels represent the fish that have been "tagged." Instead of counting every fish, which would take a long time, we're going to count and compare the amount of tagged fish to the total amount of fish. This will give us a ratio. A ratio shows a relationship to two different amounts. In this case it will be the number of tagged fish to the number of total fish. A ratio can be written in three different ways. It can be represented with a colon as a ratio symbol like this ":" or using words like "_#_ is to _#_", or you can use a fraction bar.

Be sure to show the visual examples of ratio notations and provide examples and nonexamples, such as pulling in three students and noting the number of students with blue shirts compared to students with shirts in total. Have students orally rehearse and write the multiple ways to represent a ratio.

Activity 2 (Continued)

Say:

OK, now I'm going to demonstrate how you will tag your fish and write an equation. You have an unknown amount of fish in your river section. We will call that "f" for fish. [Write on board.] Then you capture and tag a small amount of fish. We need to count how many we tagged from our river. So, let's say 12, for example. My equation will look like this $(f = 12) + c$. I will use "c" to represent the rest of the crackers in the bowl. So, f means all the fish and c means the rest of the crackers that I wasn't able to count. Now, each time I scoop, I'm taking just a sample of what is in the whole section of the river. You will use the information of the ratio of tagged fish to the number of each scooped fish to help determine how many fish in total are in your bowl.

In your group, you will capture fish while recording how many you initially tagged. Then you will recapture multiple times to find an average of tagged fish to the total amount of fish. You only exchange the captured fish once, in the beginning. Once you find the average after multiple sets, your group will use that information to estimate the total amount of fish in your section of the river. As a team, every member must be able to describe and explain to others how they estimated the total amount of fish. Your team will write a proportion equation describing how many estimated lamprey are in the river.

Students may need to review ways to find an average and determine the meaning of remainders or fractional parts of a whole and rounding in relation to determining lamprey species. Students should only use whole numbers as part of their answers in a ratio. In reality, tribal member would not harvest a portion of a lamprey.

1. Provide students with a copy of the student recording sheet (and gloves, if you choose). Organize them in groups of four and provide each group a bowl, a small cup, a set of fish-shaped cheese crackers, and a set of pretzels.
2. Have student groups work through the problem using the number of originally tagged fish to find the ratio of the total amount in the bowl.



Activity 2 *(Continued)*

3. As groups finish completing their justification and explanations of their thinking, circulate to assist student groups in accurate terminology and abstract thinking. Student groups may participate in a gallery walk to review other teams' thinking.

Activity 3

Expand with Math Around the Room

Time: 50 minutes

Students will go on a scavenger hunt and solve eight problems posted around the room to find letters to unscramble. They will choose two of the eight problems to explain in detail. Provide each student with the Student Recoding Sheet for Math Around the Room sheet and post each word problem from the Math Around the Room.

Say:

We're going to extend the mathematical thinking of using ratios to solve problems. Posted around the room are eight word problems. The correct answer will have a letter that you use to write on your sheet. You don't have to start at problem 1, just be sure to write the correct letter in the box for the corresponding question. The most important part is that you must choose two of the word problems to explain and justify in more detail: How did you solve them? Be prepared to share your thinking with others in order to find the most efficient and effective ways to solve ratio problems.