

Sea Lion Feeding Frenzy

What does sea lion feeding have to do with human health?

Overview

Sea lions migrate miles upriver to feed on salmon at hydropower dams in the Columbia River Basin. Salmon are a crucial part of the ecosystem and are a vital food source for many tribal communities. Contaminants in the water can accumulate in the bodies of fish and those who eat them, and concentrations of contaminants can magnify higher up on the food chain. As “sentinel species”, sea lions can provide valuable information about potential risks to human health. In this lesson, students learn about the “one health paradigm” by exploring the connection between contaminants, fish, sea lions, and people.

Essential Questions

- How do contaminants bioaccumulate and biomagnify in an ecosystem?
- How can we monitor and analyze levels of contamination in a species?
- Why are sentinel species important indicators in an ecosystem?
- What is the “one health paradigm”?

Learning Goals

Students will learn the following:

- Feeding relationships among species can lead to bioaccumulation and biomagnification of contaminants in a food chain.
- Scientists gather quantitative contaminant data and analyze data by converting it into percentages and creating graphs.
- Humans impact the ecosystem by producing and releasing harmful contaminants.
- Non-human species can be important indicators of ecosystem and human health.

Learning Objectives

Students will be able to:

- Develop a model for how contaminants bioaccumulate in a food chain.
- Analyze data by converting values into percentages and creating stacked column and bar graphs.
- Identify the characteristics and importance of sentinel species.
- Connect the health of non-human species to human health through the “one health paradigm”.

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Grade Level

6-12

Time

5 hours

Anchoring Phenomenon

Sea Lion Feeding Frenzy

Driving Question

What does sea lion feeding have to do with human health?

Standards

Next Generation Science Standards

LS2.A – Interdependent Relationships in Ecosystems
 LS2.B – Cycles of Matter and Energy Transfer in Ecosystems
 ESS3.C – Human Impact on Earth Systems
 ETS1.B – Developing Possible Solutions

Common Core Math Standards

6.SP.B.4
 6.SP.B.5
 6.RP.A.3
 7.SP.A.1



Photo: <https://www.dfw.state.or.us/fish/sealion/photos.asp>

Introduction

Sentinel species provide valuable information about potential health risks to humans and ecosystem health. Sea lions are a common sight to see in Oregon's coastal waters and are considered sentinel species in marine ecosystems around the world. Sea lions are prime sentinel species because they have long life spans, are long-term coastal residents, feed at high trophic levels, and have unique fatty tissues that store contaminants. Some sea lions have developed a behavioral pattern of traveling up the Columbia River Basin to feed on fish that are concentrated at hydropower dams. Since they share a common prey base with humans, they can alert coastal managers to potential health risks to humans.

Tribal communities rely heavily on fish runs. The average fish consumption rate of Umatilla, Yakama, Nez Perce, and Warm Springs tribal members is approximately nine times greater than the average consumption rate estimated for the general U.S. population. Fish, and especially salmon, are important for subsistence, economic, and cultural purposes in tribal communities. These communities are especially tied to fish health, and they are susceptible to marine contaminants.

In the first part of this unit, students will observe pictures of sea lions feeding on salmon at Bonneville Dam on the Columbia River and will be asked to start making connections between sea lions and human health. They will explore and model how bioaccumulation and biomagnification of contaminants can affect living things. Students will analyze data collected by local marine scientists and conduct research into how living things can be used as sentinels to alert us to danger. They will come away with an understanding of how scientists use the one health paradigm to make decisions about public health and the environment.

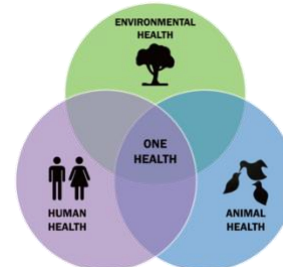


Photo: California sea lion feeding on a salmon near Powerhouse 2 at Bonneville Dam, May 2005. <https://www.dfw.state.or.us/fish/sealion/photos.asp>

LESSON RESOURCES

Vocabulary / Definitions

- **Bioaccumulation** - The process by which substances not readily broken down or excreted can build up and be stored in living tissue (usually in fat).
- **Biomagnification** – The process by which substances become more concentrated in the bodies of consumers as one moves up the food chain (trophic levels).
- **Contaminant** - A substance that makes something less pure or makes it poisonous
- **Trophic level** - An organism's position on the food chain (i.e. producer, primary consumer, apex predator).
- **Indicator species** - An organism that scientists use to see how an ecosystem is functioning simply by the presence or absence of that species.
- **Keystone species** – An organism that has a major influence on how an ecosystem works.
- **Sentinel species** - A species that can be used to detect risks to humans by providing advanced warning of a danger.
- **One Health Paradigm** – The idea that the health of people is connected to the health of animals and our shared environment.



One Health Triad. Source: Thddbfc, CC BY-SA 4.0 via Wikimedia Commons

Lesson Procedure

ENGAGE

To introduce students to the anchoring phenomena, show students showing [photos of California sea lions](#) taken near Bonneville Dam on the Columbia River from the Oregon Department of Fish and Wildlife (ODFW) website. Have students read the captions below the pictures and record their observations or questions.

Then ask students the driving question: “What does sea lion feeding have to do with human health?” Students can share their initial ideas. They will learn about the connection through these lessons.

EXPLORE

Bioaccumulation Activities

Begin by activating prior knowledge of food chains, food webs, and trophic levels. Then have students undertake one of the following two bioaccumulation activities.:

- **Activity #1: [Mercury Bioaccumulation Tag](#)**
This activity from the Environmental Protection Agency (EPA) requires a 45 minute time period (15 min for introduction, 15 min for activity, 15 min for wrap-up questions)
- **Activity #2: [Mercury in Fish](#)**
This activity from the OSU “Mercury, My Community, and Me” curriculum takes about 20 minutes and may be possibly better suited for indoors.

Directly following the activity, share the [Bioaccumulation and Biomagnification](#) presentation in the EXPLAIN section. The presentation contains the video [What Are You Toxin About?](#) from MindFuel STEM Resources.

Sea Lion Data Analysis

This activity gives students the opportunity to analyze real data on sea lion diets and blood mercury concentrations collected by marine scientists. They convert raw data into percentages and then create graphical depictions of the data. The activity may be completed with digital tools or adapted for students to complete on paper.

- [Student Data Analysis Worksheet](#) and [Teacher Key](#)
- [Student Data Analysis Spreadsheet](#) and [Teacher Key](#)

Directly following the activity, share the [Sentinel Species](#) presentation in the EXPLAIN section.

LESSON RESOURCES

Sea Lions Eating Salmon

- ODFW: [Photos of California sea lions](#)

Bioaccumulation Activities

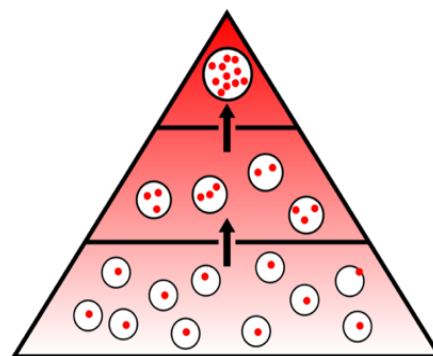
- Activity #1: [Mercury Bioaccumulation Tag](#)
- Activity #2: [Mercury in Fish \(doc\)](#) from [OSU](#)
- Video: [What Are You Toxin About?](#)

Presentations

- [Bioaccumulation and Biomagnification \(pdf\)\(ppt\)](#)
- [Sentinel Species \(pdf\)\(ppt\)](#)

Sea Lion Data Analysis

- [Student Data Analysis Worksheet \(pdf\)\(doc\)](#)
- [Teacher Key for Worksheet \(pdf\)](#)
- [Student Data Analysis Spreadsheet \(xls\)](#)
- [Teacher Key for Spreadsheet \(xls\)](#)



Source: Martin-rnr, CC BY-SA 3.0 via Wikimedia Commons

EXPLAIN**Presentation:** [Bioaccumulation and Biomagnification](#)

- After the Bioaccumulation Activity, share the presentation.
- Teachers can have students record key vocabulary in a notebook.
- When done with the presentation, students can complete ELABORATE activities or go directly to EVALUATE: *Food Chains and Biomagnification*.

Presentation: [Sentinel Species](#)

- After the Data Analysis Activity, display the presentation, pausing to discuss the questions. There are speaker notes on some slides with additional information.
- Teachers can have students record key vocabulary in a notebook.
- After the presentation, continue on to the ELABORATE section.

ELABORATE**Bioaccumulation Extension Activities**

- Assign students to research contaminants that have the potential to bioaccumulate in an ecosystem, such as DDT and other pesticides, heavy metals, and natural toxins.
- Students can research [Fish Advisories from OHA](#) and from the [EPA](#). What types of fish are generally safe to eat and what types should you limit consumption?

Sea Lions and the One Health Paradigm

- After the sentinel species presentation, distribute the worksheet [Sea Lions and the One Health Paradigm](#). There is a [teacher key](#) provided. This can be done as a whole-class reading and discussion, or can be assigned to students to complete independently. Some of the vocabulary may be too advanced for middle school students to complete without some scaffolding.
- When complete, continue with EVALUATE: *Sentinel Species* research project.

Career Connections

In this activity, students read a short [Researcher Bio](#) about the marine scientist that helped create this unit, Samantha Rae. They also explore other [Career Connection Activities](#).

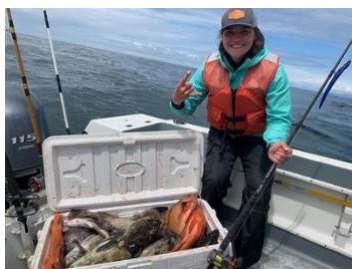


Photo: Samantha Rae



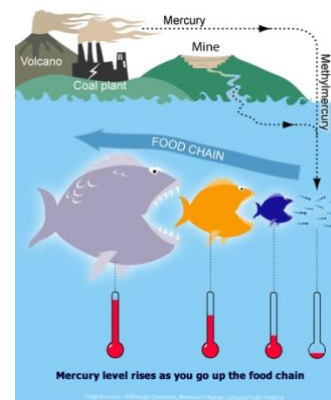
Source: Oregon Sea Grant

Fish Advisory Resources

- [Advisories and Guidelines](#) from Oregon Health Authority
- [Columbia River Health Advisories](#) from EPA

One Health Paradigm

- *Sea Lions and the One Health Paradigm* ([pdf](#)) ([doc](#))
- *Teacher Copy* ([pdf](#))



Source: Lamiot, CC BY-SA 3.0 from Wikimedia Commons

Career Connections

- *Researcher Bio* ([pdf](#))
- *Career Connection Activities* ([pdf](#)) ([doc](#))

EVALUATE

Food Chains & Biomagnification

After Biomagnification presentation, students will complete the [Food Chains and Biomagnification](#) student worksheet. A [teacher answer key](#) is provided.

Sentinel Species Research Project

For the final activity of the unit, assign students a *Sentinel Species Research* project. They will research a sentinel species (other than sea lions) and create a poster with their information.

Next Generation Science Standards

Performance Expectations:

MS-LS1-5: Construct an explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Science & Engineering Practices:

Asking Questions and Defining Problems

Analyzing and Interpreting Data

Constructing Explanations and Designing Solutions

Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas:

LS2.A – Interdependent Relationships in Ecosystems

LS2.B – Cycles of Matter and Energy Transfer in Ecosystems

ESS3.C – Human Impact on Earth Systems

ETS1.B – Developing Possible Solutions

Crosscutting Concepts:

Systems and System Models

Common Core Math Standards

Math Standards:

6.SP.B.4 – Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

6.SP.B.5 – Summarize numerical data sets in relation to their context.

6.RP.A.3 – Understand ratio concepts and use ratio reasoning to solve problems.

Food Chains & Biomagnification

- Student Food Chain Worksheet ([pdf](#))([doc](#))
- Teacher Key for Worksheet ([pdf](#))

Research Project

- Sentinel Species Research ([pdf](#))([doc](#))

7.SP.A.a – Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is a representative of that population.

Math Practices:

MP.2 – Reason abstractly and quantitatively

MP.4 – Model with mathematics

Acknowledgments

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See more lessons on the ORSEA webpage:
<https://oregoncoaststem.oregonstate.edu/orsea>

