



# GRADE

## TEACHER RESOURCE GUIDE

**THEME:**

Sea Lions are part of a complex ecosystem that is impacted by human activities.

**CRITICAL ISSUE:**

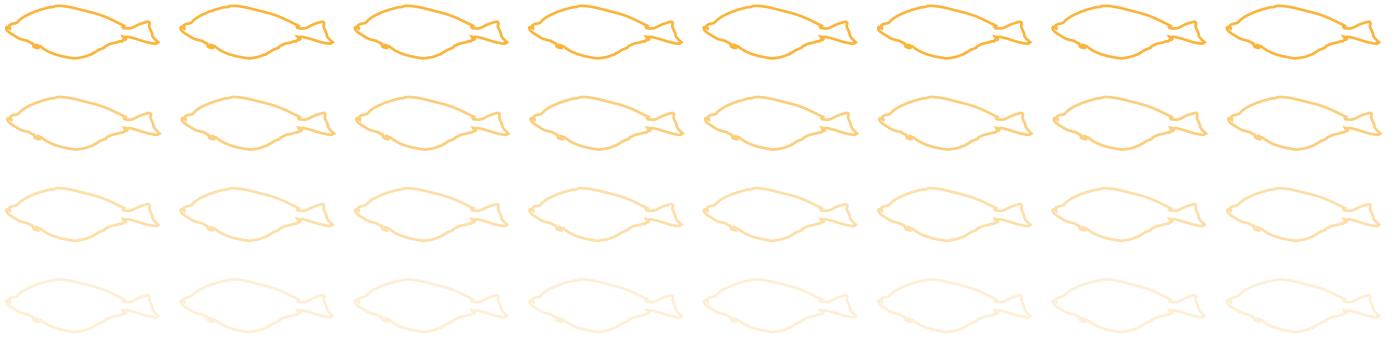
Sustainable Seafood, Marine Debris, Plastic Pollution

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## MISSION STATEMENT:

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

## ACKNOWLEDGEMENTS:

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# LESSON 1

## FAMILY MATTERS

**Enduring Understanding:** Groups of animals, such as sea lions, can be classified into groups, such as pinnipeds, according to their various features.

### Materials

- Poster paper
- Pens, markers, pencils
- 5 spoons of different types (i.e., wooden spoon, ladle, ice cream scoop)

### SETUP:

1. Prepare the art materials.

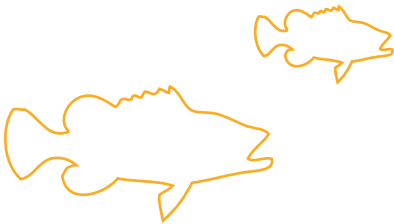
### PROGRAM OUTLINE:

#### How do we classify things in the natural world?

- With this activity, you will demonstrate the classification of animal families by using the classification of spoons as an analogy
  - Hold up a regular spoon and ask students to talk about its features as if they were describing it to someone who had never seen a spoon before.
  - Take out the next spoon. How is this one different? How is it the same?
  - Do this for each of the remaining spoons (the more different the spoons, the better the message will get across).
    - o Ask students if they would call each of these a spoon.
    - o Do they all belong to the same group of utensils?
    - o Do they have different uses?
    - o Why is it important to be able to differentiate among them?
  - Classifying spoons is similar to the way in which we classify animals.
  - We identify the features that make them different in order to group them into different families.
  - This makes it easier to talk about, learn about, and study them.

#### What is a pinniped?

- Pinnipeds are marine mammals that are “flipper footed,” having both back and front flippers, and belong to the monophylum Pinnipedia, which includes seals, sea lions, and walruses.



## PROGRAM OUTLINE CONTINUED:

- There are three families of pinnipeds: Phocids (seals), Otariids (sea lions and fur seals), and Odobenids (walruses).
  - Each of these families has distinct characteristics that allow it to be classified into a specific group.
  - Go over these characteristics with the students. Show them pictures so they can see the physical differences between families (see “Pinniped Identification” in program materials).
  - As animals evolve over time they develop different characteristics that allow them to adapt to their specific environments.
  - The three pinniped families all share a common ancestor but have evolved in slightly different ways with slightly different adaptations that allow them to be successful.

### **Students will create their own classification chart with the three families of pinnipeds on a large piece of paper.**

- They should include the details needed to distinguish the groups from one another. They may draw pictures, if they like, or use written words.
- Students can be creative in the way they design their chart so long as it is clear that Phocids, Otariids, and Odobenids are all families of the monophylum Pinnipedia.
- If students finish quickly and want to add even more detail, they can research the subfamilies within each of the pinniped families, as well as the suborder Caniformia and the order Carnivora, to which pinnipeds belong.

### **Once students are done, their charts can be displayed around the room so that others can view them.**

#### **Further questions to explore include:**

- Can you think of any other items that are grouped together but have distinct differences and subsets within those groups? (i.e., shoes, tables, chairs—pretty much anything!)
- What other animal families can you think of that include various subspecies?
- To what family do humans belong? What other animals are closely related to humans?
  - What makes us different from other primates?
  - What makes us the same as other primates?



## TEACHER BACKGROUND:

### Biological Classification

Biological classification is a way of categorizing organisms that share similar characteristics into groups, such as genus or species, called taxa (the singular of which is taxon). From the largest to the smallest, the eight main taxonomic ranks used in this biological hierarchy include life, domain, kingdom, phylum, class, order, family, genus, and species. These groupings are rooted in the idea that groups of living things share common ancestors and evolve from these ancestors into distinct species over time as the biological populations change over successive generations.

### Pinnipedia

The monophylum (or clade) Pinnipedia contains three families: the Phocid family (true seals), the Otariid family (sea lions and fur seals), and the Odobenid family (walruses). Pinnipeds are named for their large fin-like flippers; the word “Pinnipedia” comes from Latin and means “feather or fin foot.” Pinnipedia belongs to the suborder Caniformia, meaning “dog-like,” which in turn belongs to the order Carnivora, meaning “to devour.” The order Carnivora also includes more than 280 other species of animals.

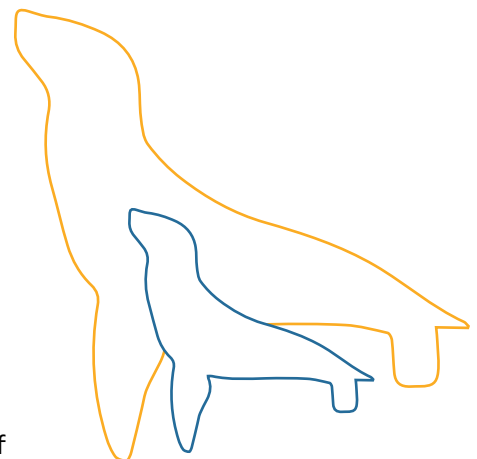
Pinnipeds in general are somewhat clumsy on land but agile and graceful in the water. A clear membrane that acts as a second eyelid allows them to open their eyes underwater. They are able to hold their breath for up to two hours at a time. Their blubber keeps them insulated and warm in cold ocean waters, and they absorb heat by basking in the sunlight when on land. Pinnipeds that live in warmer areas stay cool by resting in tidal pools and shady areas on land. All pinnipeds are carnivores and eat a variety of other marine life, such as fish, squid, octopuses, penguins, and many marine invertebrates.

### The Families

The Phocid family is the most diverse group of pinnipeds and consists of animals that are considered true seals. True seals have ear holes but no visible external ear flap. Their front flippers are small. They move on land by undulating on their stomachs. When swimming, they use their back flippers like a fish’s tail. Despite their name, fur seals actually belong to the Otariid family and are not considered true seals.

The Otariid family (also known as eared seals) consists of sea lions and fur seals, both of which are recognizable by their external ear flaps and large front flippers. On land they use all four flippers to walk, and at sea they use their large front flippers like oars to swim. They are well suited to cold temperatures, with both blubber and a fur coat to keep them warm. Fur seals can be distinguished from sea lions by their longer flippers and thicker coats.

The Odobenid family has only one living member: the walrus. Walruses have no external ear flaps, like seals, but they can rotate their hind flippers forward and walk on all fours, like sea lions. Another easy way to recognize them is by their tusks, which both males and females have. Walruses are big and bulky. They are one of the larger pinnipeds, though they are still smaller than two species of



## GLOSSARY:

**Pinnipeds:** Diverse group of “flipper-footed,” semiaquatic marine mammals with front and hind flippers; well adapted to swimming

**Taxon:** Group of organisms

**Monophylum (also known as clade):** Group of organisms including an ancestor species and all its descendants; characterized by shared derived characteristics

**Family:** Taxonomic group classified by their shared attributes

**Family Phocidae:** Family of true seals, with small front flippers and no external ear flap

**Family Otariidae:** Family of fur seals and sea lions, with large front flippers and external ear flaps

**Family Odobenidae:** Family of walruses, which can rotate their hind flippers forward and walk on all fours; have no external ear flaps

## 7TH GRADE STANDARDS:

### California Science Content Standards

- 3.d. Students know how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.

### California Next Generation Science Standards

- MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
  - Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.

## PROGRAM MATERIALS:

- Pinniped identification pictures

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## PINNIPED IDENTIFICATION



### Sea Lions (Otariids)

- visible external ear flaps
- large front flippers
- walk on land using all four flippers



Photo A



Photo B

### Fur Seals (Otariids)

- visible external ear flaps
- large front flippers
- walk on land using all four flippers



Photo C



Photo D

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## PINNIPED IDENTIFICATION CONTINUED



### True Seals (Phocids)

- no visible external ear flaps
- small front flippers
- move on land by flopping on their bellies



Photo E



Photo F

### Walrus (Odobenids)

- tusks on males and females
- no visible external ear flaps
- walk on land using all four flippers



Photo G



Photo H



## PINNIPED IDENTIFICATION PHOTO CREDITS



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# LESSON 2

## THE FOOD WEB GAME

**Enduring Understanding:** Sea lions, like all living things, are part of an intricate food web that can be impacted by human behavior.

### Materials

- 50 bandanas (20 green, 10 yellow, 10 purple); These can be modified depending on the number of students, but the 2:1:1 ratio should stay relatively the same.
- 105 poker chips (or other tokens)

### SETUP:

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

### PROGRAM OUTLINE:

#### The food web

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

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

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

#### The Food Web Game

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

## PROGRAM OUTLINE CONTINUED:

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



## TEACHER BACKGROUND:

### Sea Lions

Sea lions eat a wide variety of seafood, including squids, octopuses, herring, rockfish, salmon, anchovies, and more. In the San Francisco Bay they are generally safe from great white sharks, due to the great white sharks' aversion to the bay's brackish water. However, outside of the bay, great white sharks and orca whales are the sea lions' main predators. Sea lions are affected by ingesting plastic pollution thrown away by humans. They can also get tangled in nets and fishing line, leading to infection, strangulation, or malnutrition.

### Producers, Consumers, and Decomposers

The food web consists of three main types of organisms: producers, consumers, and decomposers. Producers are organisms that are able to create their own food and energy through the process of photosynthesis. Consumers are herbivores, carnivores, or omnivores. They cannot produce food on their own and need to consume other living things in order to get energy. There is also a special type of consumer called a scavenger that does not hunt its own food but eats the leftover meat that has already been killed by another animal. There are other special types of carnivores, such as insectivores, that eat only specific foods. Decomposers, such as bacteria and fungi, eat decaying matter and break down organic material so that its nutrients and minerals can be recycled back into the soil.

### Roles in the Food Web

Plants, algae, and phytoplankton are primary producers, as they get their energy from the sun through photosynthesis. Herbivores, such as sea urchins and some zooplankton, rely on primary producers for all of their energy. They are called primary consumers. Omnivores and carnivores, such as otters and anchovies, that eat herbivores are called secondary consumers. These secondary consumers are eaten by even larger carnivores and omnivores, such as sea lions and large sharks, called tertiary consumers. At the top of this food web are apex predators, which are animals that have few or no predators of their own, such as great white sharks, orca whales, and humans.

### Human Impact

Our human activities can greatly affect the carefully balanced food webs in the ocean. One way to reduce our human impact on ocean wildlife is by supporting sustainable seafood practices that don't overfish and are not environmentally destructive. When population numbers of a certain species are drastically reduced by overfishing, it can have a big impact on other animals that prey on and are preyed upon by that species. This impact ripples outward in the food web and can end up having dramatic consequences for the ecosystem. The Monterey Bay Aquarium Seafood Watch program helps consumers choose seafood that is healthy and sustainable and restaurants that serve sustainably fished species.

One of the biggest threats to the San Francisco Bay is pollution that comes from our homes. Many household pollutants that aren't properly disposed of make their way to the bay by being washed into storm drains. Plastic bags and polystyrene containers are two of the biggest culprits, but motor oil, pet waste, trash, and other pollutants also have an impact. Marine wildlife like sea lions, seals, turtles, birds, and fish can be killed by eating or becoming entangled in plastic and other debris. When one animal population is affected by something like pollution, it can have big consequences for other organisms in the food web.

## GLOSSARY:

**Apex Predator:** Carnivore that eats other carnivores and is not hunted by any other animals; top of the food web

**Carnivore:** Animal that eats other animals

**Consumer:** Animal that eats other plants and/or animals in order to get energy

**Herbivore:** Animal that eats only plants

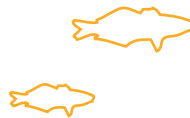
**Omnivore:** Animal that eats both plants and animals

**Predator:** Animal that hunts other animals

**Prey:** Animal that is hunted by other animals

**Producer:** Organism that makes its own food from nutrients in the soil or ocean

**Trophic Level:** Position that a group of organisms occupies in the hierarchy of the food web; shares the same function within the ecosystem and the same nutritional relationship to the primary sources of energy



## 7TH GRADE STANDARDS:

### California Science Content Standards

- 3.e. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
- 4.b. Students know the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.

### California Next Generation Science Standards

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem
  - Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
  - In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
  - Growth of organisms and population increases are limited by access to resources.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
  - Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.



# LESSON 3

## SEA LION INQUIRY

**Enduring Understanding:** We can use science inquiry to learn more about the behavior of animals, such as sea lions.

### Materials

- Computer (to visit the Sea Lion Center website)
- Poster paper
- Pens, markers, pencils
- Notebooks (for gathering and recording data)

### SETUP:

1. Have the computer available each day.
2. Prepare the art materials (once the data have been gathered).

### PROGRAM OUTLINE:

#### What is science inquiry?

- Science inquiry is the process of asking a question based on background information and creating an investigation to answer that question.
  - It's how we learn about the world around us, from the oceans to the stars to our own bodies.
- Science inquiry is not a linear process but a cyclical one, where testing ideas, exploration and discovery, community analysis and feedback, and benefits and outcomes are all intertwined.
- We can test our ideas by creating a hypothesis (what we expect to happen) and gathering data based on that hypothesis.
  - When we gather data, we can compare our expected results with our actual results.
  - After gathering and interpreting data, we may be inspired to revise our hypothesis or come up with a completely new question to investigate.
  - It is important for investigations to be shared so that others can give feedback, discuss new ideas, and build on the knowledge we have gained.
  - Peer review and replication are integral to the integrity of the scientific process. If others are able to replicate an experiment and get similar results, it further validates your findings.
    - o In science inquiry, an incorrect hypothesis does not mean the investigation was a failure!
    - o In fact, as scientists, we often learn more when our



## PROGRAM OUTLINE CONTINUED:

hypothesis turns out to be wrong.

- o You can always go back to the original question, adjust your hypothesis according to the new information you gained, and do more investigation.
- Ask students for examples of projects that could be considered science inquiry. A good place to start is by thinking of “testable ideas” as opposed to simple “yes” or “no” questions.

### California sea lions in the San Francisco Bay

- The California sea lions first arrived at Pier 39 in 1989, after a big earthquake hit San Francisco.
- Though originally seen as a nuisance, the sea lions have since become a permanent and integral part of the bay, as well as a major tourist attraction.
- Most of the year the sea lions live in separate groups of males and females.
  - During breeding season they live in groups called harems, consisting of one bull (male) and several cows (females).
- The number of sea lions at the pier fluctuates throughout the day and throughout the year.
  - Most sea lions at the pier are male. In the summer they migrate to where the females are to breed.
  - They are highly dependent on the amount of available food, such as anchovies and herring.
  - Strong correlations have been found in the past between the number of anchovies and the number of sea lions.
- Watch this video made when the sea lions first arrived at the pier: <http://www.pier39.com/home/the-sea-lion-story/> (NOTE: It is referred to as a “Seal Invasion” in the movie, but while both are pinnipeds, seals and sea lions are not the same animal!)

### Science inquiry with sea lions

- Because sea lions are a local marine mammal, we have easy access to data gathered on them. (<http://www.sealioncenter.org/>)
- The Sea Lion Center website tracks how many sea lions are on the pier, the outside temperature, and the water temperature.
- Have students get into groups of four to five and design a question that can be answered by checking the data on the website throughout the week, for example
  - Are there more sea lions on the dock in the morning or in the afternoon?
  - What is the correlation between the water temperature and the number of sea lions on the dock?
- Students can also choose how often they want to check the data and should keep it consistent each day
  - Each group should create a chart in their notebook to capture all the data they are gathering. Their charts may look different depending on how many variables they are investigating (see sample chart below).
- Emphasize the difference between correlation and causation.
  - Finding a correlation between two variables is only one piece of the picture and does not necessarily imply that one causes the other.
  - More research is often needed to determine a causative relationship, but finding a correlation can be the first step.
- This investigation will serve as an introduction to field research methods, which involve observing animals in their environment and making inferences from their behavior.
  - Although this investigation does not take place directly in the field, students will be using data from the Sea Lion Center website as if they were out at the dock observing the sea lions.



## PROGRAM OUTLINE CONTINUED:

- “Real” scientists often conduct investigations this way, gathering data that others have collected or provided and looking for correlations.

### Report findings

- After a week of gathering data, students should analyze and interpret their findings considering the following questions:
  - Did they find a correlation between their variables? If so, was it positive or negative?
  - What can they infer about sea lion behavior from the data they gathered?
  - What further questions did this investigation lead to?
  - What other data could they collect to learn more about sea lion behavior?
- Students create posters to share their findings with the rest of the class.
  - Students should decide which display method (i.e., bar graph, histogram, etc.) would be the most appropriate for their particular question and the number of variables they are including.
  - Encourage students to discuss their findings as a class and ask questions of each other regarding their data and inferences.
  - Now that students have done this investigation, what other questions would they like to explore? What further hypotheses can they create given the data they found?

### Options

- You may decide how long you would like this project to last, with a minimum of a week or as long as a month or a year.
- A longer project length would allow students to investigate other variables, such as time of year or amount of daylight. It may also give greater variability in temperatures.



## TEACHER BACKGROUND:

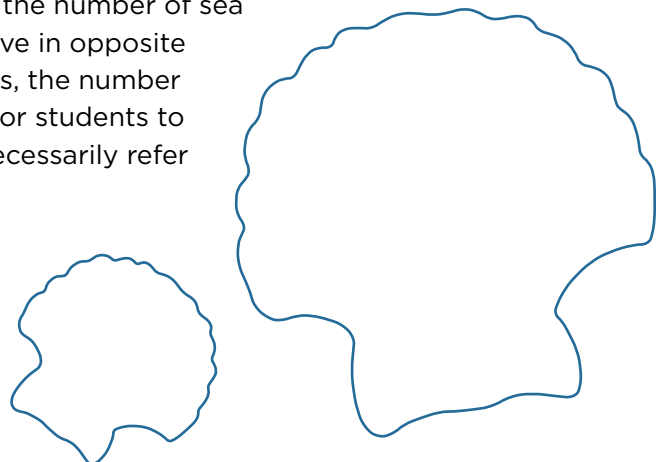
Sea lions are marine mammals that belong to the pinniped (flipper-footed) monophylum, which also includes seals and walruses. There are seven species of sea lion: California sea lion, Steller sea lion, Australian sea lion, Galapagos sea lion, New Zealand sea lion, South American sea lion, and the extinct Japanese sea lion. The most common species living in the San Francisco Bay is the California sea lion, but there are also Steller sea lions and northern fur seals, which are also pinnipeds.

Most of the year sea lions live in separate groups of males and females. During breeding season they live in groups called harems, consisting of one male and many females. California sea lions weigh about 600 to 800 pounds and live 20 to 30 years in the wild. Sea lions eat a wide variety of fish and cephalopods, including octopuses and squids, and their numbers in the bay have been affected in the past by the availability of anchovies. They provide one of the main food sources for great white sharks. They are also hunted by orcas, but sea lions have few other predators.

California sea lions first arrived at Pier 39 in October of 1989 and quickly rose in number, reaching 400 by March 1990 and a record high of 1,701 in November 2009. The floating docks at Pier 39 provide the sea lions a home that is never covered up at high tide the way rocks out in the ocean might be. They also offer the sea lions easy access to schools of fish, like anchovies and herring, and the brackish water of San Francisco Bay deters their main predator, the great white shark.

Science inquiry is a powerful method to get students engaged in investigating the world around them. It allows students to actively participate in their own learning and gives them tools to ask their own questions and find creative ways to answer them. Students are often taught a linear, step-by-step process of science that doesn't accurately represent how real science is done in the field. Science inquiry should be seen as a cyclical process where questions, experiments, analysis, and discussions all feed back into each other. It more closely resembles the real process of science and gives students a better idea of how to create and execute their own scientific experiments. In addition, the importance of sharing science and collaborating with others should be stressed, as this is an integral part of the integrity of the scientific process. For more information, visit the "Understanding Science" website ("The Real Process of Science"), which offers an in-depth summary of the process of science inquiry: [http://undsci.berkeley.edu/article/O\\_0\\_0/howscienceworks\\_02](http://undsci.berkeley.edu/article/O_0_0/howscienceworks_02).

A positive correlation occurs when both variables move in the same direction; in other words, as the temperature decreases, so does the number of sea lions. A negative correlation occurs when variables move in opposite directions; in other words, as the temperature increases, the number of sea lions decreases. This can be a difficult concept for students to grasp, as the terms "positive" and "negative" do not necessarily refer to "increasing" or "decreasing."



## GLOSSARY:

**Causation:** Describes a relationship where changes in one variable can be directly attributed to changes in another

**Correlation:** Describes the degree of relationship between two variables; can be positive or negative; doesn't imply causation, but simply states that two variables are related in some way.

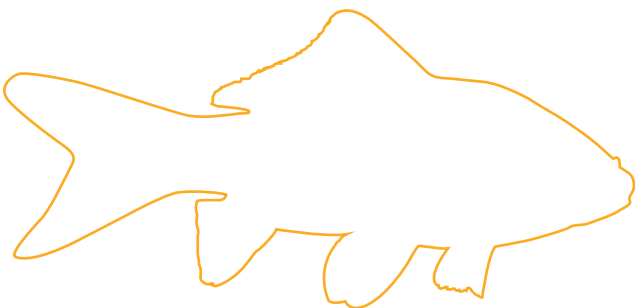
**Field Research:** Method where data are gathered outside of the laboratory, library, or workplace setting

**Harem:** Group of sea lions that live together during breeding season, consisting of a dominant bull (male) and several cows (females)

**Negative Correlation:** Relationship between two variables where high values on one variable are associated with low values on the other

**Pinniped:** Group of "flipper-footed" marine mammals, including sea lions, seals, and walruses

**Positive Correlation:** Relationship between two variables where high values on one variable are associated with high values on the other or low values on one variable are associated with low values on the other



## 7TH GRADE STANDARDS:

### California Science Content Standards

- 7.b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
- 7.c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
- 7.e. Communicate the steps and results from an investigation in written reports and oral presentations.

### California Mathematics Standards

#### Algebra and Functions

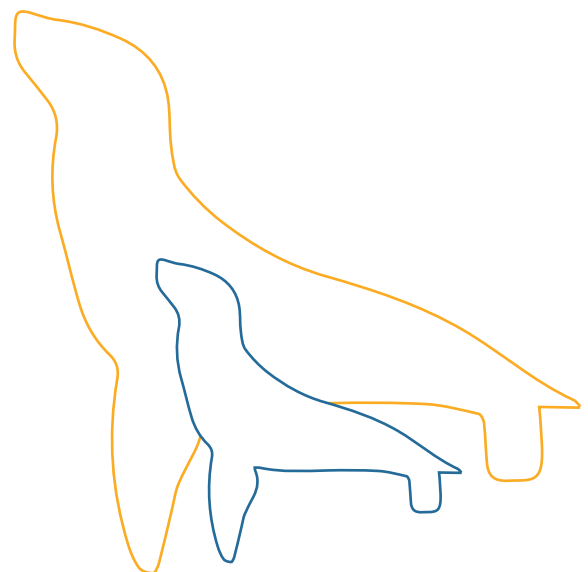
- 1.0-1.5. Represent quantitative relationships graphically and interpret the meaning of a specific part of a graph in the situation represented by the graph.

#### Statistics, Data Analysis, and Probability

- 1.0-1.1. Know various forms of display for data sets, including a stem-and-leaf plot or box-and-whisker plot; use the forms to display a single set of data or to compare two sets of data.

### California Next Generation Science Standards

- MS-LS-1-1. Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.
  - Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.
- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
  - Plan an investigation individually and collaboratively.



Name: \_\_\_\_\_

## SAMPLE DATA CHART



	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 a.m. outside temperature	66°	62°	67°	59°	62°
9:00 a.m. # of sea lions	2	8	3	10	3
3:00 p.m. outside temperature	73°	68°	70°	63°	65°
3:00 p.m. # of sea lions	11	16	7	16	18

# LESSON 4

## BAN THE BAG

**Enduring Understanding:** Plastic pollution has a negative effect on the environment, and there are steps we can take to reduce our impact.

### Materials

- Computer (to watch a movie on plastic pollution)
- Poster or construction paper
- Notebook paper
- Pens, markers, pencils

### SETUP:

1. Prepare the art materials.
2. Provide each student with a couple pieces of notebook paper and a pen/pencil.
3. Have the movie ready to watch.

### PROGRAM OUTLINE:

Students will learn about the harmful effects of plastic pollution and practice their writing skills.

### **A major threat to California sea lions and other animals in the bay is plastic pollution.**

- Sea lions, seals, turtles, birds, fish, and other marine wildlife can be killed by eating or becoming entangled in plastic and other debris.
- Much of this pollution comes from the thousands of plastic bags used by people every day.

### **Watch this short movie, “The Bay vs. The Bag”**

- <https://www.youtube.com/watch?v=jSD21zp89zM>, a project of the Save the Bay website about plastic bag pollution in the bay.
- How does this movie make you feel?
- What did you learn from watching this movie?

### **Another movie you can watch with your students is this parody of the song “Empire State of Mind”**

- <https://www.youtube.com/watch?v=koETnRONgLY>, about banning plastic bags and using reusable products. (You should decide whether or not the language in this movie is



## PROGRAM OUTLINE CONTINUED:

appropriate for your students.)

- What did you learn from watching this movie?
- What kinds of plastic products, other than bags, are often used?
- What other ways can we encourage people to not use plastic products?

### **Why are plastic bags bad for the bay? What harm do you think plastics could have on wildlife or the environment?**

- Marine life and birds may accidentally eat plastics, causing them to become sick or die.
- Plastic pollution can entangle, suffocate, or poison animals.
- Plastics, such as polystyrene, are not biodegradable, which means they will never change into anything else or become part of the soil again. They will, however, break down into smaller pieces of plastic that are easily eaten by animals and absorbed into human blood.
- Plastic bags are a huge part of the plastic pollution problem.

### **There are many steps we can take to reduce our plastic waste and encourage others to do the same.**

- We can all make a difference by encouraging our local government to get involved in environmental issues.
- Many cities in California and across the United States have banned plastic bags. Retail stores either charge a small fee for plastic bags or have gotten rid of them altogether.
- If your city already has a plastic bag ban, students can advocate for banning many other products, such as single-use plastic cups, cutlery, plates, or take-out containers.

### **Using what they have learned about plastics pollution, have students write a letter to the current mayor of their hometown, urging him or her to support legislation and initiatives that aim to reduce plastic pollution.**

- In order to make their arguments more persuasive, students should do some of their own research on plastic pollution in the Bay Area.
  - Encourage them to look online to find concrete examples of the harm that plastic bags can do to the ecosystem.
  - Many other cities and states have instituted plastic bag bans. Students can research what happened in those places and whether or not the bans have been effective.

### **Students should use information and facts they have learned to emphasize the issue, including the information they think is most important to share.**

- Tell the mayor why a ban on plastic bags (or other plastic product) is important and how it will help wildlife and the environment.

**Students can start by writing a rough draft in pencil once they've decided exactly what they want to say. The final draft should be written in pen. Once all of the letters have been written, you can collect them in a manila envelope and send them to the mayor's office.**

## PROGRAM OUTLINE CONTINUED:

### **What other steps can we take to reduce our waste and protect the bay?**

- Use reusable grocery bags, reusable food and drink containers, and other such items whenever possible.
- Sort waste into recycling and compost containers instead of throwing it all into the trash (this is called “waste diversion”).
- Buy products made from recycled, sustainable materials and look for as little packaging as possible.
- Support local organizations, such as Aquarium of the Bay, The Sea Lion Center, and The Bay Institute, that are working to making the bay a healthier place for our animals.
- Encourage our local government to get involved and pass legislation that protects animals and the environment by banning harmful plastic products.

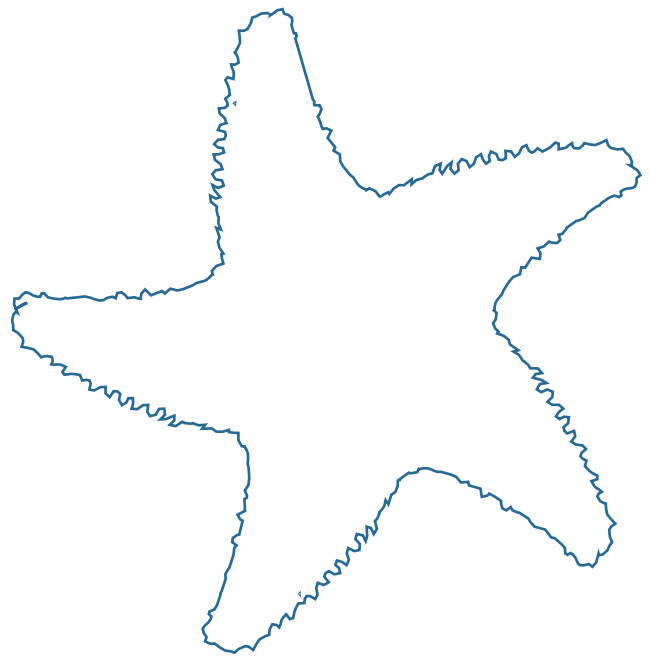




## TEACHER BACKGROUND:

One of the biggest threats to the San Francisco Bay is pollution that comes from our homes. Many household pollutants make their way to the bay when they're not properly disposed of and they wash into storm drains. Plastic bags and polystyrene containers are two of the biggest culprits, but motor oil, pet waste, trash, and other pollutants also have an impact. For example, cigarette butts are the number one type of plastic debris found in the ocean. Sea lions, seals, turtles, birds, fish, and other marine wildlife can be killed by eating or becoming entangled in plastic and other debris.

Approximately 19 billion plastic bags are used in California each year, and millions of these end up in the bay and in the ocean. Most of these bags do not get recycled and they never degrade. Over the last several years many cities in the country have initiated bag bans, which have greatly reduced the amount of plastic waste. In San Jose alone, the bag ban led to 89 percent fewer plastic bags in the trash and 69 percent fewer plastic bags in creeks after being in effect only one year.



## GLOSSARY:

**Ban:** To officially or legally forbid something

**Biodegradable:** Able to decay or be broken down by microorganisms and other living things

**Pollution:** Contamination introduced into the natural environment that has negative effects

## 7TH GRADE STANDARDS:

### California Science Content Standards

- 7.b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.

### California Common Core Standards

#### ELA/Literacy

- Text Types and Purposes: 1. Write arguments to support claims with clear reasons and relevant evidence.

### California Next Generation Science Standards

- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
  - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

# 7TH GRADE

## RESOURCES



### **These books can be found at the San Francisco Public Library.**

- Allison, Rachel Hope. *I'm Not a Plastic Bag*. Boom Entertainment, 2012.
- Bonner, Nigel. *Seals and Sea Lions of the World*. New York: Facts on File, 2004.
- Miller, David. *Seals and Sea Lions*. Minneapolis: Voyageur, 1998.
- Patent, Dorothy Hinshaw. *Seals, Sea Lions, and Walruses*. New York: Holiday House, 1990.
- Shehata, Kat. *San Francisco's Famous Sea Lions*. Chicago: Angel Bea Publishing, 2003.
- Thomas, Peggy. *Marine mammal preservation*. Minneapolis: Millbrook Press, 2000.

### **These library books are for more advanced readers.**

- Berta, Annalisa. *Return to the Sea: The Life and Evolutionary Times of Marine Mammals*. Oakland: University of California Press, 2012.
- Moore, Charles, and Cassandra Phillips. *Plastic Ocean: How a Sea Captain's Chance Discovery Launched a Determined Quest to Save the Oceans*. New York: Avery Trade, 2012.
- O'Hara, Kathryn J., and Suzanne Ludicello. *A Citizen's Guide to Plastics in the Ocean: More Than a Litter Problem*. Unity, ME: Center for Environmental Education, 1988.
- Roberts, Callum. *The Ocean of Life: The Fate of Man and the Sea*. New York: Penguin Books, 2013.

### **Electronic resources/videos that can be found at the library.**

- de Herrera, Alan, *California Sea Lions: An Unforgettable Encounter* [videorecording]. Rio Films and the Pacific Marine Mammal Center, 2005
- Silverman, Buffy, *Can You Tell a Seal from a Sea Lion?* [electronic resource]. Minneapolis, 2012.



# 7TH GRADE

## RESOURCES CONTINUED



### Other books

- Arnold, Caroline. Sea Lion. Great Neck, NY: StarWalk Kids Media, 2013.
- Duboise, Ted. Initiate a Plastic Bag Ban. On Point! Publishers, 2014.
- Fleisher, Paul. Ocean Food Webs in Action (Searchlight Books). Minneapolis: Lerner Publishing Group, 2013.
- Kalman, Bobbie. What Are Food Chains and Webs? (The Science of Living Things). Catharines, ON: Crabtree Publishing Company, 1998.
- Kalman, Bobbie, and Jacqueline Langille. What Is a Marine Mammal? (The Science of Living Things). New York: Crabtree Publishing Company, 2000.

### Organizations

- The Bay Institute  
<http://www.bay.org/>
- Marine Mammal Center  
<http://www.marinemammalcenter.org/>
- Save the Bay  
<http://www.savesfbay.org/>
- Sea Lion Center  
<http://www.sealioncenter.org/>

### Websites

- Monterey Bay Aquarium Seafood Watch  
<http://www.seafoodwatch.org/cr/seafoodwatch.aspx>
- Save the Bay, "Pollution Prevention"  
<http://www.savesfbay.org/pollution-prevention>
- Aquarium of the Bay, "Marine Protected Areas" video  
<http://www.aquariumofthebay.org/plan-a-visit/explore-the-aquarium/discover-the-bay>
- "Understanding Science: How Science Really Works"  
[http://undsci.berkeley.edu/article/O\\_0\\_0/howscienceworks\\_02](http://undsci.berkeley.edu/article/O_0_0/howscienceworks_02)