

OBJECTIVES

- Explain the process of biomagnification.
- Create a book that illustrates biomagnification through a food chain.
- Describe how various toxins get into the environment and affect aquatic life.
- Explain why marine mammals are key species that reflect the health of an aquatic ecosystem.
- Create dot art and a corresponding story to show their understanding of the effects of biomagnification.

SUMMARY

Students will learn about biomagnification by simulating how toxins move up the food chain. They will explore the effects that it has on marine organisms and why marine mammals are key species that reflect the health of ecosystems by reading real life scenarios and doing research. They will create a book that illustrates the process of biomagnification and create a piece of dot art and a corresponding story to illustrate their understandings.

TIME NEEDED

2–3 sessions

MATERIALS

SCIENCE MATERIALS:

- Animal Line Drawings (SB pages 40–43)
- Marine Mammal Issue Cards (found in Activity Cards and SB pages 44–46)
- Student activity sheets (SB pages 47–48)
- Students' field notebooks
- Multiple small items of one color and multiple items of another color (poker chips, beans, beads, etc.)
- Large, clear container
- Small, plastic bags
- Books on the ocean and/or Internet access

UNIT 8

MARINE MAMMALS

MATERIALS *(cont.)*

ART MATERIALS:

- Construction paper or cardstock (for pages in student-created books)
- White cardstock or manila folders (for templates)
- Scissors (or craft knives depending on age of students and what is allowed in your classroom)
- Cutting mats (if using craft knives)
- Pictures of ocean animals
- Permanent markers (of different colors)
- Crayons or regular markers
- Transparencies (cut in half)
- Glue or clear tape
- Stapler and staples
- Examples of aboriginal dot art
- All-purpose art or construction paper
- Variety of colors of tempera paint
- Variety of paintbrushes
- Cotton swabs
- Containers for paint
- Water for rinsing brushes

PREPARATION

- Read the science background information about watersheds, the food web, and biomagnification on pages 16 and 27–30.
- Read the art background information about dot art on page 51.
- Create a sample book by photocopying the provided Animal Line Drawings, SB pages 40–43, (or by creating your own) onto transparencies. Cut construction paper to make “frames” for the images. Staple the pages together to make a book. Add captions that go along with the images.
- Cut templates for book pages that students can use.

ACTIVITY INTRODUCTION

1. Ask students what happens when toxins and pollution enter the ocean or other aquatic ecosystem. What animals are affected the most? What animals are indicators that there is a problem with toxins? Write their ideas on the board and discuss. When chemicals, minerals, metals, and other toxic substances get into water supplies, their impact grows as they spread up through a food web. This effect is called “biomagnification.” Here is how it works: toxic substances like mercury or the pesticide DDT enter the water supply from air pollution or runoff from higher ground. They are absorbed by plants and microscopic life like plankton. The plankton are eaten by clams and fish. The clams and fish are eaten by gulls, birds of prey like ospreys, eagles, or marine mammals.

ACTIVITY INTRODUCTION *(cont.)*

- (continued)* There may not be a lot of a chemical in each plankton or clam. But because each larger animal eats many of the smaller animals, the total adds up, or is “magnified.” This is why marine mammals (mammals that eat aquatic animals) and many birds at the top of the food web, are the ones that really show the effects. These animals can be referred to as “key” animals because without their presence, the delicate balance in the ecosystem would be upset. The health of these animals is an indicator of the health of the ecosystem.
- Show students the sample biomagnification book you created, and/or draw some examples on the board and explain how biomagnification works. Here’s a simplified example:

A big fish



Ate 10 smaller fish



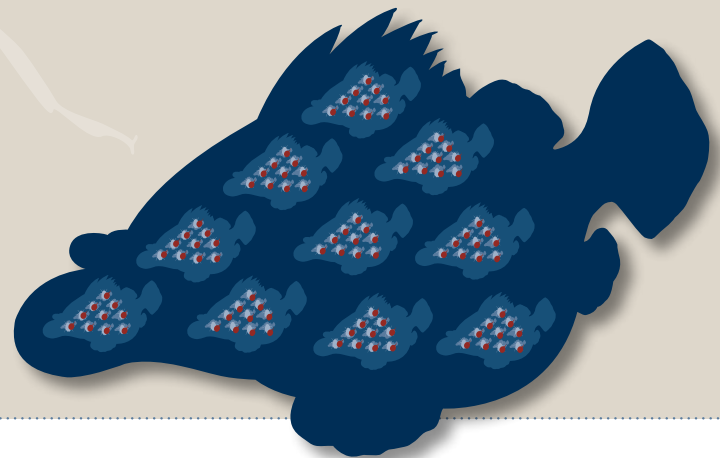
Which ate 100 smaller fish



Which ate 1,000 insects



Which ate 10,000 plankton  which took up mercury.



- Tell students that they will participate in an activity to demonstrate how biomagnification works in the food chain. Select one student to be a marine mammal that eats fish. Divide the rest of the class as follows:
 - Group 1: Plankton — about 60% of your students
 - Group 2: Plankton-eating fish — about 30% of your students
 - Group 3: Fish that eat other fish — about 10% of your students
 - Group 4: Marine mammal that eats fish — this will be the designated student

UNIT 8

MARINE MAMMALS

ACTIVITY INTRODUCTION *(cont.)*

3. *(continued)*

How to conduct the demonstration:

- 1) Give half the plankton students (Group 1) five items each of one color and give the other half five items each of the other color.
 - 2) Instruct the plankton-eating fish (Group 2) to walk around the class and find the plankton students. When they find plankton students, they should take their items. Do this until all items have been collected from Group 1 students.
 - 3) Tell the fish that eat other fish (Group 3) to walk around the class and find the plankton-eating fish. When they find one of those students, they should take his or her items. Do this until all items have been collected from Group 2 students.
 - 4) Have the marine mammal student (Group 4) take the large, clear container around the room and collect all the items from the fish (Group 3).
 - 5) Have all the students look at the collection of items. Tell them one of the colored items represents toxins. Identify which color item represents the toxins. Let them know that the clear container represents the marine mammal's body. Can they see how the toxins add up in the marine mammal? Discuss the process, answer questions, and clarify any misconceptions that the students might have.
4. Complete a shared reading about the examples involving orcas in the Puget Sound, manatees in Florida, and sea otters in Northern California with the Marine Mammal Issue Cards (SB pages 44–46, copy one per student. Teacher can use the ones found in the Activity Cards.)

EXPLORATION

1. Have students form groups and pick one of the Marine Mammal Issue Cards or another marine mammal to research. (If working on a freshwater habitat, students can research mammals and birds that eat aquatic animals). Students should find information on the various issues and each complete the student activity sheet (SB page 47).
2. Show students the example Animal Line Drawings (SB pages 40–43). Show students how the toxins get magnified as they move up the food chain by using the transparencies that you created for your sample book. Show them the first page, which represents plankton, and explain that plankton absorbs some of the toxins. Show the next page and explain how one small animal (fish) eats a lot of plankton and, therefore, toxins. Show the next page and explain how this animal (seal) eats a lot of the fish that have eaten the plankton and is therefore eating even more toxins. Repeat this process until you get to the top of the food chain in your sample book. Tell them they will be creating a book that illustrates what happens in the food chain when toxins, such as mercury and pesticides, enter the ecosystem.
3. Tell students that they can choose what animals they will illustrate. They can use the sample drawings provided or create their own, but the food chain must be accurate!
4. Students should use the Food Chain Storyboard handout (SB page 48) to sketch the pages in their books before working with permanent markers on the clear plastic.
5. Once they have chosen the animals that they will use in their food chain and made sketches, students should collect needed supplies to make their books.

COMMUNICATION/ASSESSMENT

1. Have students share their books in small groups and/or have a “gallery walk” around the classroom so students can view all of the designs. Student volunteers can also read their books to the class.
2. Students should respond to the following in their field notebooks:
 - a. Explain biomagnification.
 - b. Describe how biomagnification relates to the local watershed.
 - c. What animals are the greatest indicators of toxins in the environment? Give an example.
 - d. Why were the different sizes of your line drawings so important in this project?
3. Art Challenge: Aborigines used dot art as an aid to tell their traditional stories. Read the art background information about dot art on page 51 to the students and show them examples of dot art. Have students create dot art that shows the story of one of the examples of biomagnification. Have them write stories in their field notebooks to go along with their dot art from the point of view of an older person who has watched a marine mammal become extinct in his or her lifetime. Then have them use their dot art as an aid to tell their stories.

EXTENSION ACTIVITY

Have students research other issues with biomagnification and what is being done about the problem. If appropriate (depending on where you live), have students write their local representatives. Have them create a game that younger students could play that illustrates biomagnification.

UNIT 8

ANIMAL LINE DRAWING

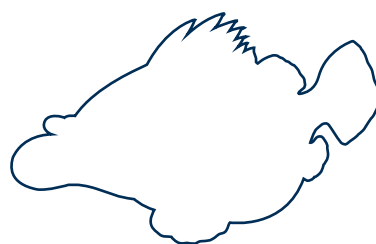


PLANKTON

Toxins like mercury and pesticides are absorbed by plankton.

UNIT 8

ANIMAL LINE DRAWING

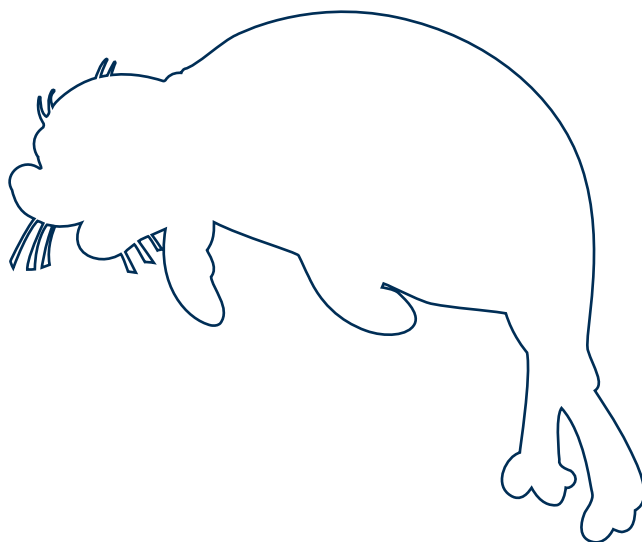


FISH

Fish eat lots of plankton, which have absorbed toxins.

UNIT 8

ANIMAL LINE DRAWING

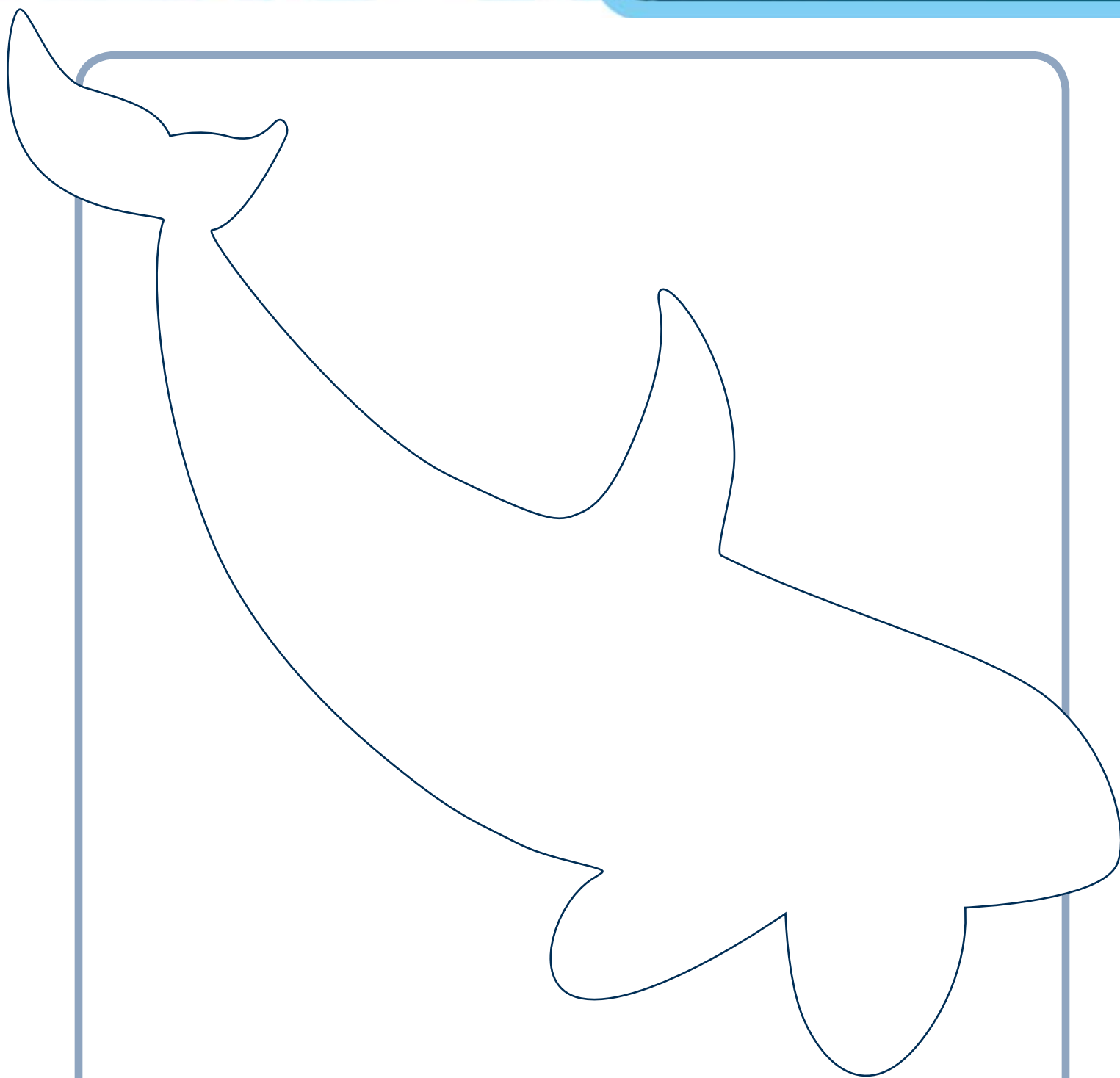


SEALS

Seals then eat lots of fish, which have eaten the plankton, which have absorbed toxins.

UNIT 8

ANIMAL LINE DRAWING



KILLER WHALE

The toxins are magnified in the killer whale.

At the top of the food chain, the killer whale eats lots of seals, which ate lots of fish, which ate lots of plankton, which had absorbed a lot of toxins.

UNIT 8

MARINE MAMMAL ISSUE CARDS

Marine Mammal Issue

CARD

Orcas



Keiko's World By WYLAND

When it comes to chemical pollution, the bigger the animal, the bigger the problem. In no case is that clearer than in the community of killer whales that live in the Pacific Ocean off the coasts of British Columbia and Washington state. Killer whales, also known as *orcas*, are some of the most impressive mammals in the sea. They also are some of the hardest hit by pollution. The 85 resident killer whales that swim between Georgia Strait and Puget Sound are considered some of the most polluted marine mammals in the world. Their bodies are contaminated with chemical pollutants like PCBs and DDT, which were banned years ago but are still in the environment. These chemicals have accumulated in the whales' blubber through biomagnification. As a result, the whales have problems reproducing, lowered immunity to diseases, and disruptions to the endocrine system, which produces hormones necessary for good health.

Marine Mammal Issue

CARD

Manatees



Manatee Encounter By WYLAND

Off the coast of Florida, the water can sometimes look a dark, reddish color. When that happens, it's called a *red tide*, and it is caused by an overgrowth of algae. Recently, red tides have been occurring more often. The algae produce toxins that can kill fish, sea turtles, birds, and marine mammals such as manatees. The worst part is that there is evidence that the toxins stay in the environment long after the red tides disappear. Constant exposure to the toxins causes health problems for the manatees. Specifically, the toxins target their lungs and cause them to go into shock and eventually die.

Marine Mammal Issue

CARD

Sea Otters

*Sea Otter Seals By WYLAND*

Cat feces contain a tiny parasite that is killing sea otters off the coast of California. Since cats live on land, how is this possible? Well, freshwater runoff washes feces from backyards, streets, and illegally dumped kitty litter into streams, rivers, and ultimately, the ocean. Studies have shown that otters living near freshwater runoff are much more likely to be infected by the parasite. The parasite causes otters to shake, become uncoordinated, and have seizures. It is the primary cause of death in some otter populations living along the coast.

Marine Mammal Issue

CARD

Sea Lions

*Photography By WYLAND*

California Sea Lions are dying of cancer at an alarming rate. Studies show that pollutants are one of the main causes of the cancer. The pollutants accumulate in the food that the sea lions eat, such as anchovies, squid, and mussels. The pollutants then build up in the sea lions. The cancer caused by the pollutants spreads throughout their bodies, eventually ruining their spinal cords, paralyzing them, and causing them to wash up on shore.

UNIT 8

MARINE MAMMAL ISSUE CARDS

Marine Mammal Issue

CARD

Bottlenose Dolphins



Photography By WYLAND

The Atlantic Bottlenose Dolphins, which live in the Indian River Lagoon in Florida, are coming down with unusual diseases such as hepatitis, meningitis, and pneumonia. Scientists suspect that high concentrations of pollutants from sewage or other sources, toxins from red tides, and other factors, may be a big part of the problem. Studies are underway at the Harbor Branch Oceanographic Institute to determine why the dolphins are getting sick. The scientists at HBOI are studying water quality and the conditions in the habitat. They are doing medical examinations of the dolphins on a regular basis to try and solve the mystery.

Marine Mammal Issue

CARD

Beluga Whales



Photography By WYLAND

Some of the Beluga whales that live in the St. Lawrence River have so many toxins in them that when they die, their remains must be handled as toxic waste. Tumors, cysts, cancer, and bacterial infections are affecting the health of this beluga population. In the early 1900s, there were about 7,000 beluga whales in this area; now there are about 700. The waters of the St. Lawrence River are polluted due to many years of industry dumping, dredging, and shipping. Runoff from farms are at least partially to blame, as well.

NAME:

DATE:

1. What marine mammal (or other animal) are you studying?

2. What are the symptoms that this animal is showing?

Describe or draw this animal's food web.

3. What do scientists think might be causing the problem?

4. What do you think is the cause, and is there anything people can do to help?

NAME:

DATE:

Page 1 (Plankton)

Page 2 (Level 2 in the food chain)

Page 3 (Level 3 in the food chain)

Page 4 (Level 4 in the food chain)
