A Coastal Arctic Food Web

Levels V-VI

Grades 9-12

Overview:

Students construct a model of a coastal Arctic food web and use the model to examine how climate change is affecting the Arctic ecosystem.

Objectives:

The student will:

- create a coastal Arctic food web; and
- explain how loss of sea ice will affect the Arctic coastal ecosystem.

GLEs Addressed:

Science

- [9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.
- [9] SC3.3 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by identifying dynamic factors (e.g., carrying capacity, limiting factors, biodiversity, and productivity) that effect population size.
- [10] SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by exploring ecological relationships (e.g., competition, niche, feeding relationships, symbiosis).
- [11] SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by analyzing the potential impacts of changes (e.g., climate change, habitat loss/gain, cataclysms, human activities) within an ecosystem.

Whole Picture:

Though the Arctic can look desolate to someone who lives near the equator, where there are bats and snakes and thousands of insects flying around, the far north is a rich place, especially near the ocean. Some of the most productive fishing grounds on the planet are only a few hundred miles south of the Arctic Circle, because ocean upwelling is favorable to the growth of tiny photoplankton eaten by creatures called krill, which are eaten by fish and the largest mammals on Earth, whales. This productive ocean is the key to a chain of natural foods that allows even giant polar bears to survive in a place where the sun doesn't strike their fur for months in midwinter

Materials:

- Slips of paper or index cards
- String
- Scissors
- STUDENT WORKSHEET: "Sea Ice Web"

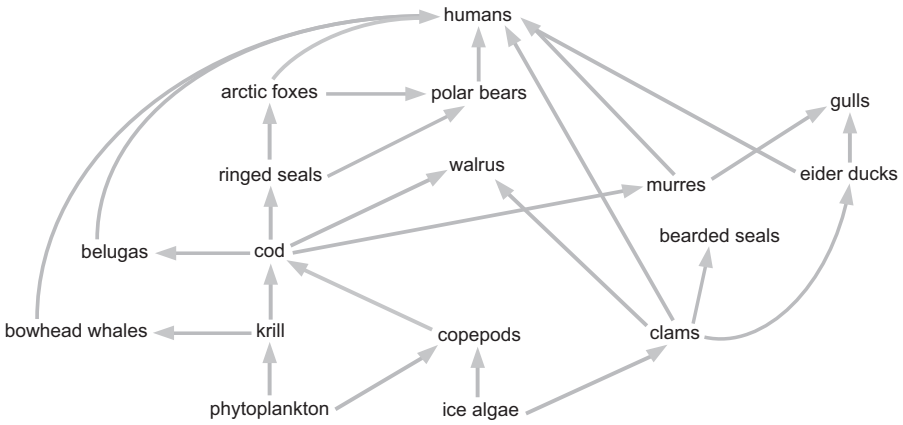
Activity Preparation:

Cut string into long lengths. (See Activity Procedure 8)

Activity Procedure:

1. Ask students to brainstorm plants and animals that reside in the Arctic coastal ecosystem; types of fish, bears, seals, etc. that live along the coast of Alaska and in Arctic waters. List student ideas on the board.
2. Using the class brainstorm and the chart below as a guide, create a food web on the board. A food web (often referred to as a food cycle) shows the connections between all the plants and animals in an ecosystem. Begin by asking students to name the organism that makes up the foundation of the food web (algae). Next, work as a class to finish the web, building up by showing each organism followed by its predator.

Coastal Arctic Food Web



3. Explain that algae grow on the bottom of sea ice. During the summer, as the sun shines through the water, the algae grow rapidly. These algae provide food for a variety of animals, including copepods, krill, crustaceans, and jellyfish. Krill, copepods, and other zooplankton, in turn, are food for fish, squid, seals, and whales.
4. As sea ice melts, that balance of sunlight shifts. Ask students how that will affect the food web. (*More algae will grow, which will result in more krill*.) Explain that more algae will grow to a point, resulting in more food for the krill. However, as the water continues to warm and sea ice continues to melt, the algae will have less surface area on which to grow and eventually will decrease in population.

Teacher's Note. There are zones of water in the ocean: pelagic (open sea or ocean that is not near the coast), demersal (water that is near and significantly affected by the coast), and benthos (seabed). Explain each zone has its own food web, which are connected at some points, but not all. For example, much of the ice algae sinks to the bottom of the oceans, the benthos zone, where it is fed on by organisms such as clams, which are eaten by bearded seals, walrus, and other bottom-feeders.

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5. Additionally, the melting of ice on the surface of the ocean has resulted in a larger section of fresher (less salty) water. This warmer and fresher water is causing certain species of algae to die and others to replace them. Scientific studies suggest that many species of algae usually associated with freshwater have already replaced the more productive Arctic algae.

Teacher's Note. The increase of freshwater to the Bering Sea is also caused by inflow from rivers such as the Yukon River. As permafrost and glaciers melt, the freshwater is discharged into the oceans.

6. Ask students what other animals will be affected by the loss of sea ice (*polar bears, seals, and sea birds*). Explain that polar bears need sea ice for places to rest during hunting and to build dens for their young. Seals give birth and nurse their pups on the ice; the loss of ice will affect their birthing habits and also reduce their food availability. Sea birds scavenge on top of the ice; as the ice retreats away from shore, they will have to travel farther for food.
7. Ask the class which organism they believe is the least important in the food web and why.

Critical Thinking Method: Circle Discussion Method. Divide students into two groups. The groups should form concentric circles. Ask the interior circle to discuss how the loss of the organism they chose in #7 will affect the Arctic ecosystem. Students should be encouraged to share their opinion and agree and disagree with others, however, all statements should be backed up with reasonable arguments. Once the first group of students have explored the topic (5-10 minutes), instruct the students to reverse positions. This technique stimulates student interest and provokes discussion.

8. Using the cut pieces of string, recreate the class food web with students. Label slips of paper or index cards with the name of each animal in the web. Distribute a card to each student and ask all students to stand in a circle. Then, pass sections of string around so that students are connected in the same way shown on the board. For example, the algae and krill will hold one length of string. The krill will also hold a second piece of string that is connected to the cod. Some students will only be holding one section of string (connected to only one other organism); others will be holding several sections (connected to several different species).
9. Ask the student representing the organism identified in #7 to drop their string. The students that are the predators connected to that animal should drop the string that is connected to that organism. The animals connected to those should also drop their string for the same reason and so on until every animal that was connected directly or indirectly with the first one has dropped the connecting string.
10. As a class, discuss how the loss of this one species affects the ecosystem and the local community.
11. If time allows, repeat this process with another organism.
12. As a class, discuss how the loss of sea ice will affect the Arctic ecosystem. Ask students if the results shown in the food web are realistic. What are options for a species that loses its habitat other than extinction? (*Some animals will find alternative sources of food or migrate to more productive territories.*) Encourage student discussion and research.
13. Distribute the STUDENT WORKSHEET: "Sea Ice Web" and instruct students to complete the worksheet, individually or in pairs. Allow students the use of the Internet and other classroom resources for completing the food web.

Extension Idea. Ask students to research one particular animal in the food web and to write a short paper or essay describing the likely impact of global climate change on that species. ([9-10] W4.2.2, [11] SA2.1)

Answers:

1. Answers will vary, but should resemble the diagram from the activity procedure.
2. walruses, kittiwakes, polar bears, ringed seals, bearded seals
3. C. The algae will increase at first and then decrease.

Levels V-VI

Name:_____

Sea Ice Web

Student Worksheet

Grades 9-12

Directions: Use the information below to answer the following questions.

The following animals are part of the Arctic coastal ecosystem:

polar bears	walruses	ice algae
arctic foxes	krill	photoplankton
cod	copepods	belugas
bowhead whales	eider ducks	murres
gulls	ringed seals	bearded seals
humans	clams	kittiwakes

1. Draw a food web that shows the connection between all the organisms listed above.

2. Which animals listed in the food web will be directly affected by the loss of sea ice?

_____ _____

_____ _____

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3. As sea ice melts, more sunlight reaches the surface of the ocean. How will this affect the algae that currently grow on the bottom of the sea ice?

   A. The algae will become extinct.
   B. The algae will increase in number.
   C. The algae will increase at first and then decrease.