FOOD CHAINS

Overview

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

Objectives

On successful completion of this lesson, students will be able to:

- diagram a food web of arctic organisms; and
- classify organisms as producers or consumers.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[6] 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.

[6] 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 organizing a food web using familiar plants and animals.

Alaska Cultural Standards:

[E] Culturally- knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.

Bering Strait School District Scope & Sequence

M.S. sequence 6.3: Cycling of Matter & Energy

Materials

- Slips of paper or index cards
- String
- Scissors
- Overhead "Coastal Arctic Food Chain"
- Overhead "Coastal Arctic Food Web"
- Student Worksheet "Sea Ice Web"

Additional Resources

Glencoe Life Science Ch 20-21

Activity Preparation

1. Cut string into long lengths. (See Activity Procedure Step #9.)

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 phytoplankton 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.

Food webs are made of interconnected food chains. At each link in the food chain energy is lost as it passes from one organism to another. Roughly only 10% of the energy is passed along. The remaining 90% is lost to heat. When krill eat phytoplankton only 10% of the energy is passed along. When cod eat krill another 10% is passed along, so only 1% of the energy available from phytoplankton is a passed along to the cod. The same applies to terrestrial food chains. In a food chain such as grasses -> muskox -> wolves only 10% of the energy available in the grass will be passed along to the muskox, then 10% from the muskox is passed along to the wolf. Consequently, there are fewer wolves than there are muskox.

Due to the difficult growing conditions of the tundra, there is limited productivity of producers. It is estimated that tundra producers only make one-tenth to one-third the amount of food that is produced in a forest ecosystem. In general, food chains in the tundra ecosystem tend to be short. In order to survive some animals will hibernate, or migrate elsewhere.

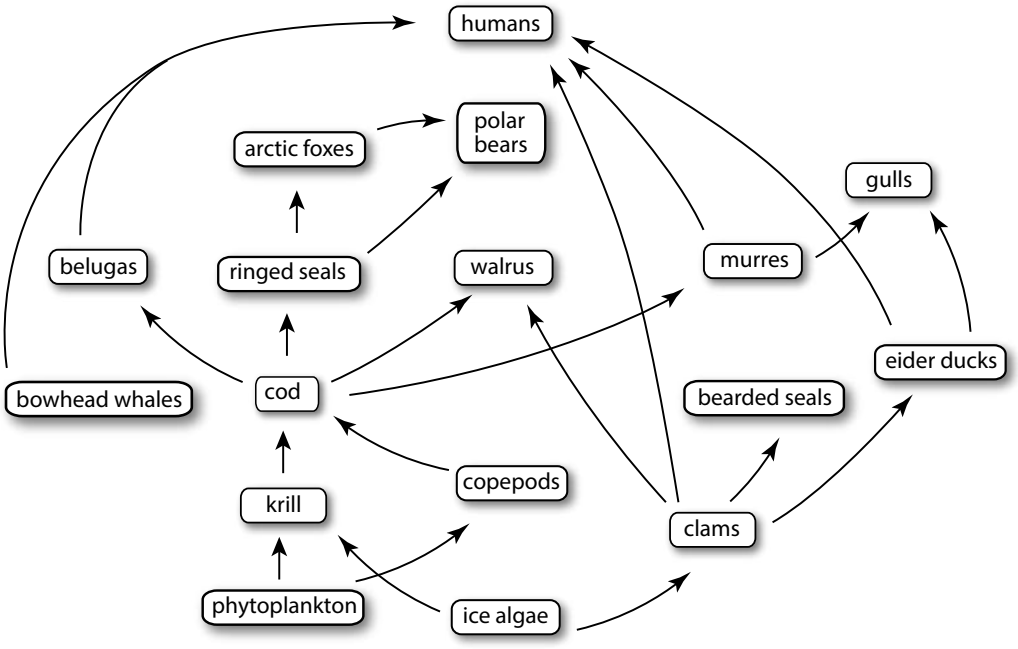
Vocabulary

consumer	an organism that eats another organism
ecosystem	a community of living organisms that interact with one another and their physical environment. Energy and materials are exchanged in the ecosystem
food chain	a sequence of connected producers and consumers. Energy is transferred to higher levels in the food chain.
food web	interrelated food chains that interact within an ecosystem. A food web shows the interdependence of organisms in an ecosystem
producer	an organism that makes its own food

Activity Procedure

1. Begin by showing the class the overhead Coastal Arctic Food Chain. Ask students why the phytoplankton is pictured at the bottom and not the top. Explain that phytoplantkon are micro-organisms that contain chlorphyll and go through photosynthesis, so they fill the producer role in the food chain, similar to a plant. Explain that producers are at the base of the food chain, and that the arrows show the direction of the energy transfer. If necessary, review the vocabulary terms producer and consumer. Ask students to classify the remaining organisms on the overhead as producers or consumers.
2. Ask students to brainstorm plants and animals that reside in the Arctic coastal ecosystem in addition to the those shown in the food chain overhead: types of fish, bears, whales, etc. that live along the coast of Alaska and in Arctic waters. List student ideas on the board.
3. Using the class brainstorm and the chart below as a guide, create a food web on the board. A food web 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. Draw students attention to how the example food chain from the overhead fits within the larger food web; a food web is made up of multiple food chains. Show the overhead Coastal Arctic Food Web. Identify the animals that were not included with the class list.

Coastal Arctic Food Web



4. 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.
5. 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 (sea- bed). 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.

6. 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.

7. 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.
8. Ask the class which organism they believe is the least important in the food web and why.
9. 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).

10. Ask the student representing the organism identified in Step #8 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.
11. As a class, discuss how the loss of this one species affects the ecosystem and the local community.
12. If time allows, repeat this process with another organism.
13. 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.
14. Distribute the STUDENT WORKSHEET: "Sea Ice Web" and instruct students to complete the worksheet, individually or in pairs. .

Answers

Student Worksheet: Sea Ice Web

1. Phytoplankton and ice algae
2. Answers will vary. Explanations should demonstrate critical thinking.
3. C. The algae will increase at first and then decrease.
4. Answers will vary. Diagrams should demonstrate understanding of producers and consumers.

Student Worksheet: Sea Ice Web

Name _____

Use the information below to answer the following questions. The following animals are part of the Arctic coastal ecosystem:

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

1. Which of the organisms listed above are producers?

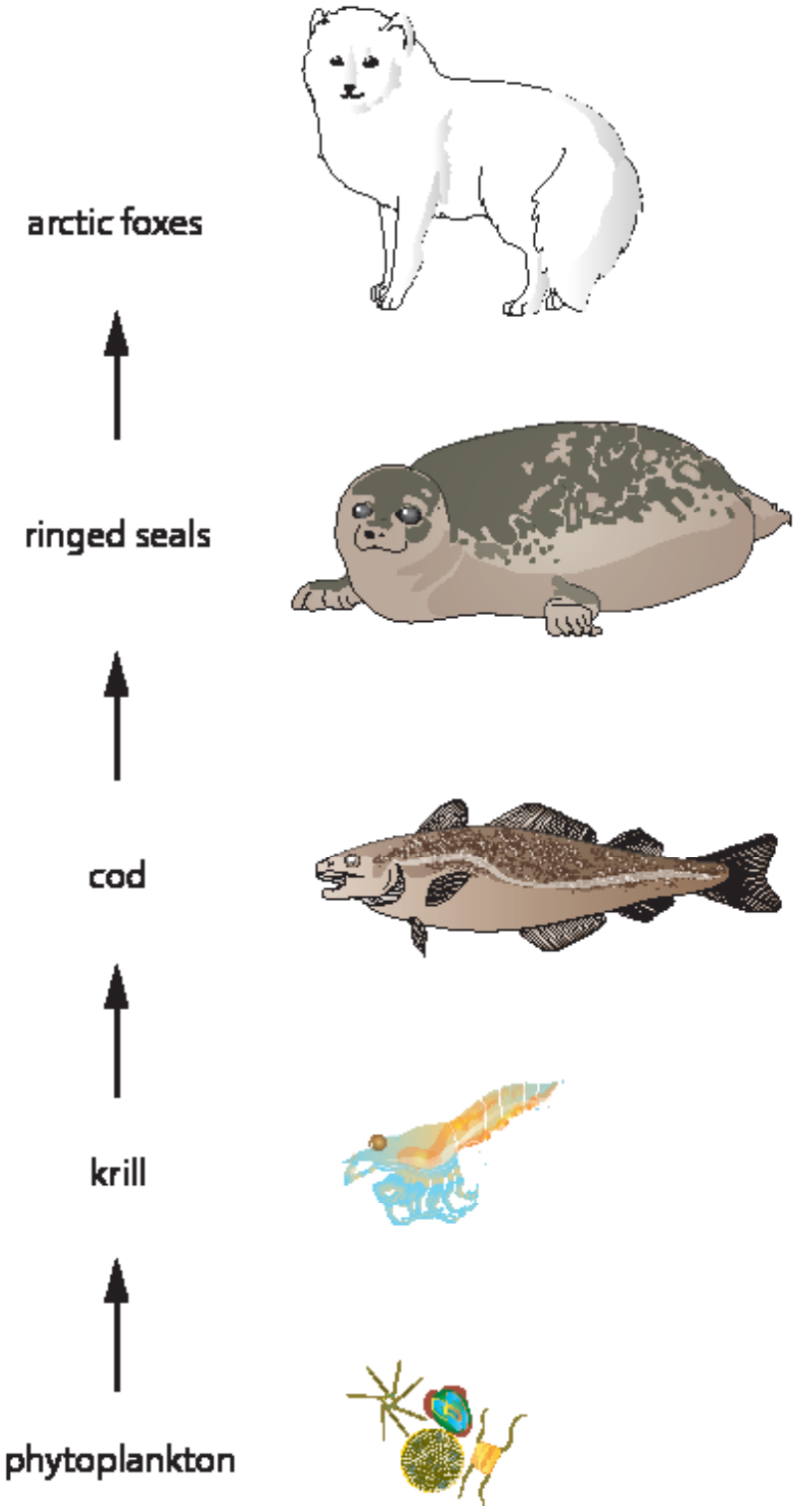
2. Name an organism that is directly affected by the loss of sea ice and explain how it is affected.

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

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

4. On the back of this paper, draw a diagram of a food chain from the Arctic coastal ecosystem. It should have at least 3 organisms. Draw arrows to show the transfer of energy from one level to the next.

Overhead: Coastal Arctic Food Chain



Overhead: Coastal Arctic Food Web