POLAR TREC
Learning Resources

Details

Completion Time: 2-3 hours

Permission: Download, Share, and Remix

Antarctic Undersea Foodweb

Overview

Using photos from a variety of websites, including the PolarTREC and SCINI websites, students will identify organisms to phylum and/or class level (e.g. polychaetes, starfish, brittle stars, sponges) and then research the primary foods that these organisms eat. They will then develop a simple food web for these organisms.

Objectives

Students will identify eight to ten Antarctic undersea organisms to phylum and/or class from website photos. Students will research the trophic (feeding) relationships of these organisms. Learner vocabulary will include: producers, consumers, herbivores, omnivores, carnivores, filter-feeders, detritivores, scavengers, decomposers, and predators. Students will create an undersea Antarctic food web for these organisms.

Lesson Preparation

Teachers need to have access to the photos for students to use. If students have access to the internet, they can do this themselves. If the students cannot access the internet, or to save time, the teacher can print out photos for students to use. Laminating the photos will allow them to be used over and over again. Resources for identifying organisms (most biology books and the Undersea Field Guide are helpful) and information on how the organisms gain energy ("eat") is needed. The teacher needs an understanding of food webs and how they can be diagrammed or illustrated. Numerous examples of this exist in textbooks and on the web.

Procedure

Engage: What do you think of when you think of Antarctica? What organisms live on the continent? Why aren't there very many organisms? What organisms do you think live underwater in Antarctica? Show slides of

Materials

- Photos for this activity are from an Antarctic Undersea Field Guide. Please see the Resources section for website addresses.
- A simple key is provided to help teachers guide students to appropriate nomenclature and trophic relationships between organisms.

some of these organisms to engage student interest. Why are there so many more organisms under the ice than on the ice? Stimulate student discussion. The undersea environment has more stable environmental conditions (temperatures are fairly steady) and there is food available from producers underwater (diatoms and other phytoplankton as well as some algae) whereas the environmental conditions on the ice are extreme and varied, and there are limited producers on the ice. Why are so many of these organisms invertebrates? (Invertebrates are animals without a backbone and are supported in the water so can grow larger than most invertebrates on land such as insects and snails.)

Explore: In small groups of two or three, the students find photos at listed websites or the teacher provides photos to students. Students list organisms they see. They may use biology textbooks or the underwater field guide (listed) to determine the phylum and/or class of organisms they observe. Using the underwater field guide or biology books, the students determine the main foods that these organisms eat.

Explain: Students, in small groups, develop a food web for the organisms. The learners then articulate their food webs to the rest of the class. The teacher and class can evaluate whether the food web seems accurate based on their knowledge. What types of feeding behavior have the students identified in their food web?

Extend: What would happen if a disease took out all of the starfish? (The starfish are predators on the sponge, so the sponge population would increase. Paul Dayton's experiments, described on both the SCINI and PolarTREC websites, used floating platforms or strings to enable sponges to get off the seafloor and away from the starfish. These sponges were able to grow much larger away from the predatory starfish.)

What kind of larvae do these organisms have? How can they distribute themselves in the seascape? (Some of the organisms have swimming larvae and can spread to new areas more easily. Other organisms have offspring that cannot travel as far.)

Evaluate: Did the students identify eight to ten organisms and their trophic relationships? Did the students understand the roles of each organism in this polar undersea ecosystem?

Extension
Learners could add more organisms to their food web.

Resources
Photos for this activity are from an Antarctic Undersea Field Guide (www.PeterBrueggeman.com/nsf/fguide/index.html) and from Dr. Stacy Kim's SCINI expedition to Antarctica in October – December, 2007 (scini.mlml.calstate.edu) and from Mindy Bell's section of the Polartrec website (www.polartrec.com/Antarctic-undersea-rov/)
A simple key is provided to help teachers guide students to appropriate trophic relationships
Students can present their food web on a small white board, or make a poster with photos of

organisms or of illustrated organisms.

Assessment

Informal assessment of each student group as they present their food web. Did they identify eight to ten organisms and their trophic relationships? Did the students understand the roles of each organism in this polar undersea ecosystem?

Credits

Mindy Bell wrote this lesson based on similar activities she has previously done with students in the 6th to 12th grade. You can contact Mindy at mbell@apscc.org if you have questions about this lesson.

PolarTREC Learning Resources

National Science Education Standards (NSES):

Understandings about Scientific Inquiry
Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects of the natural world, explain recently observed phenomena, or test the conclusions of prior investigations or the predictions of current theories.
Scientists rely on technology to enhance the gathering and manipulation of data. New techniques and tools provide new evidence to guide inquiry and new methods to gather data, thereby contributing to the advance of science. The accuracy and precision of the data, and therefore the quality of the exploration, depends on the technology.
Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.

The Interdependence of Organisms
Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.
Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.

Other Standards:
Arizona State Science Standards
Strand 1: Inquiry Process
- Concept 1: Observations, Questions, and Hypotheses
  - PO 1. Evaluate scientific information for relevance to a given problem.
- Concept 4: Communication
  - PO 1. For a specific investigation, choose an appropriate method for communicating the results.
  - PO 3. Communicate results clearly and logically.
  - PO 4. Support conclusions with logical scientific arguments.

Strand 4: Life Science
- Concept 3: Interdependence of Organisms
  - PO 1. Identify relationships among organisms within populations, communities, ecosystems, and biomes.
- Concept 4: Biological Evolution
  - PO 4. Predict how a change in an environmental factor can affect the number and diversity of species in an ecosystem.
- Concept 5: Matter, Energy, and Organization in Living Systems
  - PO 4. Diagram the energy flow in an ecosystem through a food chain.

Antarctic Undersea Food Web Key

Producers
Phytoplankton – Diatoms
Ice algae
Benthic diatoms
Macroalgae (seaweed)

Zooplankton
Fish and invertebrate larvae
Foraminiferans
Radiolarians
Krill and copepods
Salps

Phylum Porifera - Sponges
Filter feeders of phytoplankton and zooplankton

Phylum Cnidaria, Class Anthozoa – Anemones and Coral
Anemones have stinging tentacles and some are carnivorous on fish, jellyfish, and starfish that get too close to their tentacles.
Most coral are filter feeders and suspension feeders. One soft coral, *Gersemia antarctica*, will bend over and feed on the detritus on the bottom of the seafloor! Soft coral will be eaten by nudibranchs (Phylum Mollusca, Class Gastropoda), and by Sea Spiders (Phylum Arthropoda, Class Pycnogonida).

Phylum Cnidaria, Class Scyphozoa – Jellyfish
Most jellyfish eat pelagic (free-floating) organisms including fish, pterapods (Phylum Mollusca), and euphausids (Phylum Arthropoda, Class Crustacea). Some, including *Desmonema glaciale,* will also eat benthic organisms including Nemertean worms (Phylum Nemertea) and Sea stars (Phylum Echinodermata, Class Asteroidea).

Phylum Annelida, Class Polychaeta
Polychaetes are a diverse group with many different feeding strategies. Some are filter feeders, other suspension feeders, some have mucus that traps food, others have eversible armed pharynxes and are predators. Therefore polychaetes eat a variety of organisms including plankton, algae, detritus, and small animals. Polychaetes are preyed on by some anemones, the Giant Antarctic Isopod and fish.

Phylum Annelida, Class Hirudinea
The Piscicolid Leech is a parasite that attaches to fish and is a blood sucker.

Phylum Nemertea
Nemertean worms are both predators and scavengers and will eat just about anything they can get their mouths on including sponges, jellyfish, diatoms, sea stars, anemones, polychaetes, mollusks, crustaceans

Phylum Mollusca, Class Gastropoda
Nudibranchs will eat soft coral.

Phylum Mollusca, Class Bivalvia
Scallops are generally filter or suspension feeders eating plankton.

Phylum Mollusca, Class Cephalopoda
Octopus will eat amphipods, polychaetes, fish, brittle stars. Giant Antarctic isopod and sea urchins.

Phylum Arthropoda, Class Crustacea
Crustaceans include amphipods, isopods, euphausids, shrimp, krill, ostracods, etc. One of the most diverse groups, the amphipods, vary from filter feeders to grasping prey such as polychaetes and even sea cucumbers. Amphipods are eaten by fish and squid.

Phylum Arthropoda, Class Pycnogonida
Sea spiders have been seen chewing on jellyfish that are trapped by anemones.

Phylum Echinodermata, Class Asteroidea – Starfish (Sea stars)
Sea stars are often predatory on scallops (Phylum Mollusca, Class Bivalvia), sponges (Phylum Porifera),
Sea stars are preyed on by some anemones and each other

Phylum Echinodermata, Class Holothuroidea – Sea cucumbers
Sea cucumbers are usually suspension feeders or detritivores.

Phylum Echinodermata, Class Ophiuroidea – Brittle stars
Brittle stars are usually scavengers or detritivores, and they eat a wide variety of organisms including plankton, tunicates, sponges, hydroids, bryozoans, sea urchins, bivalves, crustaceans, and other brittle stars. Predators include the largest brittle star, *Ophiosparte gigas*, and fish.

Phylum Echinodermata, Class Echinoidea – Sea Urchins
Sea urchins will eat sponges, diatoms, foraminifera, bryozoans, hydrozoans, polychaetes and amphipods.
Weddell seals will eat sea urchins.

Phylum Echinodermata, Class Crinoidea
Crinoids have feathery arms and are filter feeders of plankton.

Phylum Chordata, Subphylum Vertebrata, Class Osteichthyes – Bony fish
Fish in Antarctica eat amphipods, polychaetes, krill among other organisms. Fish are eaten by penguins, Weddell Seals, Sperm whales and Orcas.

Phylum Chordata, Subphylum Vertebrata, Class Aves – Penguins

Adelie Penguins eat primarily euphausids (70% of their diet) and also fish and squid.
Adelie Penguins are eaten by Leopard Seals.
Emperor Penguins eat fish, squid, euphausids, and amphipods.
Emperor Penguins are eaten by Leopard Seals.

Phylum Chordata, Subphylum Vertebrata, Class Mammalia – Seals and Whales
Weddell Seals eat fish
Leopard seals are the only seal that preys on warm-blooded animals like other seals.
Leopard seals will eat fish, penguins, seals, cephalopods (octopus and squid), krill, and seal and whale carcasses.
Killer Whales (Orcas) will eat seals.
Minke whales eat krill (euphasids).