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Charleston Bump Expedition

How Am I Supposed to Eat THAT?

Focus
Feeding adaptations among benthic organisms

Grade Level
7-8 (Life Science)

Focus Question
What physical feeding adaptations are found among benthic organisms typical of deep-water coral communities?

Learning Objectives
Students will be able to describe at least three nutritional strategies used by benthic organisms typical of deep-water coral communities.

Students will be able to describe physical adaptations associated with at least three nutritional strategies used by benthic organisms.

Materials
- ❒ Popped popcorn
- ❒ Circulating electric fan
- ❒ Protective eyewear
- ❒ Baseball gloves (optional)
- ❒ Materials for student-generated adaptations (optional)

Audio/Visual Materials
- ❒ Chalkboard, marker board, or overhead projector with transparencies for brainstorming sessions.

Teaching Time
One or two 45-minute class periods, plus time for group research

Seating Arrangement
Groups of 4-6 students

Maximum Number of Students
30

Key Words
Charleston Bump
Deep-water coral
Sponge
Feeding strategies
Filter feeding
Feeding adaptations

Background Information
The Blake Ridge is a large sediment deposit located approximately 400 km east of Charleston, South Carolina on the continental slope and rise of the United States. The crest of the ridge extends in a direction that is roughly perpendicular to the continental rise for more than 500 km to the southwest from water depths of 2,000 to 4,800 m. About 130 km east of the Georgia-South Carolina coast, a series of rocky scarps, mounds, overhangs and flat pavements rise from the surface of the Blake Plateau to within 400 m of the sea surface. This hard-bottom feature is known as the Charleston Bump. While the Blake Ridge has been extensively studied over the past 30 years because of the large deposits of methane hydrate found in the area, benthic communities on the continental shelf of the United States are virtually unexplored (visit http://198.99.247.24/scng/hydrate/about-hydrates/about_hydrates.htm for more information about methane hydrates and why they are important). Although this area has

been important to commercial fishing for many years, until recently it was generally assumed that benthic communities of the continental shelf were scattered and relatively unproductive,and that useful fisheries were the result of migrations from other areas and/or nutrients carried in from deeper or coastal waters. But once scientists actually began exploring the area more thoroughly, they found many diverse and thriving benthic communities.

As the Gulf Stream flows around and over the Charleston Bump it is deflected, producing eddies, gyres, and upwellings downstream (to the north). These kinds of water circulation patterns are associated with increased concentrations of nutrients and marine organisms in many other areas of the Earth's oceans, and may be an important factor to the productivity of the southern U.S. continental shelf.

The 2001 "Islands in the Stream" Expedition to the Charleston Bump found a series of very complex habitats, and numerous fishes and invertebrate species involved in communities that we are just beginning to understand. (Visit http://oceanexplorer.noaa.gov/explorations/islands01/log/sab_summary/sab_summary.html, and click on logs from September 27, 28, and 29 for more information). These organisms have a variety of physical adaptations that enable them to use various nutritional strategies. In this activity, students will investigate these strategies and adaptations, and will use this information to infer adaptations that might improve the feeding efficiency of an experimental organism (themselves).

Learning Procedure

[NOTE: Portions of this activity were adapted from "Why we aren't filter feeders…" by Naturalists at Falls of the Ohio State Park, Clarksville, Indiana, on the Geologic and Paleontologic Cook Book website. Visit http://www/uky/edu/KGS/education/cookbook.html for more edible education ideas!]

1. Lead an introductory discussion of the Charleston Bump and the 2001 and 2003 Ocean Exploration expeditions to the area. The website for the 2001 Islands in the Stream expedition is: http://oceanexplorer.noaa.gov/explorations/islands01/log/sab_summary/sab_summary.html; click on logs from September 27, 28, and 29. The website for the 2003 Charleston Bump expedition is: http://oceanexplorer.noaa.gov/explorations/explorations.html; click on "Charleston Bump." You may want to show students some images from the Ocean Explorer website and/or http://pubs.usgs.gov/of/of01-154/index.htm.

   Tell students that detailed surveys of the Charleston Bump are just beginning, but we can have a general idea of what to expect based on explorations in other deep-water, hard-bottom habitats. Preliminary observations on the Charleston Bump in 2001 revealed a variety of complex communities involving a variety of different organisms and habitats. Animals in these communities typically use a variety of feeding strategies that often involve specialized physical adaptations that allow the animals to efficiently use a particular type of food. Tell students that their assignment is to investigate these strategies and adaptations, and to use this information to design adaptations that could make them (the students) more efficient filter-feeders.

2. Tell students that we will begin this activity with a demonstration of human abilities as filter feeders.

   Students should be spread out so they are just beyond hand-to-hand with their arms outstretched (baseball gloves optional). Some students should sit on the floor, others should stand behind them. Use a circulating fan set on its highest setting and gently pour popcorn directly in front of the fan so it sails through the air. (You may want to practice without students first, so you can place them at the proper distance.) Students can move their arms (but cannot move their body) up and down/

back and forth, but cannot grab popcorn that is beyond their grasp. They can either eat any popcorn they catch or hold and count it (i.e. on a paper plate) in order to see who caught the most food. To prevent choking, discourage students from catching popcorn with their mouths.
– from "Why we aren't filter feeders…" by Naturalists at Falls of the Ohio State Park, Clarksville, Indiana.

Be sure students use protective eyewear during the above activity!

You may also want to have the students do the companion activity on scavenger feeding described on the same web page (see Resources).

3. Tell student groups that their assignment is to
   - Find out what sorts of organisms are typical of deep-water coral communities;
   - Identify at least three different feeding strategies found among these organisms; and
   - Identify what physical adaptations allow organisms to use these strategies.

   Trip logs from the 2001 Islands in the Stream Expedition are a good starting point, and general descriptions of these communities can be found at http://southeast.fws.gov/vbpdfs/commun/reef.pdf, and http://www.fnai.org/dev/PDF/Natural_Communities_Guide.pdf. You may also want to have students find pictures or illustrations of these organisms from printed reference books, the Ocean Explorer Gallery (http://oceanexplorer.noaa.gov/, click on "Gallery") and/or http://biodicac.bio.uottawa.ca.

   Lists of typical organisms should include soft corals (such as gorgonians, sea fans, sea feathers, sea fingers, sea pansies, sea plumes, sea rods, sea whips), sea anemones, sponges, mollusks, tube worms, burrowing shrimp, crabs, isopods, amphipods, sand dollars, and fishes. Feeding strategies may include filter feeding (suspension feeding), deposit feeding, scavenging, grazing (i.e., scraping organic material from living or non-living surfaces), and carnivory.

4. Have each group present their research findings. Discuss and list the feeding strategies and their associated physical adaptations. Lead a discussion of which strategies seem most prevalent, and why this is the case. Students should recognize that photosynthesis is virtually absent in deep-sea communities because these communities receive very little light. However, photosynthesis is still an important source of nutrition in these communities due to the influx organic material produced by photosynthesis in shallower water. Similarly, the remains of dead organisms that inhabit shallower waters settling to the bottom provide another source of nutrition that originates outside the deep-sea communities.

5. Have students brainstorm about adaptations they might use to make themselves more efficient filter feeders based on adaptations used by other filter feeding organisms. Strainers, nets, and/or sticky substances (e.g., masking tape wound around hands with the sticky side out), for example, may be suggested as analogous to gills and mucous nets. You may want to offer an opportunity to test these ideas by repeating Step 2 with the addition of one or more suggested adaptations. Retaining the pieces of popcorn (rather than eating them immediately) provides an objective means for evaluating potential improvements to feeding efficiency.

The BRIDGE Connection

www.vims.edu/BRIDGE/ – Click on "Ocean Science" in the navigation menu to the left, then "Biology," then "Invertebrates," then "Other Inverts," for resources on corals and sponges. Click on "Ecology" then "Deep Sea" for resources on deep sea communities.

The "Me" Connection

Have students write a short essay describing their own nutritional strategy and the physical adaptations that enable them to use this strategy.

Connections to Other Subjects

English/Language Arts

Evaluation

You may want to have students prepare written reports (either individually or in groups) prior to the group discussion in Step 4. You may also want to have them include ideas for adaptations discussed in Step 5.

Extensions

Log on to http://oceanexplorer.noaa.gov to keep up to date with the latest Charleston Bump Expedition discoveries, and to find out what researchers are learning about deep-water hard-bottom communities.

Log onto http://www/uky/edu/KGS/education/cookbook.html for more edible education ideas.

Resources

http://oceanica.cofc.edu/activities.htm – Project Oceanica website, with a variety of resources on ocean exploration topics

http://pubs.usgs.gov/of/of01-154/index.htm – U.S. Geological Survey Open-File Report 01-154 "Sea-Floor Photography from the Continental Margin Program"

http://oceanexplorer.noaa.gov/explorations/islands01/log/sab_summary/sab_summary.html – Summary report of the 2001 Islands in the Stream Expedition

http://www.fallsoftheohio.org/education/filter-feeders.html – Activities on scavenger feeding and filter feeding upon which Step 2 is based.

http://southeast.fws.gov/vbpdfs/commun/reef.pdf – U.S. Fish and Wildlife Service report on coral communities on the continental shelf

http://www.fnai.org/dev/PDF/Natural_Communities_Guide.pdf – Guide to the natural communities of Florida, including a general description of octocoral communities

http://www/uky/edu/KGS/education/cookbook.html – The Geologic and Paleontologic Cookbook

National Science Education Standards

Content Standard A: Science As Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard C: Life Science

- Structure and function in living systems
- Populations and ecosystems
- Diversity and adaptations of organisms

Content Standard F: Science in Personal and Social Perspectives

- Populations, resources, and environments

For More Information

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