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Northwestern Hawaiian Islands Exploration

The Odd Couple

Focus
Symbiotic relationships

Grade Level
5-6 Life Science

Focus Question
Why do some hermit crabs have sea anemones attached to their shells?

Learning Objectives
Students will be able to define and describe symbiotic, mutualistic, commensal, and parasitic relationships between organisms.

Students will be able to describe the benefits of a mutualistic relationship between hermit crabs and sea anemones.

Additional Information for Teachers of Deaf Students
In addition to the words listed as key words, the following words should be part of the vocabulary list.
Atoll
Nautical
SCUBA
Exploration
ROV
Coral
Consumed
Capable
Predator
Infer
Tentacles
Predator
Nematocysts
Toxins

The words listed as key words are important to the unit. There are no formal signs in American Sign Language for any of these words and many are difficult to lipread. Having the vocabulary list on the board as a reference during the lesson will be extremely helpful. Also give the list as a handout to the students to refer to after the lesson.

Print the Northwestern Hawaiian Islands Expedition log entries for September 17-20, 2002 (see http://oceanexplorer.noaa.gov/explorations/ 02hawaii/welcome.html), and hand out to be read as homework prior to the activity. Copy the definitions listed in Part 2 of the Learning Procedure and distribute as a handout. Include the "Me" Connection as a classroom discussion rather than a short essay. This can also be used as an evaluation tool.

Materials
❒ "The Odd Couple Investigation" Worksheets, one for each student

Audio/Visual Materials
None

Teaching Time
One 45-minute class period, plus time for research (may be done as homework)

Seating Arrangement
Groups of two students

Maximum Number of Students

32

Key Words

Symbiotic
Mutualistic
Commensal
Parasitic
Nematocyst

Background Information

Nearly 70% of all coral reefs in U.S. waters are found around the Northwestern Hawaiian Islands, a chain of small islands and atolls that stretches for more than 1,000 nautical miles (nm) northwest of the main Hawaiian Islands. While scientists have studied shallow portions of the area for many years, almost nothing is known about deeper ocean habitats below the range of SCUBA divers. Only a few explorations have been made with deep-diving submersibles and remotely-operated vehicles (ROVs), but these have found new species and species previously unreported in Hawaiian waters.

The Northwestern Hawaiian Islands are regularly visited by Hawaiian monk seals, one of only two species of monk seals remaining in the world (the Caribbean monk seal was declared extinct in 1994). Waters around the Northwestern Islands may be an important feeding area for the seals, which appear to feed on fishes that find shelter among colonies of deep-water corals. These corals are also of interest, because they include several species that are commercially valuable for jewelry. The possibility of discovering new species also has commercial importance as well as scientific interest, since some of these species may produce materials of importance to medicine or industry.

The 2002 Ocean Exploration Expedition to the Northwestern Hawaiian Islands included mapping the previously-unexplored deep-sea regions around the islands; investigations of deepwater fishes and corals; exploration of deepwater habitats; and studies of ecological relationships between monk seals and the deepsea environments of the Northwestern Islands. On September 20, 2002, scientists aboard the deep-diving submersible Pisces IV observed and photographed a hermit crab with what appeared to be several sea anemones attached to its shell. While none of the Expedition scientists were able to identify the species of these animals, associations between hermit crabs and sea anemones are one of the classic examples of symbiotic relationships between marine organisms. This activity focuses on the hermit crab-sea anemone symbiosis.

Learning Procedure

1. Introduce the location of the Northwestern Hawaiian Islands, and point out some of the features that make this area important (discussed above). Have students read the Northwestern Hawaiian Islands Expedition log entries for September 17-20, 2002 (you may want to have this discussion in the latter half of one class period, and assign the log readings as homework in preparation for the remainder of the activity.)

2. Call students' attention to the observation of the hermit crab and cnidarian described in the September 20 log entry. Ask students to speculate on why these animals are so closely associated. Students should infer that at least one of the organisms is receiving some benefit from the association. Introduce the following relationships between organisms:

symbiotic – a relationship in which two organisms exist in close association, which may or may not benefit both organisms

mutualistic – a relationship between two organisms in which both organisms benefit

commensal – a relationship between organisms in which one organism benefits and the other is not affected

parasitic – a relationship between organisms in which one organism benefits and the other is harmed

3. Have students research answers to questions on "The Odd Couple Investigation" Worksheet using classroom references, school or public library resources, or the Internet (this research may be assigned as homework or work in-class). Suggest that one member of each group research answers to questions about hermit crabs, and the other member find answers for sea anemones. Students may find reference materials that specifically describe the hermit crab-sea anemone symbiosis.

4. Have students pool their answers, and lead a discussion of the potential benefits of the symbiosis to the hermit crab and the sea anemone. Be sure students realize that the hermit crab lives in a borrowed shell, often formerly occupied by a mollusc. Students should recognize that the anemone benefits by having a source of transportation, and may also receive a nutritional benefit from food scraps that escape the crab's feeding activities. A sea anemone is capable of moving on its own by alternately attaching to the substrate with its tentacles and pedal disk in a sort of cartwheeling motion, but it is a very slow process.

The primary benefit to the hermit crab is protection from predators. Students should recognize that the crab is prey to fishes and octopi, and typically retreats into its borrowed shell for protection. The octopus, however, has a strong beak that is capable of crushing mollusc shells, and the entrance to octopus dens are often marked by numerous fragments of shells that contained former meals. Sea anemones (and cnidarians in general) are equipped with stinging cells called nematocysts that may contain powerful toxins (the deadly sea wasp jellyfish is an extreme example). Octopi and many fishes are sensitive to these toxins, and the anemone is capable of delivering a discouraging sting to potential crab predators.

Call students' attention to the fact that the hermit crab must periodically move into a larger shell as it grows, and ask what happens to the sea anemone when the crab changes shells? A striking fact about this relationship is that when some hermit crabs change their shells, they take their anemones along! The crab causes the anemone to release its attachment to the old shell by stroking the column of the anemone, then brings the anemone close to the new shell. The anemone holds onto the new shell with its tentacles until it re-attaches its pedal disk, then the happy couple is off again!

The BRIDGE Connection

http://www.vims.edu/bridge/otherinverts.html

The "Me" Connection

Have students write a short essay describing a symbiotic relationship that they personally have or have had with another species.

Connections to Other Subjects

English/Language Arts

Evaluation

Have students submit the worksheets completed in Step #3 prior to pooling their results. You may also wish to have students prepare a written analysis of the hermit crab-sea anemone symbiosis prior to the group discussion.

Extensions

Visit http://explorers.bishopmuseum.org/nwhi/geoact.shtml for others activities relevant to the Northwestern Hawaiian Islands.

Resources

http://oceanexplorer.noaa.gov – The Ocean Expeditions Web site

http://www.aqua.org/animals/species/pranem.html – The National Aquarium Web page on sea anemones

http://www.museum.vic.gov.au/crust/hermbiol.html – Web page on hermit crabs

http://www.bigelow.org/reefwatch2001/activities/grades2-5/reef_partnership.PDF – Another activity on symbiotic relationships

http://www.pbs.org/wgbh/nova/teachers/activities/2609_abyss.html – NOVA online activity on symbiotic relationships

http://www.hawaiireef.noaa.gov/maps/maps.html – Information about the Northwestern Hawaiian Islands region

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

- Regulation and behavior

For More Information

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Student Handout

The Odd Couple Investigation Worksheet

What types of food are consumed by hermit crabs?

What predators or other enemies do hermit crabs have?

How does the hermit crab protect itself from its enemies?

Where does the hermit crab get its shell?

What types of food are consumed by sea anemones?

What predators or other enemies do sea anemones have?

How do sea anemones protect themselves from their enemies?

Are sea anemones capable of moving from place to place?