Plant or animal?

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*****Note: Figures may be missing from this format of the document**

MOST SECONDARY SCIENCE students can readily distinguish between common plants and animals. Many species of marine animals, however, are unfamiliar to students and have characteristics that make it difficult to classify them by casual observation alone, leading students to wrongfully assign them to the plant kingdom. Using these organisms in the classroom can help students build classification skills and illustrate some of the less obvious differences between plants and animals.

When students are presented with specimens of organisms with which they are unfamiliar, they may attempt to rely on casual observations about physical appearance or behavioral patterns, such as apparent degree of motility and method of obtaining food, in order to classify the organisms as plants or animals. Using these methods, many types of branched, stalked, colonial, flowerlike, or sessile marine organisms will be incorrectly identified as plants.

A brief look through any field guide of marine organisms will show a wide range of animals that resemble plants in external appearance. The Audubon Society Field Guide to North American Seashore Creatures (Meinkoth, 1981) groups organisms into the sections "Plantlike Animals" and "Flowering Animals." It is a good reference for designing activities that address the proper classification of these organisms, although any good field guide will contain ample lists of species to explore in lab activities.

The following activities illustrate the differences between plants and plantlike animals and stress the importance of observing, asking questions, and hypothesizing. These activities also invite comparisons about the mechanisms by which sessile plants and animals deal with common problems such as obtaining energy, defending themselves, successfully reproducing, and dispersing their offspring. Activity I requires a minimum of two class periods to complete but requires additional time if students design and carry out their own lab experiments. Activity II can be done in three or four class periods or can be conducted during a field trip to the beach.

ACTIVITY I

Part A. Collect pictures of marine animals that look like plants and pictures of some common plants and animals with which students may already be familiar. Many members of the phyla Cnidaria (particularly the hydrozoans and anthozoans), Bryozoa, Annelida, and Echinodermata look like plants at first glance.

Pictures can be obtained by cutting up field guides, posters, scuba diving magazines, or outdated biology textbooks. Be sure to conceal the names of the organisms but keep samples or extra field guides for identification later. Pictures can be laminated for extra durability.

Divide students into groups of two or three, give each group 10 pictures to examine, and ask them to classify the organisms as plants or animals. After students have completed their task, ask each group to record the characteristics that they used to divide their pictures into separate groups. Compile a list of ideas from all groups and discuss the value of each observation as a tool for classifying the organisms. Ask students which organisms were the most difficult to classify and why.

FIGURE 1.

Plant characteristics versus animal characteristics.

Plant characteristics:

1. Cell wall made of cellulose.
2. Production and storage of starch.
3. Presence of chlorophyll in chloroplasts.
4. Supported by turgor pressure, cell walls, and lignified secondary cell walls (in woody plants).
5. Autotrophic.

Animal characteristics:

1. Absence of cell wall.
2. Production of glycogen instead of starch.
3. Absence of chlorophyll and chloroplasts.
4. Supported by hydrostatic skeleton, chitonous exoskeleton, protein axial skeleton (spongin, gorgonin), or mineralized endoskeleton (bone, spicules).
5. Heterotrophic—capture and eat food.

Part B. Have each group try to design methods of observation and experimentation that go beyond physical appearance and might make it easier to distinguish between plants and animals. Ideas like "see if it can make its own food," "see if it moves," "see if it is attached to the ground," "dissect it," "look at its cells under a microscope," and "test its chemical makeup" may surface. Students may design their own experiments to test their hypotheses on living specimens.

Part C. At this point you may want to consult a biology text and discuss the taxonomic distinctions between plants and animals (Figure 1). Compare students' ideas from Parts A and B with the characteristics that taxonomists use to divide plants and animals into separate groups. Have students divide the pictures into a plant group and an animal group using these descriptions and compare their new grouping to the classification they made in Part A. Did the textbook descriptions help students achieve better success? Do not disclose the identities or real nature of any organisms at this point.

ACTIVITY II

Part Present living or preserved animals that look like plants to each group for inspection and have students attempt to classify them as plant or animal. Students have more success using actual specimens rather than pictures and can follow up on some of the ideas they formulated in Part B of Activity I. Sample organisms can be obtained from supply houses or collected while beachcombing. Collected organisms can be kept alive if placed in a cooler full of seawater with a battery-operated aerator. Instructors and students should carry out field activities in a manner that will cause minimal impact to fragile habitats and should be aware of any federal or

state laws governing the collection of marine organisms. Students should also be cautioned against stepping on organisms and overcollecting.

Part B. Have students observe the zooids of bryozoan colonies under a hand lens or dissecting microscope.

Living zooids observed in a wet deep-well slide will often extend their lophophores if the slide is kept very still (Headstrom,1941). Students should recognize the zooid's waving tentacles as an animal feature.

Bryozoans, or moss animals, can be found attached to rocks or shells in shallow marine areas or washed up on shore attached to driftwood and algae such as Fucus (Lincoln and Sheals, 1979), but they are small and often unnoticed. Individuals, or zooids, may be only 0.5 millimeters long (Gosner,1971), but their colonial nature and the bushy appearance of some species make them easier to spot (Alexander, 1979). Two of the more common species of the Atlantic coast are Bugula neritina, a purple, bushlike species found near the low tide mark, and Amanthia distans, often found attached to docks, piers, or oyster reefs (Ruppert and Fox,1988). Bryozoans not only resemble plants but also use chemical defenses, as do many plants, to avoid being eaten (Reed, 1991).
Part C. Hydroids may be observed in a similar manner. Have students look for the tentacles and the contractions and expansions of the individual polyps in the colony (Buchsbaum, et al. 1987). Hydroids are very common and can be found attached to almost any solid object that remains continually submerged or on algae that wash ashore. Snail fur (Hydractinia echinata) is often found on shells inhabited by hermit crabs, while feather hydroids (Halocordyle disticha), Obelia species, fern hydroids (Sertularia marginata), and Tubularia species are often attached to rock jetties or dock pilings on the southeastern Atlantic coast (Ruppert and Fox, 1988). When possible, a class trip to the ocean to look for and observe these animals is the best bet.

Part D. Compare the cellular structure of bryozoans and hydroids to that of common plants. Plant cells have cell walls while animal cells do not.

Part E. Obtain a dried and preserved sea fan (Gorgonia species) or sea whip (Leptogorgia virgulata and L. setacea). Sea whips may wash up on beaches from New Jersey to Florida, while sea fans are common on tropical beaches (Amos and Amos, 1989).

Have students soak a piece of the "stem" in a few drops of bleach on a microscope slide for a minute or so to reveal the calcium carbonate spicules that make up a portion of sea fan and sea whip skeletons (Kinzie,1982; Cosner,1971). Observe under a microscope at 100 times magnification to see the different types of spicules (Gosner,1971). Similar treatment of plant tissue will not reveal spicules, which are an animal feature. If two species of gorgonians can be obtained, have students compare the spicules from each type, which should be different. Taxonomists use the shape, size, color, and arrangement of spicules to classify these organisms (Lewis and Von Wallis, 1991).

Part F. Octocorals, such as sea fans and sea whips, also have a central supporting rod made of gorgonin, a protein material, in addition to spicules. Plants have no similar structure, although the gorgonin axis does show growth rings (Kinzie, 1982). The living tissue covers these layers and rots away after the organism is washed ashore.

Have students burn a small piece of dried sea fan and compare it to the smell released from burning wood. Gorgonin, a protein, is rich in sulfur, iodine, and bromine, while wood is made of cellulose and lignin (Kinzie, 1982). Burning gorgonin smells like burning hair, illustrating a chemical difference between these animals and members of the plant kingdom.

After observing chemical and physical differences between common plants and plantlike animals, you may wish to discuss their apparent similarities in further detail. Have students compare branching patterns in plants and plantlike animals. Ask students why it is advantageous for these animals to form branching colonies. In

plants, branching creates more surface area for the collection of light, while animals who branch can collect more food as currents flow around them.

Discuss the problems of a sessile lifestyle for plants and plantlike animals. How do these organisms overcome problems such as dispersal of reproductive cells and larvae, collection of food, and avoidance of predators? After completing the preceding exercises, students will understand more about the differences between plants and marine animals, have improved their observational skills, know more about diversity in the animal kingdom, and know how to use scientific techniques to answer questions. They should also be aware that apparent similarities between these two groups of organisms may represent evolutionary responses to similar problems such as energy procurement or defense. They should now realize that physical appearance is not the only criterion for classifying an organism as a plant or an animal.

REFERENCES

Alexander, R. M. 1979. The Invertebrates. Cambridge: Cambridge University Press. Amos, W. H. and S. H. Amos. 1985. The Audubon Society Nature Guides: Atlantic and Gulf Coasts. New York: Alfred E. Knopf. Buchsbaum, R., M. Buchsbaum, J. Pearse, and V. Pearse.1987. Animals Without Backbones. 3d ed. Chicago: University of Chicago Press. Gosner, K. L. 1971. Guide to Identification of Marine and Estuarine Invertebrates: Cape Hatteras to the Bay of Fundy. New York: John Wiley and Sons. Headstrom, R. 1941. Adventures with a Microscope. New York: Dover Publications. Kinzie III, R. 1982. "Soft Corals." in A Field Guide to Coral Reefs of the Caribbean and Florida. Ed. E. H. Kaplan. Boston: Houghton Mifflin. Lewis, J. C. and E. Von Wallis. 1991. The function of surface sclerites in gorgonians (coelenterata, octocorallia). Biological Bulletin 181: 275-288. Lincoln, R. J. and J. G. Sheals. 1979. Invertebrate AnimalsCollection and Preservation. London: British Museum (Natural History) Cambridge University Press. Meinkopf, N. A. 1981. The Audubon Society Field Guide to North American Sea Shore Creatures. New York: Alfred A. Knopf. Reed, C. G. 1991. Turbulent world of moss animals. Natural History April, 1991, 41-46. Rupert, E. and R. Fox. 1988. Seashore Animals of the Southeast: A Guide to Shallow-Water Invertebrates of the Southeastern Atlantic Coast. Columbia, S.C.: University of South Carolina Press.