How-To-Do-It

Is There Life Among the Plants?

Patsye D. Peebles
William H. Leonard

Do your students start yawning when they hear the words "mosses," "ferns," "fungi" and "life cycles?" Are you looking for a way to break the monotony and get out of the classroom into the field? Traditional presentations of the fungi and the simpler plants seem very dry, dull and irrelevant to students who often can't even identify the common forms of these organisms that they see every day.

This unit of activities was developed to provide a more interesting and meaningful way to study these organisms. It integrates the concepts of adaptation to environment, evolutionary development and life cycles of plants in a discovery learning format. The activities were designed using the extended discretion method (Leonard 1980, 1981). This approach is an attempt to get away from the rigidity of "cookbook" labs and to encourage the student to extend his ability to plan and carry out investigations on his own. The process also aids in developing the scientific patterns of thought. This unit of investigations incorporates the inquiry mode of teaching and helps to develop a higher level of skills, including the acquisitive, organizational, creative, manipulative and communicative skills. As Yager (1981) states, "Scientific information is valuable only if learned *and* used." Activities such as these allow students to develop a broader conceptual understanding of how the different foci in biology fit together in the world of nature. When these concepts are developed by the student, rather than the teacher, they will have far greater meaning.

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Patsye Dickinson Peebles teaches biology and life science at Runnels High School, 17255 S. Harrell's Ferry Rd., Baton Rouge, LA 70816. She received her B.S. in Biology and Chemistry from the Univ. of Arkansas at Monticello in 1967, and is currently working toward an M.A. in Science Education at LSU. She is a member of NABT, NSTA and LSTA. **William H. Leonard** is an associate professor at Louisiana State Univ., Baton Rouge, LA 70803, appointed jointly in the Dept. of Zoology and Physiology and the Dept. of Curriculum and Instruction. He earned his B.A. and M.A. in Biology at San Jose State Univ. and his Ph.D. in Biology Education at the Univ. of California at Berkeley. He taught high school biology for 13 years and also taught biology at the Univ. of Nebraska. Much published, Leonard's most recent article "The Question Is Where Should the Questions Be?" appeared in the April 1986 issue of *ABT*. He is an active NABT member, serving as Region VI coordinator and chair of the Scientific Integrity Committee.

Planning

The anticipated class time needed for the activities is one week, and the most appropriate time of year would be spring, although the fall in most areas of the country, and even winter in the south would be fine. In preparation for the first investigation, the teacher must survey the area to ensure a suitable variety of organisms. If the school grounds do not offer variety, perhaps a trip could be made to a nearby park or wooded area. The day before the first investigation, the students should plan a collecting procedure which produces a wide variety of fungi and plants.

At this time, pictures of the different organisms that might be found can be displayed on the bulletin board without names. These might include, according to your area, the larger green algae, bracket fungi, mushrooms, puffballs, lichens, liverworts, mosses, ferns, horsetails, club mosses, and even psilopsids if you live in southern Florida or some Gulf coast regions. Even if the last three aren't found in your area, it would be useful to include them in the display for their place in the developmental scheme. Be sure to point out to students the caution about touching their mouths or faces during the collection period and while handling the specimens. The students should also learn to quickly recognize poison oak, ivy and sumac (whichever are in your area) and not make contact with these plants. They should also be instructed to preserve the environment as much as possible by not tearing up large clumps of plants or indiscriminately disturbing the area. Organisms should be gently teased or dug out in small samples, and the area reconstructed.

The activity sheets given to the students are as follows:

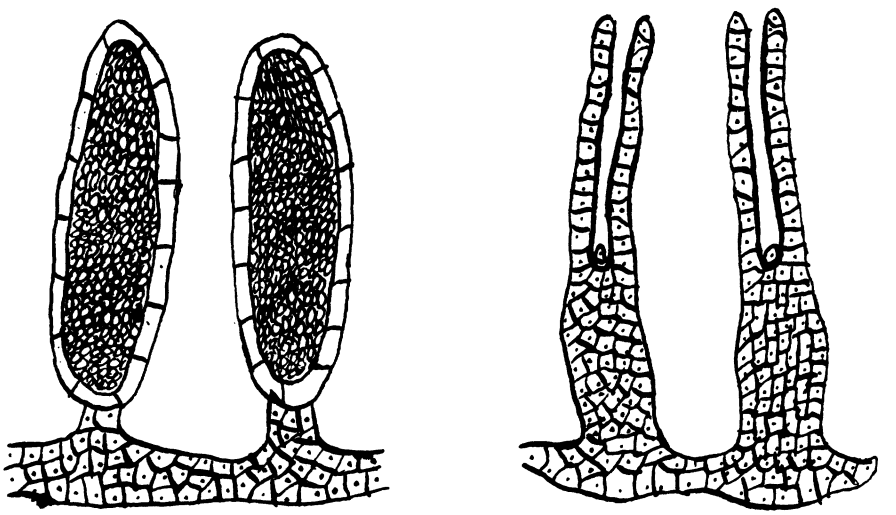

Figure 1.

INVESTIGATION 1: A FIELD AND LAB STUDY OF LESS COMPLEX PLANTS AND FUNGI

GOALS: to observe mosses, liverworts, ferns, fungi, lichens and small nonseed-bearing plants of various kinds in their natural habitat; to collect specimens and identify them; and to hypothesize how the characteristics of the organisms determine their habitat.

CAUTION—Remember that some organisms might be poisonous. Wash your hands after handling specimens, and don't put your hands around your mouth or face during collection.

STEPS: REVIEW POINTS

1. Plan a procedure for collecting, labeling and describing the location of each specimen. _____
2. Collect samples from area designated by teacher.
3. Return to classroom, where each person will be assigned to a group. The group should put their specimens together and identify as many organisms as possible. _____
4. Examine the structure of each different organism found by your group, and working individually, relate the structure to the habitat in which the organism was found. Determine possible needs of each organism and tell how the environment meets those needs. _____
5. Write a report including collecting procedure, number and kinds of organisms found by your group, and your conclusions from step 4.

RESOURCES:

1. Time: Three days.
2. Materials: bags, cups, tape, digging tools (trowels, metal forks, toothpicks), hand lenses, dissecting microscope, bulletin board.
3. *Reference A* is a list of questions to answer about each organism. The answers will aid in identifying the group to which each specimen belongs using *Reference B*, a chart giving some characteristics for the different organisms.

We will be studying the less complex plants. Do not collect seed-bearing plants, either conifers or flowering plants, or microscopic specimens, such as pond scum.

REFERENCE A

1. What is the size of the organism?
2. Does it contain chlorophyll?
3. Does it live in water? in a damp place.
4. Do many of the organisms live close together and bunched up?
5. Does it grow on rotting wood and leaves?
6. Does the organism have true roots, stems and leaves?
7. Does it grow from a horizontal underground stem?
8. Does it have hair-like projections instead of roots?
9. Does the organism appear to have spores?
10. Does the organism appear flat and scale-like with some green areas?
11. Does it appear as branching masses of green tissue with no stems or leaves?
12. Does it have forking stems without leaves?
13. Does it have hollow jointed stems with small leaves arranged in a circle around stem joints?
14. Does it have club-like cones at the tip of the branches?

Application and Variations

Even if a field trip to collect specimens is impossible for your class, the activity can still be done using teacher-collected specimens. If it is done in this way, be sure to include information about where the organism was or might be found, preferably with pictures of the habitat. Most classes can at least collect their own moss, as few school grounds would not have one or more areas where it is found. You might have a complete school collection available so you can draw from it to fill voids in student collections.

If you have a large group of students, you can assign them to groups before the collection field trip instead of afterwards. This will decrease the number of specimens needed and minimize the impact on the environment. During the collecting you can probably expect some small angiosperms to be included mistakenly in the specimens. Even this is useful, because angiosperms will serve as a contrast to the less complex plants. If questions about conclusive identification come up, a useful reference for the teacher would be Jacques' field guide, *Living Things—How To Know Them.* If other investigations are desired, they can be planned around the different organisms collected, such as the fungi.

Investigation 2 is not set up to produce certain "correct" answers. You will be interested in the methods used to determine an order of complexity, and the development of the students' thought processes. If students produce varying lists, this could be the basis for profitable classroom discussion. If predetermined results are desired, Investigation 5.2 from BSCS *Biological Science: An Ecological Approach* (1978) can be adapted for use with the collected specimens. It contains a chart and method for determining complexity, which should produce more focused answers.

By the time you get to Investigation

3, fresh specimens of moss may need to be supplied. Be sure the specimens available have both gametophyte and sporophyte generations.

I hope that these activities will be helpful to you in involving students in the search for science knowledge, in developing their science skills, and in motivating them to "make sense" of what they are learning.

References

BSCS. (1978). *Biological science: An ecological approach*. Chicago: Rand McNally & Co.

Jacques, H.E. (1947). *Living things—how to know them*. Dubuque, IA: William C. Brown, Co.

Leonard, W.H. (1980). Using the extended discretion approach in biology laboratory investigations. *The American Biology Teacher*, *42*, 6.

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REFERENCE B

mosses	green; no vascular tissue; grow in damp shady areas; grow in clumps or masses; found on trees and rocks as well as ground; leaf-like structures attached spirally on central axis; need water for sexual reproduction; hair-like rhizoids instead of roots; reproduces by spores on separate part of plant.
ferns	green; vascular tissue; true root, stems and leaves; spores on back of fronds on some specimens, branching leaves with many leaflets; usually found in damp areas.
green algae	bright green; live in water or very damp areas; often look like small seaweed.
fungi	mushrooms; puffballs; bracket fungi; no chlorophyll; may be various colors; no vascular tissue; live in damp areas and rotting wood and leaves; produce spores.
lichens	algae and fungi living together; grayish with some green; flat and crusty, flat and leathery, or may have network of slender branches; grow on tree trunks and rocks.
liverworts	deep green, flat leaf-like structures without central vein; either stem-like or masses of tissue; damp shady places; no vascular system; rhizoids instead of roots; need water for sexual reproduction; spores often present.
horsetails	have vascular system; produce spores; hollow jointed stems with small leaf-like structures arranged in a circle around stem joints; true roots.
club moss	small; vascular; spores sometimes present; evergreen-looking with underground stem instead of true root.
psilopsida	vascular system present; spores sometimes present; forking stems without leaves; grow in warm areas; no true roots.

INVESTIGATION 2: COMPLEXITY COMPARISONS

BACKGROUND: Biologists believe that species living today are related to each other through their ancestors. Some species have less structural complexity than others and are less related to more complex organisms. Those that are more evolved are considered more complex.

GOAL: to arrange the previously collected organisms from less to more complex.

STEPS:

REVIEW POINTS

1. Using the organisms collected and identified in the last investigation, examine the characteristics of each and list them in order from less complex organization to more complex organizaton.
2. Write a report giving your list and explaining your reasons for placing the organisms as you did.

RESOURCES:

1. Time; one class period.
2. Below is a chart of traits arranged roughly according to complexity. Traits found in more primitive organisms are on the left and traits of more advanced organisms are on the right.

SIMPLER ORGANIZATION	MORE COMPLEX ORGANIZATION
smaller in size	larger
chlorophyll absent	chlorophyll present
no vascular tissue	vascular tissue
location: water ..... rotting wood or leaves	damp place ..... dry land
spore-producing	seed-producing
no roots ..... hair-like projections	underground stem ..... true roots and stems
flat, scale-like gray-green ..... fleshy, branching tissue masses, green	stems or stem-like structures

tion. *The American Biology Teacher, 43,* 5.
Yager, R.E. (1981). The laboratory in science teaching: Main course or dessert? In Trowbridge, et al., *Becoming a Secondary School Science Teacher,* Charles E. Merrill Publishing Co.

INVESTIGATION 3: SEX AMONG THE MOSSES—ALTERNATION OF GENERATIONS

GOALS: to examine moss plants macroscopically and microscopically; to observe the reproductive structures and distinguish between them; to identify gametophyte and sporophyte plants; and to draw a diagram showing alternation of generations in moss plants.

STEPS: REVIEW POINTS

1. Examine the moss plants with hand lens and dissecting microscope, sketch and label the sporophyte and gametophyte generations. _____
2. Prepare and examine gametophyte tips to find the two different types, the antheridium (sperm producing organ) and archegonium (egg producing organ). Make a sketch of each and label. _____
3. Prepare and examine the spore capsule of the sporophyte. Sketch what you see. _____
4. Draw a diagram showing the life cycle of the moss.
5. Turn in your diagram and sketches.

RESOURCES:

1. Time: one class period.
2. Materials: standard microscopic equipment.
3. Techniques:
   A. *How to prepare gametophyte tips.* Cut a 1 cm portion of the tip of the plant. Use tweezers to remove the leaf-like structures along the stem but *not* the structure at the tip. Place the tip on a slide. (You can place several tips on one slide.) Cut off the "stem" with a razor blade 0.5 cm from the tip, and leave only the tips on the slide. Place 2-3 drops of water on each, place a second slide on top of the first slide, and press down with your thumb to slightly squash tips. Examine under low power of microscope.
   B. *How to prepare sporophyte capsule.* Mount the capsule at the end of the stalk in several drops of water between two slides as indicated in procedure for gametophytes. Examine under low power. If no spores are seen, try another capsule.
4. To distinguish between antheridium and archegonium, compare with diagrams in Figure 1.
5. References: Biology textbook.