High School Botany Course Emphasizes Herbarium Techniques

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MOST PEOPLE don't know a walnut from a hemlock, and too many are not even familiar with local plants that cause dermatitis, like poison ivy or poison sumac. For typical students in an introductory college botany course, the instructor might as well be talking about Martian life forms when he mentions Acer or Equisetum because they are completely uninformed about these common plants. High school students are worried about saving an environment whose most important component—the plant life—is largely unknown to them. These are the considerations that directed the design of our botany course, in which emphasis is placed on student familiarity with local flora—from algae to wildflowers.

The course is one semester long, that is, about 18 weeks. The first half of this time is spent on lectures, quizzes, and tests. The subject matter is organized around a survey of the plant kingdom by phyla, and a great deal of class time is devoted to life cycles of representative plants. Specimens donated by previous botany classes and projection slides of local plants are used to illustrate important points.

This half of the course is streamlined to conform to the small amount of time available, and it is geared heavily toward characteristics of plants that aid in identification. So, for example, in a discussion of flowering plants the sepals are noted not only for their function but also for their usefulness in identifying genus and species.

Student Plant Collections

While the first half of the semester is lecture-dominated because there is too little time for extensive lab work, the second half is entirely action-oriented. Students are very enthusiastic about the major work of the nonlecture part of the course—the plant collection.

Each pupil is required to prepare his plant specimens in the format shown in fig. 1. We use 5-by-8-inch index cards (available from most stationers and general school supply companies), and we have found that using a rubber stamp (purchased locally or from some scientific supply houses) in the upper right corner for uniform presentation of information greatly facilitates grading procedures.

Collecting the Specimens

Class time is used almost exclusively for plant identification and the preparation of herbarium cards. Pupils do the actual collecting before or after school.

To keep specimens from drying out too quickly, the students store specimens of land plants in plastic bags until they can bring them into class and put them in our refrigerator. Jars are also used when appropriate, although they are less convenient for pupils to carry. The most successful students make notes on some of the more difficult specimens as they are collecting. A note in reference to a leaf might indicate not only the date collected and the location but also whether it is opposite or alternate on the stem and whether it is from a tree or a shrub. Unusual characteristics like thorns might also be noted.

Some students carefully place all the specimens collected in one trip in the same bag after they have placed notes on top of the specimens requiring them. This system occasionally leads to great confusion when notes and specimens get mixed. The better organized people put each specimen with a note into a separate plastic bag (sandwich-sized bags are usually adequate for this purpose). Although this takes a little longer in the field, it saves the student a great deal of time if identification problems arise.

Any kind of plant is fair game for the collector, but different kinds are prepared differently. Flowers and leaves are pressed and glued to the card (we find Elmer's glue with a very small amount of water added works best). Specimens suitable for preserving in liquid (like delicate mushrooms) are placed in jars. A label on the jar shows the pupil's name, the specimen's genus and species, and a number. That number is placed on the herbarium card. The same procedure is used for specimens like bracket fungi which are tagged (fig. 2).

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Microscopic plants like algae must be identified by the pupil under the microscope. Unlike other specimens, their identification must be verified by the teacher before the pupil begins the actual work on the card. After the teacher has verified the pupil's identification of the species, he initials the pupil's card and then the pupil may draw the specimen (fig. 3).

Common sense dictates whether a specimen is to be pressed, jarred, tagged, or drawn. Mosses, for example, are usually taken in small tufts. These are most easily prepared by simply placing the tuft in a jar.

There are rules about what to collect—or, more precisely, what not to collect. They are important. Local ornamental plantings, for example, are not acceptable. The result of ignoring this rule is extremely poor public relations! In their zeal, students can injure or even denude their parents' or neighbors' readily accessible cultivated yard plants.

There is also the "no wood" rule. Pupils must bring only the leaves of trees and shrubs and not any part of the stem. Cedars and spruces are not accepted because it is difficult to collect their leaves without breaking the stems. Their cones, however, may be used. Pines are acceptable because the needle bundles are easily picked without damage to the stem.

Pupils are required to keep away from endangered species. Slides of the ones they might encounter are shown in class.

These rules, once explained, are violated very rarely. The pupil's awareness of them has the additional benefit of fostering a greater respect for plant life.

Identifying the Specimens

Pupils are expected to find both the genus and species of the plants they collect. There are some exceptions to this rule. Few high school students have the time or skill to accurately determine the species of some of the more difficult genera; so, for many algae and mosses, only the genus is required. Other exceptions are made when they seem reasonable.

Pupils identify their specimens by finding them in one of the books listed at the conclusion of this article. They are taught to use the keys, but usually they thumb through the pages until they find a picture that matches their plant. A herbarium card file of specimens difficult to identify, which was made by former botany students, is also available for matching.

Teacher Evaluation

Each herbarium card is submitted to the teacher for grading when it is completed. After the card has been graded, it is returned to the pupil, who adds it to his collection.

Actually, the individual cards are not graded in the usual way: they are punched. A better card receives more punches. For example, a specimen of a wild plant that has been correctly identified and is displayed exceptionally neatly receives five or more punches; a herbarium card with a wild plant that contains no information mistakes receives three punches; a wild plant
with incorrect information, one; a garden plant with no information mistakes, one; and a garden plant with incorrect information, zero. A copy of a "card punching guide" provides each student with not only the basic punching procedure but also the general hierarchy of specimen desirability. Any specimen that indicates a violation of collecting rules automatically receives a zero.

Punches are placed over the information stamp unless the identification of genus and species is not correct. Then a punch hole is made below it. Pupils are allowed three tries at finding genus and species, but they must be correct on the third attempt. The teacher usually helps a student who has missed the identification twice. This happens surprisingly rarely, probably because pupils are allowed to help each other.

Care should be taken to select a punch that cannot be easily duplicated. We use one that produces the number 13. This keeps enterprising students from adding punches—a potential problem because the number of punches each card receives is not recorded by the teacher and the card is given back to the pupil to add to his collection. Recording the evaluation of each card would require an excessive amount of paperwork. The punch system saves a great deal of time.

Each pupil must submit all his punched cards at the end of the semester for his plant collection grade, which counts toward two-thirds of his half-semester grade. Each collection must have a minimum of 75 punches to get a passing grade. Our students' collections have an average close to 200 punches. Pupils are periodically reminded that failure to turn in a collection within the allotted time means a considerably lowered grade. In the four years of this program, not a single pupil has failed to submit a collection.

The other third of the report-card grade comes from a practical examination. The best cards of important specimens are posted in the "practical case" (fig. 4), and for the examination 25 of the 30 or so cards are arranged around the room. Students are expected to know the common name, the genus, and the phylum of each of the posted species. They are given 25 seconds at each card to give whichever of the three is asked.

Conclusion

The plant collecting portion of our botany course is shifted to coincide with the growing season. In the fall semester, collection takes place first and is followed by the more traditional part of the course. The sequence is reversed in the spring semester.

The tendency to collect things is probably a natural motivating force behind everyone who collects stamps, rocks, coins, and so on. Perhaps this course capitalizes on that natural inclination in students. At any rate, it is satisfying to see them studiously making herbarium cards to add to their collections. Often, the students are at work before class begins or during their free periods. They learn a great deal, and most enjoy the work. A teacher could ask for little more.

REFERENCES


The Best Teacher

There is the greatest practical benefit in making a few failures early in life.—Thomas Henry Huxley