GROUP PROJECTS FOR THE BOTANY LAB

Debora L. Mann, Ph. D.

Biology Department
Millsaps College
1701 North State Street
Jackson, MS 39210-0001
601-974-1415
manndl@topaz2.millsaps.edu

Debora Mann received her B.S. in Biology from the University of Miami, her M.S. in Physiology from Vanderbilt University, and her Ph.D. in Zoology from Clemson University. At Millsaps College she teachers botany, zoology, and ecology.

Reprinted From: Mann, D. L. 2000. Group projects for the botany lab. Pages 482-486, *in* Tested studies for laboratory teaching, Volume 21 (S. J. Karcher, Editor). Proceedings of the 21st Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 509 pages.

Group projects have been a popular addition to our botany labs. Students work in groups of three or four on projects involving experiments, demonstrations, outings, simulations, construction of models, production of a videotapes, or other activities that convey botanical information to the class in interesting and creative ways.

Groups may choose from a list of suggested topics or may propose topics of their own. Providing an extensive and varied list of enticing topic suggestions is important to the success of the projects since it generates enthusiasm, gives students an idea of the range of topics the instructor considers suitable, and serves as a starting point for brainstorming sessions in which groups often come up with even better ideas of their own.

Much of the work is completed outside of class time, although some time is set aside during lab periods for work on the projects, especially during the planning stage. Upon completing their projects, group members present the results of their work to the class. Because the class time requirements are modest, projects can be done in addition to regular laboratory exercises.

A sampling of past topics is listed below. Some are specific to our locality and are offered only as examples of the kinds of projects students have found appealing.

- **"Traditional Use of Plants by the Choctaws"** - Students brought plant specimens, described their uses by the Choctaws, and prepared foods and beverages to be sampled by the class (after their identifications had been confirmed).
- **"Plant Diseases"** - Students obtained many specimens of diseased plants from a plant disease clinic and collected others . They described the agents responsible for the diseases and the methods by which they are controlled.
- **"Carnivorous plants"** - Students videotaped a bladderwort and a fly-trap capturing prey, and explained how and why plants consume animals.
- **"Edible Wild Plants"** - Students collected a variety of edible wild plants, many of which were prepared for consumption by the class (again, after confirming identification).
- **"Adaptive Geometry of Trees"** - Leading the class on a campus tour, the group used various tree species to illustrate Henry Horn's (1971) hypotheses on the adaptive significance of different growth forms of trees.
- **"Uses of Hot Pepper"** - Students conducted an experiment in which they counted the number of barnacles settling on submerged boards they had treated with paint, paint containing hot pepper sauce, and paint containing a commercial copper-based anti-foulant. They concluded that pepper has a slight effect as an anti-foulant. In another experiment they tested the effectiveness of hot pepper sauce in retarding food spoilage.
- **"Biological Control of Mosquitoes by *Bacillus thuringiensis israeliensis*"** - Mosquito larvae reared in the lab showed higher mortality in the presence of this commercially available bacterium.
- **"Goldenseal as an Antibacterial"** - Agar plates prepared with and without an infusion of goldenseal root were inoculated with *Escherichia coli, Micrococcus luteus, Streptomyces griseus* and *Bacillus subtilis*. Goldenseal retarded the growth of all four bacterial species.
- **"Photoperiodism in Plants"** - short-day, long-day and day-neutral plants were reared in growth chambers at different photoperiods to illustrate the effect of light/dark cycles on flowering.
- **"Landscaping for Environmentalists"** - Students collected specimens of ornamental plants including natives that thrive locally without pesticides or irrigation. They constructed a model home and garden to show how each of these species could be used in the landscape.
- **"Plant Mineral Requirements"** - The effects of mineral deficiencies were illustrated by growing sunflowers hydroponically in a series of nutrient solutions, each lacking one of the minerals necessary for plant growth.
- **"Fossil Plants of the Petrified Forest"** - Students prepared a brochure describing the processes by which plant fossils form and led the class on a guided tour of the Petrified Forest in Flora, MS.
- **"A Model of the Endodermis of Plant Roots"** - Using wood and plexiglas, students built a model of root endodermis illustrating the function of the Casparian strip.

- **"Effect of Some Medicinal Plants on Heart-rate in *Daphnia*"** - Students observed and videotaped the effects of plant extracts on the heart rate of daphnias which had been immobilized on depression slides with petroleum jelly.
- **"Does the Mosquito Plant Repel Mosquitoes?"** - In behavioral preference experiments, students found that mosquitoes did not avoid a citronella-scented geranium advertised as a mosquito repellant, although pennyroyal was somewhat effective in repelling mosquitoes.

Avoiding the Pitfalls, Overcoming the Challenges

Through trial and error we have managed to resolve the problems sometimes associated with group projects.

Fairness Students want to be rewarded for their own efforts and become concerned when they feel that one member of the team isn't doing his or her share of the work. Teams are required to write and sign a **contract** outlining the duties of each member and describing the arrangements for group meetings. The contract may be amended if all agree. Any member not adhering to the terms of the contract may be eliminated from the group. Students are told at the outset that upon completion of the project, each member will submit a brief written description of his or her contributions to the project along with an estimation of the percentage of the work done by each team member.

Since group members utilize the time before and after class to meet and discuss plans, I consider attendance in lecture and laboratory mandatory and I require each student keep an **attendance log** to be pledged and turned in to me before I assign grades.

Additionally, each student writes a **paper**, individually and without collaboration, on the topic of the project. This seems to satisfy the highly motivated individualists that at least a portion of the project is theirs alone. Many students include these papers in their writing portfolios.

Grading Not surprisingly, we have found that students work harder on the projects and produce work of higher quality when the project grade counts more toward the course grade. The challenge for the instructor is to accord the projects enough weight to encourage students to work to a high standard without devaluing other aspects of the course. This may take some tinkering. Counting the group project grade as 10% and the individually written paper as 5% of the total grade (lecture and lab combined) works well for us.

Grading criteria for the group projects are described in the syllabus. Grades are based on:

- information content,
- relevance to the content of the course as described in the syllabus
- quality of the work, including creativity, clarity of purpose, organization, thoroughness
- effectiveness of presentation.

An **evaluation form** for the instructor's notes during the group presentation, with prompts for comments on the points to be evaluated, is a useful grading tool. Group members receive the same grade if their contributions are equivalent; otherwise they are graded accordingly.

Cost The group projects cost relatively little beyond the usual costs of operating the lab. I tell my students the world is green and they should be able to find abundant plant material at no cost. We do, however, make available greenhouse supplies, hormones, microbiological media, bacterial cultures, and chemicals and glassware already on hand and order inexpensive living cultures of bacteria, fungi, algae, etc. if we don't already have them. Occasionally we purchase plants or supplies such as grafting tape. Expensive projects are vetoed. The additional cost per student is about $1 to $3 ($4 the term we paid admission to the Petrified Forest).

Class time The initial explanation of the projects requires about half an hour. After they have had time to think about possible projects, an additional 45 minutes to an hour is allotted for groups to discuss possible projects during which time the instructor circulates among the groups, listening to their ideas and providing guidance. Labs are taught by faculty at Millsaps. If labs are normally handled by graduate or undergraduate students at your institution, it would be advisable to have a faculty member on hand to provide guidance at this stage.

Students may work on their projects during lab periods if they have time after completing the scheduled lab work. They have access to the lab and greenhouse at times during the week when it is not being used by another class. For projects involving special equipment, such as videotaping from a microscope, I meet with students outside of class time and try to schedule training sessions for several groups at once.

Our students accomplish much of their work outside of class time; however, if your campus serves many commuter students for whom outside meetings are burdensome, or if the lab is unavailable except during the lab period, you may have to allow more time during class for groups to work together on projects.

Presentation of the projects to the class usually takes about twenty minutes at the beginning of a lab period. Occasional projects involving outings take longer. A trip to the Petrified Forest took an entire class period. A campus tour illustrating "The Adaptive Geometry of Trees" took about 45 minutes.

Organization Early in the term, after brainstorming with one another and conferring with the instructor, each group submits a **written proposal** describing the project they plan to undertake, outlining the tasks to be performed with an approximate time table for the completion of each step, and listing supplies needed. This proposal enables the instructor to perform any necessary troubleshooting, and simplifies the task of assembling the necessary supplies.

Upon submitting their proposal, each group signs up for a date on which to present their results, keeping in mind the time requirements for their project**.** In the fall semester, for example, groups relying on gathered plant materials are scheduled earlier in the term before the

first freeze is expected, while groups growing plants from seed are scheduled later. The instructor provides the list of available dates for presentations, avoiding days on which the scheduled lab exercises are particularly lengthy.

We generally have two sections of lab with 24 to 32 students each. With three to four students per group, we have a total of 16 groups doing projects in a semester under the supervision of one instructor.

Benefits of Group Projects

Group projects receive favorable comments on student evaluations of the course. They add variety to the botany lab, which students enjoy and which helps keep the course fresh for the instructor. Because students may choose from a wide range of topics, these projects can capture the interest of even those students not initially eager to study botany. They also allow highly motivated students to pursue in depth a topic of special interest.

Literature Cited

Horn, Henry S. 1971. *The Adaptive Geometry of Trees.* Princeton University Press, Princeton.