

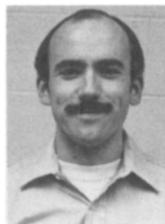
Holding Together a Multifunctional College Zoology Course

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WHEN A DEPARTMENT chooses to offer Zoology or Botany as its introductory course, rather than General Biology, it faces certain problems. The title "Zoology," for instance, implies that a significant portion of the course will be a survey of a large number of animals. However, the curriculum requires the course to introduce some of the general concepts that describe all organisms. Since each of these subjects could easily fill all of the time available in a term, an instructor has the task of trying to fit the contents of two courses into one. A student in such a course also has a challenge: to integrate this diverse expanse of information. We have attempted to solve both of these problems by using a taxonomic framework to build a series of standard lectures and laboratories augmented by student-paced instruction.

Our department serves about 150 students per year in each of a pair of introductory one-term courses, Zoology and Botany. Most of these students are freshmen. Al-

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though both courses deal with general principles of biology, we discuss the bulk of them in Zoology. Concurrently, students in the Zoology course obtain general information on the taxonomy and natural history of many animals, and anatomical details of selected animals.

The Way It Was

Traditionally, daily lecture-discussion sessions and textbook assignments have centered on the principles of biology, using examples from the animal kingdom. The weekly laboratory period was a "march through the phyla," in which a published laboratory manual was the guide for dissections and microscopic observations. A variety of preserved animals representing the "phylum of the week" was haphazardly displayed around the laboratory room, and students were expected to study them sometime during the session. Thorough study of taxonomy and natural history was lacking. Many students did not seem aware that the material presented in lectures and readings was related to either the dissection work or the animal displays. This sort of situation convinced Postlethwait and his colleagues (1972) to develop the audio-tutorial alternative. We did not follow them into a rejection of live lectures, because lectures are effective for our small classes. However, study of the Postlethwait methods led us to some variations that we will describe here.

The Way It Is: Emphasis on Relationships

The Zoology course has been gradually but significantly altered. We now organize lectures on the basis of taxonomic relationships. We still deal with principles applicable to all organisms, but we now discuss each principle in the context of the particular phylum that illustrates it best.

In addition, there are out-of-class reading assignments presenting an aspect of each major phylum. We choose these from “non-traditional” sources, such as the magazines *Natural History*, *Smithsonian*, and *Science 81*. The articles have several useful features. They do not look like—or read like—textbooks. They contain attractive photographs, and are relatively easy to read, especially when a student brings to them background information gleaned from other sources within the course. We believe that students perceive and appreciate their newly acquired ability to understand these articles, and that this acts as an immediate reward for their labors in other portions of the course. We provide a short study guide for each article, designed to help students pick out its most important points and to accentuate the topic’s relationship to other course material. The articles also allow detailed study of a few topics, a welcome change from the superficial treatments necessary elsewhere in the course. Finally, they provide opportunities for students to sense the excitement of zoologists writing about the work that they love. The attractiveness of the articles is demonstrated by the report of 75% of our students that they sometimes read other, unassigned articles in the same magazine after they have finished the one that is required.

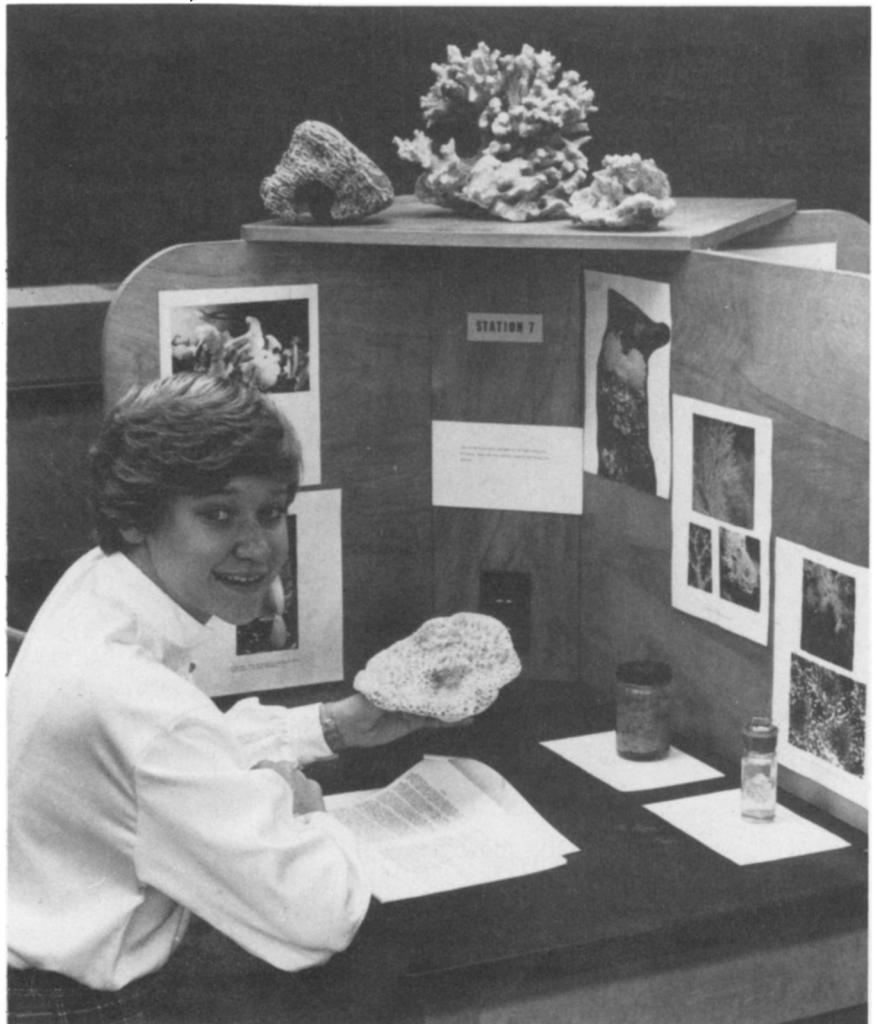
Afternoons with Animals

We have reduced the physical and intellectual clutter of the scheduled laboratory sessions by removing most displays of preserved animals. The laboratory time is used for the concentrated analysis of one or a few representative animals of the major phylum that has most recently been introduced during lecture. Students work with microscope and scalpel, guided by our own manual in conjunction with an atlas of zoology (Gilbert 1965). We chose this combination to replace published manuals because the latter inevitably confuse students by presenting far more information than can be absorbed during a one-term course.

We have prepared sets of 2" × 2" slides describing each week’s laboratory work, available for preview before the laboratory periods and for review in preparation for examinations. Our department operates a learning resource center equipped with audiovisual equipment in carrels, where slides may be viewed at leisure.

Perhaps the most innovative portion of the revised course is a “self-paced laboratory” devoted to acquainting students visually with a large number of animals from each phylum. The learning resource center is the site of

FIGURE 1. A student works at the self-paced laboratory station that introduces class Anthozoa.



this activity. A series of adjacent carrels, usually eight to ten in number, is equipped with displays of living or preserved specimens and accompanying art layouts (fig. 1). Representatives of a particular phylum are available for study for approximately one week, coinciding with relevant lectures and laboratory work. Students work through the carrels at their own pace, using a guide book. The guide book's contents overlap with lecture material on taxonomy to some extent to add continuity, but focus on describing the characteristic anatomy of the phylum of the displayed animals. The self-paced feature allows students to take whatever notes they deem necessary at their leisure. A station may have from one to ten labeled specimens representing a class or an order. It may also have as many as five 8" × 10" color photos of organisms in their normal habitats. We currently display 113 specimens and 134 photos or diagrams during a term of self-paced laboratories.

Pulling It Together

We encourage students to follow this sequence in studying each phylum: (1) examine the self-paced laboratory, (2) attend lectures and read appropriate portions of the textbook, (3) read the magazine assignment, and (4) participate in an afternoon of detailed analysis by microscopy and dissection. In a recent survey of our students, nearly all indicated that they can best appreciate the dissection of an animal when it is preceded by relevant discussions of taxonomy and physiology.

We regularly remind students of the importance of relating the information from all of these sources. To provide strong incentive to do this, we formulate tests that require students to integrate all available information into a coherent whole. In other words, there is no separate "practical examination" that tests only for knowledge gained in laboratory periods. We construct 15 to 30% of each test from questions that are coupled to displays from the self-paced and dissection laboratories, or directly related to information presented in those settings. Another 10 to 15% of a typical test may concern the magazine assignments described earlier. Some test items require that a student pull together information from several sources. Students are informed of the test format at the beginning of the term, so they work at integrating material from the start.

Student Perceptions

What do students think about all of these changes? That is hard to gauge, since each student saw and could evaluate only one version of a course that evolved over a period of several years. One way to look at this question is to compare responses to identical portions of the student evaluation of faculty members and courses that occurs at the end of each semester at Furman University.

We compared responses from the ten class sections (approximately 32 students per section) immediately preceding the Spring 1978 term with those from the ten sections that have been taught since then. (It was after Spring 1978 that we began to implement most of the changes described here.) One of the pertinent questions on this instrument asks, "Do you feel the course provided an opportunity for you to learn what you think such a course should teach?" Among the five possible responses, the most positive is, "I feel the course provided an unusually large number of opportunities." The average proportion of the class choosing this response during the most recent set of sections was 48.3% higher than the proportion of the class making the same response previous to the changes. The other evaluation question bearing upon students' perceptions of the quality of a course is worded "What 'grade' would you give this course?" A comparison of the same two sets of Zoology sections shows that the proportion of students choosing the grade of "A" increased by 26.3%.

We examined the trend in the entire university between these two periods of time, to determine whether the favorable changes for the Zoology course were simply reflections of a more positive attitude toward the entire curriculum. For both questions, the university-wide average did change positively, but not nearly as much as for the Zoology course. The percent increase throughout the school for the "unusual number of opportunities" response was 8.9, and the proportion of all students giving their course a grade of "A" increased by only 3.5%.

After the most recently evaluated term (Spring 1980), 61.3% of the Zoology students gave that course a grade of "A," while 38.3% of all students did the same for their courses throughout the university.

Conclusion

We believe that there has been significant progress in making this introductory course more coherent than it had been. By placing the discussion of physiology, genetics, biochemistry, and ecology within the framework of taxonomic relationships, we have been able to emphasize how lecture and laboratory activities are interconnected. By retaining the lecture format for a significant portion of the course, we have nurtured the valuable student-teacher relationship that is distinctive of a small college setting. By placing other portions of the learning environment in a limited, self-paced mode (photographic review programs, textbook and magazine assignments, self-paced laboratories), we have provided flexibility in the time available for assimilation of information. The afternoon observation and dissection laboratory meetings are leisurely affairs, with plenty of extra time for those

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brilliant display of fireworms (*Odontosyllis enopla*). For above five days following the full moon, the fireworms give a spectacular bioluminescent display commencing within a few minutes of 55 minutes past sunset. A single female can be observed from a distance of more than 1,000 m!

Some Finishing Touches

Near the end of the nine-day experience, after they have become familiar with the plants and animals, the participants are given an opportunity to conduct a small field or laboratory research project on their own. They select from a list of suggested projects, or they may have an idea of their own approved by one of the instructors. We do this to prevent students from selecting projects they will not be able to complete. Also, because they will be scattered all over the islands, we like to know where they will be working. By dividing the supervision of projects among the three of us, we are able to monitor each student's progress. All projects involving a boat or swimming require that each student go with a buddy. The report of their research investigations is presented as an addendum to their final written report.

We stress academics heavily during the Bermuda program, but we also give students a little free time for exploring on their own. A noon-to-noon break scheduled during the middle of our stay provides an opportunity for them to see the sights of Hamilton and St. George's and to renew their energy for more work. We try hard to make the experience a memorable one and to provide opportunities to do things they cannot do at home. Our last morning in Bermuda is spent taking the group picture and frolicking in the surf on a secluded south beach.

After returning to Connecticut, students have one month to prepare and submit a term paper. A date is set for a cookout-reunion where we gather to show slides, swap stories, and generally relive the memorable moments.

What does the course cost each participant? The total fee for 1980 was \$525, which did not include moped

rental. This includes room, board, airfare, laboratory and facility fees—the works. The mopeds run about \$66 for the eight days, including gasoline. All fees must be paid before the group leaves for Bermuda. A penalty fee is assessed if a student withdraws from the course within a month of our departure.

Some Reflections on Leadership

Running an extended field course is not easy. More than academics must be on the minds of the leaders. Not only must a high-quality educational program be offered, but the health and welfare of the participants must also be considered. We keep a watchful eye on the progress and activities of each of the students. Though we are not trying to control their private lives or their personal behavior, we feel obliged to see that they take full advantage of the benefits of the program. Most of our students have never before been so far from home. The change in surroundings can be stimulating to some, intimidating to others. We observe, but do not over-control, the group dynamics as the field portion of the course progresses. Interpersonal relationships develop by themselves. We speak to students about their behavior only if it interferes with someone else's safety or with the smooth functioning of the program. Having a variety of activities helps to prevent the formation of cliques. The goal, if any, of controlling the social part of the program should simply be the bonding of everyone into a cohesive functioning unit.

It would be practically impossible for one—or even two—instructors to run such an active program. The demands are great. We often find ourselves spelling each other; generally, students are on the go from 7:00 a.m. to after midnight. During mealtimes, or in hours scheduled for relaxation, we socialize with our students, yet retain their respect. We are visible and available for consultation. Finally, a course such as this should be fun and rewarding for everyone, including the leaders.

NOTE—This paper is contribution 852 from Bermuda Biological Station.

Zoology Course

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students who work slowly or who wish to go beyond the assignments. The variety of presentation modes used in this course may stimulate students' interest by allowing them to immediately use knowledge gained in one format to enhance the understanding of material in other formats.

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