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ABSTRACT

This publication, published quarterly by the American Institute of Biological Sciences, focuses on biology education in colleges and universities. Included in this issue are articles dealing with mini-investigative labs in microbiology for nonscience students, the effects of various components of the Keller system on student attitudes and performance in plant anatomy, marine biology curricula, available BIOTECH modules, and short courses on the biology of the Gulf Coast. (MH)

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES EDUCATION AND COMMUNICATIONS DEPARTMENT

AIBS EDUCATION REVIEW

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Mini Investigative Labs in Microbiology for Nonscience Students

Daniel D. Burke

During the past four years, I have taught a general microbiology course for nonscience majors. One type of extra credit project in the course has involved small groups of students participating in short (four to six weeks) investigative laboratory studies of the type described by Thornton (1971). This experience has led me to derive guidelines which should be of value in structuring an investigative laboratory experience for nonscience majors.

The investigative approach I have used stresses student involvement. While a number of problems may be suggested to the students, it is critical that the final choice be theirs; this is central to developing the intellectual commitment necessary for success. Once the students have chosen a problem, they must prepare a written outline stating the problem and the experimental protocols which they will use. Even though most procedures used are standard techniques it is useful to have the students work out what they must use. The more the students discover for themselves, the more valuable the experience is.

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The use of this written outline has proved valuable in helping students define the questions they ask carefully and determine exactly what must be used in attempting to answer them.

Thirty-seven students have been involved in these projects. Nineteen have worked singly, and the rest in groups of two or three. They have all been freshmen or sophomores. There is no biology or chemistry requirement for this course; only three students had had college chemistry, and seven had had college biology. The student group was not a random sample of the class. Most of them were grouped in either the top 20% or the bottom 30% by test score performance. More than 30% of the participating students were black students in a special academic program, while this group comprised only 6% of the class as a whole. The participating students ran the gamut from prelaw and sociology to religious studies and drama majors (with one preveterinary student).

The projects attempted were clustered in several areas: 30% were involved with isolating and identifying an unknown soil organism, 30% with measuring the effects of various parameters (heat, UV, antibiotics, and various chemicals) on

microbial death, and 30% with growth studies measuring the effects of various parameters (light, temperature, phosphate concentration, and carbon source) on microbial growth. The remainder covered such topics as isolation of coliform phage from sewage, antibiotic resistance spectrum of soil organisms, enrichment for blue-green algae, DNA transformation in *Acinetobacter*, and determination of sewage pollution in a pond and stream.

Performance of these projects was varied, but for the poor students was much better than their test performance, for the good students was at least the equal of their test performances, and, in most cases, even better. Performance was measured in several ways. All students had to prepare a written laboratory report. These showed the number and quality of outside sources consulted, how numerical data were handled to determine its significance, and how results were related to the question originally posed. I also monitored the amount of time spent on the project and questioned each student a number of times over the course of the studies.

While this is an admittedly small sample, several observations have come out of these experiences which should be of direct use in course design as well as of value in designing further studies. First, the problem must be, to as large an extent as possible, of the student's own choosing. This cannot be overstressed since this personal commitment is the key factor to success. This is not to say that experiments assigned to students cannot be done successfully; they are, however, most often only technical exercises not conducive to intellectual stimulation. Second, whatever work is done should generate positive results, and the data obtained should be numerical rather than only qualitative. The student must have the reinforcement of success and real data with which to work. Even when the experiments fulfill these criteria, the first results are typically failures. I think this initial failure is a good learning experience, forcing a student to delve further into both the mechanics and theory of what is being attempted.

These conclusions may seem self-evident, but disregarding them has led to consistent failure in producing a good learning experience. The most striking example of this has been the failure of students to derive any real value from the microbiologist's most cherished set of laboratory exercises, the identification of an unknown organism. Unknown identifications were suggested to students who seemed to have no strong preference as to laboratory project. It was felt that these experiments would illustrate logical design as well as examine a variety of standard microbial laboratory tests. It soon became evident that these investigations failed, even though an organism was ultimately identified, because the students really did not care what the organism was. An interesting sidelight to this was that negative results, which are as useful as positive results in identification, struck the students as a failure rather than as something learned. Even if the organism was selected so as to yield positive test results, the experiment failed to interest the students because they expected positive results. Overall then, this type of experiment does not involve the student intellectually and settles into a boring routine.

The most consistently successful experiences were experiments which measured either growth or killing. The techniques applied are learned in a very short time. Therefore, all of the students can be shown the basic techniques of isolation and enumeration of cells at the same time and can then adapt these to their own projects. These experiments generate meaningful numerical data which stimulate interest. The measurements relate well to questions of interest to the students: Does my mouthwash (or soap) work? Why do I receive certain antibiotics? Does my phosphate detergent really stimulate microbial water pollution? Does the refrigerator keep my food safe? The numbers obtained lead students into interpretations: How much is really effective killing? How fast do microorganisms grow? They almost universally generate enthusiasm, as measured by the extra time students put into their projects.

Other types of experiments exist, but they require more careful consideration of the project and a subjective judgment of the student's ability and enthusiasm before starting.

Is this laboratory experience worthwhile? Certainly these students, with rare exceptions, will not pursue a career in microbiology or any biological science, so the techniques learned are not of lasting value. Further, students could rely on texts or lectures for the basic concepts and factual material in this area. So what do they get?

They acquire an insight into several of the fundamental processes which occur in science: how questions are chosen, how they are attacked, how data are interpreted, and a reality sometimes overlooked, how often failure is the initial result of an investigation. The ability to phrase and answer scientific questions is central to an understanding of science and is almost impossible to achieve outside the laboratory. With this ability comes a significant carryover into their personal lives. All professions are essentially involved in problem solving; the ability to pose the right questions and the use of quantitation in examining answers are of general importance. Students learn that the flow of science is not necessarily smooth, that failures are quite probable; this understanding of the strengths and limitations of scientific method is of value.

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AIBS EDUCATION REVIEW. Published by the AIBS Education and Communications Department, 1401 Wilson Blvd., Arlington, VA 22209. Editorial Board: Vernon Avila, Edward Buss, Robert Coler, Donald Dean, Robert Hurst, Bill Rushing. Editorial Staff: Richard Trumbull, Publisher; Richard A. Dodge, Editor; Sophie Dodge, Managing Editor. Subscription free to AIBS members. Published quarterly. © 1976 American Institute of Biological Sciences, Vol. 5, No. 1, February 1976.

In summary, I would say that the mini investigative laboratory has proven to be an extremely valuable device in this general education course for building enthusiasm and for promoting the concepts of question phrasing and problem solving in a laboratory situation. While it requires a large amount of instructor time, it should be possible to expand this mini-course concept to handle a large number of students and, judging by what I have spent (about $10 per student), keep the costs within bounds.

Reference Cited

Thornton, J., ed. 1971. *The Laboratory: A Place to Investigate.* Publication number 33. The Commission on Undergraduate Education in the Biological Sciences, Washington, D.C.

AIBS Education Committee Establishes New Procedures and Policies for the *AIBS Education Review*

During a recent meeting of the AIBS Education Committee, the purposes of the *AIBS Education Review* and the composition and role of its Editorial Board were considered. The names of the members of the AIBS Education Committee and their report concerning the *Review* follows.

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Richard Dodge, AIBS Staff
Head, Education Department

Purposes

The *Education Review* should serve several purposes including the following:

- The *Review* should keep the total biological community aware of the continuing interest of the AIBS in educational matters and keep it posted on new developments in the field.
- It should serve as a vehicle for disseminating news of interest to members (e.g., announcements of meetings, symposia, publication of book reviews, etc.).
- It should publish papers concerned with the philosophical, methodological, or substantive aspects of college biology teaching.

Composition of the Editorial Board

- There shall be six members serving staggered three-year terms. Board members may be reappointed.
- Members of the Board are appointed by the Editor with the advice and consent of the Chairman of the Education Committee of the AIBS.
- In selecting members of the Board, consideration should be given to disciplinary and perhaps geographical distribution.

Members of the New Editorial Board

Because the present Editorial Board has served more than three years, it was decided that the *AIBS Education Review* Editorial Board would be a matter for early consideration, and new appointments have been made in order to carry out the recommendations of the Education Committee. Accordingly, with the advice and consent of the Chairman of the Committee, the following individuals have been invited and have indicated their acceptance to serve on the Editorial Board of the *AIBS Education Review*.

Vernon Avila
San Diego State University
San Diego, California

Edward Buss
Pennsylvania State University
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Robert Coler
University of Massachusetts
Amherst, Massachusetts

Donald Dean
Baldwin-Wallace College
Berea, Ohio

Robert Hurst
Purdue University
West Lafayette, Indiana

Bill Rushing
Navarro College
Corsicana, Texas

Role of the Editorial Board

- The Board shall be advisory to the Editor in establishing and maintaining editorial policy.
- The Board shall make an annual evaluation of the *Review* and prepare a summary report to be made available to the Education Committee.
- The Board shall assist the Editor in locating competent reviewers for papers submitted.

Effects of Various Components of the Keller System on Student Attitudes and Performance in Plant Anatomy

Jay C. Davison and Thomas L. Rost

The Keller Plan, or Personalized System of Instruction (PSI), is an individually paced, mastery oriented teaching method which has become more popular in science courses in recent years (Kulik et al. 1974). Several studies have compared PSI courses with similar courses taught in the traditional (lecture, group paced) method.

Lewis and Wolf (1973) compared a freshman chemistry course taught by PSI with several other sections of the same course taught by the lecture method at Colgate University. They found that all sections scored approximately the same on both the course final and an American Chemical Society general chemistry examination. Philippas and Sommerfeldt (1972) at Portland State University compared a PSI course in general physics with a control section in a lecture course. At the end of the one-year course sequence their results showed no significant differences in performance between the two groups, but students rated the PSI section very highly.

At Long Island University, McMichael and Corey (1969) compared PSI students with others in a traditional lecture section of introductory psychology. The PSI students performed about 10% higher on the final examination than the lecture students, and they maintained this superiority over a ten-month period following the course. The PSI students also rated the course significantly higher than did the lecture students.

In another study Roth (1973) compared a PSI course with a lecture course in digital systems engineering at the University of Texas. He found that the PSI students scored about 10% higher than the lecture group and also rated the course about 10% higher.

What these and many similar studies indicate is that students in PSI courses perform as well as, or slightly better than, students in traditional lecture courses, and that generally they rate PSI courses higher.

A logical question is whether certain components of PSI are more important than others in promoting the positive results which have been reported, that is if only part of the procedures are implemented, which ones are most important? Keller warns against this approach, saying "Neither should the plan be tried by any teacher who does not intend to use it as a whole" (Keller and Sherman 1974). A scientific examination of PSI, however, would seem to require an examination of its parts. One such examination was done by Peck and Brown (1975), who compared group-paced vs. self-paced instruction in human anatomy at the University of Kentucky College of Medicine. They found no difference in teaching effectiveness between the two systems and concluded that cost size effectiveness should be the determining factor.

The present study tested two parameters of PSI: use of lectures for information or for motivation only and use of proctors. Sections were compared on the basis of content learning, retention, and attitude changes.

Materials and Methods

The course was an upper division plant anatomy course in the Botany Department of the University of California, Davis. The enrollment was divided randomly into two lecture sections of 50 students, each of which was further divided into two laboratory sections. One lecture section heard two lectures per week covering all required course material; the other had no lectures on course material, but instead had a guest lecture on a topic of interest and a discussion meeting each week.

One laboratory section from each lecture section had proctors in the laboratory along with the graduate teaching assistant. These proctors were upper division botany majors who had previously taken the course, and were assigned to groups of about 10 students each. Their duties were to ask questions in lab, to encourage group study, and generally to direct and motivate their students. The other lab section within each of the lecture sections used no proctors; only the teaching assistant was available.

All sections received identical treatment in all other aspects of the course. All students were given sets of study objectives covering the material they would be tested on. All were given weekly quizzes, which were personally graded (by the proctors in the proctored sections, and by the TA's and outside help in the other sections) with the student involved present. Slide sets (2x2) were available to all students for review, and a comprehensive final examination was given to all.

Testing and Measurement

Content learning was tested as follows: a 17-question test covering a very broad sampling of the subject matter was constructed and administered to all the students on the first day of class. These same 17 questions were included in the final exam for the course, and a separate record was kept of student performance on these questions. Finally, five months after the course ended the same questions were given to a random sampling of students from each of the sections in order to measure their retention of the course material.

Attitude changes were measured by several means. A lengthy postcourse questionnaire was given to all students at the conclusion of the course. Questions were of four types: Part I

This research was supported by an Undergraduate Instruction Improvement Grant from the Regents of the University of California.

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was a "rate the instructor on the following characteristics" section, with answers ranging from one (low) to seven (high) and including statements like: "explains concepts clearly," "has genuine concern for and interest in the quality of his teaching," and so on. Part II included similar questions about the course, and also included multiple choice questions asking what type of exams students preferred, whether they felt lectures were needed, and what grading system they preferred. Part III asked a series of questions like "how many times this quarter have you read an article on botany not required for this course?" Part IV asked the student to evaluate his/her TA.

In addition to the postcourse questionnaire, we constructed various attitude scales which were administered to the students on both the first and last days of the class. These scales asked students to choose, from a series of statements, which ones they agreed with and which ones they disagreed with. The scales were then scored on the basis of how many of the statements favorable to the subject the students agreed with; this number was then expressed as a percentage. These attitude scales were designed to measure attitude toward three things: the subject itself, college education in general, and professors in general. Along with the attitude scales we administered a test of "approach responses" designed to measure the students' tendency to choose the subject from a field of other subjects in the same general area.

A final attempt at measuring attitude differences between sections was done by ongoing observations of certain behavior traits among the students, such as whether they arrived on time, whether they put away their microscopes correctly, and other similar observations. This technique was suggested by Mager (1972) in his book *Goal Analysis* as a way of finding out whether the goals of a training program are being met.

All results were subjected to a covariant analysis, and differences between sections were examined on the basis of changes among individual students in the sections, as well as responses of the students in each section as a whole.

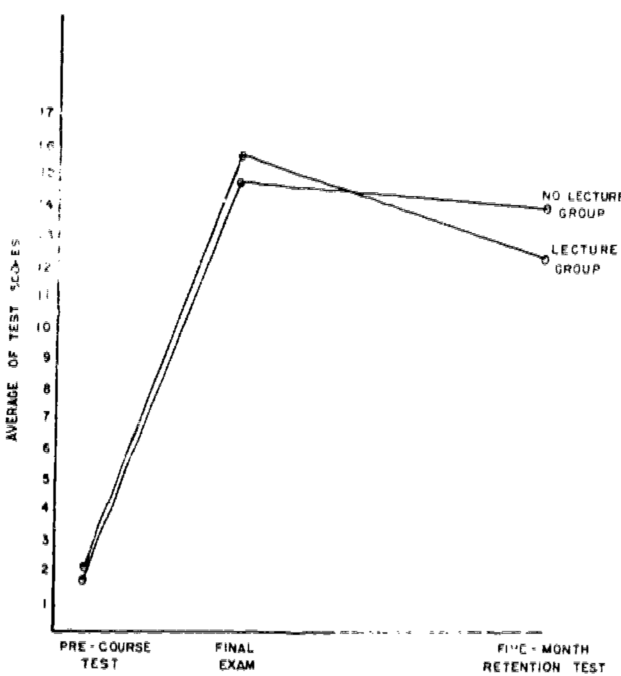

Figure 1. Content examination scores by lecture section.

Results and Discussion

Results of the content testing are shown in Figure 1. Although there was no difference between proctored and nonproctored treatments within each section, lectures did make a difference. Both sections started at an equal level, as shown by the precourse test. In the course final examination, the lecture students scored slightly but significantly higher than the nonlecture students. This difference was reversed on the five-month retention test as nonlecture students scored slightly but significantly higher than lecture students (these results are significant at the .05 level).

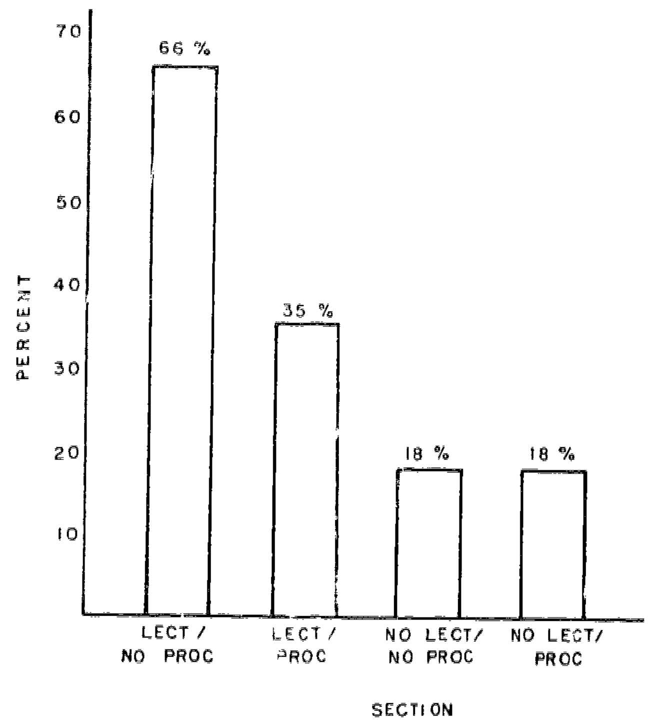

Figure 2. Percentage of students choosing "lectures on all course material."

These data suggest that lectures are useful for promoting short-term memory, but that students who are forced to search out their own answers retain material longer. Differences are very small, however, and further study of this question is in order.

The attitude test results were not as straightforward as those of content learning. Of the three methods employed, direct observation proved the least fruitful (and most difficult), showing no differences among the sections. Scores on the postcourse questionnaire were likewise virtually identical among sections, with the exception of one question concerning lectures which shows a clear difference (Figure 2). The question asked whether students preferred lectures on "all course material" or some other option. Interestingly, the students in the section most similar to a traditional course chose the "all course material" option most often, and as each component of the course was varied the percentage choosing this option decreased. This response suggests that most students in a more or less traditional format believe they need lectures, but if lectures are taken away, the students realize that they do just fine without them.

The pre- and postcourse attitude surveys also showed different response in the section concerning the course itself, but not in those sections of the survey dealing with professors or college education in general. These data were analyzed with respect to the students' class status (graduate or undergraduate) as well as treatment, with an unexpected result: graduates showed no significant attitude changes in any section! Undergraduates did show a difference, however, presented graphically in Figure 3.

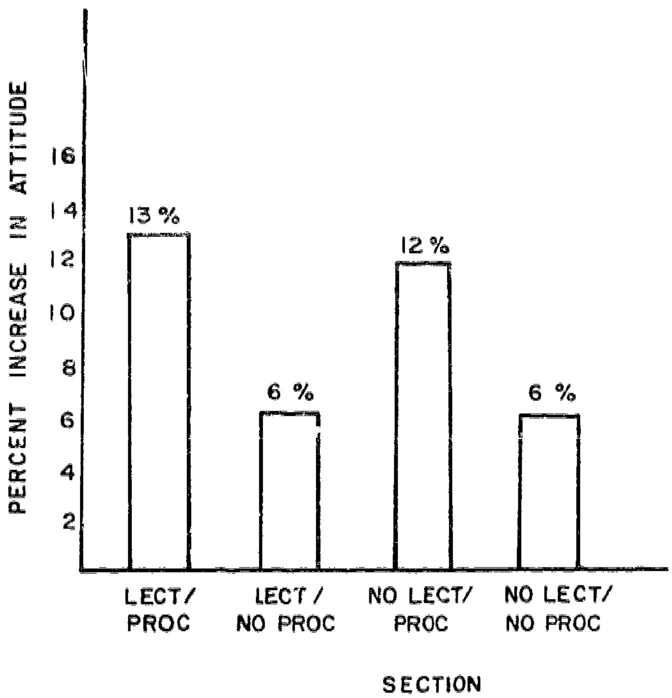

Figure 3. Percent increase in attitude by section.

Attitude increases among proctored students averaged twice that for nonproctored students; here the lecture made no contribution to the change. Proctors do seem to make a significant contribution to attitude improvement, if not to increasing final exam scores.

In summary, the components of PSI tested in this experiment each affected different aspects of the course. Lectures seemed to give a slight advantage to students on the course final, but perhaps at the expense of their long-term retention of the material. Lectures had no effect on attitude changes, except that lecture students believed more strongly in the necessity of lectures than did nonlecture students.

Proctors contributed to the affective changes in the students. Proctored groups showed approximately twice the attitude increases of nonproctored groups, although no differences in course performance were seen between those groups within each lecture section. And finally, graduate students were not significantly affected by proctors, as their attitudes showed no change regardless of treatment.

In performing this experiment, we encountered two important difficulties. The first of these is that the science of attitude measurement is in its infancy. The literature on PSI contains many enthusiastic reports about the system. However, comparisons of content learning between PSI and lecture courses seldom show significant differences. For this reason, we felt that the success of the system must lie in its effects on classroom atmosphere, personal relations between staff and faculty, and other affective changes. These changes should be measurable as changes in students' attitudes toward a given course or course material. However, wanting to measure attitudes and being able to measure them are two different things. Attitude surveys often give answers which are tenuous at best. If our educational psychologists could give us a better handle on this problem, our understanding of teaching and its effects on the student would increase considerably.

The other dilemma is the classical one of experimenting with a student's educaton. Teachers have a responsibility to provide a student with the best education they know how to give; so it becomes difficult to vary factors in an attempt to produce results which demonstrate differences as dramatic as we might like to see. All-or-none comparisons of PSI vs. lecture occasionally accomplish this goal, but they seem so obvious as to be almost patently ridiculous. In our experiment, however, there may have been too many similar factors present—weekly testing, personalized grading, study objectives—and these may have provided enough likeness to obscure differences that might have shown up. But having once used a system and gotten the feeling that it was more successful than the traditional, how can you go back to a traditional system for the sake of experiment and still look students in the face?

Finally, we suggest that it might be profitable to concentrate experimentation of this type on the introductory courses in our discipline, where the student population is more heterogeneous and less highly selected for success in a given field. Our lack of response from graduate students seems to suggest that as students progress up the educational ladder they are more self-motivated and less subject to the influences of instructional technique than beginning students might be.

Acknowledgments

The authors would like to acknowledge the assistance of the following people in carrying out this experiment: The graduate teaching assistants, Dan Simper and Don Santana; the proctors, Cheryl L'Italien, Jock Hamilton, Vito Polito, Katie Morrison, Stan Allen, and Steve Jeffers; and Wanda Mast and Karol Paterson, who led discussions and corrected exams in the nonproctored sections.

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Project BIOTECH Demonstration Laboratory and Mini Work Shops

In cooperation with the publisher and selected users of Project BIOTECH modules, the American Institute of Biological Sciences, Education Department, will sponsor a demonstration laboratory, and four mini workshops on the use of modules in the biology laboratory during the Annual AIBS Meeting at Tulane University, New Orleans, Louisiana. All completed module programs will be available for viewing, and project staff will be on hand to discuss the project materials with you. Module presentations, of your choice, will be made between the hours of 9:00 a.m. and 12:00 noon and 1:00 p.m. and 3:00 p.m., Monday, 31 May through Thursday, 3 June 1976.

An added attraction will be the presentation of four mini workshops and demonstrations by developers, producers, and established users of BIOTECH modules. The mini workshops will be scheduled from 3:00 p.m. to 5:30 p.m., Monday through Thursday. In order to help us determine requirements for facilities for the mini workshops, those individuals interested in participating in the program, are urged to write the AIBS Education Department.

Call for Papers

A joint Beta Beta Beta–AIBS Education Department student contributed research paper session will be held during the Annual AIBS Meeting at Tulane University, New Orleans, Louisiana, 30 May–4 June 1976. Student contributors from Beta, Beta, Beta and AIBS Student Chapters, as well as unaffiliated student biologists, are encouraged to contribute to this session. Contributors should send a title and a short abstract to the AIBS Education Department, American Institute of Biological Sciences, 1401 Wilson Boulevard, Arlington, Virginia 22209. Contributors should also indicate their requirements for projection or audio playback equipment when submitting their titles and abstracts. All papers will be scheduled for fifteen (15) minutes. Student research paper contributors, at the session, will be provided with a certificate of recognition for their efforts.

Students not presenting a research paper are also encouraged to participate by identifying topics for an open forum discussion. Here is an opportunity for students to convey to AIBS and Beta, Beta, Beta staff, in a general session, concerns, needs, and problems related to professional biology. Contributors to an open forum should communicate directly with Dr. Richard A. Dodge, Head, Education Department, AIBS, for purposes of scheduling an agenda for a student forum session.

Credit to be Offered to Participants in AIBS Pre- and Post Annual Meeting Courses at Tulane University

Five special courses will be offered by Tulane University during the period 29 May through 5 June 1976 in conjunction with the 27th Annual AIBS Meeting. The courses, directed to aspects of the biology of the Gulf Coast, will be offered for university credit or audit to registrants at the Annual Meeting in New Orleans, Louisiana.

Because each course will involve field trips, the number of participants in each section will be limited to 25 individuals. Interested participants are urged to register as early as possible to ensure a place in the class. The application below is provided for your convenience. Registration for the AIBS Meeting is required and should accompany your application for course enrollment. For your convenience, *both application forms below should be completed and mailed together to the AIBS Education Department prior to 1 May 1976.* Checks should be made payable to "AIBS." (Detailed Meeting registration, housing, and transportation information appeared in the February issue of *BioScience.*) Requests for refund of prepaid registrations will not be honored after 14 May 1976.

Biology 709. Problems in Advanced Biology: The Avifauna of the Gulf Coastal Plain and Environs
Robert D. Purrington, Tulane University
Lectures: Th, F (3-4 June) 8:00 a.m. Observatory, Room 100.
Field Trips: Th, F (3-4 June) 7:00 a.m.

An introduction to the breeding birds of the central southern USA and, in particular, the Gulf coastal plain. While examining the principal plant associations and their bird fauna, the seminar will emphasize the typical nesting birds of cypress-tupelo and bottomland hardwood swamp woodlands and coastal marsh. Studies will include field identification, vocalization, breeding biology, ecological relationships, and the influence of man. Field trips will be taken to swamp, marsh, and coastal strand habitats.

Biology 715. Problems in Plant Ecology: Flora and Plant Communities of Southern Louisiana
Joseph Ewan and Leonard Thien, Tulane University
Lectures: F, S (4-5 June) 8:00 a.m.-5:00 p.m. Dinwiddie Hall, Room 214.

Field Trip: S (5 June) 8:00 a.m.

Survey of flora and plant communities of southern Louisiana. Habitats include deciduous-evergreen forests, salt marshes, freshwater marshes, and cypress-tupelo swamps.

Biology 717. Problems in Animal Ecology: Pollution Ecology of the New Orleans Area
Alfred E. Smalley, Tulane University
Lectures: S, M (30-31 May) 8:00 a.m.-5:00 p.m. Dinwiddie Hall, Room 214.
Field Trip: M (31 May) 8:00 a.m.

New Orleans and the surrounding parishes are situated on flat terrain, with many areas completely surrounded by levees. Extensive wetlands, impermeable soils, and heavy rainfall cause difficult problems of pollution control. Emphasis on water and solid wastes.

Biology 729. Problems in Protozoology: Aquatic Invertebrate Microhabitats
Stuart S. Bamforth, Tulane University; *Walter G. Moore*, Loyola University
Lectures: S, S (29-30 May) 8:00 a.m.-5:00 p.m. Dinwiddie Hall.
Field Trips: S, S (29-30 May) 8:00 a.m. Mornings only.

Survey of the highly organized communities of aquatic invertebrates; analysis of the chemical and physical components of the immediate environments in which the communities exist. Participants will collect from habitats in shallow wetlands and identify and describe the spatial relationships of the organisms to one another.

Biology 737. Problems in Host-Parasite Relationships: Helminths of Lower Mississippi and Gulf Coast Regions
David W. Fredericksen, Tulane University
Lectures: S, S (29-30 May) 8:00 a.m. Percival Stern Hall, Room 1002.
Field Trips: S, S (29-30 May) Afternoons.

Helminth parasites of local fauna will be considered in general. Certain of these helminths will then be discussed in reference to pertinent research efforts on both trematodes and cestodes. Live hosts will be available for firsthand experience in conjunction with specific laboratory demonstrations. Field trips will be taken.

Fees for the above courses will be *$40.00 for one unit of credit or audit.* Course participants must also register for the Annual AIBS Meeting. Complete and return the following applications to: American Institute of Biological Sciences, Attn: *Dr. Richard A. Dodge*, Education Department, 1401 Wilson Boulevard, Arlington, VA 22209.

REGISTRATION APPLICATION—AIBS SPECIAL COURSES

27th Annual AIBS Meeting, Tulane University, New Orleans, 30 May-4 June 1976

PRINT OR TYPE

Name ____________________

Address ____________________

Applications must be received by the AIBS Education Department by *1 May 1976.*

Registered in: ______ Bio 709 ______ Bio 715

______ Bio 717 ______ Bio 729 ______ Bio 737

MAKE CHECKS PAYABLE TO "AIBS"

Amt. enclosed: ______ ($40 per hour credit/audit)

Mail to:

American Institute of Biological Sciences
Attn: *Dr. Richard A. Dodge*, Education Department
1401 Wilson Blvd.
Arlington, VA 22209

ADVANCE REGISTRATION APPLICATION

27th Annual AIBS Meeting, Tulane University, New Orleans, 30 May-4 June 1976

PRINT OR TYPE

Mailing Address ____________________

Institution or Company Affiliation ____________________

Address ____________________

Society of Primary Interest ____________________

Member AIBS ☐ Yes ☐ No Student ☐ Yes ☐ No

Local Convention Address ____________________

LAST NAME	FIRST & INITIAL	DATES ATTENDING

REGISTRATION FEE IN THE AMOUNT OF $ ______ IS ENCLOSED.
I, ☐ We, ☐ (how many? ______) plan to attend the *"Seafood Festival"* on Sunday evening, 30 May.
Tickets will be sold at the time of registration. **DO NOT SEND MONEY.**

REGISTRATION FEES

Prepaid *(Before 30 April)*	Late *(After 30 April)*
$25.00 Regular	$30.00 Regular
$10.00 Students	$15.00 Students
$ 5.00 Spouse	$ 5.00 Spouse

MAKE CHECKS PAYABLE TO "AIBS"

Mail to:

AIBS MEETINGS DEPARTMENT
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Notes on a Curriculum of Attainments in Marine Biology: The Mentor's Role

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Introduction

The Department of Biological Science of the Florida State University (FSU) introduced a competency-based, time variable curriculum in marine biology in the fall of 1974. The goals of this effort are to test: (a) the responses of undergraduate students to a learning environment which emphasizes independent, self-pacing study, (b) the quality of student products, (c) feasibility and cost effectiveness, and (d) the attainment of established scholastic standards. This program is part of a broader study on competency-based education [known at FSU as the Curriculum of Attainments (COA)] being conducted at FSU under a three-year grant from the Fund for the Development of Post Secondary Education, U.S. Department of Health, Education, and Welfare.[1] The other units at FSU included in the program are the School of Nursing (undergraduate) and the School of Urban and Regional Planning (graduate).

While competency-based education has been explored at all levels of education, it is gaining interest in higher education on the grounds that it may offer students greater flexibility and less regimentation in their preparation for the pursuit of life goals. In this sense, the attainment of specified learning goals would reflect scholarly accomplishment as set forth and assessed by the faculty. Final attainments may be reached through the students' own initiative and intellectual resources at a pace most suitable to their individual needs (students would not be consigned as a floating cork to a wave-like progression of classmates through course sequences).

Harris (1972) offers a prospective that a reorientation towards attainment-based baccalaureates may be the principal course open to colleges and universities in meeting the following challenges:

- "to become better focused and, hence, delimited in their distinct societal roles;
- to individualize instructional programs in terms of the proficiencies of entering students as well as their degree plans;
- to free liberal education from the strictures inherent in prescribing common exposures to standardized degrees; and
- to control for certain minimal levels of proficiency in each of their graduates."

There is little argument that higher education is being challenged on these points and others. In a practical sense, how do we meet these challenges? One possibility is through a curriculum based on the assessment of student outcomes as opposed to a series of exposures.

Harris (1972) expresses the operational rationale for an attainment-based curriculum as follows: ". . . the baccalaureate would come to represent the culmination of *demonstrated, documented* and, hence, *validated attainments judged against explicit criteria.* The primary requirement for these criteria would be *susceptibility* to *consensual observation* by *competent observers.*" This formulation provides a logical starting point for a brief discussion of the exploration of attainment-based degree programs now underway at FSU. The marine biology program represents an application of the above concept to the natural sciences.

The Mentor and the Student

In the COA the "mentor" plays the key role in the conduct of this method of pedagogy. The mentor is the designated person responsible for preparing learning materials, recruiting students, arranging for student assessment, individual guidance, and many other chores. Without a doubt, the single most important function of the mentor is one-to-one guidance of the students enrolled in the program. The mentor guides and tutors students through a set of required competencies until they feel they are ready to test their mastery against a set of standards to be observed by faculty juries. (The nature of competency statements are considered later in this essay.) The mentor, on the other hand, refrains from typical instructor tasks such as lecturing, administering reading assignments, giving weekly and/or midterm and final examinations, and turning in grades reflecting memorized facts.

The mentor/student relationship is of greater depth and is more critical than the relationship between an instructor and the students in a given conventional course. The mentor and student are able to achieve this degree of personalization because the program runs, in this case, for two years. There is time for a one-to-one development of interests between all students and the mentor. In conventional courses in mass higher education, opportunities to establish this kind of relationship at the undergraduate level are limited.

The mentor's contact with a given student starts on the initial interview: educational goals are defined and stated, the extent of preparation for them is examined, what remains to be done and what route should be taken to achieve the goals are discussed in detail. These interviews last an hour or more and are repeated from time to time. They have two important results: (a) most students for the first time receive insights into the relations between curriculum and career goals, and (b) the first step toward a long-term, harmonious scholarly interaction between student and mentor takes place. The importance of these interviews and followups to them should be emphasized because they furnish a footing, as it were, for the posture of adviser and critic that the mentor must assume.

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[1]Daisy Flory, Dean of Faculty, FSU, and John Harris, formerly Director, Division of Instructional Research and Services, FSU, made the initial proposal and gained the necessary financial support. Gary Peterson, FSU Center for Educational Design, and John Merrill, Director, Center for Educational Design, coordinated and directed the planning stages of the overall project. They gave much valuable assistance in the initial stages of developing the instructional materials for the marine biology portion.

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Because today's undergraduates, as a group, appear to be poorly conditioned for independent study, many are totally lost when thrust into independent study situations as found in the COA. It is as though they have spent all of their lives chained to an enormous steel ball and when suddenly confronted with the removal of the chains, the experience of newfound freedom prevents the taking of a single independent step—the ball and chain syndrome of production line higher education. Hence, at the outset of the program, the mentor must impose enough structure to get them started in developing independent problem-solving skills.

An additional function of the mentor is to assist students in developing their own motivation for independent self-study habits. There are no general rules; each student is a unique case requiring special consideration. But a mentor with 30 or more students must find a systematic approach to the problem. One possible solution may be found in a student's need to relate classroom experiences to applied situations consistent with an occupational goal. Since all of the students in this group are interested in marine biology, examples may be used of the application of marine science to the solution of problems faced by the fishing industry in abiding by various regulations set forth by state and federal governments. An ample supply of trade journals and government documents is provided giving almost day-to-day accounts of events in the world of marine commerce and related government activities. At weekly meetings, speakers from a variety of subject matter areas are invited to discuss in round-table fashion the practical problems of their own work. By these means, students are encouraged to learn material relevant to the real world and that basic funds of knowledge and skills are required to function effectively in practical settings. When individual students are interested in some specialized area, a project is planned with the aid of the mentor. Perhaps, acquiring the ability to initiate and sustain inquiry into a given problem will be as, if not more, valuable to the student's future development as the knowledge gained will be.

Teaching Materials

The mentor is responsible for the acquisition and coordination of the teaching materials contained in a given "learning package." Typically, a learning package consists of a set of competency statements, pretests, posttests, and sometimes special projects. All of these materials are prepared, as nearly as possible, for use in the self-teaching mode. The most important item in the learning package is a set of competency statements, which tell students to do something to prove to an examiner that they have mastered the knowledge or skill set forth in the statement. Example of competency statements may be, "prepare T-S diagrams of the major ocean water masses and be able to explain the distinguishing characteristics of each water mass" or "can demonstrate through oral or written examination a thorough knowledge of the following fundamental concepts of marine primary production."

The author of such a set of statements must always consider, "what should students learn and retain when they complete this unit?" and "how specific should this statement be? how general?" Experience, thus far, has indicated that any competency statement is fair game for revision as a result of actual application. Students at one point were concerned about specificity/generality problems. Their final consensus was that statements which are too explicit take away the challenges; the more general statement requires more study and judgment.

In a given subject matter area the competency statements cited above are designated "specific competency statements." A number of these statements compose a "Generic Attainment" (i.e., the latter covers the broader subject matter). For instance, the unit headed "Marine Ecology" is headed with the following Generic Attainment: "student can demonstrate his knowledge of selected ecological concepts and with his attainments in earth science and descriptive oceanography, apply them to problems in marine biology." This particular Generic Attainment is supported by 15 specific competency statements, all of which must be mastered by the student. The above Generic Attainment calls for the use of preceding units already mastered. The Generic Attainments in the marine biology program fall in the following areas: earth science, descriptive oceanography, general marine ecology, phytoplankton ecology, fisheries biology, and pollution biology. In all of these areas, there are a variety of teaching aids. There are eight Generic Attainments required to fulfill requirements for the program in marine biology.

The Department of Biological Science has set aside a room for the exclusive use of students in the COA Project which houses facilities for group and individual study. Learning carrels contain 2 Telex slide-tape units, one super-8 film loop projector, 1 TV cassette player and color monitor, and 1 microfiche reader. Through the assistance of the FSU Media Center, a good stock of instructional audiovisual materials has been acquired. The students use these films, slides, and tapes to supplement the reading materials suggested to assist them in mastering Generic Attainments. The laboratory exercises are done on a self-instruction, self-paced basis.

The Communication Problem

When the students are free to pursue learning at their own pace and level of intensity, the ability of the mentor to help them overcome the tendency toward procrastination depends heavily on maintaining channels of communication. This is particularly important when students are carrying a mix of conventional courses and COA learning packages. The mentor must find ways to maintain contact with students so that encouragement can be given and judicious monitoring maintained. A problem has been to find the ideal balance between the amount of freedom accorded students and the need for the mentor to impose structure so that students accomplish their goals in a reasonable amount of time.

Student contact is maintained by requiring students to attend one meeting per week. These meeting periods are used to invite speakers who may work in the field of applied marine biology outside of the university system, teach in some area outside of biology, or teach in some area which supplements the teaching material in the program. Since the general meeting does not give students the opportunity to discuss any difficulties they may have with competencies, a series of small group seminars have been organized for not more than eight students (there are 36 students in the program). At these miniseminars, students volunteer to present a formal review of

their work on any competency statement that they may have completed. Following the review, the group critiques the presentation by suggesting ways for improved treatment or offering additional information. The miniseminars may also be used for developing skills in self-criticism and in written communication. Students may be asked to write a short abstract of the material they covered on one of the competencies. The abstract is duplicated and copies given to each participant. The author of the abstract then leads a verbal critique and it is revised accordingly. Thus students receive additional experience in writing, as well as greater familiarity with the subject matter.

Assessment of Attainments

In the COA, juries certify the accomplishment of attainments required for the degree. Jury members, however, are more than external observers (as indicated by Harris 1972); they offer advice about the program, participate in evaluation of students and, for the students, serve as contacts beyond the faculty associated directly with the program. Jury panels are drawn from the faculty and advanced graduate students of the Department of Biological Science, faculty of the Department of Oceanography, and practicing professionals. The last come from various fisheries research and natural resource management agencies of the state and federal governments. Formal student assessment begins with a written comprehensive examination over the Generic Attainment for which a student petitions certification. The examination is the essay type, and a grade of 75 or better is required for appearance before the jury for the oral examination. If the grade is less than 75, a reexamination must be taken before the next scheduled jury appearance. Questions asked by the members of the jury panel often extend beyond the material covered by the written comprehensive. Students are expected to use blackboard illustrations effectively and to otherwise make their exposition clear. With the required mark on the written comprehensive and a satisfactory oral performance, the students earn a grade of B for the unit. If they give an outstanding performance, an A grade may be awarded upon unanimous vote by the jury.

Advantages and Disadvantages of the COA

The following observations and impressions are necessarily subjective because it is still too early in the experiment for reliable empirical data to be gathered and analyzed. Even so, whether some of the factors can be interpreted numerically is subject to doubt.

From the students' point of view, the advantages appear to be the following:

1. The opportunity to seek content mastery in a format allowing the time needed appears to produce confidence and competency. The students are responding to this provision of the program very well. Evidence of the result is seen in the confidence and thoroughness with which most of them respond to questions in the oral examination.

2. The responsibility for, and the motivation to carry out, personal inquiry for the satisfaction of the competency statements contributes strongly to the students' capacity for independent thought.

3. The opportunity to pursue individual work over a wide range of subject matter affords the best possible opportunity for students to find an area of specialization.

4. The format affords superior preparation for leadership in the working world or advanced graduate study. At this point, some of the students in their junior year have acquired an intellectual maturity and a research attitude superior to many beginning graduate students with whom I have had contact.

5. The freedom to work slowly in COA, when pressures from conventional courses require a major portion of time, is a definite advantage to the students. (This factor will be discussed below.)

6. Students can enjoy a closer contact with the instructor on problem solving in difficult areas. Cognitive material is more efficiently learned without lectures. The small group meetings described above are open to any student any time so there is no difficulty in getting help when needed.

7. There is a better than average opportunity for student interaction and development of peer judgments.

Some of the disadvantages for the students include the following:

1. Since this program is all in marine biology, the students may not be able to redirect their major interest without the loss of a considerable amount of effort unless they complete a Generic Attainment. This would require a sustained effort beyond the point of loss of interest.

2. There is no way for students to know that they are mentally and emotionally adapted to the rather long and rigorous, but free-style, study of the COA without attempting it.

3. Because of the requirement for superimposing the COA effort on an already heavy load of required conventional courses, the students' progress can be demoralizingly slow. This problem should be one to which the mentor gives a great deal of attention.

In some ways, these advantages and disadvantages have their counterparts for the mentor. The disadvantages for the mentor may be expressed as follows:

1. A group of 30 or more students in the COA demands a great deal more time than a similar number in a conventional course, especially in the early stages of development and implementation.

2. In the initial stages, at least, the COA mentor works under the disapproval of most of the faculty with only a sympathetic chairman to help through the rough spots.

3. Because of the latter point, it is difficult to find willing, to say nothing of enthusiastic, colleagues to perform the jury function.

4. There is little time left for typical basic research activities in the content area.

Whether or not the disadvantages are affected by the advantages is a matter that individual faculty members will decide for themselves. The following advantages, at this time, seem to compensate for the disadvantages:

1. The opportunity exists to replace the lecture monologue with one-to-one teaching.

2. There is greater freedom to develop a variety of teaching aids for the self-instructional aspects of the program.

3. A full two years are available to know the students and to become a personal associate in their intellectual and occupational development.

4. The flexibility exists to adapt content emphasis to the interests and needs of individual students as they develop beyond the necessary fundamental material.

For a COA program to survive as an institutional effort, the advantages must outweigh the disadvantages. This is particularly true with respect to costs.

As in any endeavor whose operation involves economics, the manpower costs of the COA are the most significant. Based on experience thus far, one mentor at 3/4 time, one half-time teaching assistant, and one half-time clerk typist could manage 40 COA students in the marine biology program with little difficulty. The teaching and jury functions then, are distributed as follows:

Mentor	3/4 F.T.E.
Jury	1/4 F.T.E.
Teaching Asst.	1/2 F.T.E.
	1 1/2 F.T.E.

Based on 40 students completing 35 credit hours of work in the program, the productivity for one F.T.E. of faculty time (mentor and jury) is 1,400 quarter hours, an average of 233 quarter hours per term for six terms. This figure is very close to the average for all conventional courses taught at the junior and senior level in the FSU Department of Biological Science.

There is a hidden economic advantage in the fact that highly motivated COA students may finish their baccalaureates up to one or two terms early. The effect of this would be to increase the productivity of mentor and jury on a quarterly basis. For the university as a whole, there are economies, although not measurable at this time, in having students finish early. There is considerable real benefit to the student in early graduation.

Some preliminary impressions are:

- There is a significant reservoir of students who adapt to and thrive intellectually in COA.
- There are strong indications that these students do superior work in the program.
- The program produces students better prepared for employment or graduate study.
- The most difficult practical problem is gaining faculty support, especially for jury panels.
- Faculty productivity in quarter hours is a little more than the average faculty member teaching classes of average size each quarter of the academic year.
- One mentor at 3/4 F.T.E. can handle 40 COA students without strain.
- In the early stages of their study in the COA, the students find it difficult to overcome competition for their time from required conventional courses.

Acknowledgments

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Reference Cited

Harris, J. 1972. Baccalaureate requirements: attainments or exposures? *Educational Record*, Winter, pp. 59-65.

Announcement

Undergraduate Student Paper Contest

We are pleased to announce the continuance of the Undergraduate Student Research Paper Contest as an important part of the AIBS student program. Listed below are the guidelines for submission of papers.

1) The contest is open to any undergraduate biology student who is an *individual member* of the AIBS.

2) The paper may be on any biological research topic utilizing style and format of presentation appropriate for reporting scientific research.

3) Papers must be submitted on or before 15 April 1976, and notification of awards will be made no later than 30 April 1976.

4) The winner will receive an all expense paid trip to present the research paper at the Annual AIBS Meeting to be held at Tulane University, New Orleans, Louisiana in May-June 1976. Awards will also be made to the second, third and fourth place runners-up.

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Manuscripts are to be submitted to the AIBS Education Department, Attention: Undergraduate Student Research Paper Contest.

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The 1976 Asia Foundation Grants

The Asia Foundation is continuing its support of biologists who are pursuing pre- or postdoctoral graduate study in the United States and who intend to return to their home country upon completion of their work. Nationals from the following countries are eligible for awards under the program: Afghanistan, Bangladesh, Burma, China, Hong Kong, India, Indonesia, Japan, the Khmer Republic (Cambodia), Korea, Laos, Malaysia, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka (Ceylon), and Thailand.

Those qualifying on the above criteria are eligible to apply for the following:

Grants-in-Aid – The Asia Foundation has authorized the AIBS to offer grants-in-aid of up to $250 each to qualified Asian biologists or scientists in closely related fields for the purpose of assisting them to complete research projects. The grants may be used to purchase materials, literature, or to obtain clerical service for the preparation of a thesis or final report.

Travel Awards – The Asia Foundation has authorized the AIBS to offer grants of up to $200 each for travel or *per diem* expenses to enable Asian biologists who are visiting the United States to conduct research or pursue graduate studies to attend the 1976 Annual AIBS Meeting at Tulane University, New Orleans, LA, 29 May-5 June.

Asian Foundation Award – The Asia Foundation has established the Asia Foundation Award for outstanding research published during 1974 or 1975. Papers may be submitted by the author, his mentor, or any co-worker in the fields of biology, agriculture, natural resources and basic (nonclinical) medical science. Only single author papers will be considered. The award, to be presented at the AIBS Annual Meeting, carries an honorarium of $400, plus up to $150 to cover travel expenses. In the event the recipient has already returned to his home country, the honorarium award will be made in absentia.

Procedures:

Grants-in-Aid and Travel Awards – Application forms are available from: AIBS Asia Foundation Program, 1401 Wilson Boulevard, Arlington, Virginia 22209. If the applicant is a student, the need for such a grant must be established by the student's major professor or department head. All applicants must explain the limitations of their present financial aid and must state an intent and expected date of return to Asia in the near future. The university or organization affiliation in the home country, an explanation of source of present financial support, and a brief paragraph explaining present research should be included in the application. Deadline for receipt of applications is 15 April 1976; notification of action will be made by 30 April 1976.

Asia Foundation Award – No application form is required. Five (5) copies of the paper should be submitted to AIBS Asia Foundation Program at the address given above. The paper should be accompanied by a brief statement indicating the (1) author's U.S. address; (2) university or organization affiliation in his home country; (3) social security number; and (4) expected date of return to Asia. Final date for receipt of papers is 15 April 1976; the recipient will be notified on or about 30 April 1976.

Biology Students!

AIBS Student Chapter Regional Conference

The Student Chapter at Moravian College, Bethlehem, Pennsylvania will sponsor an AIBS Student Chapter Conference on 10 April 1976. Undergraduates in the fields of biological sciences will present papers concerning their research and several workshops will be offered. Further information can be obtained by writing to:

AIBS Student Chapter
Biology Department
Moravian College
Main Street and Elizabeth Avenue
Bethlehem, Pennsylvania 18018

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