

fects two hours of activity per ASTE student. Telephone cost reflects the telecommunication cost of one-on-one interaction between the instructor and the student. Finally, the service of a one-half time secretary has been required for correspondence with ASTE students, and for record-keeping; this cost is based upon the average annual ASTE enrollment.

The revision of an on-campus course to a video-taped course requires some effort on the part of the instructor; our experience suggests, that these revisions require nearly one month of instructor time for a three semester-credit-hour course. This cost is not included in Table 1.

#### Total Costs

Since certain ASTE costs are fixed and were converted to a per-student cost based upon the average annual ASTE enrollment of each course, the total per-student costs of our ASTE Agricultural Economics courses vary among themselves dramatically. For example, although ASTE courses A and B are each comprised of 18 two-hour video-cassettes, their total costs differ by nearly \$40 per student.

### Current Status of the ASTE Program

The ASTE program went on-line in Summer 1987; during the following two-year period, it was considered to be a pilot program, and received no appropriated funding. As a result, ASTE registration fees had to be set so as to cover total costs. Although, during this period, the program was limited in terms of exposure and enrollments, it was demonstrated to be a cost-effective distance-learning deliver-method. As a result, it was brought into the WIU School of Continuing Education during the Fall 1989 semester.

Additionally, on behalf of Western Illinois University, the Illinois Board of Governors of State Colleges and Universities has entered into marketing services agreements with two firms, whereby these firms now act as marketers of our Agricultural Economics courses. And, the Board has also entered into a royalty free license with the instructor, whereby royalty payments are made to the instructor for each set of tapes rented via the two marketing firms.

### Summary

The Western Illinois University Applied Sciences Televised Education program is designed to provide the off-campus professional with undergraduate, graduate, and non-credit continuing education courses. Courses are delivered to the student via video cassettes, and instruction is at the convenience of the student. An analysis of the per-student costs of four-ASTE Agricultural Economics courses suggests that the program is a cost-effective delivery system that satisfies the instructional needs of off-campus students who are unable to attend class on the WIU campus.

### References

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# Biotechnology in Agriculture: Science and Socio-Economic Issues

L. G. Sterling, C. K. Halbrendt and S. L. Kitto

*An interdisciplinary course was designed as an introduction to the applications of biotechnology in agriculture. Topics were presented from members of government and industry, as well as from faculty members in Animal Science, Plant Science and Food and Resource Economics. Students were asked to complete a survey covering a wide range of biotechnology-related issues before and after the course. Survey results showed that education is an effective means of increasing the understanding of, and allaying the fears associated with biotechnology.*

The changes brought about due to the applications and products of agricultural biotechnology will have an enormous impact on society, potentially overwhelming producers, consumers and decision-makers. Commercialization of biotechnology-derived products will depend largely upon the nature of the technological advances, government regulation, and the public's education and perceptions. The rapid rate of technological growth in biotechnology has left a void in the education process. Students not majoring in the sciences may have little, or no knowledge of this emerging technology.

An interdisciplinary course was designed as an introduction to the applications of biotechnology in plant and animal science, and the related socio-economic issues. The topics were presented through a combination of faculty lectures, invited speakers from government and industry, and field trips. The objective of the course was to enhance the ability of both science and non-science majors to make informed judgments on biotechnology-related issues.

### Course Development

Development of the course was funded by a competitive grant from the University Committee on Educational Innovation. Funds also were provided by the College of Agriculture and the Center for Teaching Effectiveness for additional teaching materials, field trips, video tapes, publication of proceedings, and honoraria for invited speakers. The course was developed and coordinated by three faculty members, one from each department represented in the course outline; Animal Science, Plant Science, and Food and Resource Economics.

Instructors were asked to provide a written transcript of their lecture. The manuscripts will be compiled into a proceedings that will be published and made available to the public. Proceedings also might serve as a model for those developing similar courses at other institutions.

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## Description

The course was organized as a series of lectures given by specialists and individuals involved directly with agricultural biotechnology and/or its possible applications. There were no prerequisites for the three-credit course which met daily for 1 1/2 hours during a five-week winter semester. Students enrolled from many different majors and, from all levels of education, freshman to graduate school and continuing education (Table 1). The course opened with a short discussion on the definition of "biotechnology". In a broad sense, it was defined as including any technique that uses living organisms or parts of organisms to make or modify products, to improve plants or animals, or to develop microorganisms for specific uses. The "new" biotechnology was defined as the industrial use of recombinant DNA, cell fusion, and novel bioprocessing techniques. The opening discussion closed with a viewing of the video tape "Genetic Engineering: The Nature of Change", produced by Monsanto Company.

The next five lectures were presented by faculty members from the Department of Animal Science and Agricultural Biochemistry. The history of recombinant-DNA research, and the science and techniques of genetic engineering were discussed by molecular geneticists. These lectures were followed by three lectures on the applications of biotechnology in the animal sciences including the manipulation of animal growth, transgenic animals, and the control and prevention of disease. The Animal Science section closed with a field trip to Intervet America, a company using biotechnology to produce vaccines for the poultry industry.

The section of the course on plant science began with two lectures on plant tissue culture, which provided an introduction to the lecture on genetic engineering of plants. Those were followed by two lectures on applications of biotechnology in plant science including nitrogen fixation, and applications with soil mycorrhizae. The last lecture in this series was presented by a faculty member from the Food Science Department and focused on the use of biotechnology and microorganisms in the production of food. The Plant Science section concluded with a field trip to the Dupont Agricultural Crops Research Laboratory where the company is using biotechnology to develop improved agricultural crops.

The final section of the course was devoted to the social and economic issues surrounding biotechnology. In addition to lectures from faculty members in the Department of Food and Resource Economics on topics including farm-level impacts of biotechnology, consumer perceptions and attitudes concerning biotechnology, and historical and future perspectives of biotechnology, there were several invited speakers. An overview of the socio-economic issues was presented by a guest speaker from the U.S. Office of Management and Budget. Government regulation of biotechnology was discussed by a representative from Animal and Plant Health Inspection Service (APHIS). The DuPont Company gave their perspective on the public/private interface. And finally, a representative from the Conservation Foundation discussed challenges for managing biotechnology in the

Third World. The final class period was devoted to open discussion of any topic related to biotechnology in agriculture.

Throughout the semester, students were given reading assignments from scientific journals, popular press publications and newspapers, that pertained to current issues in agricultural biotechnology. During the section on socio-economic issues, there were several writing assignments pertaining to issues discussed by guest lecturers. Grades were based on three examinations and writing assignments. In addition, ten percent of the grade was dependent upon class participation.

## Course Evaluations

The course instructors were evaluated in two different manners. After each section, students were asked to evaluate the individual instructors and the topics they presented. In addition, the course coordinators served as peer evaluators for all guest lecturers. At the end of the semester, the entire course was evaluated using the standard course evaluation for the College of Agriculture.

In general, the course was very well received. When asked to give the course an overall rating on a scale of 1 to 5, with 1 being excellent, students ranked the course at 1.7. They listed some of the strengths of the course as; providing a "vast amount of applicable information on a new and emerging topic", providing "many different points of view in order to force students to think about the issues associated with biotechnology", and providing an "opportunity to

Table 1. Descriptive Profile Of Students

	Percent	
<b>Gender</b>		
Male	30	
Female	70	
<b>Year in College</b>		
freshman	7	
sophomore	28	
junior	26	
senior	28	
graduate	9	
continuing education	3	
<b>Age</b>		
17-18	7	
19-20	38	
21-22	38	
23-24	6	
25+	10	
<b>Major Field of Study</b>		
Animal Science	46	
Plant Science	13	
Agricultural Business	10	
Agricultural Economics	8	
Undeclared	10	
Chemistry	5	
Other	8	
<b>Number of Courses Taken in:</b>		
	Sciences	Biology
0	3	12
1-3	23	65
4-6	21	18
7-10	33	3
11+	20	0