

## Teaching the principles of biotechnology transfer: A service-learning approach

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As concerns about genetically modified crops, biotechnology and technology transfer have come to the forefront of media coverage and governmental policies, such issues clearly have implications on the life of every citizen around the world. To combat uncertainties about biotechnology and technology transfer with firsthand knowledge of these subjects, a biotechnology service-learning course was designed. This class examines interdisciplinary issues regarding the transfer of biotechnology and agricultural and medical technologies through the utilization of didactic and service-learning activities. The course provides a forum to discuss global issues with respect to biotechnology transfer, which are becoming more commonly addressed by scientists, social scientists and politicians in our society. The objectives of this undergraduate course are (1) to broaden the perspective of students on global issues related to technology transfer from developed countries to developing countries, (2) to examine the efficacy of technology transfer to developing countries through case studies, (3) to critically evaluate current opinions regarding the benefits and costs of technology transfer to both developed and developing countries, and (4) to become aware of and involved with community organizations addressing the needs for and methodologies involved in technology transfer to developing countries.

### Establishing a service-learning environment

During the course term, students are guided through an exploration of interactions between developed countries and developing countries with regards to whether technology can and should be effectively transferred to developing countries to combat current social ills such as hunger, disease and poverty. The course is composed of both lecture and service components and is offered to undergraduates at all levels and of all majors. During the lecture module, brief lectures are dispersed among class

discussions throughout the class period. Lectures are designed to present new information and model critical thinking patterns. In-class discussions allow students to present personal views with each other, to collectively synthesize new perspectives on the topics presented in class, and to engage in discussions addressing what responsibilities developed countries have in providing access to the latest advances in agricultural and medical technologies and what approaches to knowledge and wealth sharing are most appropriate. Reflective writing assignments allow students to demonstrate their mastery of concepts discussed in class and to present questions about the lecture and/or discussion material. Most students elect to complete such writings using a guideline provided in class that encourages them to include a summary and evaluation of both materials covered in class and assigned readings, which include journal articles, commentaries and reviews.

The service-learning setting affords an opportunity for students to gain personal experience with issues encountered in readings, the sharing of ideas between students and guest speaker experts and allows many sides of the issue to be encountered by students. Ultimately, the service-learning experience is designed to offer students an opportunity to demonstrate their acquisition of knowledge about biotechnology and to report transformations in their attitudes about biotechnology through direct involvement in the dissemination of knowledge about biotechnology and the exploration of innovative approaches to the transfer of biotechnology in a sustainable, economically viable and socially responsible manner. The service-learning module has two major requirements: involvement with a local service agency and the completion of a service-learning portfolio. Effective portfolios can include a range of materials including formal documentation of service activity, copies of reflective journal writings, directed writings assigned during the class period, and/or copies of

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products completed during the service experience (Hatcher, 1998). The service-learning portfolio documents evidence of processes utilized and products completed during this service-learning course. Summarily, it allows the students to demonstrate that they have completed the learning objectives of the course and that they understand the connection of these objectives to the service completed. This is vitally important as explained in the publication "Students in Service to America": therein, the National Commission on Service-Learning among others report "when teachers explicitly tie service activities to academic standards and learning objectives, students can show gains on measures of academic achievement, including standardized tests" (2002).

One example of a service component most recently utilized in this course involved students working with the Programs Director of a local non-profit organization, Scientific Technology and Sustainable Agricultural Development (STSAD, Inc.). STSAD, Inc. is a charitable organization dedicated to educating the public on scientific technology and sustainable agricultural development with special attention to educating the underserved public about how to utilize current scientific developments to improve their quality of life. Students work with the organization for 2 hours weekly to assist in implementing one of the following projects: (a) development and publication of pamphlets and brochures explaining what technology transfer is and how it could impact the lives of citizens in developing countries with attention to both potential negative and positive outcomes for distribution at a local project site in Kambuga, Uganda during an upcoming workshop; or (b) planning and hosting a local roundtable discussion of issues such as the role of science in sustainable development with students and faculty members from different disciplines of local universities and with community members. The collaborative effort with STSAD, Inc. allowed students to gain additional perspectives from experts active in the field including agricultural and medical technology transfer experts. More importantly, this nonprofit institution reinforced the class methodology of addressing at least two sides of the issue including technology transfer efforts and encouraging the education of citizens in developing countries on the grassroots level.

### Extracting the learning from service learning

A comparative study on the impact of service-learning on various aspects of undergraduate academic learning showed that students exposed to service-learning were better able to make decisions about complex social problems than their counterparts in traditional courses (Batchelder and Root, 1994). Moreover, previous investigations have noted that service-learning components can reinforce academic rigor in courses by supporting the development of critical thinking skills by requiring students to adapt to learning

from community service experience and integrating that learning with the acquisition of formal factual knowledge (Howard, 2000). The integration process can be facilitated through the use of learning activities that require students to reflect upon service experiences and utilize these experiences as a learning tool to reinforce didactic learning (Howard, 2000).

Specifically, service-learning experiences in biology are designed to "accentuate the need for understanding basic principles of biological science" and to "help illuminate and reframe specific questions research scientists aim to answer and, in turn, help stimulate interest in the principles that underlie these phenomena" (Kennell, 2000). These engagement projects "help students gain an appreciation for the methods, complexity and goals of scientific research" (Kennell, 2000). Furthermore, it has been noted that the use of service-learning components in biology helps to "engage students in biological issues that they often have little interest in understanding or to which they have had little exposure" (Kennell, 2000). With these reported benefits of service-learning classes in mind, this course was designed as a tool for investigating the impact of service learning on the acquisition of knowledge and change in student attitudes about biotechnology and technology transfer. This is an important undertaking as a recent study that surveyed undergraduate students to determine the students knowledge and attitudes about biotechnology revealed that students have a low amount of knowledge about biotechnology and a majority of students were more likely to reject biotechnology than support it (Sohan et al. 2002).

### Concluding Remarks

Specific methodologies that I employ to gain further information about the impact of service learning on the acquisition of knowledge of issues at the interface of science and society includes comparing reflective writings of students in regular biology courses to those from service-learning courses, and analysing student self-reports from papers submitted expressing views on a specific topic prior to becoming involved in the service experience compared to reports from post-papers and/or interviews collected after the service-learning experience. The goal of these investigations is to determine aspects of the design and implementation of student service work that maximally impact student learning and to explore instructional and evaluative strategies to advance the learning objectives for service learning in the sciences. I continue to assess the types of service-learning projects that will be most effective for advancing student knowledge and improving student attitudes about issues at the forefront of the science and society discipline.

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