Bio Class Gets Extreme Makeover

New technology turns lecture-based course into interactive experience

By Greg Rienzi
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At a recent session of the undergraduate General Biology I course, students clogged Homewood’s Mudd Auditorium seats from the front to its very rear rows. Not a bad turnout for a class that three years earlier had had trouble getting half its number to show up.

The large-section survey class, which began in 2000, typically enrolls some 300 students per semester. Faced with low attendance rates its first two years of existence, however, faculty felt innovative approaches to the course were needed to help the students get excited about biology.

With the help of the Johns Hopkins Center for Educational Resources and a $300,000 grant from the Howard Hughes Medical Institute, General Biology in the past two years has been transformed from a primarily lecture-based course to an interactive learning experience that features an electronic in-class polling system, mentoring by upperclass students and a Web-enabled field study project that requires students to scour the campus for flora and fauna.

Today, attendance rates are consistently in the 70 percent range, and students, according to faculty, are more engaged in the course content. An account of the retooled class’s success will be published in an upcoming edition of the journal Cell Biology Education.

The HHMI grant money obtained in 2002 allowed the Biology Department to secure the services of CER staff in order to address pedagogical issues in science classrooms, specifically the large-section survey courses.

The first innovation was the introduction in spring 2003 of hand-held electronic voting units that allow students to anonymously respond to questions posed by the faculty. Multiple-choice questions, for example, are posted on a projection screen, and a student with the touch of a button chooses what he or she feels is the correct answer. Once all the votes are in, the faculty can immediately post the results on the screen to see how many, or few, got them right.
For the current fall semester, the class introduced the Biomes of Homewood project, centered on a CER-developed software program that splits the campus into 60 separate biomes, which are life zones of interrelated plants and animals determined by the climate. Through the Web-based software, students were randomly put into groups of five or six and assigned a particular biome, or region, of the campus on which to conduct field study.

Allen Shearn, chair of the Biology Department and one of four faculty who collaboratively teach the General Biology course, said that the department had previously looked into taking the students on off-campus field trips but felt that it was logistically near impossible.

"But we didn't give up on the idea entirely," Shearn said. "We said, Why not focus on the nearby area, where students could walk and not have to deal with transportation issues?"

In stepped Rae Brosnan, a senior information technology specialist at CER, who up until her departure from the university earlier this month served as lead on the General Biology project. Brosnan polled students to see what areas of the General Biology course could benefit from some technological advances, and she also canvassed other schools to see what they were doing in similar large lecture courses.

For the Biomes of Homewood project, introduced in fall 2004, the goal of Brosnan and the CER staff was to create something that would give students experience with fieldwork and collaborative research.

The Biomes of Homewood Web tool, which students can log onto using their JHED logins, contains an interactive map that provides close-up satellite views of the region selected, with clearly delineated boundaries. The tool also allows the students to post messages to one another, and the faculty to post assignments, both general ones and tasks for specific groups.

At the beginning of the term, each group was told to follow its assigned biome through the semester to see how it changed. They also were given specific assignments that included looking for types and quantities of trees in their area, the number of squirrels in the region and the number of acorns produced by oak trees to see what effect the recent outbreak of cicadas had on their numbers. The assignments related to class lectures on ecology, environmental science and ecosystems.

Shearn said that it's all about getting students to observe nature.

"The idea behind the assignments is that you only see what you look for. If you don't look for things, you don't notice them," he said. "But if you know what to look for, you see a lot more."

The students turn in their team assignments online and are graded on them. To help them with the assignments, each group is assigned a mentor, an upperclass former General Biology student who can help answer questions. Mentors are also available at drop-in help sessions held on weekday evenings during the term and through the Biomes software environment, where they can respond directly to questions students post.

In addition to Shearn, the faculty who teach the General Biology class are Doug Fambrough and Richard McCarty, both professors, and Rebecca Pearlman, a lecturer. Theron Feist, senior information technology specialist in the CER, led the development of the Biomes of Homewood application, aided by Lee McDaniel, an undergraduate student in computer science. Richard Shingles, a curriculum design specialist working in the CER, composed the Biomes assignments. Fambrough was the lead author on the Cell Biology Education journal article that endeavors to make a case for survey courses in biology.

Pearlman said that students seem more excited about the subject matter now, as they can apply directly some of what they are learning.

"I think all the students enjoy that there is some real-life aspect to what they are learning in class, and one of the ways we do that is with this Homewood Biomes project," Pearlman said.
"They study the different organizational and trophic levels of their specific biome. It's one thing to learn from a textbook; it's another to go out and actually see a concept in action — something that is right under your nose on a part of campus that you walk by every day but never noticed. I can see the students having all these 'ah hah' moments now. We love those."

Pearlman said that the combination of in-class voting, group projects and mentoring have made the class more interactive and lively.

"In a class this size, it's easy to feel anonymous," she said. "So being part of a team and also having mentors to consult with has helped the students make a connection and feel that there is someone approachable they can talk to. I also see more collegiality now between the students. They get to know more of their classmates and seem happy to come to class. We've had some really nice interaction between the students in the individual biomes groups. It's been really great to see."

In class, Shearn said that the voting system has been an effective way to break up long lectures and keep a student's attention.

"It provides a wake-up call in the middle of class, but the other thing it does for both students and the instructors is to see whether or not the students are 'getting it,'" he said. "We can tell right away if 50 percent of the class gets an answer to a question wrong that we should stop right there and try to explain the concept again. But even if just 10 percent get it wrong, that group knows there is something they've missed and need to brush up on."

Richard Shingles said the Biomes of Homewood software was designed in such a way that it could be applied to other subjects, such as art history or Earth and planetary sciences. It also allows subsequent classes to take advantage of the field surveys for students to do comparative studies, perhaps to determine if, for example, squirrel populations are rising or declining.

Shearn said that the changes made to the General Biology course have had a direct impact on the curriculum. The success of the "tremendously important" foundation course, he says, has raised the bar in subsequent classes.

"The expectation now among faculty of upper-level courses, more than ever, is that they expect the students to know the material from the General Biology class and can thus challenge the students more," he said. "General Biology has gotten to be more than a regular course. There are more opportunities now for the students to get really involved with the subject. We feel we've always provided a good product, but now we have enhanced our service even more."

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**Want to Innovate Your Class?**

The CER has additional funding to partner with faculty to upgrade the Biomes application to enable integration with courses in other disciplines. For more information, contact Candice Dalrymple at 410-516-8848 or cdalrymple.

To read a description and see a live demo of Biomes of Homewood software, go to [www.cer.jhu.edu/index.cfm?pageID=272&CFID=129798&CFTOKEN=91538140](http://www.cer.jhu.edu/index.cfm?pageID=272&CFID=129798&CFTOKEN=91538140).