State, including biotechnology, electrical engineering, and textiles.

The task for each team, say Kingon and Markham, is to find concepts that make sense both scientifically and commercially. The team starts by identifying potential business ideas, such as a new catalyst for pollution control or a new high-strength fabric, and signing up the university researcher who made the discovery. The next steps are assessing the market, scouting out the needed personnel, and drawing up a business plan. If the idea still seems feasible, the group will pursue the necessary funding.

Unlike scientists in most start-ups, those on the TEC teams are trained to handle all areas of the project. That means taking marketing and finance courses. At the same time, the program prefers business students with a background in a relevant technical field.

"I think the concept is fantastic," says Jeffrey Glass, director of research and development at Kobe Steel USA in Research Triangle Park, North Carolina. "There is a real void in teaching product development in high-tech. So I think this program will be great for industry." Many educators also see it helping academe by broadening the career options available to science graduate students. If it works, "I expect you'll see more of [such programs]," says Glenn Doell, director of a "business incubator" program at Rensselaer Polytechnic Institute in Troy, New York, designed to help RPI researchers commercialize scientific innovations.

Of course, good science doesn't necessarily mean good business, and not all TEC team efforts are expected to become companies. But Kingon and Markham hope the interdisciplinary training and teamwork experience will help team members land jobs in industry even if their ideas don't turn a profit. And for those students whose ideas hit the jackpot, the problem of finding that first job will already have been solved.

–Robert F. Service

Novel Course I: Digital Neuroscience

Computers have become a staple of undergraduate life for electronic mail, word processing, and games. But what bothered Larry Abbott, a physicist-turned-neuroscientist at Brandeis University in Waltham, Massachusetts, was the failure of universities to teach students how scientists use computers in their profession. That's why Abbott designed a course to teach all undergrads—even the most computer illiterate—to simulate events and processes on the computer as if they were researchers working in their own labs. "The idea is to get anyone, whatever their mathematical sophistication, able to make computer models," says Abbott. Topics his students have modeled include the progression of Black Death in 15th-century Florence, the use of neural networks for pattern recognition, the hormonal fluctuations of the human menstrual cycle, and the gravitational interaction of stars.

Abbott is still ahead of the academic curve, but he's not alone in bringing computer modeling into the educational mainstream. At Carnegie Mellon University (CMU) in Pittsburgh, for example, there's a three-part computational biology course that tackles database use, biological imaging, and modeling. And classes at the University of Pittsburgh teach students to use mathematical equations to model physical, social, or biological processes as a "way of converting the real world into something quantifiable," says mathematics professor Bart Ermentrout.

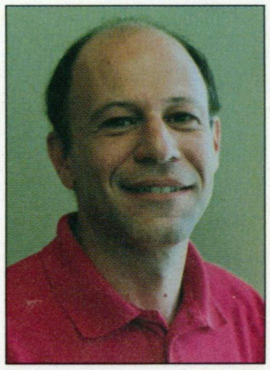
It's hard to understand why such courses remain the exception on college campuses. For one thing, they are very popular with students, who say experience in modeling gives them a leg up on whatever career ladder they choose. "They want to have an advantage over their peers," says Robert Murphy, who helped develop CMU's computational biology program. Abbott agrees: "They see it as something they might do in science," which is why his course attracts students from the biology, physics, chemistry, and mathematics departments.

This diversity also makes Abbott's class one of the most exciting on campus, according to Eve Marder, a Brandeis neuroscientist. He "allows students to apply the [modeling] methods to anything they find exciting," she says, from earthquakes to genetics. Marder has seen the fruits of Abbott's own labor: He developed a package of computer programs for her introductory neuroscience course that simulate classic experiments demonstrating the electrical properties of nerve cells. For example, students can measure current flowing through ion channels in a cell with software simulating so-called patch clamp techniques.

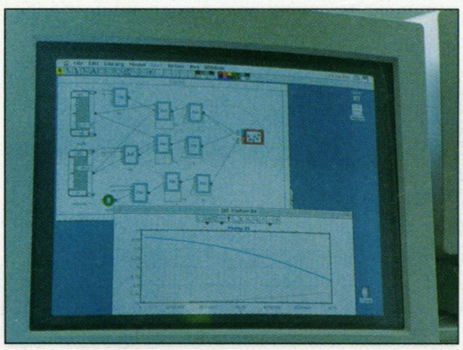
In his own course, Abbott starts off with the mathematical fundamentals of modeling, explaining how differential equations can be used to describe everything from chemical reactions to neurons firing, his own area of interest. (Abbott says he deserted particle physics because "I didn't want to be an old man before I got my next piece of data.") Once his students are grounded in the principles, Abbott lets them work with a software program called Extend, which makes modeling a breeze. Without any real computer programming, students can define equations that represent some process—say, an oscillating object—and link them by drawing arrows between the boxes that hold each equation. They then run a simulation, in which they can control a number of variables, that shuttles the results into a plotting device.

More ambitious students go beyond Extend to program their own models. One student, before going off to medical school, modeled a heart to observe how it reacted to different concentrations of gases in the bloodstream, he recalls. The example reminds Abbott of the importance of his approach to teaching undergraduates. "This is what people are doing in the labs," he says. "The students have to learn it."

–John Travis



Teacher-hacker. Larry Abbott is a pioneer in the design of virtual labs that use computer modeling to display such phenomena as magnetic fields and the trajectory of a batted ball.



PHOTOS BY HEATHER PILLAR