



Room to Grow—and Learn

GIVEN DEDICATED SPACE FOR BOTH LECTURE AND LAB, STUDENTS CAN EXPERIENCE THE FULL ARC OF SCIENTIFIC RESEARCH.

Susan Wessler gazes around the brand-new science learning laboratory with a mixture of pride and anticipation.

On one side of the blue-and-white checkered hallway, there's a wet lab with most of the same equipment found in her plant genetics research lab one building away. Just across the hall is a discussion room and computer lab, with new Mac laptops for 25 students.

The Campbell Science Learning Laboratory, which opened at the University of California, Riverside, in early July, is designed to integrate teaching and hands-on experimental science. It aims to give incoming freshmen the experience of working in a real genetics laboratory, down to the radio playing music and the coffee machine. “For many students, this will be their first biology course—something very different from traditional, impersonal lecture courses,” says Wessler.

Special spaces devoted to exploring science are beginning to appear on university campuses, changing the way science courses

are organized and taught. “We were losing a lot of students who are interested in majoring in sciences because of big lecture courses,” says Richard Losick, a professor of biology at Harvard University who has launched two HHMI-supported lab spaces.

When Wessler began teaching undergraduate biology courses at the University of Georgia more than two decades ago, the experience was not what she had hoped. “To be honest, it was disappointing,” she says. She noticed something peculiar in the students when she saw them in lectures and when they worked on projects in her research lab: “I would walk out of the classroom and people wouldn’t be particularly excited. But the undergraduates in the lab were bouncing off the walls.” Seeing the instant engagement in the laboratory got her thinking about better ways to keep students engaged in science.

With support from an HHMI professor grant, awarded in 2006, Wessler developed a course that replicated her research program

in an undergraduate classroom laboratory, allowing students to analyze transposable DNA—small pieces of DNA that can jump from one location to another inside a cell’s genome. At the same time, she spearheaded the design of a special place to teach the unusual class—with all the elements of a working lab space. When Wessler made the move from Georgia to UC Riverside last year, bringing the lab and the class were part of the deal. The Riverside lab is named after the late Neil Campbell, an alum and coauthor of the biology textbook used in many high school and college introductory courses.

The crossover between discovery and practice in such learning spaces means that concepts get put to work immediately, and lab isn’t just an add-on to lecture-based learning. “Rather than going to the lab the next day, we can do experiments at the same time we discuss concepts,” says James Burnette, a researcher who coordinates Wessler’s class laboratory. Even more importantly, students have the opportunity to repeat experiments if something doesn’t work—just like a research lab—and they must master concepts before moving on to the next project.

The investment in infrastructure isn’t small—Wessler says her space cost \$700,000, with nearly three-quarters of that coming from Rochelle Campbell, Neil Campbell’s widow. Now that the lab is paid for and in place, however, Burnette notes that it can be run with nearly the same student lab fees as a typical undergraduate science course.

For undergraduates who have the opportunity to do high-level research, the experience can be unforgettable. Paris Stowers, who took Wessler’s course at the University of Georgia, says the class was one of the most influential of her college career. “We were guided through the process of designing an experiment, writing a grant proposal, and presenting the results.” The class cemented her plans to pursue a career in medical research. Starting in September, Stowers will spend a year conducting research on neuroblastoma through Baylor College of Medicine’s medical student research track program.

Ownership and Discovery

Rich Losick believes that labs and classrooms have the potential to work symbiotically for students—and professors. “For me, teaching and research go hand in hand, and I’d like to think I’m a better teacher for being a researcher and vice versa,” he says. “It leads me to see the big picture and get to the heart of the matter.”

Losick spearheaded the design of the new science learning spaces with help from HHMI professor grants, starting in 2002. His aim was to move away from formulaic science teaching where students go through the motions without really learning. “There are two features that make for a successful hands-on experiment: ownership and discovery,” he says, adding that science is not just a series of facts but an active process.

Of course, designing courses so that every student can discover something novel is not easy. Losick has created two teaching spaces to take on the challenge. The Jeremy Knowles Teaching Lab, which opened at Harvard in December 2009, is a highly flexible space that can accommodate different science classes, from molecular biology to a new course on the science of cooking.

Around 120 students can simultaneously use the 7,000-square-foot laboratory for the research component of different lecture courses, thanks to engineering tricks like moveable benches and a false floor that serves different equipment. The space can be divided up with sound-proof walls, creating two or four smaller spaces. In this setting, rote-learning science labs are out and true experiments are in: small teams of undergrads tackle a semester-long project. One course, for example, trains students to work with a protein implicated in cancer and then has them look for other proteins involved.

The second space Losick designed is a 50-person, interdisciplinary laboratory used solely for research-based classes. In one project, students built their own confocal microscope and then used it to study neuronal firing in zebrafish. In another project, students studied samples of cheese from a gourmet store, identifying microbes in the cheese and rinds. “The projects are changing all the time, and the course is entirely devoted to research,” says Losick. “It’s like working in a real lab with a team of five or six students who are tackling some question of current research.”

Back at Riverside, Susan Wessler would love to see the model of project-based science classes grow—for the students and for slightly more selfish reasons. “When we started, I thought that we’d be bringing ideas from my research lab to the classroom, to design and deconstruct complex projects to their fundamentals. But I’ve been surprised that the learning goes both ways—some of the user-friendly computer software we’ve developed in the classroom has moved back to my research lab,” she says. “The lesson is: if you teach students what’s out there in science and give them the right tools, they can do real experiments.” And she’s betting they’re making discoveries for life. ■ —KATHARINE GAMMON