



# Tomorrow's Tools

Biomedical engineers learn by building

On a Thursday evening before finals last semester, **Brent Geiger x'05** found himself staring at a spaghetti bowl of black wires, protruding at odd angles from a circuit board on a table before him. He and his four teammates had a problem, and it wasn't so much that the project they had worked on all semester was due the next morning, nor that they still had to solder all those wires into place to get the thing working.

That night, amid the darkened labs of the Engineering Centers building, the problem was that none of them had ever used a soldering gun.

"We've designed circuits and built them on test boards. But this was our first time to actually work on a real board," says Geiger. "You just have to jump in and try to figure it out."

Fortunately for them, jumping in is no problem around the UW-Madison biomedical engineering department, where Geiger is one of 140 students learning how to design the tools of medicine and life science research. Majors complete a sequence of six design courses, in which they create and build biomedical equipment for clients around the university and in private industry. Beginning as early as a student's third semester on campus, those courses leave little option but to dive into unfamiliar waters.

"In almost every other class, if you give students a problem, they can go home and work on it, and there's always an answer in a book somewhere," says **John Webster**, one of six professors who oversee the design courses. "This is different."

The difference begins with the projects. Nothing is in the hypothetical — these are real problems in need of real solutions. Webster and colleagues round up more than a dozen design challenges by asking professors and other contacts in the life sciences what tools they need to do their work better. "Most have some problem they've always wanted to work on or have solved," he says. "We say, here's a team that is willing to spend time on it and get the thing done."

On the first day of each semester, students divide into teams of five or six and sign on for projects, which might involve anything from designing a better IV tube to figuring out how to resperate a blue whale. It's pretty much a given that they will start in over their heads, lacking the technical skills or specific knowledge to complete the task. The whole point, says

Webster, is to figure out what they need to know and how they can learn it. "They learn to work contacts and go places they haven't gone before to find answers," he says.

In the case of Geiger's team, that meant learning about the life of a twelve-year-old boy with lissencephaly, a rare neurological disorder that severely impairs mental and physical development. The students' client, a nurse who oversees the boy's care, had been searching for a muscle-activated massage pad that could provide positive feedback and pleasurable stimulation when the boy flexed a particular muscle. Nothing like it existed on the market, and so it fell to the students — four juniors and one sophomore — to build one from scratch.

During fall semester, the team designed a circuit that would pick up a signal from two electrodes wrapped around the boy's thigh and trigger the massage pad to turn on for two minutes. They ordered the parts and tested them out on Geiger's biceps muscle. They even made a colorful slipcover to put over the pad.

Technical knowhow, though, was only part of what it took to complete the task. "At first, when we got this project, we really had no idea how to do it," says Geiger. "We had to go through the process of designing it, and you really learn a lot by doing that."

At most universities, hands-on design comes only after students have completed a sequence of more traditional classes that teach the basics of instrumentation and biomechanics. Wisconsin's curriculum includes those classes, too, but its emphasis on design is unique — a product of a faculty-led overhaul of the

CLASS NOTE

## The Madison Connection

Film historian **Tino Balio** knows plenty about the history of Hollywood, and he puts much of it into the course he's taught since 1990. Still, he recognizes that he's dealing in secondhand knowledge. "I can only describe what other people do," he says. Until now. With the help of the UW Foundation, Balio has lined up an all-star cast of guest speakers for his course this spring, including movie producers **Walter Mirisch '42**, **Jim Abrahams x'66**, and **Jerry Zucker '72**, studio executive **William Immerman '59**, and Home Box Office mogul **Lee DeBoer '74**. More than a dozen alumni will come back to Madison, and their talks will be open to the public. "These people can give a perspective most professors just are not able to have, because they're insiders," says Balio. "And we hope they give students an indication of what type of success is possible with a UW degree."



SPENCER WALTERS

— M.P



JEFF MILLER

**Tom Chia x'05 tests a circuit board, which eventually will power a muscle-activated massage pad that he and four other students built as a project for Biomedical Engineering Design. In the past two years, fifteen inventions from the class have been considered for patenting by the Wisconsin Alumni Research Foundation.**

curriculum undertaken six years ago. Now, the UW program is the only one in the country in which students are exposed to open-ended design throughout their time on campus.

"It's my favorite class to teach, because it's so creative," says Webster. He points out that the only lectures come at the beginning of the class, when professors offer a few insights on teamwork and the design process. But even those paltry touches of formality try

students' patience. "They just hate it. They want to get into the lab and get going," he says.

To ease the culture shock, Webster teams sophomores with juniors, who can help them with rudimentary skills and serve as mentors. But students say even the most experienced team members rarely have all the answers.

"You're thrown into a lot of new areas where you have to learn on the fly," says **Jon Millin x'05**. He recalls an experience

from a previous semester, when his client was a veterinarian who wanted students to design a ventilator for use on mammals in the field — including animals as large as blue whales. "We had to spend all this time just researching how animals breathe," he says.

By the time they become seniors, students have experience on four or five projects, and their savvy shows. In the past two years alone, fifteen student teams have disclosed their inventions to the Wisconsin Alumni Research Foundation for patent consideration, including a new needle insert for breast biopsies, an apparatus that measures a patient's ability to swallow, and a portable device that allows people with speech disorders to regulate the volume of their voice.

Not all projects go so well. Biomedical engineering is no different from any other tool-related endeavor, in that it's rare that everything works perfectly the first time it's assembled. Most teams endure prolonged periods of trial and error before they arrive at functional solutions.

"Our credo in this class is, 'Try it, see what's wrong, and fix it,' " says **Brian Frederick x'05**, whose team hit a dead end when trying to design a restraint that would make it easier for researchers to administer eye drops to lab animals.

But as teammate **Ross Gerber x'05** points out, you can learn as much from the things that don't work as the ones that do. "When things fail, you have to look at different concepts and try other ways," he says. "One of the most important lessons in engineering is to know when to give up on an idea."

— *Michael Penn*

Opera soprano **Julia Faulkner**, who has hit the high notes on stage at the Metropolitan and throughout Europe, is back in her native Wisconsin, teaching voice to UW-Madison music students. After joining the music faculty as an associate lecturer in the fall semester, Faulkner is now leading the course Language Diction for Singing, in addition to individual studio instruction. She lent her own accomplished voice to a faculty music concert in January.

When lakes diminish, climates change, or animals disappear from the landscape, it's often the task of scientists to explain why. Researchers at the Center for Sustainability and the Global Environment have designed a new course dedicated to that science. Titled **Ecology and a Changing Planet**, the course will teach students how researchers draw on a broad range of scientific observations to evaluate changes in local and regional environments. Most of the instruction takes place over the Web — although weekend field trips are optional — allowing teachers and others in the field to participate.

Speaking of the Web, more and more popular UW courses are popping up there as students clamor for flexibility in the curriculum. The latest is **American History 102**, Stanley Schultz's survey of post-Civil War history. Taking advantage of its much-lauded Web site, produced by multimedia editor William Tishler '91, the course has moved almost entirely online as of this spring. Students log on to hear lectures through streaming audio and download readings and supplemental materials. Only weekly discussions draw warm bodies.