TA SUPER BOOSTER

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Enhancing TA Performance

Instead of letting teaching assistants sink or swim, risking their failure and the ire of the undergrads, some schools are prescribing a class in how to teach before they get in front of a class.

By Andrea Widener
illustration by VSA Partners

After seven years, Catherine Drennan was finally happy with her lectures for her introductory chemistry class. She had integrated engaging techniques and worked hard to find meaningful examples from biology for the 200-plus student class at the Massachusetts Institute of Technology (MIT). But the recitation sections—the small groups where teaching assistants (TAs) and undergraduate students meet to reinforce lectures and work problems—were hit or miss.

While some TAs were dedicated teachers, others thought that teaching freshmen interested in engineering or life sciences was beneath their abilities. That meant some undergraduates thought they weren't getting the support they needed to pass the class. And that made Drennan miserable—especially when students showed up in her office to complain. "It was very disheartening," she says.

So Drennan, an HHMI professor and now an HHMI investigator, decided the best way to improve the class was to revamp the TA experience. In 2007, she joined with fellow instructor Elizabeth Vogel Taylor, a recent graduate of the doctoral program in chemistry at MIT, to expand TA training by creating a TA "boot camp" to be held the week before school began.

The boot camp included everything from team building exercises to advice from former TAs to a discussion on teaching students from diverse backgrounds. What's more, the TAs had to apply to teach the class. The number of applicants for what had been a dreaded assignment surprised Drennan and Taylor: 11 of 44 chemistry graduate students applied in 2007, the program's first year, and 16 of 41 did the same in 2008.

The results have been better than Drennan imagined. Student complaints have been replaced by enthusiasm about chemistry. And, rather than grumbling about their teaching assignment, the class's dozen TAs get together to grade papers, share ideas, and talk about the best ways to help problem students.

"It seems to defy the laws of thermodynamics," Drennan says. "The amount of time we've put into TA training is so little compared to the time it saved with complaints and issues later."

While TA training itself isn't new, more faculty like Drennan say comprehensive TA training improves large introductory science courses for everyone involved: undergraduates, TAs, and professors. Undergraduates get better instruction in labs and recitation sections where one-on-one instruction most often occurs. TAs learn from the beginning how to handle common classroom problems and present challenging material in an engaging way. And faculty can worry more about teaching and less about complaints from students.

"I was actually very excited they were giving this type of training because you really want to put your best self forward when you're teaching," says Mike Morrison,

who was a TA for Drennan's class in fall 2008. That is especially important when teaching freshmen who are often scared and overcommitted, he says. "You need to connect with these students early on, and to do that you really need to have a basis and a foundation to teach. I had never had that before."

Morrison used that connection to help bring one student back from the brink. She had stopped coming to his recitation and her grades were dropping, so Morrison tracked her down after lecture one day. Like many MIT freshmen, she was bright and driven, but as they talked she confessed that she was having trouble managing her time. He gave her advice on balancing commitments, and soon she was back in recitation and ended up doing well in the class.

"As long as you get to a student quick enough, when you start seeing them slip a bit, you can get on the problem and show that you care," Morrison says. "I think they get a boost of confidence and are more likely to do better in the class."

Focus on Critical Thinking

Robert Mason's first experience with a TA was when he became one. In the 1980s, Mason went from College of the Holy Cross, a small liberal arts school in Massachusetts with no graduate students, to pursue a doctoral degree at the University of Texas at Austin, one of the largest schools in the nation.

He remembers being told he was a TA, and that he'd have to report to the introductory biology classroom on Monday morning. "It was pretty much, 'Knock 'em dead, kid!'" laughs Mason, who now heads the undergraduate biology program at Oregon State University. "I have a vivid memory of standing up in front of the class thinking, 'Holy cow, three months ago I was over there, and now I'm over here.'"

Mason thought back to that experience when he began looking for ways to improve Oregon State's introductory biology class, with funding from an HHMI grant. The class includes two immense lecture sessions of 650 students each—which doesn't give the faculty much opportunity to reach out to individual students. But Mason had at least 28 graduate students serving as lab TAs, each meeting with undergraduates weekly in smaller lab sections. When Mason asked around about TA training, colleagues pointed him to Jessica White, an education professor.

White studies the factors that cause graduate students to stay in or drop out of school, and she had heard a lot about the TA experience. Some students were glad for the income from the paid position, since it helped them finance their education. But often, students cried during interviews when talking about teaching. "They felt really unprepared and felt they were being fed to the wolves," White says. What scared them wasn't the subject matter—it was how to deliver a lecture, how to manage a classroom, how to write a quiz.

White agreed to help teach a course for TAs who were assigned to run introductory biology labs. But first she looked to see what was available elsewhere and learned that TA training nationwide varies greatly. Some schools offer intensive certificate programs that span years and cover many types of classes and teaching experiences. Others offer university-wide courses for a few hours or a few days before school starts, though some science TAs complain that those are often generic. Many schools, including Oregon State, had no organized training at all.

White wanted the TA course to begin with the practical: teaching TAs how to set expectations for the lab, work with students who have disabilities or otherwise

Paul Fetters

Catherine Drennan
Massachusetts Institute of Technology

need special assistance, manage disruptive students, and deal with academic dishonesty.

Then she moved on to subjects that would make the TAs better teachers: writing thoughtful quiz questions, addressing different learning styles, and breaking the cycle of memorization and repetition. During the school year, White saw a notable increase in confidence among the graduate students that they could handle both the class and the material. "It became evident that many of the people were just craving this," White recalls. "Even the veteran TAs were thrilled to have this opportunity because they had already had a year or two of really floundering."

Sarah Eddy, a veteran TA and zoology graduate student, says White's course made her think about her class differently. She revised her introductory lectures to include more group activities and learned how to streamline her weekly grading duties. But the part she found most interesting was the focus on improving critical thinking, both in lectures and on quizzes. "If you can give the students that skill, then they are much closer to becoming scientists," she says.

Within a few weeks after White's class began in fall 2008, other graduate students were asking if they could join. Now faculty and graduate students in chemistry, physics, and even departments outside the sciences want to find out what the class is about. The idea has been so popular that Mason and White are creating a teaching certificate program for graduate students at Oregon State. But what drives Mason to do this is the effect on the students.

"My responsibility is to make sure that these undergrads are taught as effectively as possible," Mason says. "Now we're saying [to TAs] the onus is on us to make you an effective teacher. I can't just say be an effective teacher. We have to teach them how."

Leah Fasten

A Jumping Off Point

In a TA training course at the University of Delaware, on a humid August day, about 60 new biology and chemistry graduate students gathered around tables debating the best way to explain dependent and independent variables. They had just suffered through a video of an obviously unprepared TA struggling to answer just that question. The TAs responded with occasional groans or chuckles.

Hal White, a biochemistry professor who has taught Delaware's HHMI-funded "Introduction to Laboratory Instruction" class for eight years, says that first-time TAs often fear they won't know the material or be able to answer questions like this one. But that usually isn't the kind of problem they encounter. "There are more issues of management than there are of content," he says. For example, how do you get students to come to class on time? What do you do if they are constantly texting or talking on a cell phone?

White's goal in this science-specific TA training is to get them past their personal fears and these common problems quickly, so they can move on to the serious business of teaching. He wants them to think about how people learn—even if for just one hour a week. "What I'm trying to do is take the focus from one's self to a focus on the students," he says.

Graduate students need to understand that they can have a big impact on undergraduates, White says. College is a time when many students change how they think about the world, from a simple black and white view to one that includes the shades of gray so common in science. The TAs can also help students understand the importance of science—this science class might be the only one they take in their college career.

Graduate student Brad Bauer took the Delaware TA training course in 2006 when he started teaching an introductory

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the chance of losing a baby can be as high as 80 percent in areas of the world where NICUs are lacking, and most babies who do survive will have long-term mental and physical disabilities.

"For a woman, that is like being told she has metastatic cancer. She's willing to try anything to save her baby's life," Karumanchi says. A therapeutic agent that could prolong her pregnancy by even a few weeks would increase the odds dramatically—babies born after 28 weeks have a greater than 90 percent chance of survival, with fewer complications.

Rowitch now cares for babies born too soon in a new unit at UCSF, the Neurointensive Care Nursery, which opened in April 2008. The nursery is the only one in the country with round-the-clock brainwave monitoring and magnetic resonance imaging for premature infants. With these tools, doctors and researchers are developing and testing supportive therapies for the most vulnerable babies' brains.

"These are the hardest patients, the ones with neurological injuries. It's extremely hard to see what families go through and to routinely have to tell them there are no therapies available," says Rowitch. "One way for doctors and nurses to combat emotional exhaustion is by thinking toward the future. For me, that's working on a neuroprotective strategy for these very premature babies."

WEB EXTRA: To read about an HHMI professor's efforts to refine inexpensive incubators, and to hear her describe her students' work, visit: www.hhmi.org/bulletin/nov2009.

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probe the membrane as a complete system, rather than as isolated proteins. "The single molecule approach will always be there, that's essential," Groves says, "but we're starting to have tools to go after the collective as well. We want to see the forest and the trees both."

Harvard's Walz shares this view. He has moved from studying the structure of aquaporins to looking at the broader view—probing how the channels interact with the membrane around them.

His lab has been testing the theory that helix-shaped parts that exist in many membrane proteins, including aquaporins, can adjust to the bilayer surrounding them by expanding and contracting like a spring. If they're in a thick lipid membrane, the helices can stretch a little bit, and if they're in a thin spot, the helices will condense.

"That is just a theory, and using aquaporins we can actually measure whether this is happening or not," says Walz. By doing crystallography of aquaporins while they're embedded in the membrane, as he and Gonen did for the AQP-0 structure, Walz can see how the structure changes in membranes of varying widths.

Innovative experiments like this, membrane scientists agree, will answer the questions raised by a decade of structural work.

"It's a little like the stage of biology back when collectors were going out and collecting things and sending them back to museums," says Rod MacKinnon. "We have a large collection now. Which means we have to start figuring out the logic to how this all fits together." ■

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chemistry lab at the university, which is consistently among the 10 schools with the largest number of undergraduate chemistry and biochemistry majors in the country. Introductory classes are often packed with 2,200 or so students each fall. The training helped him overcome his initial nervousness, and the support structure was important when he encountered his first major problem in the lab.

In that instance, a nontraditional student in his 70s wasn't working well with the other students, most of them just 18, and he ended up being a burden to his lab mates. Bauer brought the problem to his TA training class. After much discussion, they concluded it might be best for the older student to rotate to a different lab group each week. "I implemented that change in the lab and it seemed to work," he says.

Bauer says he would like to be a teacher some day and will use what he learned in White's class. "He pushed the boundaries of what else we could try [in class] and helped us get out of our comfort zones. I think it's a good jumping off point," Bauer says.

That's what White hopes these biology and chemistry TAs learn: teaching well is a constant learning experience. In the rush to get into graduate school, most graduate students haven't spent time thinking about teaching, he says, and TA training can be the first step toward becoming a great teacher one day—whether his students become professors or not. "It doesn't come easily—and it doesn't happen in one semester." ■

WEB EXTRA: Visit www.hhmi.org/bulletin/nov2009 to see an audio slideshow of a new TA as he prepares for his first time teaching a University of Delaware lab and an audio slideshow of Catherine Drennan's MIT training class on diversity.