



March 23

## A Scientific (Teaching) Revolution

The idea wasn't terribly subtle: Money talks at research universities. So if you want to change the way science is taught there, you need to have enough money to capture people's attention.

The Howard Hughes Medical Institute (with an endowment in excess of \$12 billion) has that kind of money. So in 2002 it decided to turn 20 professors at research universities into "million dollar professors," giving [them](#) each \$1 million to push for real change in the way students are taught at top universities. In terms of grants for curricular or teaching change, where many professors are thrilled to get \$50,000 from a foundation or relief from teaching one course, \$1 million is huge.

Peter J. Bruns, vice president for grants and special programs at Hughes, said, "We didn't want to just get the scientists' attention, but the institutions' attention."

Three years into the program, evidence is emerging that the Hughes grants are indeed changing many courses. While the efforts of the various professors differ, there is a strong emphasis on making introductory courses more exciting, looking for ways to enhance professor-student interaction even in large lecture courses, and trying new approaches to testing what students learn.

Because the emphasis of the Hughes awards is on programs that could be spread nationally, the impact may be seen soon on campuses without their own "million dollar professors." And if you missed out last time, there's a chance to join that elite group. The institute is now [accepting](#) nominations for a second group of awards — again, up to 20 people will receive \$1 million.

For a good example of how \$1 million can change things, talk to [Jo Handelsman](#), a professor of plant pathology at the University of Wisconsin at Madison. With her grant, she is focusing on two projects, both of which involve evangelizing on new approaches to science education that will be felt far from Madison. One project involves changing how graduate students and postdocs learn to teach, so that they start their careers with better techniques than they experienced as undergraduates. The other project involves an intense Madison seminar over the summer — also supported by the [National Academies](#) — to help teams of professors learn to revamp their introductory biology courses.

While the teams at last summer's program represented only 20 universities, they taught introductory biology to 22,000 students this year. "Our goal is really to change the way science is taught everywhere," Handelsman said.

Handelsman said she decided early on after receiving a Hughes award to focus on "training the next generation of faculty to be better teachers" because she could have the most impact there. "I can change my own teaching, but it's very difficult to change senior faculty."

To reach postdocs and grad students, she designed a course on teaching biology. During the course, students serve as mentors to undergraduates, create new approaches to teaching basic concepts in biology, critique one another's approaches, and test those approaches by teaching portions of various biology courses at Madison and at Edgewood College, a much smaller, private institution nearby.

"The hallmark of our program is active learning," Handelsman said. "No matter how large a lecture, undergraduates can be actively involved in their learning, and we need to focus on all students, and remember that one teaching method is never going to work for everyone."

What does that look like?

"As opposed to someone standing up and talking for 50 minutes, the teacher does a combination of delivering information and getting students to think about it," she said. "They might give the results of a scientific study and ask students to make a prediction. Or have students work in small groups, even for three minutes, and then report. Or ask students to write on a notecard the most important thing they learned. Or they might use clickers to ask questions and get instant feedback on whether students understood something."

What these techniques have in common, she said, "is that they create a dialogue and the teacher is always getting feedback."

Other approaches Handelsman teaches her graduate students include the importance of moving beyond the multiple-choice test (short written answers may encourage more understanding by students), and thinking about the relevance of what they are teaching. Handelsman said, for example, that women tend to become more interested in science when they see its applications — and how science helps people — than when ideas are discussed only in the abstract.

Postdocs and graduate students who have been through Handelsman's program say that it has changed their approach to teaching — and even to getting a job. Patrick D. Schloss is in the final stages of negotiating a position for himself at a major research university and he said he based his job talk on the principles Handelsman taught — in the process showing how he can now teach.

"Much of my research has involved using novel statistical techniques to describe bacterial communities and thinking about how they might be different and when to say we've sampled enough," he said. "So for my job seminar I incorporated an interactive component where attendees sample different candies from a paper bag and they have to determine when to stop sampling, how to define a species, and similar questions."

The summer program for teams of faculty members lasts only a week, and during that week each team must develop a new "teaching unit" based on the principles of active learning, and then teach the unit to fellow participants. The summer program reconvenes in January so participants can talk about how effective they were at putting their new ideas into courses.

The University of California at Irvine is among the institutions where these new ideas are now being tried. Diane O'Dowd came to Madison, along with several colleagues, with the goal of changing the way they taught Bio 93, "DNA to Organisms," the first course in a sequence required of biology majors.

When the professors taught the course this fall — to 1,317 students in four different sections — a number of changes were made. Each class session featured multiple instructional styles, not just lectures. Video clips, animations, and demonstrations were added — and most sessions started with

identifying a specific question and then worked toward the answer to that question. Students were also encouraged to work in groups — both in class, to answer some questions quickly, and on longer homework assignments.

O'Dowd said that many students were skeptical of the group projects when they were described at the beginning of the course, but that more than 70 percent of students rated the group experience as positive at the end of the course. She said that for her, a highlight of the experience was when the overwhelming majority of students agreed with a statement on the course evaluation that doesn't always do well in large lecture courses: "Course instructor encourages student to think in this course."

— [Scott Jaschik](#)

## Comments

### Economics

I tried to interest our economics department in these types of innovations over a decade ago. They weren't interested. At some point, however, market forces will induce more schools and more departments to move in these directions.

[The Eclectic Econoclast](#), University of Western Ontario, at 7:54 am EST on March 28, 2005

Got something to say? [Add a comment](#).

© Copyright 2005 *Inside Higher Ed*