

Rebalancing Teaching and Research

In universities across the United States and in many other parts of the world, the biological sciences continue to enjoy a wonderful revolution. Everything has changed in the research laboratory, but it is likely that far less has changed in the classroom down the hall. The same detachment of professor from student that frustrated university education 25 years ago is just as pervasive today. Although each course is now likely to have its own Web site, with class schedule, lecture notes, and assignments, the professoriate still struggles with how to use technology to achieve a greater impact on student learning and how to communicate the genuine excitement surrounding today's discoveries.

For this shortcoming we are paying a huge price: a decreasing percentage, here in the United States, of students who wish to pursue research careers; school districts that struggle to find qualified K-12 science teachers; and a public that has only a hazy understanding of the research advances that are sweeping through our society.

At the Howard Hughes Medical Institute (HHMI), we've recently empowered 20 outstanding teacher-scholars to make an impact on university education. These HHMI Professors, chosen through a nationwide competition,* are each being given \$1,000,000 over 4 years to develop new modes of science teaching. Their approaches are diverse; in essence, they'll be carrying out 20 experiments in innovative education. Yet they share the common denominator of providing many more undergraduates with a real research experience. Other themes include teaching graduate students and postdocs how to teach; extending research experiences to high-school students and teachers; bridging biology with engineering, chemistry, and computer science; and engaging more underrepresented minorities in research.

How will their activities have a more general impact? The HHMI Professors will meet regularly to compare notes about what works in the classroom and what doesn't. Their best practices will then be broadly disseminated. We expect them to create Web- or DVD-based resources—including animations of biological processes and "virtual laboratories"—that encourage participatory learning. Furthermore, they will share successful curricula and materials by publishing in journals such as the new Web-based *Cell Biology Education*.†

Why do today's university faculty so rarely apply the same innovation and energy to their teaching that they invest in their research? There is no mystery here. Promotions, large salaries, and prestige at a research university are dependent on publications, patents, and grant funds. Good teaching may be appreciated, even applauded, but good research is at the heart of the reward structure. By providing recognition and research-level dollars to accomplished scientists who have a track record of exciting teaching and a penchant for more, we hope to tilt the research/teaching balance back to a healthy equilibrium.

These individual awards should enhance what is already going on at an institutional level. HHMI, the National Science Foundation, and others have nurtured undergraduate research through grants to both research universities and 4-year colleges for many years. Hands-on research experiences, though inherently inefficient with respect to faculty effort per student, are strikingly effective in their impact on young people's lives. We now have the opportunity to extend such experiences from independent research projects, often carried out by science majors in the junior or senior year, to core projects for many more students, preferably beginning much earlier in their undergraduate careers.

Reinvigoration of science teaching at research universities will benefit students, of course, but faculty will also find new stimuli for their research. G. N. Lewis's invention of the electron dot system for depicting chemical bonding while teaching introductory chemistry at the University of California, Berkeley, is a story that has been repeated with countless variations over the years. Students' questions force faculty to read and think outside their narrow field, often expanding or revising their approach to research problems. Above all, faculty members find great personal satisfaction in excelling at the activity that gives real meaning to the title "professor."

Thomas R. Cech

Thomas R. Cech is president of the Howard Hughes Medical Institute and for 22 years has been a teacher of undergraduates at the University of Colorado, Boulder.

*See www.hhmi.org. †See www.cellbioed.org and pubmedcentral.nih.gov.



For Jo Handelsman (right), a HHMI "million-dollar professor," research and teaching can't be separated.