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What's Wrong with Undergraduate Science Education and What Can Be Done About It?

What's wrong with undergraduate science at research universities?

Undergraduates who take science at research universities often find themselves in large lecture halls, listening to lectures comprising laundry lists of facts rather than being directed to discover things for themselves. According to a National Research Council report, many undergraduates take no more than one year of science, and public understanding of how science is done and how scientists think is poor. *Bio 2010: Transforming Undergraduate Education for Future Research Biologists*, a report issued in 2002 by the National Research Council of the National Academy of Sciences, notes that the culture of research universities tends to undervalue teaching. *Bio 2010* also reported that graduate students and postdoctoral fellows in the sciences aren't trained or motivated to teach well.

Why don't researchers pay more attention to teaching undergraduates?

In 1998, the Boyer Commission on Educating Undergraduates in the Research University reported that:

Tenure and promotion decisions tend to be based almost entirely on research and publications rather than on teaching. Graduate students and postdoctoral fellows are not encouraged to teach or mentor undergraduates, and they receive little, if any, training in how to teach effectively. National scientific meetings still do not include many sessions dealing with teaching. When they do, those sessions are typically not integrated with the meeting as a whole, reinforcing the separation/separateness of the two activities. Departmental budgets at universities often preclude the kind of interdisciplinary collaborations that might include undergraduates. Most universities do not have budgets which take into account the expense of time and equipment needed to create truly innovative new ways to teach. Even at universities where good teaching is valued and expected, faculty members who attained tenure in a different era often have trouble adapting.

Models for change HHMI has awarded \$20 million to 20 research scientists who, as HHMI Professors, are bringing innovative, research-based science to undergraduate classrooms.

An institute at the University of Wisconsin-Madison in July 2004, co-sponsored by HHMI and the National Academy of Sciences will help undergraduate science faculty from across the nation develop more effective ways to teach introductory courses. Bio2010, a report issued by the National Research Council of the National Academies and supported by HHMI and the National Institutes of Health, recommends a new, interdisciplinary approach to undergraduate life sciences education, including independent research and courses that communicate the excitement of doing science. See http://www.nap.edu/catalog/10497.html?onpi_topnews091002. The University of Arizona and the University of Wisconsin now consider a faculty member's commitment to undergraduate teaching in granting tenure. Colgate University has replaced "cookbook" experiments with research that can generate results of publishable quality. Cornell University has created a program that exposes freshmen to research. The University of Miami invites local community-college students to join research teams of its faculty members. The Georgia Institute of Technology has committed \$250,000 to help faculty members involve more undergraduates in research. The National Science Foundation recognizes a dozen Distinguished Teaching Scholars each year for their work with undergraduates across all scientific disciplines.