HHMI
HOWARD HUGHES MEDICAL INSTITUTE

RESEARCH NEWS

SEPTEMBER 18, 2002

Undergraduate Science Education at Research Universities

Challenges for undergraduate science education at research universities Undergraduates who take science at research universities often find themselves in large lecture halls, taught by junior faculty. Their interaction with prominent research scientists ranges from limited to nonexistent. Minorities and women are underrepresented in science majors, particularly at research universities. The 2001 National Survey of Student Engagement reported that only 25 percent of seniors across all majors at doctoral universities work with professors on research outside of course requirements. According to the National Research Council, many undergraduates take no more than one year of science, and public understanding of how science is done and how scientists think is poor. The culture of research universities tends to undervalue teaching. Graduate students and postdoctoral fellows in the sciences arent trained or motivated to teach well. **Why dont researchers pay more attention to teaching undergraduates?** 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 publication 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 rarely include sessions dealing with teaching. When they do, those sessions are 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. Even at universities where good teaching is valued and expected, faculty members who attained tenure in a different era often have trouble adapting. **Twenty researchers now have been named HHMI Professors (www.hhmi.org/news/091802.html)** Last year, the Howard Hughes Medical Institute (HHMI) issued a challenge to 84 research universities to nominate tenured professors with active research programs to compete for $20 million in grants. Those selected will receive $1 million each over four years to help break the mold in science education and strengthen the ties between researchers and undergraduates.

How will the HHMI Professors help? Among their innovative solutions: Involve freshmen in a research project to test lead levels in soil in inner-city Chicago. (Hilary Godwin, Northwestern University) Design a course for non-science majors connecting science to other fields, such as law or

business. (Robert Goldberg, UCLA) Create courses at the intersection of biology and chemistry, applying the tools of chemistry to biological systems. (Alanna Schepartz, Yale University) Give engineering students experience in human clinical trials research. (Rebecca Richards-Kortum, the University of Texas at Austin) Develop a Pre-Doc program similar to Pre-Med programs. (Tim Stearns, Stanford University) Teach genomics to undergraduates, high school and middle school students. (Sarah Elgin, Washington University in St. Louis) Create a mentoring ladder as a support system for minority students. (Isiah Warner, Louisiana State University) Use interactive computer software to help undergraduates learn genetics. (Elizabeth Jones, Carnegie Mellon University) Require a Frontiers in Science course of all entering freshmen. (Darcy Kelley, Columbia University) Give graduate credit toward a teaching certificate for mentoring undergraduates. (Ellen Fanning, Vanderbilt University) They will come together periodically to create ways to disseminate their best practices to their colleagues. **Models for change** Since 1988, HHMI has awarded more than $500 million in grants to enhance undergraduate science education. The University of Arizona now considers a faculty member's commitment to undergraduate research 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.

Elsewhere: Bio2010, a report just issued by the National Research Council of the National Academies, sponsored 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 . A number of universities have developed effective programs to help minority students succeed in the sciences. Examples include the University of Maryland Baltimore County and Louisiana State University, both HHMI grantees, both cited by the National Research Council of the National Academy of Sciences as examples of diversity programs that work. The Georgia Institute of Technology has committed $250,000 to help faculty members involve more undergraduates in research. The University of Chicagos National Opinion Research Center is establishing a National Science Foundation-funded program to explore effective ways to improve math and science teaching at all levels. More than half of undergraduates at the Massachusetts Institute of Technology do undergraduate research. The National Science Foundation supports a dozen Distinguished Teaching Scholars for their work with undergraduates across all scientific disciplines.