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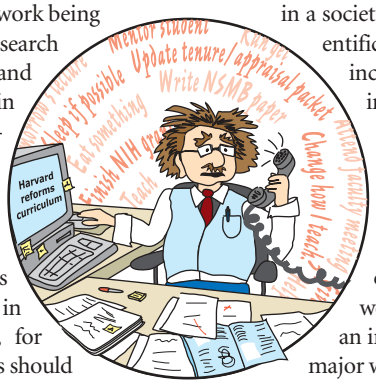
Educating the masses

A few months ago the Committee for Curricular Review at Harvard said that "graduates of Harvard College should be able to understand the news and expository articles in journals such as *Science* and *Nature*." This is great news for us—the more readers the better. Unfortunately, the average history major is unlikely to have the scientific background to appreciate the significance of the work being featured in the front end of the journal. Furthermore, research scientists have little time and incentive to change what and how they teach students. With any luck, this might change in the next decade as top universities such as Harvard transform their undergraduate curriculum and support innovative teaching.



The idea of reforming science education is not new, but until recently, much of the work has focused on improving the science curriculum for majors. In 2002, the United States National Academies made recommendations, outlined in BIO2010 (http://www.nap.edu/books/0309085357/html/), for how undergraduate education for future research biologists should be revamped. The overall theme of these recommendations is to provide students with a more realistic and integrated picture of science. For example, the report suggested that interdisciplinary teaching should be used to help students understand the 'big picture' view of science. Furthermore, inquiry-based methods could be used to teach scientific problem-solving. Freshman seminars led by research scientists and laboratory research experiences were also recommended to give students hands-on experiences and more contact with researchers at the university.

Harvard's curricular renewal recommendations have their roots in BIO2010 but go beyond educating the science major to include improving science education for all undergraduates. The extensive recommendations (http://www.fas.harvard.edu/curriculum-review) are under discussion in college committees. After a full year of data collection and evaluation a detailed plan for the implementation of the changes will be distributed to the entire faculty for a vote. The approved modifications would be implemented over subsequent years.

It is worth emphasizing that Harvard is not trying to train everyone to become a scientist. On the contrary, the idea is to teach students how a scientist formulates a question in much the same way that one learns how to construct a sentence. A student does not need to know every word in the dictionary to write a grammatically correct sentence. Likewise, an undergraduate does not have to know all the details of a cellular process to understand how a scientist goes about studying a complex system. In the process of understanding the scientific method, the undergraduate will learn the vocabulary and start to understand the details. William Kirby, Dean of the Faculty of Arts and Sciences, explains that "every Harvard College student should be educated in the sciences in a manner that is as deep and broadly shared as has traditionally been the case in humanities and the social sciences." Indeed, it would be great if all students could graduate with some understanding of science.

What are the benefits of investing time and money to improve the science literacy of a nonscience major? For research scientists, improving general science education could have a significant impact on how and whether they do experiments. The National Research Council notes that undergraduates typically take one year of science in college. This results in a society in which the public understanding of the scientific process can be poor. Many nonscientists, including the president, senators and lobbyists, influence funding levels of key government agencies. Furthermore, lobbyists and politicians have a significant role in setting priorities and legislating ethics—consider the current debate over stem cell research, for instance. Therefore, a basic understanding of science benefits everyone. In theory, our hypothetical history major would gain skills to function more efficiently in an increasingly technological world and the science major would gain financial support and understanding from his or her politician.

Obviously, redesigning courses and changing the way science is taught require significant investment from the university. Curriculum renewal also requires that administrators and faculty think outside of the current departmental boxes and embrace the reforms. The development of interdisciplinary courses that provide students with a 'big picture' view of science will require crossing and perhaps lowering the classical departmental boundaries. Lastly, faculty must find the time and motivation to restructure undergraduate science courses.

One way to ease the burden on current tenure-track professors is to hire additional faculty. But this does little if the new hires simply fall into the existing culture of focusing on research above all else. It is not unheard of for faculty to be discouraged from spending too much time on their teaching because it can detract from the main job of an academic scientist—doing cutting-edge research to obtain grant dollars. In the current university culture, a faculty member may often face the challenge of carefully assessing the trade-off between research and teaching. With mounting responsibilities and demands on their time, most faculty place curriculum reform near the bottom of their to-do list.

For this to work, the reward structure at universities and the culture in science departments will have to change. Currently, faculty who contribute to both research and teaching are rarely rewarded for their exemplary teaching skills. Therefore, tenure and promotion committees need to carefully examine how they evaluate and reward research versus educational contributions. Perhaps somewhere in the volumes to be written about educational reform, there will be a discussion of how departments and administrators should renew themselves to emphasize the value of teaching.

Until then, we wait to see if the majority of research scientists, at Harvard and elsewhere, will join the movement to renew the undergraduate curriculum and improve the science literacy of the masses. ■

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