

# Rethinking graduate education

All available evidence suggests that over 60% of new Ph.D.s in science in the United States will not have careers in academic research, yet graduate training in science has followed the same basic format for almost 100 years, heavily focused on producing academic researchers. Given that so many students will not join that community, the system is failing to meet the needs of the majority of its students. Many academic, governmental, and professional leaders and organizations have lamented this disconnect and have suggested worthwhile adjustments, but most of these have been minor changes in graduate course offerings. It is time for the scientific and education communities to take a more fundamental look at how graduate education in science is structured and consider, given the current environment, whether a major reconfiguration of the entire system is needed.

Some relatively new government programs and curriculum supplements are positive steps that are likely to give students greater career flexibility. For example, the Strengthening the Biomedical Research Workforce Program from the U.S. National Institutes of Health supports innovative approaches to help biomedical graduate training better reflect the range of career options that students might pursue. Individual institutions are also working on the problem. As one example, the Massachusetts Institute of Technology offers a Global Entrepreneurship Bootcamp to help students learn innovation-driven entrepreneurship through hands-on learning experiences with successful entrepreneurs. However, these efforts are limited in scope and primarily take the form of adding offerings to an already overcrowded curriculum. What is needed is a fundamental system analysis and reconfiguration that results in graduate training programs that are better designed to meet the diverse career needs of today's students. One of the last system-level reviews was in 1995, when the U.S. National Academies' Committee on Science, Engineering, and Public Policy published a

report\* calling for a reshaping of graduate education to reflect the evolution of careers in science and science-dependent fields. Some experiments and much discussion, but not much real progress, ensued. It is time to do that scale of analysis again and include an action plan for making the recommended changes.

Making such fundamental change may encounter substantial resistance. After all, the current system does produce first-rate academic scientists and does meet the needs of faculty who depend on graduate students as research assistants. The system also works for the very best graduate students at the top research universities, whose career paths often do point toward academia. Indeed, because the current approach has generated one of the strongest academic scientific enterprises in the world, there will be understandable reluctance to tinker with success. "Do no harm while doing good" will have to be a mantra of any system redesign.

This scale of change has been tackled before, with substantial success, in related fields. The U.S. National Academy of Engi-

neering's Educating the Engineer of 2020 project recommended dramatic changes in undergraduate engineering education, many of which have been implemented. The Vision and Change in Undergraduate Biology Education project organized by the U.S. National Science Foundation and the American Association for the Advancement of Science, and involving a large number of other scientific organizations, has similarly been directed toward major changes in the way biology is taught to undergraduate students, and many other initiatives are under way. The experiences of both projects are cause for optimism.

Leaders from the scientific, academic, industry, and government communities will have to work together to mount a project of this scope, develop an action plan, and monitor its progress. No group can do it alone. The benefits for the science students of the future will be well worth the collective effort.

— Alan I. Leshner



Alan I. Leshner is Chief Executive Officer, Emeritus, of the American Association for the Advancement of Science and former Executive Publisher of Science. E-mail: alan.i.leshner@gmail.com



*"...a major reconfiguration of the entire system is needed."*

\*www.nap.edu/catalog/4935.