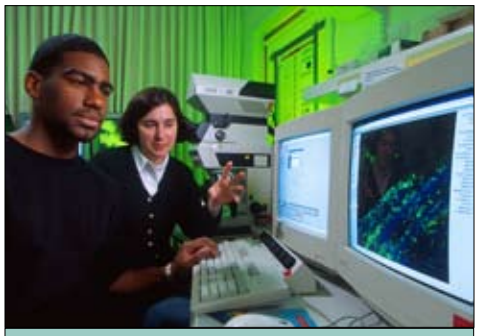
THE NATIONAL ACADEMIES

REPORT IN BRIEF

Transforming Agricultural Education for a Changing World

Many of today's major challenges—including energy security, national security, human health, and climate change—are closely tied to the global food and agriculture enterprise. Academic institutions with programs in agriculture are in a perfect position to foster the next generation of leaders and professionals needed to address these challenges. However, to keep pace with changing times, undergraduate agricultural education needs a new focus. This report proposes nine steps for institutions to implement to attract top students and prepare them for the challenges of tomorrow.

Today's global agricultural enterprise stretches beyond the farm to encompass hundreds of thousands of entities involved in the production and distribution of food and other agricultural products worldwide. Together with the public institutions that regulate and support them, this highly diverse enterprise generates a level of economic activity of staggering magnitude and breadth. It is supported by a workforce that includes not only farmers, but also an enormous array of other skilled professionals, including scientists, seed suppliers, food chemists, ethanol producers, packaging engineers, food safety experts, risk assessors, grocery suppliers, and many others.



Sweeping changes are needed in agricultural education to prepare a workforce to meet 21st century needs. Photo from USDA's Agricultural Research Service.

This agricultural workforce must constantly respond to changes in the physical, economic, and social environment surrounding agriculture. For example, meeting food demands of the expanding human population is complicated by a new demand for biofuels. In addition, as climate change alters the planet's physical and ecological conditions, growers and distributors are under increasing pressure to adjust their practices and take steps to mitigate their greenhouse gas emissions. Agriculture must adapt to a continually changing landscape of health and nutrition issues, consumer preferences, national security concerns, environmental impacts, and many other factors.

Because agriculture is affected by so many factors, its participants must always be prepared to react, to adapt, and to think ahead. Is the next generation of leaders in agriculture prepared to address the increasing and ever-changing demands on agricultural systems? How can the future agricultural workforce be recruited and cultivated?

Colleges and universities with undergraduate programs in agriculture must undergo a significant transformation to foster the agricultural workforce of tomorrow. Such institutions must position themselves at the cutting-edge and offer students the opportunity to learn about the complexities of agriculture, grapple with its emerging challenges, and find their opportunity to contribute as leaders and participants. This report, authored by a committee convened by the National Research Council, considers the evolving agricultural enterprise and identifies opportunities for undergraduate programs to more effectively support a flexible, well-prepared workforce.

Steps for Achieving Change in Agricultural Education

This report describes aspects of the undergraduate educational experience in agriculture that need to be created, strengthened, or modified. Keeping up with the evolving nature of the agricultural

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences • National Academy of Engineering • Institute of Medicine • National Research Council

enterprise is not a simple task: it requires a much more dynamic approach to the curriculum and teaching than most academic institutions have developed, as well as an increased sensitivity to the changing nature of the student body. Undergraduate agricultural education involves a wide array of 2- and 4-year colleges, each with its own level of resources, unique student body, and specific needs. As such, there is no single recipe for change—but a *commitment* to implementing change is imperative.

The following nine steps should be implemented to better enable agricultural education programs to meet the needs of students, employers, and the broader society. If institutions of higher learning do not address the changes needed, they risk becoming irrelevant. Without significant action, graduates of these programs will have difficulty keeping up with the changing needs of society and building stable careers, and the nation will miss its opportunity for leadership in addressing the global challenges related to food and agriculture.

Implement Strategic Planning

Colleges and universities with agriculture programs should act strategically to recruit, retain, and prepare the agriculture graduate of today and tomorrow. Strategic planning is needed that involves a broad array of participants, including faculty within and outside of agriculture colleges, current and former students, employers, disciplinary societies, commodity groups, local organizations, farmers, and representatives of the public. Institutions should develop and implement a strategic plan within the next two years and revisit it every 3–5 years thereafter to evaluate progress and to refine and improve new programs and policies.

Broaden Treatment of Agriculture in the Overall Curriculum

Topics related to agriculture are found in numerous disciplines, from engineering and technology to chemistry and biology to the social sciences. Accordingly, academic institutions should broaden the treatment of agriculture in the overall undergraduate curriculum. In particular, faculty in colleges of agriculture should encourage discussion of agriculture in courses throughout the institution and work with colleagues from other departments to develop shared introductory courses that serve multiple populations and can illuminate underlying themes shared by agriculture and other disciplines.

Box 1. Agriculture and the STEM Disciplines

The disciplines of science, technology, engineering, and mathematics are often referred to collectively as the STEM disciplines. In many ways, we are now in an era of "scientific agriculture," in which genomics, ecology, chemistry, engineering, and other disciplines play essential roles. As these disciplines become increasingly intertwined with food, fiber, and fuel production, agriculture now so thoroughly combines basic and applied aspects of the traditional STEM disciplines that the acronym might rightly expand to become STEAM—joining agriculture with the other fundamental disciplines.

Outreach is critical to fostering awareness of agricultural issues among pre-college students. Here, high school students tour campus facilities. Photo from Becky Kirkland, Department of Communication Services, North Carolina State University.

Broaden the Student Experience

The skills and knowledge that employers value most are not always well-aligned with undergraduate agriculture programs. Institutions should broaden the undergraduate student experience to include training in transferable skills such as communication, teamwork, and management. Institutions should also increase student opportunities to participate in the outreach and extension activities common in many colleges of agriculture as well as undergraduate research, internships, and similar programs. Finally, institutions should increase students' exposure to international perspectives by supporting targeted learning-abroad programs and by incorporating international perspectives into existing courses.

Prepare Faculty to Teach Effectively

Despite recent advances in the understanding of how people learn, university faculty do not generally receive much training in effective teaching, and universities still tend to use an outmoded method of teaching focused on facts and lecturing. As a result, many classes fail to engage students. Academic institutions, professional societies, and funding agencies should support faculty-development activities focused on effective teaching. These activities should also provide appropriate training to graduate students and postdoctoral researchers—the next generation of agriculture faculty. Academic institutions should ensure that the responsibility for faculty development rests with departments, colleges, and institutions, rather than on individual faculty members.

Reward Exemplary Teaching

Achievements in teaching are only rarely rewarded in substantive ways. Efforts by academic institutions, funding agencies, and professional societies are needed to support effective teaching. Academic institutions should enhance institutional rewards for high-quality teaching and curriculum development, especially including rigorous consideration in hiring, tenure, and promotion. Funding agencies should also support and reward excellence in teaching: the National Science Foundation's "broader-impacts criterion," for example (which requires grantees to include in their grants elements promoting education, outreach, and societal benefits) should be considered by other agencies. Professional societies should raise the profile of teaching within disciplines, for example by sponsoring education sessions at society meetings, hosting workshops on teaching and learning, supporting education-focused articles in society publications, and facilitating the dissemination of teaching materials.

Build Stronger Connections among Institutions

Academic programs in agriculture tend to exist in isolation, with few connections between institutions—even between those in the same geographic area. In addition, community and tribal colleges produce large numbers of students, including high percentages of members of traditionally underrepresented groups, but there are currently few pathways for those students to pursue agricultural careers. Institutions should partner with each other to better support the needs of students in agriculture, such as by establishing joint programs and courses and developing pathways for students pursuing careers in agriculture.

Start Early

Increased awareness of agriculture's important role in addressing major societal problems can help to raise the profile of the field and attract more students. It is, therefore, in the best interest of institutions with programs in agriculture to foster greater awareness among pre-college students. Colleges and universities should reach out to expose K–12 students and teachers to agricultural topics and generate interest in agricultural careers. Programs that might be considered include agriculture-based high schools, urban-agricultural education programs, summer high-school or youth programs in agriculture, and partnerships with youth-focused programs, such as 4-H, National FFA (formerly Future Farmers of America), and scouting programs.

Build Strategic Partnerships

Although colleges and universities are responsible for preparing students for careers in agriculture, there is little communication between educational institutions and the employers of their graduates. Academic institutions should include representatives of industry and

Box 2. Questions to Guide the Review of Undergraduate Food and Agriculture Programs

The report offers a checklist of items to be used by any individual or group conducting a review to evaluate how well-prepared a given agriculture education program is to foster the next generation of leaders. The questions touch on the curriculum and student experiences, the institutional commitment to teaching and learning, and the organization and structure of outreach activities. A sample of the review criteria follows.

Curriculum and student experiences

- How does the curriculum incorporate experiences focusing on teamwork and working in diverse communities, working across disciplines, communication, critical thinking and analysis, ethical decision-making, and leadership and management?
- What opportunities are available to students for internships, cooperative experiences, service learning or mentorships?
- What opportunities are available for students to engage in undergraduate research?

Institutional commitment to teaching and learning

- What faculty development resources and opportunities are available at your institution? What training is made available to new faculty and others offering instruction?
- How are teaching and learning incorporated into considerations for hiring, promotion and tenure?

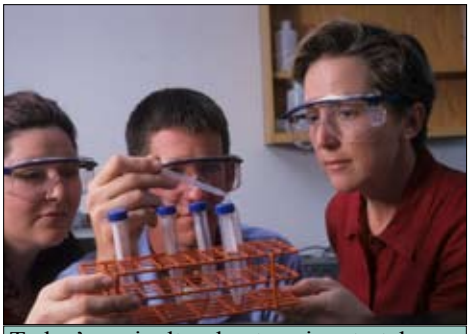
Outreach and organizational structure

- How are business, industry, government, non-governmental organizations, and community and consumer groups engaged in the development of the curriculum?
- How often do faculty members spend sabbaticals outside of academe? How often do industry scientists teach courses at your institution?
- What types of connections and interactions does your institution have with other area academic institutions? Are there joint programs, shared resources, or other types of partnerships?
- What types of connections and interactions does your institution have with K–12 students and teachers? With area youth-focused programs such as 4-H, National FFA, and scouting?

other employers on visiting committees, on advisory boards, and in strategic planning. Conversely, companies should include academic faculty on their advisory committees. In addition, exchange programs should be developed to enable agriculture professionals to spend semesters teaching at academic institutions and enable faculty to spend sabbaticals working outside of academe. Finally, opportunities for students to work in professional settings should be developed and expanded. These opportunities can include internships, cooperative education programs, summer opportunities, mentoring and career programs, job shadowing, and other experiences.

Focus Reviews of Undergraduate Programs in Agriculture

Those responsible for conducting reviews related to undergraduate education in agriculture should incorporate the elements discussed in this report to guide their evaluations and decisions in accreditation, review of grant proposals, department and other institutional reviews, and other venues. The report offers a checklist of items that should be used by any individual or group conducting a review of a program, curriculum, department, college, or institution. The checklist includes questions about the nature of the curriculum, the ways that courses are taught, and the teaching style and knowledge of faculty about how students learn, among others (see Box 2 for example review criteria).



Today's agricultural enterprise stretches far beyond the farm. Programs must keep pace with changing times. Photo from Herman Lankford, Dept. of Communication Services, North Carolina State University.

Conclusion

Although conversations about improving education in agriculture have been under way for many years, implementation has been slow. The time to act is now. The changing needs of students, universities, society, and the environment will not wait. Transforming and sustaining education in agriculture requires an ongoing commitment with strong leadership from many with a strong interest in agriculture. Their investments in undergraduate education will play an important role in shaping the future of agriculture and in meeting the challenges of the 21st century and beyond.

Committee on a Leadership Summit to Effect Change in Teaching and Learning: James L. Oblinger *(Chair)*, North Carolina State University; **John M. Bonner,** Council for Agricultural Science and Technology; **Peter J. Bruns,** Howard Hughes Medical Institute; **Vernon B. Cardwell,** University of Minnesota; **Karen Gayton Comeau,** Haskell Indian Nations University (Retired); **Kyle Jane Coulter,** U.S. Department of Agriculture (Retired); **Susan J. Crockett,** General Mills, Inc.; **Theodore M. Crosbie,** Monsanto Company; **Levon T. Esters,** Iowa State University; **A. Charles Fischer,** Dow Agrosciences LLC (Retired); **Janet A. Guyden,** Grambling State University; **Michael W. Hamm,** Michigan State University; **Michael V. Martin,** Louisiana State University; **Susan Singer,** Carleton College; **Larry Vanderhoef,** University of California, Davis**; Patricia Verduin,** Colgate-Palmolive Company; **Adam P. Fagen**, **Robin A. Schoen**, **Karen L. Imhof**, and **Peggy Tsai**, National Research Council.

The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Department of Agriculture, the W.K. Kellogg Foundation, the National Science Foundation, the Farm Foundation, and the American Farm Bureau Foundation for Agriculture. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.

EXPERT CONSENSUS REPORT

For more information, visit http://nationalacademies.org/summit or contact the Board on Agriculture and Natural Resources at (202) 334-3062 or see the Board on Life Sciences at http://nationalacademies.org/bls. Copies of *Transforming Agricultural Education for a Changing World* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

Permission granted to reproduce this brief in its entirety with no additions or alterations. Permission for images/figures must be obtained from their original source.

© 2009 The National Academy of Sciences