The humanities disciplines are not alone in grappling with how to stay relevant and prepare graduate students for jobs that meet the demands of a rapidly changing labor market. Doctoral programs in chemistry need to be overhauled, too, including by reducing students' time to degree, the American Chemical Society says in a new report.

The chemical society released the report on Monday at news conference here at which speakers discussed ways that doctoral training needed to change to meet pressing societal needs and play a greater role in producing new jobs. The report, "Advancing Graduate Education in the Chemical Sciences," focuses on five key areas of graduate education the society says need to be overhauled: curricula, financial support, laboratory safety, career opportunities, and mentoring of postdoctoral students.

Among the recommendations are that programs need to be changed so that students can complete their Ph.D.'s in less than five years and that the chemical society collect and publish data on student outcomes in Ph.D. and postdoctoral programs.

The report is the result of a yearlong review that was conducted by 22 scientists and other experts, mostly from universities but also from industry, that the chemical society appointed to a commission. Bassam Z. Shakhashiri, the chemical society's president, said at the news conference that the report was "long overdue."

According to data from the society, nearly 25,000 jobs have been lost in chemical-manufacturing companies in the United States since 2008, and layoffs continue. Employment patterns are also
changing, as chemical companies are hiring fewer new graduates of chemistry Ph.D. programs than in the past. Small businesses are continuing to hire more new chemistry Ph.D.'s but at slow rates.

Experts in the field say they face a conundrum: Innovation in chemistry is declining at the very time that society needs scientists to come up with solutions to problems like climate change and obesity, to further drug discoveries, and to help find ways of improving food generation, infrastructure, and water supplies.

Graduate education in the American sciences, speakers at the news conference said, has not kept pace with global economic, social, and political changes since World War II, when the current graduate-education system evolved.

Among the members of the commission that drafted the recommendations were Larry R. Faulkner, president emeritus of the Houston Endowment and former president of the University of Texas at Austin, who was the panel's chair; Paul L. Houston, dean of the College of Sciences at Georgia Institute of Technology, who was the panel's executive director; Hunter R. Rawlings III, president of the Association of American Universities; and Peter J. Stang, a professor at the University of Utah, the 2013 Priestley Medal winner, and editor of the Journal of the American Chemical Society.

The commission recommended that:

- Curricula be refreshed to sufficiently prepare students for careers once they graduate. That includes cutting time-to-degree to less than five years, closing gaps in students' ability to communicate complex topics to both technical and nontechnical audiences, teaching students to work more collaboratively across disciplines, and requiring students to learn new science and technology outside of their academic training. Departments also need to be more transparent about the kinds of career opportunities available to their Ph.D. students.
- The current system of financial support for graduate students be overhauled. While student debt was not discussed at length because most students in the field receive research grants and fellowships, the speakers said that the support system now in place rests too heavily on individual research grants and involves serious conflicts between the education of graduate students and the needs of grant-supported research. The committee recommended that federal and state agencies, private foundations, and universities take steps to "decouple" more student-support funds from specific research projects so that students will have better balance between their teaching responsibilities and their research as they seek to finish their degrees in less than five years.
- Departments review the size and mix of students in their programs. While the speakers said it was important to welcome international students, programs need to place a high priority on building "the domestic fraction of their graduate enrollments," especially students from underrepresented minority groups.
• Academic chemical laboratories adopt best safety practices to protect students and other workers. Noting the heavy publicity that laboratory accidents and findings of safety violations have drawn, speakers said that faculty need to lead by example and create a "culture of safety" in campus labs. They also called for uniform lab-safety standards across campuses.

• The American Chemical Society collects and publish data on Ph.D. and postdoctoral student outcomes, organized by department, on time-to-degree, types of job placements, salaries, and overall student satisfaction with the graduate experience and employment outcome.

• Institutions, departments, and faculty mentors take greater responsibility for ensuring that postdoctoral students are integrated into the fabric of the faculty and receive better mentoring to support their professional development.

"This won't be a report that sits on the shelf," said Mr. Shakhashiri. "The ultimate goal is to have action taken."

The chemical society's board has already committed $50,000 for "dissemination activities" to get the word out to faculty, deans, college presidents, policy makers, agencies that provide financial support, industries that employ chemical scientists and engineers, and professional societies. The next phase will begin in 2013.

Mr. Shakhashiri and others said the new report had implications not just for future scholars but also for the future of the university. They said they expected some pushback from faculty who are set in current practices and may feel threatened or afraid.

"This process is not going to be free of contention," Mr. Shakhashiri said. "We are just beginning the conversation and making recommendations that programs are redesigned so they can be effective and suitable for the next 50 years. Change is difficult."