

CHART I

Purposes of Graduate Education in the Chemical Sciences

The primary purpose of graduate education is education. The proper first focus is to educate students to solve problems in society, including the effective education of the succeeding generations.

Purposes transcending the individual:

1. **At the doctoral level, to develop scientists and engineers** who have demonstrated the ability to design and carry out independent research leading to new knowledge.
2. **At the master's level, to develop scientists and engineers** with augmented technical knowledge beyond the undergraduate level, sometimes toward specialized professional capabilities.
3. **To prepare the technical workforce** for industry and government in the chemical sciences.
4. **To provide faculty for universities, colleges, and schools** who can capably educate and inspire students interested in chemical sciences at high school, undergraduate, and graduate levels.
5. **To involve students personally** in the advancement of the chemical sciences through the processes of investigation and discovery leading to new knowledge.
6. **To provide intellectual underpinnings** for continued national leadership in science and technology.
7. **To cultivate a professional culture and professional capabilities** fostering innovation, which, in turn, leads to job creation and enhanced living standards.
8. **To generate research and intellectual property** that leads to economic development for a region and for the country.
9. **To create solutions to societal needs**, for example in energy, health, climate change, security, and defense.

10. **To develop future business, cultural, and political leaders** who can articulate scientific and technological issues and help the nation toward wise choices in an increasingly technology-dependent, globalized society.

Purposes focused on the individual:

11. **To teach graduates how to enter a new field**, how to pose worthwhile problems, how to be productive in generating valuable new knowledge, and how to evaluate critically their findings and those of others. This is the first purpose of doctoral education.
12. **To prepare the student soundly**, in a reasonable period of time—preferably five years or less—for a doctoral degree after the baccalaureate—for effective, rewarding careers after graduate school, both with respect to technical knowledge and skills, and with respect to other aspects of professionalism, including high standards of integrity and effective communication.
13. **To help the student understand how chemical processes are applied** to solving problems and creating products, and how new scientific knowledge is translated into practice.
14. **To foster fearlessness in approaching** new technical areas and new operational challenges.
15. **To cultivate and preserve the student's curiosity**, joy of discovery, openness to new ideas, and desire for lifelong learning.
16. **To develop—experientially**, to the greatest practical extent—personal and professional skills needed to compete in an evolving interdisciplinary and global environment.

CHART II

Addressing Societal Needs as Well as the Needs and Aspirations of Graduate Students

1. A strategic imperative for the nation is to assure that excellent opportunities exist for the most able students, whose careers are likely to contribute extraordinarily to national technical advancement and productivity.
2. A principal national concern continues to be with the historically low participation rates in the chemical sciences of women and students from underrepresented populations. New, effective ways should be sought to increase the appeal of careers in the chemical sciences to all groups. This is not just an issue of fairness. Without better success along this line, the United States may not be able to generate a technical workforce that can sustain technical leadership.
3. Graduate students should be advised more fully and more competently about the diverse career options meriting consideration in a dramatically changing employment marketplace.
4. Standards of laboratory safety for graduate education and research should adhere to best practices found in industry.
5. Graduate education should provide opportunities for students to explicitly contemplate, discuss, and otherwise be exposed to how chemical sciences can contribute to meeting major challenges of the 21st century, such as sustainability, health, energy, security, and quality of life.
6. Students with aptitude and interest should have educational options, within the context of graduate school, to develop entrepreneurial knowledge and leadership skills.
7. Talented young scientists and engineers in the chemical sciences may be delayed too long in reaching a stage of independent or highly responsible professional practice. Ways should be sought to provide opportunities for young people to reach this stage by their late 20s, rather than their early to mid-30s.
8. Much better use should be made of master's level education, with a focus on new programs aimed at specific competencies that can form sound foundations for a healthy career.
9. More attention should be given to systematic development of educational opportunities offering substantive experiences efficiently connected with career goals, such as industrial internships, coupled enrollment in other degree programs (e.g., other sciences or engineering, public policy, law, entrepreneurship), and international experiences.