7. Development of Student Skills

While formal course work provides students with an education in chemical concepts and training in laboratory practices, students should go beyond course content alone to be effective and productive scientists. They need to master a variety of skills that will allow them to become successful professionals.

7.1 Problem-Solving Skills. The ultimate goal of chemistry education is to provide students with the tools to solve problems. Students should be able to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, and draw appropriate conclusions. In this process, students should apply their understanding of all chemistry subdisciplines. Students should use appropriate laboratory skills and instrumentation to solve problems, while understanding the fundamental uncertainties in experimental measurements.

7.2 Chemical Literature Skills. Students should be able to use the peer-reviewed scientific literature effectively and evaluate technical articles critically. They should learn how to retrieve specific information from the chemical literature, including the use of *Chemical Abstracts* and other compilations, with online, interactive database-searching tools. Approved programs must provide instruction on the effective retrieval and use of the chemical literature. A specific course is an excellent means of imparting information-retrieval skills, though such a course usually would not qualify as an in-depth course. Integrating the use of these skills into several individual courses is also an effective approach. Both library and online exercises should be a part of such instruction on information retrieval.

7.3 Laboratory Safety Skills. Approved programs should promote a safety-conscious culture in which students understand the concepts of safe

laboratory practices and how to apply them. Programs should train students in the aspects of modern chemical safety appropriate to their educational level and scientific needs. A high degree of safety awareness should begin during the first laboratory course, and both classroom and laboratory discussions must stress safe practices. Students should understand responsible disposal techniques, understand and comply with safety regulations, understand and use material safety data sheets (MSDS), recognize and minimize potential chemical and physical hazards in the laboratory, and know how to handle laboratory emergencies effectively.

7.4 Communication Skills. Effective communication is vital to a scientist. Speech and English composition courses alone rarely give students sufficient experience in oral and written communication of technical information. The chemistry curriculum should include writing and speaking opportunities, and the chemistry faculty should evaluate them critically. Students should be able to present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use technology such as poster preparation software, word-processing, chemical structure drawing programs, and computerized presentations in their communication.

Knowledge of one or more foreign languages is another component of communication. Even though English is the international language of science, chemistry is worldwide in scope. The study of a foreign language adds greatly to a student's education, although ACS certification does not require it.

7.5 Team Skills. Solving scientific problems often involves multidisciplinary teams. The ability to work in such teams is essential for a well-educated scientist. Students should be able to work effectively in a group to solve scientific problems, be effective leaders as well as effective team members, and interact productively with a diverse group of peers. Programs should incorporate team experiences in classroom and laboratory components of the chemistry curriculum.

7.6 Ethics. Ethics should be an intentional part of the instruction in a chemistry program. Students should conduct themselves responsibly and be aware of the role of chemistry in contemporary societal and global issues. As role models, faculty should exemplify responsible conduct in their teaching, research, and all other professional activities.