

White Paper: Proposed Changes to the ACS Guidelines and Evaluation Procedures for  
Bachelor's Degree Programs  
ACS Committee on Professional Training  
Prepared January 2013

## INTRODUCTION

One of the functions of the American Chemical Society (ACS) is to provide leadership in the nature and direction of undergraduate chemistry education. This charge is, in part, the purview of the Committee on Professional Training (CPT), which is tasked by the ACS with the development of Guidelines for bachelor's degree programs in chemistry and the assessment of programs that wish to be approved by ACS. The Committee is also responsible for regular examination of the Guidelines to ensure that they encourage program excellence and provide a pathway for development of competent chemistry professionals. In 2008, following solicited input from the chemistry community over a two-year period, the CPT released a new version of the Guidelines for approval of bachelor's degree programs in chemistry.

The 2008 Guidelines represented a significant paradigm shift from the previous iteration (simplifying the Guidelines, placing greater responsibility on approved programs for curricular development and oversight, and fostering innovation and flexibility). In 2011, the CPT conducted a survey on the Impact of the 2008 Guidelines - the results of which will be featured in an article in the spring issue of the CPT Newsletter. In part because of the results of that survey, but also because of feedback from various stakeholders across academia, industry, and within the ACS, certain elements of the Guidelines have been identified for potential revision. These revisions, however, would represent only relatively minor adjustments to the 2008 Guidelines. To this end, the Committee wishes once again to invite feedback from stakeholders across the chemistry enterprise regarding proposed changes to the Guidelines. **Please send your comments to [cpt@acs.org](mailto:cpt@acs.org).**

## SUMMARY OF PROPOSED CHANGES

Elements of the proposed Guidelines modifications are identified below:

- increasing the minimum number of faculty in approved programs from four to five
- increasing the flexibility for faculty contact hours, by allowing up to two faculty members to teach up to 18 weekly contact hours in a single quarter or semester so long as their contact hour load, when averaged over the academic year, does not exceed 15 contact hours per week
- increasing the weekly contact hour limit from 15 to 18 per semester or quarter for individuals whose primary teaching responsibility is laboratory instruction
- lecture courses leading to certification must be taught by full-time, permanent faculty
- requiring that students have significant hands-on laboratory experience prior to starting foundational laboratory courses
- allowing approved programs, in rare cases, to teach four, rather than five, foundation courses annually if some are taught on a regular biennial schedule that does not impede students' graduation and completion of a certified degree in four years
- in-depth course offerings must correspond to at least 12 semester or 18 quarter credit hours.
- clarifying definitions of in-depth laboratory courses
- requiring a capstone experience (broadly defined) for certified majors
- boosting student skills by requiring information retrieval and management and leadership opportunities
- changing the requirements for access to and use of the chemical literature

- requiring student exposure to at least one instrument chosen from each grouping of optical atomic spectroscopy, optical molecular spectroscopy, mass spectrometry, chromatography/separations, and electrochemistry
- requiring that all students have ready access to FT-NMR capabilities either on-site or at proximal facilities
- requiring general and specific safety training and evaluation of such training
- requiring that chemistry programs have an active safety committee
- extending the regular schedule for submission of periodic reports to every six years instead of the current five-year cycle

## PROPOSED REVISIONS TO THE 2008 ACS GUIDELINES

Below is an overview of the proposed changes to the ACS Guidelines. If a section of the Guidelines is not listed, CPT does not anticipate a significant change to that section. Page numbers refer to the 2008 Guidelines booklet.

### I. GUIDELINES FOR PROGRAM APPROVAL AND STUDENT CERTIFICATION

#### Section 3. Faculty and Staff (pp. 3-5)

##### Section 3.1 Faculty (pp. 3-4)

The following change is proposed to the minimum number of chemistry faculty: ***Increase the minimum number of full-time, permanent faculty from four to five.***

In response to the challenges involved in delivering the course work necessary for ACS approval with only four faculty members, the Committee is exploring the possibility of increasing the minimum number of full-time, permanent faculty members wholly committed to an approved chemistry program from four to five. Taken together, these five individuals should have demonstrated expertise in the five subdisciplines of analytical, biological, inorganic, organic, and physical chemistry. Independent of the number of faculty, at least 75% of the chemistry faculty must hold a PhD or equivalent research degree. Programs that are currently approved with four faculty members will be required to increase the number of faculty to five by 2025 in order to retain approved status.

##### Section 3.2 Adjunct, Temporary, and Part-Time Faculty (p. 4)

The Committee has proposed a stronger statement related to the use of part-time and temporary faculty and instructional staff: ***Lecture courses leading to certification must be taught by full-time, permanent faculty.***

The 2008 Guidelines state that “Full-time, permanent faculty should teach the courses leading to student certification...” To ensure the continuity of the program and students access to the individuals who are teaching the chemistry courses that may lead to certification, the Committee is considering making this requirement more specific. We are presently exploring the following options and are especially interested in feedback on the helpfulness of such a requirement and the ease of collecting data that would allow this to be evaluated by CPT.

- requiring that 80% of the lecture courses leading to certification be taught by full-time, permanent faculty.

OR

- requiring that 80% of the individuals who are teaching the lecture courses leading to certification be full-time, permanent faculty.

In recognition of the importance of professional development and the need of many departments to hire faculty for sabbatical replacements for a shorter period of time, such individuals would be considered among the full-time, permanent faculty for this purpose.

### Section 3.3 Teaching Contact Hours (p. 4)

In recognition of the broad distribution in the staffing needs found in the 668 currently approved programs, the Committee is considering modifying the teaching contact hour limits as follows.

- 1) In a given semester or quarter, faculty contact hours must not exceed 15 hours per week. To accommodate occasional fluctuations, up to two individuals per year may have as many as 18 weekly contact hours in a single semester or quarter, provided that the average for each individual during the academic year does not exceed 15 contact hours per week.**
- 2) Individuals whose primary teaching responsibility is laboratory instruction may teach up to 18 weekly contact hours each semester or quarter during the academic year.**

In the 2008 Guidelines, the maximum number of contact hours per week was capped at 15 and applied to all individuals who contributed to the teaching mission of the chemistry program and to all courses, classroom and laboratory. Currently, two individuals may have as many as 17 contact hours per week, provided that the average for each individual during the academic year does not exceed 15 contact hours per week.

### **Section 4. Infrastructure (pp. 5-8)**

#### Section 4.2 Instrumentation (pp. 6-7)

The characterization and analysis of chemical systems requires an appropriate suite of modern, high quality and properly maintained instrumentation and specialized laboratory apparatus utilized in undergraduate instruction and research missions.

***The Committee is proposing to broaden the scope of the student experience in addressing chemical problems by increasing the required instrumentation that is on-site and used by certified majors to include at least one instrument from each of the following five categories:***

- 1) optical molecular spectroscopy (e.g., FTIR, fluorescence, Raman, UV-Vis)
- 2) optical atomic spectroscopy (e.g., atomic absorption, ICP-atomic emission)
- 3) mass spectrometry (e.g., MS, GC-MS, LC-MS)
- 4) chromatography and separations (e.g., GC, GPC, HPLC, capillary electrophoresis)
- 5) electrochemistry (e.g., potentiometry, voltammetry)

In addition, throughout their curriculum, students ***must have adequate access to FT-NMR capabilities***. If this instrument is not on site, regular and stable arrangements and resources must be in place to provide students with NMR data in a timely manner for submitted samples. Stable, effective arrangements with proximate institutions for meeting this requirement are satisfactory.

A robust program will maintain an additional complement of instrumentation to support the curriculum, including undergraduate research. Supplemental instrumentation might include:

- vacuum and inert-atmosphere systems (e.g., Schlenk line, dry box)
- thermal analysis (e.g., DSC, TGA)

- x-ray diffraction
- imaging and microscopy methods (e.g., electron microscopy, scanning probe microscopy, confocal microscopy)

In all cases, the instruments *must* be maintained in adequate operating condition by the institution.

#### Section 4.4 Chemical Information Resources (p. 7)

No changes to the journal requirement are anticipated.

***At our meeting in January 2013, the Committee on Professional Training approved a change in the requirements for searching the literature, removing the specific requirement that students in approved programs must have access to Chemical Abstracts, including the ability to search and access full abstracts. With this change, institutions may use chemical databases that meet the needs of their programs so long as students obtain appropriate training.***

Rather than focusing on specific resources, CPT proposes to introduce a greater emphasis on this skill than appears in the 2008 Guidelines. See page 5 of this white paper for the proposed changes to the student skills section. Students must have ready access to databases and other resources that allow them to develop their skills in searching the chemical literature and support instructional and research activities.

#### **Section 5. Curriculum (pp. 8-13)**

***The Committee plans to strengthen the encouragement for departments to incorporate emerging areas of chemistry into existing course work and to develop new courses devoted to these topics. The following language has been proposed.***

The Committee encourages departments to integrate modern topics in chemistry into both the foundation and in-depth experiences. In-depth courses that fall outside of, or integrate, the traditional subdisciplines are encouraged. Among the areas that departments might include as part of foundation or in-depth course work or as independent courses are bioanalytical chemistry, chemical biology, green/sustainable chemistry, nanochemistry, polymer chemistry, and toxicology.

#### Section 5.2 Introductory or General Chemistry (p. 9)

***Given the diversity of students matriculating to approved programs, programs should develop a general chemistry experience that is appropriate for the background and needs of the student populations it serves.*** While the Committee does not anticipate providing specific requirements for the content of the general chemistry experience, it is expected that students will have a significant, hands-on laboratory experience prior to starting their foundation laboratory courses. While virtual laboratories may provide a useful supplement to hands-on labs, they are not an adequate replacement for hands-on experience.

#### Section 5.8 Frequency and Location of Course Offerings (pp. 12-13)

***The program should teach all five foundation courses annually. In rare cases, one of the foundation courses may be taught on a biennial schedule provided there is a demonstrated, stable arrangement that enables all students to complete the requirements for a certified degree within four years.*** Such transparent scheduling is particularly important for students who wish to take advantage of study-abroad opportunities or other activities that may require the student to pursue part of his or her education at another institution.

**Departments must also teach a minimum of four in-depth courses annually. While no minimum credits are placed on a course for it to be considered in-depth, a department's annual in-depth course offerings must correspond to at least 12 semester or 18 quarter credit hours.**

While the 2008 Guidelines that approved programs teach a minimum of four in-depth courses annually, they did not provide guidance regarding the courses or combination of courses which could and could not be included in these four. To provide additional clarification, the Committee proposes to expand the definition from the 2008 Guidelines, which states that "an in-depth course builds on prerequisite foundation course work," as follows:

An in-depth course builds on prerequisite foundation course work. An in-depth lab course would elaborate on prerequisite foundational laboratory course work. In general, a laboratory that represents the first laboratory exposure to a foundational area is not considered an in-depth course. Associated classroom and laboratory courses (e.g., the second semester of organic chemistry lecture and laboratory) count as a single course in satisfying the in-depth requirements even if they have separate course numbers. In order for a laboratory course to be considered as in-depth, it must represent an advanced laboratory experience along with rigorous development of advanced and integrated skills and concepts. In these courses, students are typically in the laboratory for six or more hours per week. Such courses often also have an accompanying classroom component.

New requirement for ACS approval and student certification: capstone experience

***In a robust chemistry program, students must be provided with opportunities to synthesize the knowledge and skills provided across the curriculum. Mechanisms to accomplish this could include a capstone course or a substantive experience in an existing course or courses, as well as the opportunity for a mentored teaching experience, a seminar course that emphasizes student skills, or an independent research experience with a research report.***

Possible addition to the Guidelines

***The Committee is continuing to explore how to address the question of online instruction in the ACS Guidelines. Additional information will be circulated later in 2013.***

## **Section 7. Development of Student Skills (pp. 14-16)**

A significant area of departure in the 2008 Guidelines compared to earlier editions came in the emphasis on the development and assessment of student skills. ***With the upcoming revisions, the Committee is considering a further increase in this focus. Proposed changes also include introduction of a new skill on data and information management and strengthening of statements on student skills in safety and promotion of safety awareness, development of leadership skills through teamwork, and the mechanisms for evaluating these skills.***

### Section 7.2 Chemical Literature Skills (p. 14)

A critical student skill is the ability to efficiently and effectively retrieve information by searching the chemical literature. Among the types of searches that students must be able to carry out are searches by keywords, authors, abstracts, citations, patents, registry numbers and structures/substructures. Students must have ready access to databases that allow them to complete these searches and must be able to assess the quality of the search outcomes. Students must be able to read, analyze, interpret, and cite the chemical literature as applied to answering a chemical question. The development of student skills for searching and utilizing the chemical literature must be accomplished through formal instruction and reinforced through undergraduate research or through projects incorporated into the curriculum.

### Section 7.3 Laboratory Safety Skills (p. 14-15)

Programs must train students in the aspects of modern chemical safety appropriate to their educational level and scientific needs. Approved programs must promote a safety-conscious culture in which students understand the concepts of safe laboratory practices and apply them.

- Programs must train students in the aspects of modern chemical safety appropriate to their educational and scientific needs.
- The promotion of safety awareness and skills must begin during the first laboratory experience and be incorporated into each lab experience thereafter. Classroom and laboratory discussions must stress safe practices. Students should be actively engaged in the evaluation and assessment of safety risks associated with laboratory experiences.
- Safety understanding and skills should build throughout the curriculum and be assessed.
- 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 effectively handle laboratory emergencies.
- Students must undergo general safety training as well as lab-specific training before beginning undergraduate research.
- Approved programs must have an active, departmental safety committee.

### Section 7.5 Team Skills (p. 15)

This section will be expanded to include a statement on enhancing the opportunities for developing leadership.

### Section 7.6 Ethics (pp. 15-16)

This section will be expanded to include statements on sustainability and global responsibility.

### Proposed new section on information management

Students must be instructed in data management and archiving, record keeping (electronic and otherwise), and managing citations and related information. This includes notebooks, data storage, information and bibliographic management and formatting (as exemplified by Papers, EndNote, Bibliotec, Nota Bene, etc.)

## **II. APPROVAL PROCESS AND REVIEW PROCEDURES**

### **Section 5. Periodic Review (p. 22-26)**

***The Committee is proposing that the regular schedule for submission of periodic reports be extended from every five years to every six years.***

### **Section 8. Visiting Associates (p. 27-28)**

***In 2012, CPT approved an increase in the number of Visiting Associates conducting a site visit to a program applying for ACS approval from one to two. This change took effect immediately and will be reflected in the revised Guidelines.***