cpt newsletter
Committee on Professional Training

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# CPT Symposium at BCCE

On July 31, 2000, CPT sponsored a full-day symposium at the 16th Biennial Conference on Chemical Education (BCCE) on the new ACS guidelines for undergraduate professional education in chemistry. BCCE was held at the University of Michigan in Ann Arbor, July 30–August 3. During the morning session, speakers discussed the changes in the new ACS guidelines and some of the current issues that may affect future ACS guidelines. What follows is a brief summary of the four morning talks.

## Overview of the New ACS Guidelines. Norman Craig (CPT Consultant)

*Dr. Craig served as the principal editor of the new guidelines and took responsibility for crafting language that accurately and clearly describes the policies and procedures of the ACS approval program.*

The primary objective of the CPT is to facilitate the maintenance and improvement of the quality of chemical education at the postsecondary level. The Committee strives to do so by developing and administering the guidelines that define high-quality undergraduate programs. On behalf of ACS, the Committee approves those departments or programs that meet the guidelines. In turn, the chair of an *approved* department or program *certifies* annually those students who successfully complete an approved degree program.

Dr. Craig discussed the history and evolution of the ACS guidelines. The first edition of the guidelines, which appeared in 1939, consisted of a set of minimum standards that were presented in a qualitative fashion. From 1941 to now, the number of approved programs has risen from 102 to well over 600. Over the years, the guidelines have become increasingly quantified, particularly with respect to the number of lecture and laboratory hours. The revision of the guidelines has been made more user-friendly through reorganization and through providing the rationale for various policies.

From the outset, however, the willingness of the Committee to be flexible in its administration of the guidelines has been stressed, and this practice continues to be the case. Chemistry is primarily an experimental science, and the teaching of chemistry should be approached in an experimental vein. Innovative curricula and novel methods for solving pedagogical problems are encouraged. The Committee attempts to interpret the guidelines with sufficient latitude to accommodate a variety of approaches to providing quality education in chemistry.

Since 1988, the guidelines have included several options that complement the regular chemistry track, such as those that emphasize biochemistry, chemical physics, chemistry education, environmental chemistry, materials, or polymers. There are over 133 approved option programs at this time. They are all built on a core in common with the chemistry degree program. However, in association with a degree option, departments have the flexibility of reducing the core by up to four semester hours. The essential expectation for the core remains that it include comparable emphasis on the areas of analytical, inorganic, organic, and physical chemistry, along with the expected new treatment of biochemistry.

Other significant changes in the guidelines include a minimum number of two graduates per year (certified or noncertified) averaged over five years, increased emphasis on undergraduate research, strengthened criteria for who teaches undergraduates, and professional recognition of part-time and other untenured faculty.

Finally, the Committee will continue to aid departments in developing high-quality programs. A series of supplements are available for many chemistry program areas, and they are reviewed and updated on a regular basis to ensure that they reflect the current state of chemistry. The supplements are available from the Office of Professional Training and at the CPT Web site (http://www.acs.org/education/cpt/topicals99.html).

**REMINDER!** If you have not already done so, please return the CPT library survey as soon as possible. In October, the chairs of all ACS-approved departments were mailed a four-page survey in order to assess how recent developments in electronic forms of chemical information are affecting undergraduate education. The results from this survey will assist CPT in developing future guidelines on library access and usage and will provide a concrete statistical summary about chemistry library budgets and access issues that can be passed along to ACS and Chemical Abstracts Service.

## In This Issue . . .

## Chemistry Degree Options and the New Guidelines. Sally Chapman (CPT Consultant)

Dr. Chapman started with a brief description of the history and philosophy of the option program. The ACS has approved undergraduate chemistry degree programs for more than 50 years. Over 600 programs are currently approved. In 1988, the first three options, biochemistry, polymers, and chemistry education, were initiated. The options were created to provide students with a concentration in emerging chemistry-related areas, while still maintaining the strong, traditional chemistry core.

Where do the options stand today? There are currently six options. Biochemistry has been the most widely adopted option, with over 100 programs approved. Part of the reason for its success may be that many departments already had established biochemistry majors, and part may be due to strong student support. Although some options are experiencing rapid growth (biochemistry) or moderate growth (environmental chemistry, polymers), adoption of others has been limited. In particular, the adoption of the chemistry education option has been disappointing. Only five schools have this approved option. The ACS guidelines for the option are very difficult and often impossible to meet because much of the education curriculum is driven by state mandates. The science (and chemistry) content is often limited in the standard program, whereas the ACS chemistry education option contains a strong chemistry core.

Dr. Chapman also discussed one of the most daunting challenges the Committee has faced when considering option applications, namely, how rigidly must the ACS core be retained in an option? Previously, the answer to this question was not always clear or consistent. The 1999 ACS guidelines were designed to improve clarity and consistency on this question. The following language is in the revised guidelines:

*Departments have the flexibility in association with the degree option of reducing the core by up to four semester hours. The essential expectation for the core remains that it include comparable emphasis on the areas of analytic, inorganic, organic, and physical chemistry, along with the expected treatment of biochemistry.*

Unless the core requirements at your school are especially extensive (e.g., you teach a year of inorganic laboratory), it is usually not advisable to simply eliminate a core course. Schools should consider well-designed substitutions that employ an integrated approach (such as merging physical and instrumental labs).

Finally, Dr. Chapman posed many of the questions with which the CPT continues to wrestle. How rigidly must the core be retained in the options? What reductions in the core topics can be made while maintaining a balance in the subject areas? Can a small school offer options and still teach a high-quality core? What is the future of the current and potential options? Do the options serve the community?

## Biochemistry in the ACS Guidelines. Dale Poulter (CPT Member)

The new 1999 *Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures* announced a change in the requirements for ACS-approved programs to include topics in biochemistry as part of the curriculum for certified students. Dr. Poulter described the new requirement, how and when it will be implemented, and some of the motivations that led to it.

To provide departments maximum flexibility in meeting the guidelines, the new requirement may be met by offering an advanced course in biochemistry or by incorporating equivalent material into the required core. To be certified, students may complete either the equivalent of three semester credit hours of biochemistry in place of one of the advanced courses or the equivalent of three semester credit hours in the required core. A laboratory program in biochemistry is optional. If a department adopts the advanced course approach, the minimum number of semester credit hours of basic instruction in the core would continue to be 28. If biochemistry is integrated into the core, the remaining part of the core must have a comparable emphasis on analytical, inorganic, organic, and physical chemistry. When biochemistry is integrated into the core, the CPT expects syllabi and exams to be supplied as part of five-year reports.

These course modifications should be in place by 2001. Students graduating in 2005 and thereafter must have studied biochemistry to be certified to ACS. The 2001 deadline was designed to give departments time to develop and implement new course material. The Committee will request information about the biochemistry requirement starting with the five-year reports to be submitted in December 2001.

While many schools may choose to require an advanced course or a stand-alone biochemistry course within the core, considerable interest has been expressed about integrating biochemistry topics into the traditional core areas of analytical chemistry, inorganic chemistry, organic chemistry, and calculus-based physical chemistry. For many chemistry departments, the integration of biochemistry into traditional core courses is a new approach.

Finally, Dr. Poulter announced that a new supplement to the guidelines that deals with the biochemistry requirement would be available in the fall. (Note: The full text of this supplement is available in this newsletter and on the CPT Web site at http://www.acs.org/education/cpt/ts_biochemreq.html.)

## The Place of Undergraduate Research in the ACS Guidelines. William F. Polik (CPT Member)

Undergraduate research is important in helping students acquire chemical knowledge and experimental skills, gain a spirit of inquiry and independence, and develop the ability to solve problems. The place of undergraduate research in the ACS guidelines was the subject of Dr. Polik's talk. Research is "strongly endorsed" in the guidelines and may be used to fulfill the advanced course requirements. Many issues, such as the importance of a comprehensive written research report, the nature of undergraduate research, and the commitment of an institution to undergraduate research, are touched upon in the guidelines.

A comprehensive written report is required if research is used as one or both of the advanced courses for certification. "A well-written, comprehensive, and well-documented research report must be prepared, regardless of the degree of success of a student's project" (fall 1999 guidelines, p. 12). The Committee expects to see examples of student reports as a part of each five-year review. A supplement to the guidelines, dealing with preparation of research reports, is available at http://www.acs.org/education/cpt/ts_rrguide.html. Research may be conducted on or off campus, during the academic year or summer, and in academic, government, or industrial laboratories. In all cases, however, a comprehensive written report by the student is required.

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Undergraduate research typically has the following characteristics:

- develops new chemical knowledge;
- is conducted with a faculty advisor or mentor;
- is envisioned as publishable; and
- consists of a project that is well-defined, is substantial (not a collection of small projects), has a reasonable chance of completion in the available time, avoids excessive repetitive work, requires advanced concepts, utilizes a variety of techniques and instruments (i.e., is not exclusively library work), and provides active contact with the chemical literature.

The guidelines encourage an institutional commitment toward conducting undergraduate research. Faculty teaching loads must be limited to a maximum of 15 contact hours per semester for all approved programs. However, significantly lower teaching loads are strongly recommended if faculty members are active in research. It is expected that there will be funds for supplies and stipends, equipment matching, faculty and student travel to professional meetings, and sabbatical leaves for scholarly growth. Institutions on the approved list should also have dedicated faculty and student research laboratories.

CPT is developing a new supplement concerning undergraduate research. If you have opinions on the role of undergraduate research in the undergraduate curriculum, we would welcome your comments. You may send comments to cpt@acs.org with the subject of "undergraduate research supplement comments".

# New Supplements for the ACS Guidelines

The Committee approved three new supplements this fall. One describes general expectations for the required coverage in Biochemistry, and the other two address Safety and Safety Education, and Guidelines for the Teaching of Professional Ethics. The Committee hopes that the Biochemistry supplement will provide a better understanding of the Committee's expectations for the new requirement in this area. As a reminder, the ACS Committee on Professional Training does not advocate a set curriculum for approved programs, and these supplements are not meant to be prescriptive. Collectively, they form an appendix to the guidelines for approved programs to provide guidance on a variety of curricular matters. All of the supplements may be found on the CPT Web site at http://www.acs.org/education/cpt/topicals99.html.

## Biochemistry

In the belief that future professional chemists will be at a substantial disadvantage if they know no biochemistry, the ACS guidelines require that all approved programs offer and all certified majors graduate with the equivalent of three semester hours of biochemistry. Molecular aspects of biological structures, equilibria, energetics, and reactions should be covered in the required biochemistry experience for chemistry majors. Enough of an introduction to these topics should be presented so that students can obtain the flavor of modern biochemistry. Approved programs may implement this requirement in one of three ways. One consists of integrating the biochemistry into the required chemistry core. The other two ways consist either of having a three-semester-credit-hour course in biochemistry in the chemistry core or of having the three-credit course serve as one of the advanced courses. A laboratory program in biochemistry is optional.

If biochemistry is part of the core, it can be distributed in the introductory, analytical, inorganic, organic, and physical chemistry courses. There are many ways in which biochemistry can be integrated into these courses; a number of approaches have been reported in previous issues of the CPT Newsletter. Some of the biochemical topics can be included in lower division courses, but some should also be present in upper-level core courses. If biochemistry is integrated into the core, the remaining part of the core must still maintain a comparable emphasis on analytical, inorganic, organic, and physical chemistry. CPT expects syllabi and exams to be supplied as part of five-year reports when biochemistry is integrated into the core.

If a three-semester-credit-hour biochemistry course in the core is used to satisfy the biochemistry requirement, it must be based on more than one semester of organic chemistry. In addition, the remaining part of the core must maintain a comparable emphasis on analytical, inorganic, organic, and physical chemistry. Creativity will be necessary in modifying the core so that it can include the biochemistry course while maintaining this comparable emphasis.

If the biochemistry requirement is satisfied by an advanced course, it is expected that the course will build upon core courses that cover chemical bonding and structure, organic chemistry, and thermodynamics and kinetics. CPT expects course syllabi and exams to be supplied as part of five-year reports when the biochemistry requirement is satisfied by an advanced course.

Three general subject areas in biochemistry, along with specific topics in each area, are appropriate for meeting the biochemistry requirement. CPT recognizes that most approved curricula will not be able to cover all of the topics for each of the three general areas.

- **Biological Structures and Interactions that Stabilize Biological Molecules.** Fundamental building blocks (amino acids, carbohydrates, lipids, nucleotides), organic and inorganic prosthetic groups, biopolymers (nucleic acids, peptides/proteins, glycoproteins, and polysaccharides), macromolecular conformations, membranes.
- **Biological Reactions.** Biosynthesis and metabolism of biological molecules, metabolic cycles, biological catalysis and kinetics, mechanisms, organic and inorganic cofactors.
- **Biological Equilibria and Energetics.** pH/buffers, binding/recognition, proton and electron transport, oxidation/reduction.

Some of these topics may be covered in laboratory courses. The experiments that are used for this purpose should emphasize techniques of general importance to biochemistry as described in the general guidelines outlined above. Some examples are error and statistical analysis of experimental data, spectroscopic methods, electrophoretic techniques, chromatographic separations, and isolation and identification of macromolecules.

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