CPT Newsletter
Fall 1998

Biochemistry in Approved Chemistry Programs

CPT is scheduled to publish a new edition of the ACS guidelines for undergraduate professional education in chemistry that will include a biochemistry requirement for certification of undergraduate majors. Proposed statements to be included in the sections entitled "Curriculum Requirements" and "Commentary on Curriculum Requirements" were published in the Spring 1998 CPT Newsletter.

CPT anticipates that the new guidelines will be published in late 1999. Following publication, departments will have two years to integrate the biochemistry requirement into their curriculum and four additional years before the certified graduates must satisfy the requirement. For example, if the guidelines are published in 1999, approved programs will be expected to satisfy the requirement in 2001 and graduates would have to satisfy the requirement for certification no later than 2005.

In order to permit maximum flexibility, CPT has offered departments the option of implementing the biochemistry requirement by having certified graduates take the equivalent of three semester hours of biochemistry as one of the advanced courses or by integrating the equivalent of three semester hours of biochemistry into the required core. A draft of the supplementary material that will be published to assist departments with the biochemistry requirement is as follows.

Biochemistry. The biochemistry requirement will be satisfied by offering and requiring certified graduates to take the equivalent of three semester credit hours of biochemistry as one of the advanced courses or by integrating the equivalent of three semester hours of biochemistry into the required core. A biochemistry course is expected to build on introductory courses that cover chemical bonding and structure, thermodynamics, kinetics, and upon courses in organic chemistry. If topics in biochemistry are distributed among other courses in the core, the material should be distributed among introductory and more advanced core courses. Three general subject areas in biochemistry, along with specific topics in each area, appropriate for meeting the requirement are listed below. It is recognized that most curricula will not cover all of the topics listed for each general area.

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, polysaccharides), membranes.

Biological Reactions. Biosynthesis and metabolism of biological molecules (amino acids, carbohydrates, lipids, nucleic acids, peptides/proteins), 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, macromolecular conformations.

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

Core Curriculum Requirements

Regardless of what organization is adopted, that part of the program specified as the core curriculum must be taken by all certifiable graduates and must include a minimum of 28 semester credit-hours (or the equivalent thereof for institutions on the quar quarter system) of basic instruction with comparable emphasis on the areas of analytical chemistry, inorganic chemistry, organic chemistry, and calculus-based physical chemistry. In addition, some biochemistry must also be part of the undergraduate curriculum for chemistry degree students. Two modes are possible for biochemistry. One consists of integrating the equivalent of three semester credit hours of biochemistry into the core. The other consists of having a three-semester-credit-hour course in biochemistry as one of the advanced courses.

Commentary on Curriculum Requirements

Biochemistry must be part of the curriculum for chemistry degree students. Approved programs may implement this requirement either by requiring certified graduates to take the equivalent of three semester credit hours of biochemistry as one of the advanc advanced courses or by integrating the three semester credit hours into the required core. 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. CPT encourages approved programs to consider developing such integrated core programs. When biochemistry is integrated into the core, the CPT expects syllabi and exams to be supplied as part of five-year reports.

Molecular aspects of biological structures, equilibria, energetics, reactions, and metabolism should be covered in the required biochemistry experience for undergraduates. Clearly it will not be possible to cover all of these topics in depth in the equivalent of three semester credit hours. However, enough of an introduction to these topics should be presented so that students obtain the flavor of modern biochemistry. Although there is no biochemistry laboratory requirement for approved programs, appropriate laboratory experiences can be used to satisfy part of the overall biochemistry requirement.

Minimum Number of Graduates in ACS-Approved Programs

A new edition of the ACS guidelines for professional education in chemistry is currently being prepared by CPT, with publication projected for late 1999. One change in the new guidelines will be a requirement that on average at least two graduates per yea year must receive degrees from an approved department. Over a five-year period, a minimum of ten chemistry students must be graduated. The rationale for this requirement rests on the fact that an important part of undergraduate education in chemistry takes place through students working together in teams on class assignments and laboratory investigations. A second factor is that without a minimum number of student majors, it becomes nearly impossible to justify the teaching of junior and senior-year core courses, not to mention advanced courses.

Symposium Report

At the March 1998 ACS Meeting, CPT, SOCED, and NSF cosponsored a symposium, "How Do We Know If New Ways of Teaching Improve Learning". Jerry Mohrig, Chair of CPT, organized the symposium. Featuring partnerships of chemists and evaluators, it addressed the tough question of how we can evaluate the success or failure of experiments in chemical education in the context of what they are trying to achieve. It also discussed how to build successful alliances between chemists and the evaluation and assessment communities.

The first team which engaged in dialog were John Wright of the Chemistry Department and Susan Millar of the LEAD Center at the University of Wisconsin, Madison. They talked together of their work on assessing how student learning is affected by changes in learning strategies, explaining how evaluators can help faculty design credible oral and written assessment in a large introductory chemistry course.

They were followed by Brock Spencer of the Chemistry Department at Beloit College and Joshua Gutwill of the ModularChem Consortium at the University of California, Berkeley. They described the developments underway in the ChemLinks and ModularChem projects and their strategies for evaluating student and faculty outcomes through concept tests, interviews, and surveys, including a controlled experiment that compares students from a modular course with those from a traditional course.

For his presentation, Brian Coppola of the Chemistry Department at the University of Michigan, Ann Arbor chose the intriguing title, "Evaluating Assessment". He proposed five interlocking categories for assessing undergraduate chemistry reform. The symposium elicited spirited and useful discussion between the presenters and the participants, and written materials developed by the presenters were handed out. We hope to publish a more thorough report of the symposium presentations as an insert to a later issue of the CPT Newsletter.

Teaching Chemical Information

Why Teach; What to Teach

The importance of students learning to search the increasingly complex information resources has been recognized by CPT with its emphasis on information searching and library resources in ACS *Guidelines* and in the upcoming revision. By teaching informati information skills to students throughout their undergraduate, and graduate years, students see evidence of how these skills can save them time and contribute to their success in courses and research. These skills are expected by industry for new hires (*Current Trends in Chemical Technology, Business, and Employment*; American Chemical Society: Washington, DC, 1994, p. 31), give graduates an edge with potential employers, and add to graduates? abilities to become life-time learners. A more specific guide to skills and information sources that should be taught in the undergraduate and graduate years by C. Carr and A. Somerville was developed,(Coping with the Transformation of Chemical Information. In *Using Computers in Chemistry and Chemical Information*; Zielinski, T.J.; Swift, M. L., Ed.; ACS: Washington, DC, 1997; p.123-124). The databases and other information resources available for students? use often require discussions between faculty and librarians to ensure that the optimum resources are accessible with available funds.

How to Teach

Information skills can be taught in a variety of ways: in a separate course on chemical information, included as a component in an upper-level seminar or research course, by integrating information assignments into courses, or in a workshop or short cour course. A separate course has the advantage of being able to introduce the full range of information skills and resources and is usually taken during the third or fourth year. Integration into courses has the pedagogical advantages of including information assignments as early as the freshman year, helping students recognize that efficient information gathering can contribute to success in their courses, and reinforcing skills in more than one course. Coordination among instructors is valuable for successful integration. The optimal advantages are achieved by a combination of a separate course and integration. For an extensive discussion of the teaching options, see W. Lee and G. Wiggins, Alternative Methods for Teaching Chemical Information to Undergraduates, *Science & Technology Libraries*, 1997, 16, 31-43.

Resources Available for Information Instructors

1. "Teaching Chemical Information: Tips and Techniques" is a workshop developed by the ACS Division of Chemical Information s Education Committee. This four-hour workshop is offered at most ACS national and some regional meetings and at the Biennial Conf Conference on Chemical Education. The lively interchanges among participants and leaders during the workshops provide added value. For information about upcoming workshops, contact the Committee Chairman, Dr. Gary Wiggins, Chemistry Library, Indiana University, wiggins@indiana.edu. The core workshop information is also available on the web at: http://www-sul.stanford.edu/depts/swain/edcinf/edcinf.html.

The workshop provides practical tips on:

- what to teach (including criteria for choosing the right resource to answer a question, general search tactics, how to fit it all in);
- ways to teach (examples of separate courses, integration into several courses, short courses, and workshops; ways to overcome barriers; tips for online class demos);
- ways to teach about journal articles and patents; teaching points for instruction about data collections, abstracts and indexes, structure and reaction databases, and internet teaching. This section includes, for example, Chemical Abstracts and Science Citation Index;
- low-cost teaching options;
- sources for practice and exam questions; and an extensive section of major sources of teaching aids.

2. The Clearinghouse for Chemical Information Instructional Materials, housed at the Indiana University Chemistry Library, includes more than 200 examples of class assignments for all areas of

chemistry, many specific resources (e.g., Chemical Abstracts, Beilstein, General Science Index), property data, structure and reaction searching, and specific techniques such as current awareness. Examples of lectures, syllabi, and exams are also included. It provides links to course information available on the web. For a complete description and listing of the materials available, see http://www.indiana.edu/~chemifo/cciimnro.html.

3. CHEMINFO, Chemical Information Sources: Selected Internet Resources for Chemistry, is an extensive web site, maintained by Gary Wiggins at Indiana University. It provides: information about "how and where to start" searching; "how and where to search" for subjects, patents, chemical names, and formulas; structure searching; property data; synthesis and reaction searching; and chemical safety information. Includes links to courses on the web. Go to: http://www.indiana.edu/~cheminfo/cis_ca.html.

4. "The Chemical Information Instructor" is a column in *Journal of Chemical Education* that began in July 1991. The articles provide practical information on a wide range of topics related to teaching information searching skills to undergraduates, graduate students, and other researchers. Topics include examples of courses, workshops, assignments integrated into courses (for majors and non-majors), use of web resources, specific types of information such as organic, and specific sources and databases such as Chemical Abstracts and Science Citation Index. Authors describe difficulties encountered and how they were resolved. For questions, contact Editor Arleen Somerville, University of Rochester, asomerville@RCL.lib.rochester.edu.

A major article in 1993 was a comprehensive bibliography of articles, publications, and organizations relating to information instruction by Carol Carr, *Journal of Chemical Education, 70*, 719-26. An updated bibliography is scheduled for publication in early 1999.

5. Members of the Education Committee of the ACS Division of Chemical Information are available for consultation. The list of current members is found at: http://www.lib.uchicago.edu/~atbrooks/CINF/cinfhome.html

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Aspects of Graduate Education in Polymers

Are We Training People for Industry?

"Aspects of Graduate Education in Polymers Are We Training People for Industry?" was the topic of the Eighteenth Annual Industrial Sponsors? Symposium of the Polymer Division of the American Chemical Society, held during the 1997 Fall ACS Meeting at Las Vegas. Cosponsored by the ACS Committee on Professional Training (CPT), the well-attended minisymposium and panel discussion engendered lively participation and debate. The panel, chaired by Dr. M. Jaffe of Hoechst Research and Technology and a member of CPT, included Professor William MacKnight, Macromolecular Science Department, University of Massachusetts traditional polymer program, Dr. Richard Ikeda of the DuPont Company large industry, Professor James McGrath of the Polymer Program at Virginia Polytechnic Institute and State University interdisciplinary graduate polymer program, Dr. Tony Flaim, Flaim Industries small industry, Professor Edward Samulski of the Chemistry Department at the University of NorthCarolina at Chapel Hill traditional chemistry department. Key conclusions were:

- Students with polymer degrees are in demand by industry
- Program organization/focus less important than student product
- Industry looking for people who can "hit the ground running"
  Deficiencies included:
  - Poor communication skills
  - Narrow technical background
  - Lack of experience in team participation or project management

Dr. Andrew Lovinger of the National Science Foundation (NSF) described emerging NSF philosophy that values education and/or industry collaboration, along with traditional research.

Several additional issues were raised during the open discussion. Both academic and industrial polymer chemists agreed that a "hybridized" polymer chemistry degree that included more background in the traditional chemistry disciplines would be beneficial to many polymer chemistry Ph.D. programs. Industrial polymer chemists noted the trend that many positions traditionally requiring the Ph.D. degree are now being filled by polymer chemists with degrees at the master's and bachelor's level. This was seen as consistent with the diminution of basic or discovery research being performed in industrial laboratories. There was active discussion about the need for polymer chemists being trained for industrial positions to be exposed to business and economic factors relevant to the commercialization of research findings. Whether this exposure should be through formal courses or integrated throughout the curriculum was left unresolved.

It is clear that the issue of the relevance of the modern graduate degree in polymer chemistry to industry is a topic of strong interest within the polymer community. This mirrors the concerns of the broader chemistry community as to the quality and utility of graduate degrees in chemistry and what changes, if any, might be suggested to make chemistry degrees more attractive to students and employers alike.

CPT Open Meetings to Be Held Twice Each Year

Over the past few years open meetings of the CPT have been held once each year at a national ACS meeting. Recent open meetings have seen lively discussions and have been helpful to the Committee, so much so that CPT has decided to hold an open meeting at each national ACS meeting. They will be held regularly from 12 noon to 1 PM on Sunday, the first day of the meeting. An agenda will be published in *Chemical & Engineering News*, giving the items on which CPT will present its latest thinking; however, other items which the chemistry community would like CPT to think about are also welcome. The agenda for the Anaheim ACS meeting in March 1999 will include the implementation of the new biochemistry requirement, revisions in the ACS guidelines for approved programs, and reevaluation of ACS-approved options.

Co-op and Intern Experience Valued by Industrial Managers

Recent focus group sessions conducted by the ACS Office of Industry Relations and held with managers from industry found that those managers believe summer internships and industrial co-op experiences are one of the best ways for undergraduates to prepare to function effectively in an industrial position. Internships and co-ops provide a challenging work experience as well as an opportunity to develop a familiarity with a company, its products, and an understanding of how to work in an industrial setting. This experience is valued and can make a significant difference in a student's early career. The internship also provides the company the chance to see a student?s capabilities and may lead to a permanent position at a later time. The ACS Office of Experiential Programs in Chemistry is currently updating its "Directory of Experience Opportunities" (see http://www.acs.org/education/studprog/ugcars.html); a good place to begin a search for these positions. Corporation Associates, the formal link between the ACS and the chemical process industries, supports these types of opportunities and strongly encourages students to take advantage of them if they are planning an industrial career.

� *Prepared by Robert J. Coraor Air Products & Chemicals, Inc.*

Recommended Journals Update

Resources Available for Information Instructors

In response to various inquiries regarding the use of online journal subscriptions in place of hard copy subscriptions, CPT voted at their April 1997 meeting to allow online access to journals. This online access must be to the full text and graphic mater material of the journal.

Also, CPT has recently updated the content of the recommended journal list for undergraduate programs. The updated list follows. Additional copies of the list may be obtained by calling (202) 872-4589 or sending your request by mail to the Office of Professional Training, American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036. The list is also available on the web at http://www.acs.org/cpt/library.htm.

Library Guidelines for ACS-Approved Schools

Essential to an approved chemistry program is a good library where faculty and students have access to books and periodicals and where adequate support for data base searching is available. Chemical Abstracts (hard copy or online) must be part of the col collection. An institution with a broad spectrum of research activity will require extensive holdings. The department meets the minimum library requirement for approval if its library subscribes to twenty or more refereed journals in the chemical sciences and has a range of other reference materials. If an institution subscribes to fewer than twenty current refereed journals in the chemical sciences, it must demonstrate that an adequate mechanism exists for faculty and students to gain access to the wider literature. In such instances, the on-site collection must have hard copy subscriptions to no fewer than fourteen current journals chosen from the CPT library listing (available from the Office of Professional Training, American Chemical Society, 1155-16th Street, N.W., Washington, DC 20036). Of the fourteen, at least four must be from the general content list, and at least one each must be from the areas of analytical, biological, inorganic, organic, and physical chemistry.
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American Chemical Society
Committee on Professional Training
Journals List for Undergraduate Programs

I. General Content

Accounts of Chemical Research
Angewandte Chemie *(International edition in English)*
Chemical Reviews
Journal of Chemical Education
Journal of the American Chemical Society
Journal of the Chemical Society *(London)*
Chemical Communications
Nature
Proceedings of National Academy of Sciences
Science

II. Topical

A. Highly Recommended

Analytical Chemistry
Biochemistry
Chemistry of Materials
Environmental Science & Technology
Inorganic Chemistry
Journal of Biological Chemistry
Journal of Chemical Physics
The Journal of Organic Chemistry
The Journal of Physical Chemistry (A and B)
Journal of the Chemical Society *(London)*
Dalton Transactions
Faraday Transactions
Perkin Transactions
Langmuir
Macromolecules
Organometallics
Trends in Biochemical Sciences

B. Also Recommended

Biochemical Journal
Bioconjugate Chemistry
Bioorganic Chemistry
Canadian Journal of Chemistry
Chemical Physics Letters
Chemical Society Reviews
Chemische Berichte
Chemistry and Biology
Chemistry Letters (Japan)
European Journal of Biochemistry
European Journal of Chemistry
Helvetica Chimica Acta
I&EC Research
Inorganica Chimica Acta
Journal of Catalysis

- Journal of Chemical Information & Computer Science
- Journal of Chromatography
- Journal of Coordination Chemistry
- Journal of Electroanalytical Chemistry
- Journal of Medicinal Chemistry
- Journal of Organometallic Chemistry
- Journal of Polymer Science
- Magnetic Resonance in Chemistry
- Nouveau Journal de Chimie
- Pure and Applied Chemistry
- Spectrochimica Acta
- Tetrahedron
- Tetrahedron Letters

In addition to the required journals, undergraduates may benefit from a browsing collection including some of the following: Chemical and Engineering News, Chemistry in Britain, Scientific American, CHEMTECH, and Chemtracts.

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ACS Committee on Professional Training 1998

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**Contact the Secretary of the Committee for inquiries concerning CPT and the content of the newsletter.*