ACS Chemistry for Life®

CPT
Committee on Professional Training

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CPT OPEN MEETING

We invite you to attend the CPT open meeting at the 252th ACS National Meeting in Philadelphia, Pennsylvania, from 4:00 to 5:00pm on Sunday, August 21, 2016. The location is not yet available. Please check the CPT Web page (www.acs.org/cpt) later for details.

Career Preparation and the Requirements for an ACS-certified Degree

ACS President Donna Nelson has appointed a task force that is examining reasons for the disturbingly high unemployment rate of recent chemistry graduates. Two possibilities being explored are whether there are an insufficient number of employment opportunities for new graduates or whether they are inadequately prepared for the jobs that are available to them. Tom Wenzel from Bates College (Chair of CPT) participated in a conference call with members of the task force, and along with Laura Kosbar from IBM (Vice Chair of CPT), participated in a presidential poster session at the Spring 2016 ACS National Meeting in San Diego. These two opportunities provided the chance to inform the task force about the degree to which the ACS Guidelines for a certified bachelor's degree are designed to prepare students not only for careers in chemistry but for the broad range of professional careers that chemistry majors enter. The ACS Guidelines emphasize three broad categories that are necessary for success: *Knowledge, Experience,* and *Skills*.

The *Knowledge* category includes both breadth (the equivalent of one foundation course in each of analytical, biochemistry, inorganic, organic, and physical; cognate courses in mathematics and physics; and depth (requirement of four in-depth courses that have one or more foundation courses as prerequisites). A recent change requires that the curriculum for the certified degree cover the principles that govern macromolecular, supramolecular, mesoscale and nanoscale systems with an understanding of their preparation, characterization, and physical properties. This change was a direct response to the importance of these systems within chemistry and to those companies that employ chemists. The ACS Guidelines also promote rigor of course content, the use of effective pedagogical practices, and academic excellence within the curriculum. These features of the curriculum are carefully examined by CPT in its review of programs.

The *Experience* category includes a requirement that a student complete 400 laboratory hours beyond general chemistry. The ACS Guidelines speak to the need for hands-on laboratory experiences. Undergraduate research can be used for up to 180 laboratory hours. Students must also use an NMR spectrometer and equipment from at least four of five different categories: optical molecular spectroscopy, optical atomic spectroscopy, mass spectrometry, chromatography and separations, and electrochemistry. Beyond these general requirements, student participation in undergraduate research and other capstone experiences, the use of distributed labs, open-ended laboratory experiences, and innovative curricular design and structure is encouraged.

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Using In-Depth Half-Courses for Student Certification

The ACS guidelines for certification define in-depth courses as those that build on prerequisite foundation course work, enabling further exploration and integration of topics introduced in the foundation courses. Students in an ACS-certified degree track must complete the equivalent of four one-semester in-depth courses, and ACS-approved departments must annually teach the equivalent of at least four semester-long in-depth courses. The ACS Committee on Professional Training reviews the frequency and number of in-depth courses offered by a chemistry program and also examines the content of such courses to insure the rigor of the undergraduate experience. For a variety of reasons, many programs struggle to offer the requisite number of in-depth courses. Institutional policies, for example, often lead to cancellations of in-depth courses due to small enrollments. Semester-long in-depth courses may also put constraints on faculty contact hours and lead to significant imbalances in teaching loads. Finally, the activation barrier to revising a semester-long course may limit a program's ability to maintain a modern curriculum.

For a variety of reasons, many programs struggle to offer the requisite number of in-depth courses.

Some chemistry programs have introduced in-depth "half courses" to address a number of objectives. For institutions with semester calendars, half-courses may be scheduled to run only for half of the term or, alternatively, may meet once a week for an entire semester. Two campuses – Colgate University and Harvey Mudd College (along with its consortium of institutions at the Claremont Colleges) – are examples of ACS-approved chemistry programs that have used the format of in-depth half-courses to transform their curricula.

For Harvey Mudd, chemistry half-courses have a long history, since the fall of 1970. An array of advanced physical and organic half-courses were originally introduced to provide students with both flexibility in completing in-depth course requirements and incentive to explore a wider range of offerings. The half-course model has advanced and flourished over the years, expanding to the other chemistry programs at the Claremont Colleges and giving our students a wealth of choices comparable to the more expansive curriculum of a larger university. In contrast, a suite of half-semester courses was introduced at Colgate University in response to the 2008 revision of the ACS guidelines. The transition from a more restrictive, course-based certification requirement to a competency/foundational area structure fostered Colgate's curricular rearrangement. While both institutions offer in-depth courses in the traditional semester-long format, the singular advantages of the half-course model are highlighted here along with a few suggestions to address the occasional drawbacks of such an approach.

Half-courses increase the diversity of upper-level course offerings and encourage students to broaden their chemistry experience. Such course diversity provides more opportunities for students, perhaps enabling a department to offer specialized degree tracks to capitalize on particular student interest or local faculty expertise. Half-courses can lead to less compartmentalization of courses into traditional disciplinary areas (e.g., Organic Chemistry I and II) and more creation of specialized or interdisciplinary courses. For example, Colgate offers such half-courses as Molecular Modeling and Simulation, Bioenergetics, and Bioinorganic Chemistry. Harvey Mudd offers such topics as Pericyclic Reactions, Industrial Chemistry, and Electronic Structure Theory. A "special topics" label for a half-course also enables visiting faculty to contribute their expertise to the curriculum.

Half-courses provide greater control over faculty contact hours and enable programs to weather sabbatical leaves. Chemistry programs often struggle to limit faculty contact hours within the ACS Guidelines. Two half-courses offered in a single time slot over the course of a semester allow two faculty to offer upper-level in-depth courses while keeping the contact hours of each instructor in check. Using half-courses to shift some teaching responsibilities to the first or second half of a semester can create blocks of time for faculty scholarship during the academic year. Similarly, student workload is generally lighter during the first half of the semester, encouraging students to enroll in a half-course with the

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Supplement on the New Curriculum Requirement

The Committee on Professional Training finished updating all of the supplements to the ACS Guidelines. These supplements are not intended to be prescriptive but do provide general advice on the expectations for various aspects of the requirements for ACS approval. Two new supplements were published this spring. One of them addresses the new curriculum requirement in the 2015 ACS Guidelines: Macromolecular, Supramolecular, and Nanoscale (MSN) Systems. The guidelines allow great flexibility in satisfying this requirement, and the supplement offer suggestions on topics that might be appropriate in each of the content areas. The second new supplement covers suggestions for international experiences for undergraduates. All of the supplements are available at the CPT website (www.acs.org/cpt) by clicking on the "Guidelines" tab.

UPDATED RESOURCE:
Planning for Graduate Work in Chemistry

The ACS Committee on Professional Training is pleased to announce the release of the latest incarnation of *Planning for Graduate Work in Chemistry*, which can be found at www.acs.org/cpt. In contrast to earlier versions of this resource, which were available both online and in a hard copy format, this resource is designed as a web-based source of information for students interested in graduate work in chemistry. It is structured in three parts:

The first section of *Planning for Graduate Work in Chemistry* focuses on topics that undergraduate students should consider early in their academic careers if they expect to pursue a higher degree in chemistry. This part asks questions that students might wish to think about as they consider obtaining an advanced degree. It includes background information about various opportunities for advanced study in chemistry. For students who decide to pursue an advanced degree, another section focuses on how students should prepare themselves. In addition to specific advice, this section contains links to ACS and external resources to aid students in, for example, identifying research opportunities.

The second set of topics focus on choosing a graduate program. This section takes students through the process from selecting programs and taking necessary exams to visiting programs and accepting offers. A list of questions are provided that students may want to consider themselves or ask programs as they make decisions on where they might wish to apply and ultimately attend. Students often do not know where to start in thinking about the application process for graduate study, especially given the differences in the process compared to their experience of selecting an undergraduate program or the process their peers go through as they apply to professional programs. They also often struggle with the critical questions they should be asking themselves and others. Additional information is provided for students who are applying from outside of the United States.

Although the resource is focused on helping students plan for graduate work, it includes a third section that covers the early experiences in graduate school, taking on issues of relocation to a new city, choosing an advisor, and working as a teaching assistant. It also provides information on and resources for setting up individual development plans.

A potentially very useful link for students includes timelines for both domestic and international students consisting of a pair of charts. Each of these charts provides a timeline consisting of activities students planning for graduate work should consider. The timeline starts with activities related to laying the groundwork for graduate studies, for example, getting research experience and developing skills roughly 26 months before starting graduate work (i.e., the beginning of the summer two years before completion of the bachelor's degree). The timeline extends through the first academic year of graduate work when students will have chosen a research advisor, are ready to set longer-term goals for their graduate studies, and begin to think about preparing themselves to achieve their ultimate career goals.

We hope that you and your students will find this resource helpful. We welcome feedback and suggestions. Please send them to cpt@acs.org. ■

PhD Luncheon Explores Implications of New ACS Guidelines, Laboratory Safety, and Individualized Development Plans

The ACS hosted a luncheon for representatives from more than forty PhD-granting departments at the Spring ACS National Meeting in San Diego. The Committee on Professional Training (CPT) hosts twice-yearly lunches with department chairs of PhD-granting departments to discuss data collected by the Committee, the impacts of the ACS Guidelines on the undergraduate curricula, and new developments in graduate student training. The San Diego luncheon centered on small group discussions concerning three topics:

- how departments are implementing Individualized Development Plans (IDP) in the training of graduate students;
- how departments are creating "cultures of safety"; and
- how the new "macromolecular" requirements of the 2015 Guidelines are impacting delivery of the undergraduate curriculum.

Lively discussion ensued that included spontaneous topics, such as laboratory safety, in addition to the main focus points.

The results from the CPT survey of PhD graduates elicited many discussions regarding preparing students for their lives beyond graduate studies and postdoctoral experiences. Some institutions have already embraced an IDP for their graduate students. In some cases, the biological sciences led the effort as a result of the AAAS-developed IDP. While the ACS IDP is very new, early reaction appears to be positive, particularly to its alignment with chemistry graduate studies and the incorporation of tools that provide direct access to ACS resources. Some departments have implemented IDPs for postdoctoral associates as a result of the NIH, and this compliance-based directive is beginning to extend to graduate students. In another example, students led the effort to create and implement IDP tools into their dossier, stimulating conversations about topics important to them as they develop as scientists.

Developing a culture of safety is a major ongoing emphasis at all programs. Student-led inspections can be an effective tool to develop peer-led development of safety in a very diverse range of laboratories. Deliberate, regular interjection of 'safety minutes' into courses and meetings can also be very effective tools to promote safety awareness. Research institutions face challenges related to the training of inexperienced undergraduates alongside more experienced graduate students and postdoctoral associates, but some tools can be implemented across these groups. While some departments apply the same expectations of training and evaluation to faculty, this policy is not uniform.

With respect to the macromolecular requirement, departments were clear that adding a new, required course for undergraduates was difficult and that the requirement likely would be filled by distributing the content throughout sections of other courses. For example, synthesis and characterization of polymers or nanoscale materials may be a part of existing organic and inorganic chemistry courses, and physical and analytical courses may already explore the unique physical properties arising from large molecules. Existing biochemistry foundational experiences necessarily include significant exposure to the structures and properties of biopolymers. Some departments expressed concern about the effort needed to describe how the curriculum fulfills the macromolecular requirement in the periodic review reports.

Some groups were asked to elaborate on how their institutions promote the development of safety skills amongst their graduate and undergraduate students. All agreed that the goal of effective safety training is creation of a "culture of safety". To create such a culture, one group emphasized the importance of a commitment to safety at all levels of the university, from chancellor down to the entering undergraduate. Graduate student safety teams can play a central role in the creation and propagation of safety consciousness in large departments. Elsewhere, university-wide safety officers lead the safety education and enforcement activities. Safe operating procedures customized for local laboratory environments can be effective, and their development and review can be integrated into the teaching and research activities of most institutions. While there is broad attention to safety training and management at every university, there was little uniformity in the administration and tools applied across these representative departments.

A second question concerned the mechanisms that programs use to prepare graduate and undergraduate students for their post-degree lives. A range of resources are now available to students as they evolve toward a career in chemistry. Departments certainly anticipate that students use virtual resources, such as those listed in the ACS Graduate Education Careers website (http://www.acs.org/content/acs/en/education/students/graduate/gettingready.html). Many departments are

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prospect of having more unscheduled time during the second half of a semester when course papers and projects are often undertaken.

Half-courses can be used as a vehicle for curricular innovation. Colgate University has used the half-course model to build specific research-scaffolding laboratory courses into the curriculum. Students are required to enroll in two such courses to broaden their laboratory training in different disciplines. Examples include Biophysical Chemistry Research Methods, Molecular Dynamics, Molecular Spectroscopy, and Structure and Analysis. Only Practical Quantitative Analysis remains linked to an accompanying course (Instrumental Methods). At Harvey Mudd half-courses are used to amplify the curriculum to enable students to have the opportunity to pursue a specialized program of study within the chemistry major, known as a chemistry "emphasis." Chemistry emphases tailor the required course work to satisfy particular career objectives. Current emphases include Applied Chemistry (for those interested in careers in Chemical Engineering), Computational Chemistry, Environmental Chemistry, Materials Chemistry, and Geochemistry. Numerous half-courses are available to provide the more specialized course work needed for these specialized programs of study.

Both students and faculty need to be aware that a half-course that is scheduled for half of the academic term is a fast-paced course where assignments need to be staged appropriately to give students ample feedback in a timely manner and to allow faculty sufficient opportunity to evaluate student performance.

What kinds of challenges might a program face with the half-course model? Any variation to the academic calendar requires careful forethought but is manageable. Specified dates for adding and dropping half-courses, scheduling final exams, and submitting grades are recommended. Both students and faculty need to be aware that a half-course that is scheduled for half of the academic term is a fast-paced course where assignments need to be staged appropriately to give students ample feedback in a timely manner and to allow faculty sufficient opportunity to evaluate student performance. Selecting particular time slots in the course schedule for half-courses can help to avoid conflict with traditional departmental offerings and also allow students to enroll in two such courses scheduled in sequence. With some care these challenges can be controlled, enabling a chemistry program to incorporate in-depth half-courses to achieve a coherent, vibrant curriculum that satisfies the requirements for student certification. ■

Career Preparation *continued from page 1*

The *Skills* that programs must develop in students include competence in written and oral communication, searching and evaluating the chemical literature, information management, problem-solving, teamwork, and ethics. Programs must also promote a culture of safety. The important role that undergraduate participation in research can have in developing these skills is appreciated by CPT.

The ACS Guidelines also emphasize the importance of program self-evaluation to assess whether students are getting sufficient competence in the *Knowledge, Experience,* and *Skills* areas and, if not, to alter the curriculum to achieve that goal. While the *Knowledge* and *Experience* categories develop specific competencies that students will need for careers in chemistry, the *Skills* category addresses more broadly the competencies that are needed for success in a wide range of professional careers.

CPT is confident that programs that design a curriculum that develops suitable competency in the areas of *Knowledge, Experience,* and *Skills* provide their certified graduates the background needed for success in careers in chemistry and other professional areas. ■

International Recognition of Chemistry Undergraduate Programs

The Committee on Professional Training (CPT) contributed to the symposium International and Multicultural Perspectives at the spring 2016 ACS meeting with a presentation titled *Crossing the border: Should ACS recognize international undergraduate chemistry programs*? The presentation was delivered by Edgar Arriaga, a member of CPT and a faculty member at the University of Minnesota. The symposium, which was organized by the Division of Chemical Education and co-sponsored by the International Activities Committee (IAC), focused on the opportunities and challenges to educate and train undergraduates in chemistry related fields in a rapidly changing, highly interconnected world. In addition to presentations that shared success stories of international student training through study abroad programs and partnerships, other presentations described how the ACS Office of International Activities, the IAC and the Task Force on International Chemical Education are championing educational exchanges and promoting development of projects of global relevance.

One of the emerging topics of international training and education of undergraduate chemistry majors is that of trans-national accreditation, approval, or recognition of undergraduate programs. The Canadian Society for Chemistry (CSC) and the Royal Society of Chemistry (RSC) accredit undergraduate chemistry programs not only within their territory, but also in other regions of the globe. At the time of this symposium, the CSC has accredited eight programs in seven countries and the RSC has accredited eighteen programs in twelve countries.

Through the CPT program approval process, the ACS promotes standards for undergraduate education and training of bachelor's-degree chemists in the United States. Certain components of the ACS approval program that CPT evaluates for institutions in the United States may not be applicable to institutions outside the US. However, CPT's experience is valuable in defining an ACS system of 'recognition' for undergraduate chemistry programs in other countries. CPT has been asked to provide a set of recommendations on the evaluative information, process and resources needed for an ACS program that recognizes undergraduate chemistry programs outside the US as ACS examines whether to pursue such an initiative.

CPT's contribution to the symposium highlighted three questions relevant to the role that ACS would play in recognizing international programs (1) What would be the benefit of ACS recognition to an international program, its home country, and the world? (2) What are logistics to consider in the process, if the ACS were to recognize international programs? (3) How would the ACS address the unique socio-cultural-geopolitical issues of programs outside the US seeking ACS recognition?

While participants at the symposium appreciated the positive aspects that could come from an ACS program of international recognition, they also noted the complexity of such a program. Beyond the challenges of operating and managing an international recognition program, consideration of factors such as the human development index, language differences, geography, cultural diversity, and different training and educational approaches practiced outside the US will need to be considered. Furthermore, ACS will need to carefully consider how to interpret the ACS Statement on Diversity and policy on Human Rights if ACS recognition of undergraduate chemistry programs goes beyond the border. CPT is examining these topics as it prepares its recommendations for ACS leadership. ■

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beginning to use Individual Development Plans (IDPs, http://myidp.sciencecareers.org), and a member of CPT presented a brief summary of a new Individual Development Plan tool for graduate students and postdocs that is under development by ACS. Others bring professionals to campus through seminar programs or career planning workshops, including the ACS Preparing for Life after Graduate School program (PfLAGS). Participants expressed the sense that the majority of students still depend on informal contacts made through their departments to better understand career options and find long-term employment.

The question concerning shortcomings in the preparation of students entering graduate programs elicited a lively discussion and much agreement. Concerns about writing skills dominated the conversation. The specifics of a student's preparation can vary greatly, and this presents a challenge for the first-year curriculum of many departments. Students' safety training and consciousness and writing skills were highlighted as key challenges. ■

Announcements

Changes in CPT Membership

In 2016, one new member and one associate member were appointed to CPT: Dr. Joseph J. Provost and Dr. Scott A. Reid. Dr. Provost is a Professor and Associate Chair in the Department of Chemistry and Biochemistry at the University of San Diego. Dr. Reid is a Professor and Department Chair in the Department of Chemistry at Marquette University.

The Committee members would like to express their very special appreciation for the many contributions of the following members, who concluded their terms of service on CPT at the end of 2015 or January 2016: Dr. Cynthia Larive, Dr. Lee Park, and Dr. Joel Shulman. Dr. Larive served 11 years on the Committee, and she served three year as chair and two years as vice-chair on CPT. Dr. Park served nine years on the Committee, and she served one year as a vice-chair on CPT. After 14 years as a member and then a consultant on the Committee, Dr. Shulman concluded his service on CPT in January 2016.

Status of ACS Directory of Graduate Research (DGRweb)

Access to information about graduate chemistry programs has changed dramatically since the introduction of the *ACS Directory of Graduate Research (DGRweb)* 63 years ago. With chemistry programs developing increasingly informative websites, we have observed a significant number of programs convert from full listings to free, heading-only listings and a sizeable number of programs withdraw altogether from the Directory. *DGRweb* must be fully self-supporting in order to continue. For this reason, we have decided to discontinue *DGRweb*.

The *DGRweb* and its archive will remain on the website (www.acs.org/dgrweb) throughout the end of 2016 for free online searches.

Congratulations!

The Committee congratulates the following schools on their newly ACS-approved bachelor's degree program in chemistry:

Cedar Crest College
Henderson State University
Mercyhurst University
Tarleton State University

The current number of ACS-approved programs is 684.

A New Individual Development Planning Tool for Graduate Students and Postdocs

ACS introduces ChemIDPTM, an individual development planning tool designed to help graduate students and postdoctoral scholars in the chemical sciences plan and prepare for rewarding careers. ChemIDP™ is a space to explore over 45 careers for chemists, develop strategies to strengthen skills, set goals, and map plans that reflect the users background, experiences, and career aspirations. To access this free site visit chemidp.acs.org.

Certificates Available for ACS-Certified Graduates

Chemistry majors who receive a baccalaureate degree from an ACS-approved program and complete a curriculum described in the ACS Guidelines may be certified to the Society for membership purposes by the head or chair of the approved program. If you would like to have certificates available for presentation to your certified graduates, please contact the office by email at cpt@acs.org.

Preparing for Life After Graduate School

A career development workshop from ACS

This two-day workshop is designed to inform chemistry graduate students and postdocs about their career options and how to prepare for them:

- Examining careers for PhD chemists
- Describing careers in business and industry
- Knowing critical non-technical skills
- Finding employment opportunities

To bring this workshop to your department, see www.acs.org/gradworkshop or contact GradEd@acs.org; 202-872-6864.

This program is supported by the Graduate Education Advisory Board, with members appointed by CPT, SOCED, and YCC.

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