ACS Committee
Professional Training

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In This Issue

We invite you to attend the CPT open meeting at the 256th ACS National Meeting in Boston, Massachusetts, 4:00 to 5:00pm Sunday, August 19, 2018.

The location is not yet available.

Please check the CPT website (www.acs.org/cpt) later for details.

PhD Luncheon Examines Student Skills Development in the Context of Preparing for Graduate School

The ACS Committee on Professional Training (CPT) hosted a luncheon for representatives from more than thirty PhD-granting institutions during the Spring ACS National Meeting in New Orleans, to provide a venue for discussion of the development of student skills. This discussion was framed by the inclusion of a student skills section in the 2015 version of the ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs (i.e. the Guidelines).

The Spring 2018 luncheon addressed student skills development in light of the emerging guidelines revision process. The most recent *"ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs"*, developed in 2015, incorporated an entire section on the development of student skills, including problem solving, chemical literature and information management, laboratory safety, oral and written communication, team skills, and ethics. Skill development typically occurs longitudinally along a student's undergraduate career rather than during specific specially designed courses. The luncheon, organized around small-group table discussion with subsequent reporting out to the larger group, focused on the most important skills necessary for success in graduate school (and beyond).

The consensus of the attendees was that the current guidelines are a good starting point, although some of the existing skills should be broadened or strengthened as the needs of the workforce change. As mentioned in a recent ACS comment in C&EN and incorporated in the ACS strategic plan, the need for a more complete safety education and awareness program was acknowledged as one aspect of skills development that could be strengthened. A significant portion of the attendees encouraged a continued progress of oral and written communication throughout the undergraduate curriculum, with a continued focus on undergraduate research as a key component of the curriculum where many of these skills can be promoted.

Looking forward, many of the groups mentioned the need for undergraduates to be able to move past using the basic word processing or spreadsheet packages. Several groups mentioned a desire for undergraduates to be able to write computer code, particularly for data acquisition, to understand the assumptions involved in using computer programs such as Gaussian or Spartan, to be able to apply statistics, and to deal with large data sets ("big data").

The organizers would like to thank all of the attendees for their participation and thoughts as the committee moves forward with the revision process. CPT

Imparting and Assessing Student Skills: Call for Examples

Development and assessment of student skills is one of the benchmarks of ACS-approved bachelor degree programs as described in the "ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs" (the Guidelines). The Guidelines specifically focus on skill development in the areas of laboratory safety, communication, teamwork, ethics, problem solving, and chemical literature and information management. The document "Development of Student Skills in a Chemistry Curriculum", prepared by the Committee on Professional Training (CPT) offers suggestions to faculty on how to incorporate these skills in chemistry courses. This article is a call to chemistry programs to share additional innovative strategies for the development and assessment of the aforementioned student skills in order to prepare a more extensive supplement on student skills for the chemistry community. Examples of scaffolding skill development throughout a four-year curriculum or integrating the development of several skills in a single course or experience are of particular interest.

Please share your innovative strategies for the development and assessment of student skills with us at cpt@acs.org

Laboratory Safety

A culture of laboratory safety is an essential component of ACS-approved programs. Faculty contribute to that safety culture by emphasizing laboratory safety education as a critical component of chemistry instruction. Whether an experiment is part of a structured experience or part of a research project, laboratory work must be designed and practiced with safety in mind. This is particularly necessary when the experiences include procedures which may be new to the student. To maintain a constant focus on laboratory safety, students might be asked to discuss any potential safety concerns and ways to mitigate accidents as they outline their experimental procedures in their laboratory notebook. A portion of the evaluation of a student's performance on a given experiment or research project should reflect the student's awareness of safety hazards and their ability to carry out their laboratory work safely. Recently published resources of the ACS Committee on Chemical Safety provide guidelines for chemical safety in academic institutions[1] and help in the identification and evaluation of hazards in research laboratories[2,3].

Oral and Written Communication

Students that communicate effectively, both in writing and verbally, possess a skill highly desired by potential employers and graduate school recruiters. Such experiences can be incorporated at all levels of the undergraduate curriculum and many programs report asking students to make multiple oral presentations to a variety of audiences and prepare a range of written assignments to achieve strong communication skills. Increasingly, schools have adopted the use of rubrics for the scoring of oral and written presentations by both faculty and students. CPT is particularly interested in ideas of how to scaffold writing skills throughout the curriculum, in ways to assess presentations and written assignments in a manner that reduces the burden on the evaluator, and in rubrics for evaluating communication skills.

Team Skills

The ability to work as part of a collaborative team in which each member has different knowledge and skill sets has also been recognized as one of the key elements of a successful professional scientist. While many scientists do collaborate and work in teams, undergraduate chemistry students generally have few opportunities to work on a project with a diverse set of group members. Chemistry programs often report traditional two-person laboratory partnerships as a team-building experience, but such interactions do not effectively build leadership skills, enable students to navigate group dynamics, or coordinate the varied contributions of team members with different skills and strengths. Team-based laboratory projects are increasingly being introduced in undergraduate curricula to address the deficiency of group experiences.

Ethics

Often programs report that discussions of scientific ethics are relegated to capstone research experiences. Yet modern chemistry curricula provide many opportunities for students to consider the responsibility of chemists to society and to their profession. The presentation of green chemistry principles is a perfect opportunity to discuss the role of the chemistry in optimizing environmental protection and the industrial and commercial needs of society. Courses that incorporate the discussion of literature articles allow for the consideration of aspects of co-authorship, plagiarism, collaboration, proper data treatment, and citation of others' work. A case study approach with a subsequent student discussion is often an effective way to introduce these issues. Examples focused on intellectual property and patent considerations would broaden the scope beyond only academic settings.

Chemical Literature and Information Management

The skill related to chemical literature and information management arises from the need to obtain information related to the synthesis, characterization, and/or properties of compounds, and to evaluate the credibility of the retrieved information. The skill definition in the Guidelines includes the ability to perform structure searching and the use of multiple data bases effectively. These experiences commonly begin in the general or organic chemistry sequences and extend throughout the undergraduate curriculum. For example, students should be able to draw correct molecular structures using appropriate tools, examine safety data sheets for handling recommendations and hazard issues, and find descriptions of the synthesis and properties of a particular molecule. The skill is commonly addressed in a stand-alone dedicated course, but examples of exercises and assignments that address these skills in a variety of disciplinary courses might be a preferred means of both introducing and strengthening these techniques.

Problem Solving

There are a variety of definitions of "problem solving" that have been used in describing the work of a chemist. The Guidelines define problem solving as the ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data, understand experimental uncertainty, and draw conclusions. As chemistry is an experimental science, the design of experiments and interpretation of experimental data are fundamental to the practice and learning of chemistry. Open-ended laboratory experiences provide excellent opportunities for the development and assessment of these skills. These experiences could extend from a mini-research project in general chemistry, to more open-ended experiences in upper division laboratories, to integrated laboratory experiences, or to undergraduate research. A rubric for evaluating these experiences is helpful in evaluating student progress in this area.

A Call for Examples from the Chemistry Community

Most educators would not be surprised to learn that the presentation of disciplinary content knowledge generally receives substantially more attention in the chemistry curriculum than student skill development. The CPT believes that, with additional, innovative examples of student skill development and assess-

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Student Skills, *continues from page 3*

ment to include in our student skills supplements, chemistry instructors would increase their focus on the acquisition of these skills, which are essential to the students' success in their chosen postgraduate careers. We invite chemistry programs to contribute brief descriptions of their inventive and effective practices in the area of student skill development and assessment. Contributions should be sent to cpt@acs.org. CPT

1. *Guidelines for Chemical Laboratory Safety in Academic Institutions*, ACS Committee on Chemical Safety, Washington, DC., 2016. A comprehensive document providing a broad overview of the range of safety considerations for undergraduate, graduate and continuing safety education. (www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-safety-guidelines-academic.pdf?logActivity=true)
2. *Identifying and Evaluating Hazards in Research Laboratories*, ACS Committee on Chemical Safety, Washington, DC., 2015. A comprehensive overview of methodologies that can be used to assess and control hazards that can be successfully used in a research laboratory. (www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/identifying-and-evaluating-hazards-in-research-laboratories.pdf)
3. *Hazard Assessment in Research Laboratories*, ACS Committee on Chemical Safety, Washington, DC. An on-line resource that helps with the identification of hazards, the assessment of risk, and selection of appropriate control measures to eliminate a hazard or reduce the risk of accident or injury. (www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-safety-guidelines-academic.pdf?logActivity=true)

Support for Development of Chemical Safety Information Skills

The CPT guidelines identify "chemical information skills" and "laboratory safety skills" as key elements in an undergraduate chemistry education. Recent collaborations between the ACS Divisions of Chemical Information and Chemical Health and Safety have helped identify teaching strategies that support the co-development of such skills in the chemistry curriculum. Three skills of particular importance in this respect are:

1. collecting relevant chemical safety information,
2. assessing the strength of this information as applied to a specific chemical process, and
3. documenting these decisions in their laboratory notebooks.

Specific examples of how this strategy can be implemented in an undergraduate setting can be found in two recent articles:

- **Development of an Undergraduate Course in Chemical Laboratory Safety through an Academic/Industrial Collaboration in the Journal of Chemical Education.** https://pubs.acs.org/doi/10.1021/acs.jchemed.7b00599
- **Teaching Chemical Safety and Information Skills Using Risk Assessment, in the 2016 ACS Symposium Series volume on integrating Information Literacy into the Chemistry Curriculum.** https://pubs.acs.org/doi/10.1021/bk-2016-1232.ch003 (Resources: http://hdl.handle.net/1813/44781)

In addition to the resources cited in these articles, the ACS Committee on Chemical Safety has developed a variety of other safety information resources, including education guidelines for chemical laboratory safety for both the secondary school and higher education settings. Safety information specifically written for students in the first two years of undergraduate chemistry can be found in the newest edition of *Safety in the Academic Chemistry Laboratory* (http://www.acs.org/sacl) These documents, along with many other safety educational resources, are available at the ACS's safety website, http://www.acs.org/safety. This site continues to evolve, so if you find opportunities for improving the chemical safety information resources you find there, please let us know at safety@acs.org. CPT

Ralph Stuart, Chair, *ACS Committee on Chemical Safety*
Leah McEwen, member, *ACS Committee on Chemical Safety*

Professional Development for Graduate Students and Postdocs

Since the release of the 2012 ACS Presidential Commission report on "Advancing Graduate Education in the Chemical Sciences," which provided additional evidence that current graduate education models do not provide sufficient preparation for student's careers, the ACS Graduate & Postdoctoral Scholars Office (GPSO) has created several career and professional development tools and workshops accessible to both graduate students and postdocs.

GPSO provides the following:

1. ChemIDP (FREE Online Tool)
   Launched in 2015, and with more than 3,000 users, ChemIDP is an Individual Development Plan tool designed specifically for graduate students and postdoctoral scholars in the chemical sciences. Through immersive, self-paced activities, users identify career goals, determine specific skills needed for success, and develop a plan to achieve their professional goals. ChemIDP helps users track their progress and provides tips and strategies for realizing your goals. If you are interested in bringing a workshop to your campus please contact ChemIDP@acs.org and follow us on twitter @ACSChemidp.

2. Preparing for Life After Graduate School Workshops
   The Preparing for Life After Graduate School Workshop is a two-day career development workshop designed to teach graduate students and postdocs about career options and how to prepare for them. Chemistry departments are encouraged to host this event so that, in two days, graduate students and postdocs can receive the necessary knowledge and tools that would otherwise require weeks of individual effort to obtain. The workshop addresses the following:

   - Examining careers for Ph.D. chemists
   - Knowing critical non-technical skills
   - Finding employment opportunities
   - Preparing for academic positions
   - Putting it into Practice

   To bring this workshop to your department, see www.acs.org/gradworkshop or contact GradEd@acs.org; 202-833-7707.

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

Preparing for Careers in Academia

3. Postdoc to Faculty Workshop (P2F)
   A workshop for postdocs interested in a career as a faculty member. This workshop will:

   - Compare and contrast positions and expectations in undergraduate and graduate chemistry departments
   - Provide assistance with and feedback on teaching philosophies and research statements
   - Present strategies for balancing scholarship, teaching, and service expectations with life outside academia
   - Create a network of early-career faculty along with mentors, who can guide newly-minted faculty members
   - Introduce interactive teaching models and provide resources to facilitate their incorporation

4. Postdoc to PUI Professor Workshop (P3)
   This workshop prepares postdocs for faculty careers in primarily undergraduate institutions (PUIs), including Private Liberal Arts Colleges, Comprehensive State Universities, and Two-Year Colleges. Workshop facilitators from these institutions will focus on the following topics:

   - Teaching, Research, and Service
   - Modern Pedagogies & Assessment
   - Interdisciplinary Science Initiatives
   - Writing grant proposals
   - Publishing your work
   - The Academic Job Search, Crafting an Application
   - Personalized Review of Application Materials
   - Interviews, Offers, and Negotiations
   - Surviving and Thriving – The First Year and the Tenure Process

5. The Graduate and Postdoctoral Chemist Magazine
   The Graduate & Postdoctoral Chemist focuses on career advice, science news, awards, fellowships, and general topics related to graduate student and postdoc life.

For more information on the P2F and P3 workshops please contact us at postdoc@acs.org CPT

Announcements

Changes in CPT Membership

In 2018, three new associate members were appointed to CPT:

- **Dr. Gregory A. Caputo**, Professor, Department of Chemistry and Biochemistry, Rowan University
- **Dr. Nestor M. Carballeira**, Professor, Department of Chemistry, University of Puerto Rico, Rio Piedra
- **Dr. Barbara A. Reisner**, Professor, Department of Chemistry and Biochemistry, James Madison University

Two members of CPT, Dr. **Suzanne Harris** and **Dr. Thomas J. Magliery, had appoint**ments that ended in 2017. We would like to thank them both for their many contributions to supporting excellence in undergraduate education in chemistry.

Congratulations!

Congratulations to the following schools on their newly ACS-approved bachelor's degree programs in chemistry:

Augusta University
Radford University
University of Incarnate Word
University of Virginia-Wise

The current number of ACS-approved programs is 692.

CPT Open Meeting

We invite you to attend the CPT open meeting at the 256th ACS National Meeting in Boston, Massachusetts, from 4:00 to 5:00pm on Sunday, August 19, 2018. The location is not yet available. Please check the CPT website (www.acs.org/cpt) later for details.

Thank You! Visiting Associates

We would like to express our appreciation for the contributions of Visiting Associates to the approval process during 2017. These volunteers play a critical role in the evaluation of programs that are applying for ACS approval.

Samuel Abrash – University of Richmond
Gary Brudvig – Yale University
Ron Christensen – Bowdoin College
Cheryl Frech – University of Central Oklahoma
Kimberly Frederick – Skidmore College
Tim Hanks – Furman University
Mary Hatcher-Skeers – Claremont College

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The ACS has recently hired **Michelle M. Brooks,** as Senior Portfolio Manager to lead the team that oversees the undergraduate chemistry approval program and to work with the ACS Committee on Professional Training (CPT), bringing over 15 years of experience in undergraduate education . Michelle received her Bachelor's degree in biochemistry from Eastern Michigan University and her Ph.D. in biophysical chemistry from Michigan State University (Gerald Babcock/John McCracken) where she studied the molecular orbital structure of radicals involved in photosynthetic processes by using electron magnetic resonance spectroscopy. As an NIH postdoctoral fellow at Columbia University (Ann McDermott), she studied chemically induced dynamic polarization by using solid state NMR. Michelle comes to the ACS from the University of Maryland, College Park where she was the Associate Director of the Biological Sciences Graduate Program since its inception in 2010. In this position, she developed a data management system for graduate programs, taught a "Science Teaching" course for graduate students, developed an outcome assessment plan for the graduate program, and managed a blog and social media campaign for graduate student career development. Michelle is enthusiastic about working with the team at ACS "to develop a more streamlined process for institutions seeking approval and to work with CPT on creating supporting materials that promote best practices for undergraduate chemistry education." One of the ways that she would like to accomplish this is through more engagement and communication with the community.

Help your students plan their career with ACS's new career planning tool ChemIDP™

ChemIDP™ (ChemIDP.org) is a new and free career planning tool designed for graduate students and postdoctoral scholars in the chemical sciences to help them achieve their professional goals. Through immersive, self-paced activities, **ChemIDP™** helps users self-assess, strengthen their skills, plan goals, and develop a plan that identifies their career objectives. If you are interested in bringing a workshop to your campus please contact ChemIDP@acs.org and follow us on twitter @ACSChemidp.

Visiting Associates, *continued*

Cora MacBeth – Emory University
Mark Marshall – Amherst College
Gary Miessler – Saint Olaf College
Jeanne Pemberton – University of Arizona
Jeff Roberts – Purdue University

ACS Approval Workshop

We invite representatives from any institution interested in obtaining ACS approval to a workshop to learn more about the overall process. The workshop will be held at the 256th ACS National Meeting in Boston, Massachusetts from 2:30 to 3:30pm on Sunday, August 19, 2018. The location is not yet available. Please check the CPT website (www.acs.org/cpt) for additional details.

Certificates Available for ACS-Certified Graduates

The head or chair of ACS-approved chemistry programs presents ACS certificates to students that receive a baccalaureate degree and complete a curriculum consistent with the ACS Guidelines. If you would like to have certificates available for presentation to your graduates, please contact the Office of Professional Training at cpt@acs.org. CPT

Preparing fo Life After Graduate School: A Career Develpoment 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; 202-833-7707.**

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

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ACS Committee on Professional Training 2018

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