ACS Chemistry for Life™

CPT
Committee on Professional Training

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ACS Guidelines Revision

Inside This Issue...

Over the past year, the ACS Committee on Professional Training (CPT) has been exploring possible revisions to the ACS Guidelines for Approved Bachelor's Degree Programs (the Guidelines). In the previous edition of this newsletter, we reported on some of the directions the revisions could take. Since January 2013, the Committee has developed a list of proposed changes that might take effect in this revision. A white paper describing these changes was circulated to department chairs and other members of the community in February 2013. It can be accessed at the CPT webpage (www.acs.org/cpt). We expect the revised Guidelines to be adopted in 2014.

During the spring 2013 ACS national meeting in New Orleans, CPT hosted an open meeting and ran a symposium. The focus of both activities was on the Guidelines revisions, and on generating discussion of some of the proposed changes. More than 90 individuals participated in each of the two events and both generated excellent feedback on the proposed revisions. Some of the items that were discussed, and the input that we received are summarized below:

Increasing the minimum size of the faculty of an approved program from four to five: This is a suggestion that was also proposed as part of the 2008 revision process. In the end it was not incorporated, but the Committee wanted to explore this possible change as we find that many of the small departments (approximately 30 of the 669 approved programs along with many non-approved programs that are seeking approval currently have four chemistry faculty) struggle to offer an approved curriculum at their current staffing level. If this change were to be implemented, programs would have until 2025 to bring their faculty complement up to this minimum number. Interestingly, the most vocal concerns about this change came from individuals who were either at PhD-granting programs or hold jobs in industry. The source of the concern is the challenge of increasing the size of a faculty during challenging economic times. Individuals from smaller programs were generally supportive of the change, recognizing the difficulty in providing an approved curriculum in small departments. It is unclear if many individuals from departments with four or five faculty members were able to participate in these sessions, and we would be interested in learning about the implications of such a change on both currently approved programs and programs that are considering applying for approval.

Modifying contact hour maxima: In the 2008 Guidelines, individual faculty members may teach up to fifteen contact hours per week, with some flexibility for averaging. Specifically, up to two members of the faculty may teach as many as 17 contact hours per week in one semester (or quarter), so long as their average over two semesters (or 3 quarters) does not exceed 15 contact hours per week. CPT has proposed increasing the maximum deviation from fifteen from 17 to 18 contact hours, and allowing individuals whose primary teaching responsibility is in the laboratory to teach up to 18 contact hours per week in each semester. The response to this was mixed. The greater flexibility makes it easier for programs to be in compliance with the Guidelines. On the other hand, increasing the number of contact hours raised the concern that there would be pressure to hire more non-tenure track faculty to teach the lab courses. Some individuals were also concerned that

allowing individuals who teach primarily laboratory courses to teach more contact hours than those whose primary responsibility is in non-laboratory courses devalues the importance of the laboratory in an approved curriculum.

Integration of modern topics in chemistry into the courses taken for certification: The Committee encourages departments to integrate modern topics in chemistry both in the foundation and in-depth experiences. In-depth courses that fall outside of or integrate the traditional subdisciplines are encouraged. There are a broad range of such topics. Ones that the Committee has received directed feedback on include green/sustainable chemistry and polymer chemistry. Other areas include astrochemistry, computational chemistry, nanochemistry, toxicology, or topics that cut across two or more subdisciplines, for example, bioanalytical chemistry. The Committee has been receiving directed feedback that the revised Guidelines should include a requirement that topics involving macromolecular structure and polymers be included in the curriculum taken by an approved major. The Committee recognizes the importance of exposure to modern topics but traditionally has avoided prescribing specific content in the curriculum. The Committee is continuing to discuss whether there are specific areas outside the five subdisciplines (analytical, biochemistry, inorganic, organic, and physical) that all certified majors should be exposed to, or if such decisions should be left to individual programs.

Refining the Instrumentation Requirements: The Committee is considering modifying the instrumentation requirements in two ways. First, we are considering allowing ready and stable remote access to NMR to fulfill the requirement that students be exposed to NMR. We are also thinking of broadening the list of required instrumentation to include at least representative instruments in several categories. Complete details can be found in the white paper. In the discussion it was made clear that eliminating the requirement of a local NMR would make it harder for some programs to obtain the institutional support to maintain an NMR. On the other hand, with the increased cost of cryogens, maintenance of a high-field NMR is becoming difficult. A second factor that was mentioned was the availability of desktop NMRs that might be able to satisfy some (but not all) of the teaching needs of programs, although such instruments would not address research needs. Likewise, the broader description of required instrumentation met a mixed reaction. On the positive side, such a requirement would aid programs in obtaining the institutional support to obtain and maintain such a suite. On the other hand, for smaller programs where much of the instrument maintenance falls on the faculty, the requirement that they have more instrumentation to remain approved corresponds to additional faculty efforts spent on care and upkeep of instrumentation. This could adversely affect the time available for professional development.

Introduction of a Capstone Experience: One significant curricular change that has been suggested as part of the revision of the Guidelines is the introduction of a capstone experience. Such an experience could take the form of undergraduate research, a stand-alone course, an in-depth laboratory experience, or activities such as mentored teaching or peer instruction. The goal of this experience is to provide an opportunity for students to synthesize the knowledge and experiences they gain during their undergraduate experiences into a single overarching experience. While there seemed to be general support for the idea in principle, there were some concerns about how it would be implemented. Many of these concerns revolved around equating the capstone experience either with a new course or with undergraduate research. Both of these would require additional time and effort on the part of the faculty.

Challenges with transfers: One of the important changes in the 2008 Guidelines compared to earlier versions was the introduction of requirements around student skill development. The proposed revisions include strengthening these requirements of programs. This can be challenging for transfer students as programs have much less control over skill development at other institutions.

The Committee thanks everyone who participated in the open meeting and/or the symposium as well as everyone who has sent us comments. We are interested in how all of the proposed changes to the Guidelines would affect approved programs. We are particularly interested in learning about which suggestions would help your program improve its ability to educate professional chemists and which suggestions could lead to unintended challenges for some approved programs. We encourage you to write to us at cpt@acs.org with any comments regarding the proposed revisions. The Committee will also be hosting another open meeting on Sunday, September 8, from noon to 1:30pm at the ACS national meeting in Indianapolis. The meeting will be held in the Indianapolis Marriott Downtown Hotel, and a light lunch will be served. ■

CHEMISTRY IN THE PREMEDICAL CURRICULUM: Considering the Options

In 2009, the Association of American Medical Colleges (AAMC) and the Howard Hughes Medical Institute (HHMI) released a report entitled Scientific Foundations for Future Physicians (SFFP: see http://www.hhmi.org/grants/pdf/08-209_AAMC-HHMI_report.pdf). This report, produced in response to "concerns about the science content in the current premedical and medical education curricula," emphasizes competencies for premed students rather than mandating specific courses for admission to medical school.

One result of SFFP is a major revision of the Medical College Admission Test by the AAMC, to be released in 2015 (MCAT2015). Another result is the funding by HHMI of an Experimental Collaboration (termed NEXUS) among four universities to develop innovations in their science offerings for premed students.

SFFP presents both opportunities and challenges for the chemistry community. In order to advise and coordinate ACS efforts related to this report, a Task Force comprised of members of the Committee on Professional Training (CPT) and the Society Committee on Education has developed information on approaches being introduced by chemistry programs to better meet the needs of pre-professional students, particularly around the teaching of general and organic chemistry. These approaches were the subject of two Chemistry in the Premedical Curriculum symposia in 2012: at the Biennial Conference on Chemical Education (http://portal.acs.org/portal/PublicWebSite/about/governance/committees/training/symposia/CNBP_030466); and at the 244th National Meeting of the ACS (http://presentations.acs.org/common/presentations.aspx/Fall2012/CHED/CHED019).

Among other topics, these symposia discussed five approaches to covering the chemistry that is expected to be incorporated into MCAT2015. Briefly, these include*:

- Traditional approach of one year each of general chemistry and organic chemistry. In this case, emphasizing the biological relevance of chemistry in both years is encouraged.
- 1-2-1 approach: One semester of general chemistry, two of organic, followed by one of biochemistry. This approach, with each course tied to the SFFP competencies, is the subject of an HHMI NEXUS grant to Purdue University.
- Two different second-semester organic courses. Following a common first-semester organic course for all students, two different second-semester courses can be offered: Bioorganic for premed and other biologically oriented students, and Mechanism and Synthesis for other students.
- Organic first. A "biologically flavored" organic chemistry course containing general-chemistry concepts is taught to first-year students, followed by an additional course(s) covering further chemistry concepts.
- Fully integrated foundation courses. Some programs are taking advantage of the flexibility provided to the chemistry curriculum by the 2008 ACS Guidelines for Undergraduate Professional Education in Chemistry (www.acs.org/cpt) to develop a new freshman/sophomore four-semester sequence which integrates structure and reactivity in organic, inorganic, and biochemistry and coordinates to the SFFP/MCAT2015 competencies.

The Task Force will provide additional information as implications of MCAT2015 become clearer.

* CPT does not favor any one of these approaches over another. All can meet ACS Guidelines as long as the five foundational areas of chemistry (analytical, biochemistry, inorganic, organic, and physical) are adequately covered in the curriculum.

AN INTERVIEW WITH JOE FRANCISCO:
The Globalization of Chemistry

The following represents the opinions of Dr. Francisco, a member of the Committee on Professional Training but does not represent the opinions of the Committee or as a statement of American Chemical Society policy.

Q As a member of the ACS presidential succession in 2009 through 2011 and a practicing chemist since 1986, what are the biggest changes you have seen in the practice of chemistry?

We have worked on major areas in atmospheric chemistry, both in the measurement and understanding of the fundamental chemical kinetics, and the implications of those measurements to the climate change problem. In this sense, our group has spent years trying to solve issues and tackling important problems that have not been previously addressed. While trying to determine which problems are important, we frequently talk to other investigators around the globe. Our group has made significant progress in combining the results of computational chemistry with experiments in addressing these problems. The two biggest changes I have seen are in the multidisciplinary/interdisciplinary/multi-institutional projects that are occurring, and the speed at which we retrieve information and communicate via the Internet. We see research and production have become increasingly global with the numbers of students, paper submissions, and production from non-US sources on the rise.

Q In your field of atmospheric chemistry, you certainly have collaborators elsewhere. Where are your principal collaborators and contributors to the field? What is the nature of these collaborations?

I have developed collaborations throughout the world. Most of the collaborations have been fruitful as we recognize that each of us has different ways of approaching problems, a feature which strengthens the collaborations as we respect each other's contributions. For this reason, my research group continues to pursue active collaborations with other international groups, particularly as we try to break into new fields.

Q Please describe the nature of your contacts with your collaborators. In what languages would the interactions occur?

When starting a new collaboration, I always prefer to meet face-to-face, and prefer to continue with periodic face-to-face interactions, traveling to Europe every few months to interact with my collaborators. While Internet-mediated communication is certainly both possible and useful, especially for things such as transmitting data or written drafts of materials, it does not allow the body language, syntax of the communication, or context of the information to be communicated. How often have we all been trapped by sarcasm in the context of an email message? Most of the communication is in English. Although I can speak a little bit of a number of languages, the best part of language study is to put the writing style in the context of the culture of the country. The single best way to get around these issues are the spoken word when talking face-to-face.

Q How are your graduate students and post-docs involved with your overseas collaborators?

The graduate students and post-docs in my group frequently suggest other research groups that we should be interacting with based upon their reading of the literature and information searches. One of the things we have noticed with the use of electronic searching is that the element of serendipity is reduced relative to when students just looked through the table of contents in a journal, which we see as unfortunate. When funding allows, we (the students and I) will travel to meet with the other research groups initially.

Q Do you have any advice to undergraduates and their advisors about learning languages/cultures from your experiences?

I have seen data that show that 20% of the academics in the United States have international collaborations, but almost 50% of the industrial chemists do. Clearly, with the percentage of chemists employed in industry, it would be surprising if a student didn't interact internationally. Learning a little about the language and culture of the people you are working with becomes important as a survival skill. While research in the US is still more valued, and possibly more creative, the opportunity and need for these skills still exists. With careful planning the instruments needed to perform the research can be scattered across the globe, reducing the expense for duplicating the equipment.

Announcements

Coming Soon!

2013 ACS Directory of Graduate Research - DGRweb (Searchable Online Database)

We plan to have the 2013 edition of DGRweb available online by September 2013.

DGRweb 2013 provides the most comprehensive information about graduate research and researchers at universities in North America.

Conduct free online searches at www.acs.org/dgrweb.

Congratulations!

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

Columbus State University
Fort Hays State University
United States Military Academy

The current number of ACS-approved programs is 669.

New Polymers Supplement Available!

The requirements for program approval and student certification are described in the Undergraduate Professional Education in Chemistry: ACS Guidelines for Evaluation Procedures for Bachelor's Degree Programs. The Committee on Professional Training also publishes supplements to these guidelines that provide more detailed advice to departments that wish to develop specific aspects of their chemistry program. A new polymers supplement entitled "Polymers Across the Curriculum" has been posted on the CPT web pages at http://www.acs.org/cpt.

Changes in CPT Membership

In 2013, two new members were appointed to CPT: Dr. Kerry K. Karukstis and Dr. Christopher R. Meyer. Dr. Karukstis is a Professor in the Department of Chemistry at Harvey Mudd College. Dr. Meyer is a Professor in the Department of Chemistry and Biochemistry at California State University, Fullerton.

CPT Open Meeting

We invite you to attend the CPT open meeting at the 246th ACS National Meeting in Indianapolis on Sunday, September 8, 2013, from noon to 1:30pm in the Indianapolis Marriott Downtown Hotel. Discussion will focus on the proposed changes to the guidelines for ACS approval. Light lunch will be served.

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.

ACS Committee on Professional Training 2013

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Final Report on the Results of the CPT Survey on the Impact of the 2008 ACS Guidelines

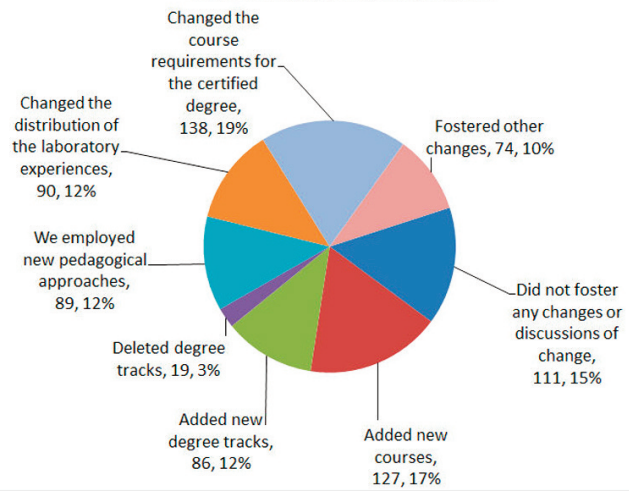
In 2008, the ACS Committee on Professional Training (CPT) released new Guidelines for approval of bachelor's degree programs. In many ways, the 2008 iteration represented a significant departure from previous versions: the Guidelines were simplified; greater responsibility was placed on approved programs for curricular development and oversight; departments were given some flexibility with respect to faculty teaching loads; and greater emphasis was placed on the development of student skills.

As part of its purview, the CPT is charged with ensuring that the approval process, through the Guidelines, continues to promote program excellence and to provide a pathway for development of competent chemistry professionals. To this end, the CPT regularly gathers feedback from the broad chemistry community on the effectiveness of the Guidelines. This feedback informs Committee deliberations on which aspects of the Guidelines need to be preserved, modified, enhanced, or eliminated. In spring 2012, the CPT conducted such a survey on the impact of the 2008 Guidelines. The survey was administered to all ACS-approved programs; 427 programs participated in the survey (a 64% response rate). Of these, 234 granted a bachelor's as the highest degree in chemistry, 69 were master's, and 124 were PhD-granting. The complete results of the survey will be available at www.acs.org/cpt; below is a short summary of the major findings from the responding programs.

Curricular changes initiated as a result of the 2008 ACS Guidelines.

The vast majority, 85%, of responding programs reported making some changes as a result of the 2008 Guidelines. Between 10% and 20% of them indicated that they had made at least one of the following

Fig. 1 How have the 2008 ACS Guidelines fostered guideline-related curricular change(s) or discussion of such change(s) in your program



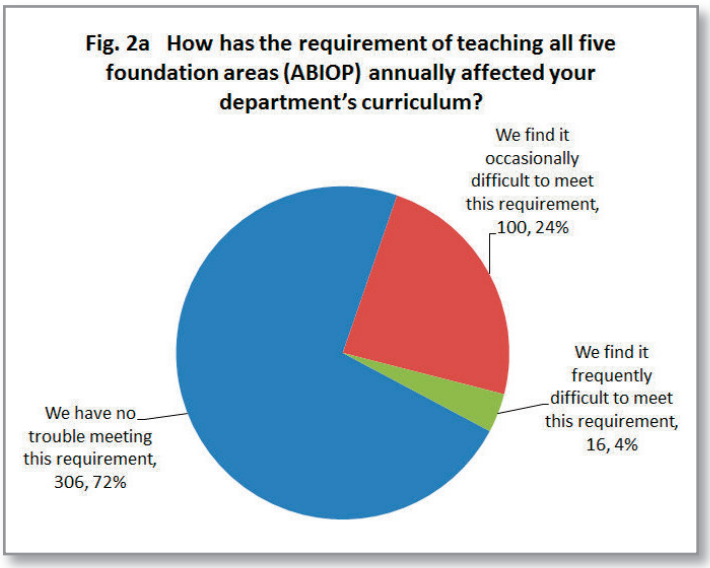


Fig. 2a How has the requirement of teaching all five foundation areas (ABIOP) annually affected your department's curriculum?

curricular adjustments: introduction of new pedagogies, new degree tracks, and/or courses, or changed the course requirements for certification. Of the responding programs, only 5% changed the distribution of laboratory courses; in most (83%) of these, integrated labs were added. Of the 2% of respondents who dropped a traditional laboratory area, 57% dropped biochemistry.

Interestingly, only 4% of responding programs indicated that they had replaced the traditional two-semester organic sequence with a one-semester comprehensive foundation course for at least one degree track leading to certification. Roughly a quarter of that number had done the same for the physical chemistry sequence. Of reporting schools, 1-3% are considering making these changes. Sixty-three percent of reporting schools have not developed any non-traditional in-depth courses, and 32% have done so but with no changes in the foundation courses. Of the 5% that developed non-traditional courses requiring changes in the foundation courses, they responded almost equally by increasing or decreasing the content in foundation course(s), and adding a foundation course. The foundation area most affected by these changes was inorganic chemistry (29%). The other areas were roughly equally affected (16 - 21%).

Annual teaching of foundation and in-depth courses.

72% of reporting schools have no difficulty teaching the foundation courses (ABIOP: analytical, biochemistry, inorganic, organic, physical) annually, 24% find it occasionally difficult, and only 4% of reporting schools struggle frequently with this requirement. Only 9% of reporting schools made significant curricular changes to meet this requirement and, of these, only 14% considered the changes a negative. The majority (78%) considered the changes a positive. The impact of teaching the required four semester-long (or six quarter-long) in-depth courses annually mirrors that of the foundation courses: 68% of reporting schools meet it without difficulty; 29% find it occasionally difficult; and as with the ABIOP foundation courses, only 3% of reporting schools struggle frequently with this requirement. Only 6% of reporting schools made significant curricular changes to meet this requirement, and of these, only 12% considered the changes a negative. The majority (64%) considered the changes a positive.

In order to meet the requirement of teaching the in-depth courses as prescribed, programs reported five common strategies:

- courses were combined
- courses (typically in biochemistry or physical chemistry) were added or modified
- the foreign language requirement was eliminated
- lab hours were reduced
- lecture components (particularly inorganic and analytical) were added to labs (especially Instrumental)

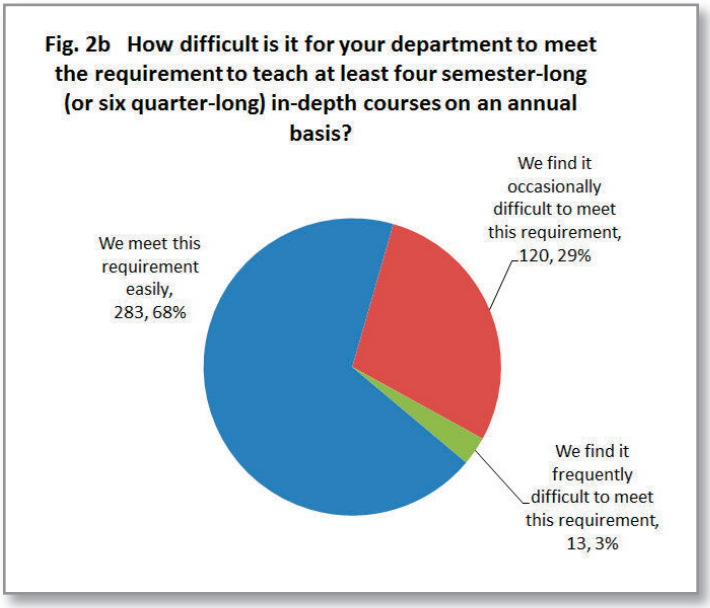
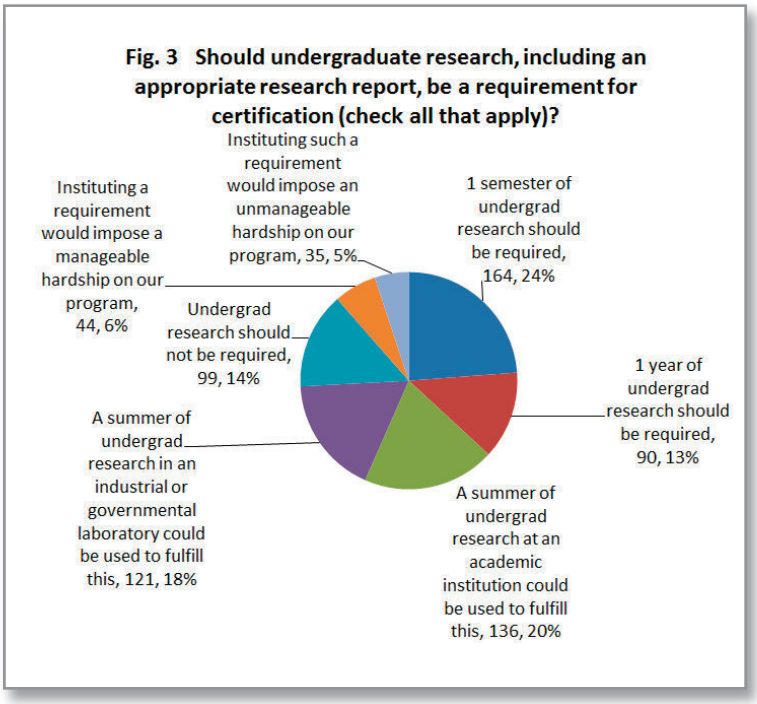


Fig. 2b How difficult is it for your department to meet the requirement to teach at least four semester-long (or six quarter-long) in-depth courses on an annual basis?

The lone problem encountered with this requirement is a lack of administrative support for low-enrollment course offerings. Some reporting schools indicated that the lack



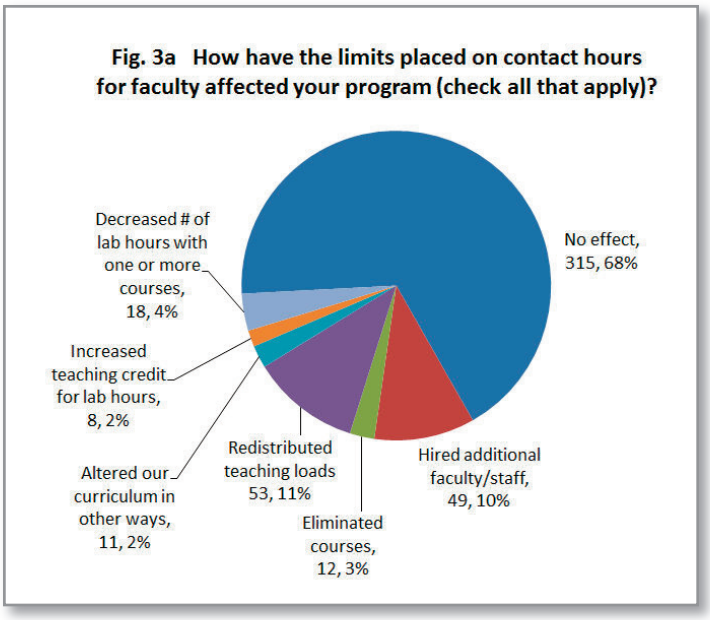
Online access and virtual courses.

Eighty-eight percent of reporting programs indicated that it is important for their undergraduates to be able to perform online structure searches. Having faculty access to online structure searches is important to 95% of the programs. Five percent of programs reported that they offer lab courses that are largely or exclusively virtual; of these programs, 80% offer virtual labs at the introductory level and 10% each do so at the foundation and in-depth levels. Thirty-eight percent of programs responded that they offer courses that are largely or exclusively online, 11% offer them at the introductory level, 2% at the foundation level, and 1% at the in-depth level. As many as 11% of responding programs were unaware if transfer students have virtual lab experiences upon matriculation; 2% are mandated to accept the credits for virtual labs, and 5% have discretion to accept such courses.

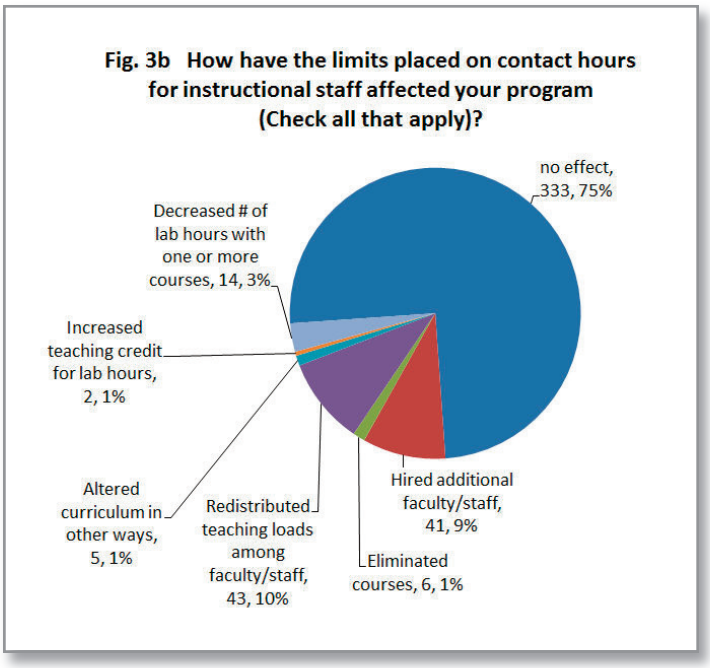
of explicit statements in the Guidelines allowing schools the flexibility to cycle courses (even though students can still complete the curriculum in four years) jeopardizes their ability to maintain approval.

Undergraduate research.

Of reporting programs, 33% require research in at least one degree track, and 35% require it for certification. Of those that do not require research for certification, 20% allow it to be used for lab hours, while 12% allow it to be used for in-depth hours. Only 2% of reporting programs considered as a negative the option of counting as many as 180 hours of research toward the requisite 400 lab hours beyond general chemistry. Fifty-four percent of reporting programs said this requirement had no impact on their course offerings. In 17% of reporting schools, the research component has been increased significantly. Seventy-five percent of respondents expressed the belief that undergraduate research should be required for certification; 24% indicated that at least one semester should be required, while 13% indicated that one year should be required. Fourteen percent of programs reported that they do not believe that undergraduate research should be required for a certified degree. If undergraduate research were required, 6% would find it a manageable hardship, but 5% would find it an unmanageable one.



When asked what role virtual labs should play in the undergraduate curriculum, 43% felt it should play no role, and 53% suggested they play a limited supplementary role to existing laboratory instruction. While 3% and 1% of respondents saw virtual labs as sufficient replacements for introductory and foundation labs, respectively, essentially none felt that they were appropriate replacements for in-depth labs. With respect to online chemistry lecture courses, 62% of respondents



do not offer such courses, and 57% consider them as inappropriate at any level. Of those that do, 11%, 2% and 1% offer online courses at the introductory, foundation and in-depth levels, respectively. As many as 25% of responding programs considered online courses as appropriate if limited to introductory courses, and 9% were in favor of them for introductory and foundation courses only. Just 7% believed they were appropriate throughout the undergraduate curriculum. Interestingly, roughly 84% of respondents felt that the Guidelines should contain a clear statement on the use of virtual labs and online lectures.

Program excellence, rigor, and flexibility.

Of responding programs, only 3% felt that the 2008 Guidelines precipitated a decrease in program excellence, and 4% believed that rigor suffered as a result of the changes. Interestingly, 8% felt that program flexibility fell. 16%, 20% and 39%, respectively of respondents thought that program excellence, rigor, and flexibility increased as a result of the 2008 Guidelines.

Faculty contact hours.

The option of allowing up to two faculty or instructional staff to carry as many as 17 contact hours in a given term with averaging to 15 hours for each individual for the academic year was viewed as a negative by 5% of respondents; 45% considered it as positive. Of responding programs, 36% have or may take advantage of the flexibility. However, for 9% of programs, the limits are still difficult to meet even with the added flexibility. The most common (~10%) program strategies to accommodating the limits on faculty and instructional staff are the redistribution of teaching loads among faculty/instructional staff and the hiring of additional personnel. Less common strategies include:

- decreasing the number of lab hours associated with at least one course (3%)
- increasing the teaching credit for lab hours (1%)
- course elimination (1%)

The CPT wishes to express its sincere gratitude to responding programs for their thoughtful and timely feedback. Because of these results, as well as input from across academia, industry, and within the ACS, we are in the process of once again revising the Guidelines (see the CPT white paper at www.acs.org/cpt). These revisions, slated for release in 2014, are expected to be adjustments rather than dramatic departures from the 2008 Guidelines. For an update on the status of the revision process, please see the article on page 1 in the Summer 2013 issue of the CPT Newsletter. Readers are encouraged to voice comments on the proposed revisions to cpt@acs.org. ■