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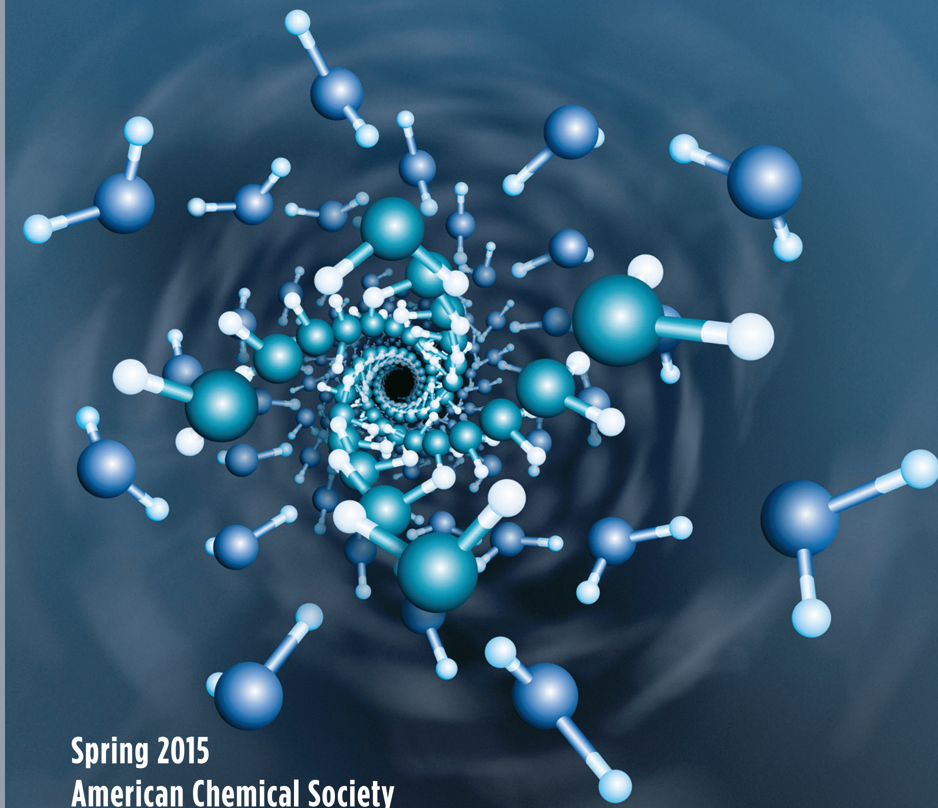
ACS
Chemistry for Life®

Undergraduate Professional Education in Chemistry

ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs



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ACS recognizes that the chemistry program would make appropriate accommodations for students with temporary or permanent disabilities to allow them to complete degree and certification requirements.

Disclaimer

The evaluation and reevaluation of undergraduate chemistry programs by the American Chemical Society (ACS) and the ACS Committee on Professional Training are undertaken with the objective of improving the standards and quality of chemistry education in America. The following ACS guidelines for evaluating and reevaluating undergraduate chemistry programs have been developed from sources believed to be reliable and to represent the most knowledgeable viewpoints available with regard to chemistry education. No warranty, guarantee, or other form of representation is made by ACS or ACS's Committee on Professional Training or by any of its members with respect to any aspect of the evaluation, reevaluation, approval, or disapproval of any undergraduate chemistry program. ACS and the ACS Committee on Professional Training hereby expressly disclaim any and all responsibility and liability with respect to the use of these guidelines for any purposes. This disclaimer applies to any liability that is or may be incurred by or on behalf of the institutions that adopt these guidelines; the faculties, students, or prospective students of those institutions; and any member of the public at large; and includes, but is not limited to, a full disclaimer as to any liability that may be incurred with respect to possible inadequate safety procedures taken by any institution.

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I. GUIDELINES FOR PROGRAM APPROVAL AND STUDENT CERTIFICATION

1. Goals of Program Approval and Student Certification

Chemistry is central to intellectual and technological advances in many areas of science. The traditional boundaries between chemistry subdisciplines are blurring, and chemistry increasingly overlaps with other sciences. Unchanged, however, is the molecular perspective that lies at the heart of chemistry. Chemistry programs have the responsibility to communicate this molecular view to their students and to teach the skills necessary for their students to apply this perspective.

The American Chemical Society (ACS) promotes excellence in chemistry education for undergraduate students through approval of baccalaureate chemistry programs. ACS has charged the Committee on Professional Training (CPT) with the development and administration of guidelines for this purpose. ***ACS, through CPT, approves chemistry programs*** meeting the ACS guidelines. Approved programs offer their students a broad-based and rigorous chemistry education that provides them with the intellectual, experimental, and communication skills necessary to become successful scientific professionals. Offering such a rigorous program requires an energetic and accomplished faculty, a modern and well-maintained infrastructure, and a coherent chemistry curriculum that develops content knowledge and broader skills through the utilization of effective pedagogical approaches. ACS recognizes that the diversity of institutions and students is a strength in higher education. Thus, these guidelines provide approved programs with opportunities to develop chemistry degree tracks that are appropriate to the educational missions of their institutions.

ACS authorizes the chair of the ACS-approved program to certify graduating students who complete a bachelor's degree meeting the ACS guidelines. Graduates who attain a certified degree must complete requirements that may in fact exceed those of the degree-granting institution, but this comprehensive undergraduate experience provides an excellent foundation for a career in the molecular sciences. An ACS-certified degree signifies that a student has completed an integrated, rigorous program including introductory and foundational course work in chemistry and in-depth course work in chemistry or chemistry-related fields. The certified degree also emphasizes laboratory experience and the development of professional skills needed to be an effective chemist. Certification gives a student an identity as a chemist and helps in the transition from undergraduate studies to professional studies or employment.

ACS approval publicly recognizes the excellent chemistry education opportunities provided by an institution to its students. It also provides standards for a chemistry curriculum based on broad community expectations that are useful for a program when designing its curriculum or acquiring resources. The approval process provides a mechanism for faculty to evaluate their programs, identify areas of strength and opportunities for change, and leverage support from their institutions and external agencies. Faculty benefit from the commitment to professional development required of approved programs. Students benefit from taking chemistry courses from a program that meets the high standards of ACS approval, and ACS-certified graduates benefit from their broad, rigorous education in chemistry and the recognition associated with their degree.

2. Institutional Environment

An approved chemistry program requires a substantial institutional commitment to an environment that supports long-term excellence. Because the approved program exists in the context of the institutional mission, it must support the needs, career goals, and interests of the institution's students. Competitive policies should be implemented regarding faculty salaries, duties, promotions, and tenure decisions. Similarly, in order to support a viable and sustainable chemistry program, the institutional environment must provide the attributes described in this section.

2.1 Institutional Accreditation. The institution must be accredited by the regional accrediting body. Such accreditation ensures broad institutional support in areas such as mathematics, related sciences, and the humanities.

2.2 Program Organization. The administration of the approved program should rest in a chemistry department organized as an independent unit with control over an adequate budget, faculty selection and promotion, curriculum development, and assignment of teaching responsibilities. If the program is

part of a larger unit, the chemistry faculty must have reasonable autonomy over these functions.

2.3 Program Budget. An approved chemistry program requires continuing and stable financial support. The institution must have the ability and will to make such a commitment at a reasonable level that is consistent with the resources of the institution and its educational mission. Adequate support enables a program to have

- a chemistry faculty with the scientific breadth to offer the educational experiences described in these guidelines,
- nonacademic staff and resources for administrative support services, stockroom administration, and instrument and equipment maintenance,
- a physical plant that meets modern safety standards with adequate waste-handling and disposal facilities,
- resources for capital equipment acquisition and replacement along with the expendable supplies required for high-quality laboratory instruction,
- modern chemical information resources,
- support for maintaining and updating instructional technology,
- research resources for faculty and students,
- personnel support to assist with the acquisition and administration of external funding,
- support for faculty and student travel to professional meetings, and
- opportunities for professional development and scholarly growth by the faculty, including sabbatical leaves.

2.4 Minimum Number of Graduates. Initial and continuing approval requires that the program award an average of at least two chemistry degrees per year during any six-year period. There is no required minimum number of certified graduates.

3. Faculty and Staff

Faculty members are responsible for defining and executing the overall goals of the undergraduate program. The faculty facilitates student learning of content knowledge and development of professional skills that constitute an undergraduate chemistry education. An energetic and accomplished faculty is essential to an excellent undergraduate program. An approved program therefore has mechanisms in place to maintain the professional competence of its faculty, provide faculty development and mentoring opportunities, and provide regular feedback regarding faculty performance.

3.1 Faculty. The faculty of an approved program should have a range of educational backgrounds and the expertise to provide a sustainable, robust, and engaging environment in which to educate students. In addition:

- There must be at least five full-time permanent faculty members wholly committed to the chemistry program. Most vigorous and sustainable approved programs have a larger number. Currently approved programs with fewer than five permanent faculty will have until 2025 to meet this requirement. In cases where faculty contracts are renewed on a regular basis, the individuals in these positions should hold the expectation for both long-term and full-time employment.
- At least 75% of the permanent chemistry faculty members must hold the Ph.D. or an equivalent research degree.

The collective expertise of the faculty should reflect the breadth of the major areas of modern chemistry. Because faculty members serve as important professional role models, an ACS-approved program should have a faculty that is diverse in gender, race, and ethnic background.

3.2 Adjunct, Temporary, and Part-Time Faculty. Courses leading to student certification in an approved program should be taught by permanent faculty. Programs may occasionally engage highly qualified individuals outside the regular faculty to deliver special courses or to replace permanent faculty members who are on sabbatical or other leaves of absence. The Committee strongly discourages excessive reliance on temporary or part-time faculty by an ACS-approved program and carefully reviews such situations.

3.3 Teaching Contact Hours. Contact hours are the actual time spent by faculty and instructional staff in the direct supervision of students in a classroom (face-to-face or online) or laboratory. Online activities that are developed as substitutes for classroom instruction should be assigned at least the same contact hour value as equivalent face-to-face classroom experiences. The institution's policies about teaching contact hours should provide all faculty and instructional staff adequate time for professional development, regular curriculum assessment and improvement, contact with

students outside of class, and when appropriate, supervision of research. For the purpose of these guidelines, the following two groups of faculty and instructional staff are identified, based on their teaching responsibilities:

Group A. For faculty and instructional staff who teach only in the classroom or in both the classroom and laboratory, the number of contact hours *must not exceed 15 total hours per week.* Fifteen contact hours is an upper limit, and a significantly smaller number should be the normal teaching obligation, particularly for faculty supervising undergraduate research.

Group B. For faculty and instructional staff who teach exclusively laboratory courses, the number of contact hours *must not exceed 16 total hours per week.*

In any given academic year, exceptions may be made for up to two individuals in Group A and two individuals in Group B above, provided that:

- The average for each individual in Group A does not exceed 15 contact hours per week during the academic year and the average for each individual in Group B does not exceed 16 contact hours per week.
- The maximum for each individual does not exceed 18 contact hours in any semester or quarter.
- The maximum contact hours for each individual are exceeded in only one quarter or semester of the academic year.

3.4 Professional Development. Institutional policies and practices should provide opportunity and resources for scholarly activities that allow faculty and instructional staff to stay current in both their research specialties and modern pedagogy in order to teach most effectively.

- The institution should provide opportunities for renewal and professional development through sabbaticals, participation in professional meetings, and other professional activities. Faculty and instructional staff should use these opportunities for improvement of instructional and research programs. Institutions should provide resources to ensure program continuity during sabbaticals and other leaves.
- Excellent programs provide formal mechanisms by which established faculty mentor junior colleagues. Proper mentoring integrates all members of the faculty and instructional staff into the culture of their particular academic unit, institution, and the chemistry profession, ensuring the stability and vitality of the program.

3.5 Support Staff. A sustainable and robust program requires an adequate number of administrative personnel, stockroom staff, and technical staff, such as instrument technicians, machinists, and chemical hygiene officers. The number of support staff should be sufficient to allow faculty members to devote their time and effort to academic responsibilities and scholarly activities.

3.6 Student Teaching Assistants. The participation of upper-class chemistry undergraduates and graduate students in the instructional program as teaching assistants both helps them reinforce their knowledge of chemistry and provides a greater level of educational support for students they supervise. If undergraduate or graduate students serve as teaching assistants, they must be properly trained and supervised.

4. Infrastructure

A modern and comprehensive infrastructure is essential to a vigorous undergraduate program. Program infrastructure must receive strong institutional support to provide sustainability through inevitable changes in faculty, leadership, and funding levels.

4.1 Physical Plant. An approved program should have classroom, teaching laboratory, research, office, and common space that is safe, modern, well-equipped, and properly maintained.

- Chemistry classrooms and faculty offices should be reasonably close to instructional and research laboratories. Classrooms should adhere to modern standards for lighting, ventilation, and comfort and have proper demonstration facilities, projection capabilities, and internet access.
- Laboratories for research and instruction in the chemical sciences must be suitable for their purpose and must meet applicable government regulations. Properly functioning and appropriate fume hoods, safety showers, eyewashes, first aid kits, and fire extinguishers must be readily available. Construction or renovation of laboratory facilities must conform to Occupational Safety and Health Administration (OSHA), national, and state regulations.
- The number of students supervised by a faculty member or by a teaching assistant in an instructional lab should not exceed 25. Many laboratories require smaller numbers for safe and effective instruction.
- Faculty and student research laboratories should have dedicated facilities appropriate for the type of work conducted in them. These facilities should permit experiments to be maintained for extended periods of time during ongoing research projects.
- The program should have access to support facilities such as machine, electronic, and glass fabrication shops to support both teaching and research.

4.2 Instrumentation. Characterization and analysis of chemical systems require an appropriate suite of modern, high quality, and properly maintained instrumentation and specialized laboratory equipment that are utilized in undergraduate instruction and research.

Approved programs must have a functioning NMR spectrometer on site that undergraduates use. The field strength and capabilities of the NMR instrumentation should support the instructional and research needs of the program. If the on-site instrument does not meet all of the program's research needs, stable arrangements must be made with proximal sites to provide ready access to appropriate NMR instrumentation.

In addition, instruments from at least four of the following five categories must be on site and used by undergraduates:

- optical molecular spectroscopy (e.g., FT-IR, fluorescence, Raman, UV-Vis)
- optical atomic spectroscopy (e.g., atomic absorption, ICP-atomic emission)
- mass spectrometry (e.g., MS, GC-MS, LC-MS)
- chromatography and separations (e.g., GC, GPC, HPLC, ion chromatography, capillary electrophoresis, SEC)
- electrochemistry (e.g., potentiometry, amperometry, coulometry, voltammetry)

Programs must maintain an additional complement of instrumentation that is adequate to support the curriculum, including undergraduate research. For example, programs might have multiple instruments from one or more of the categories listed above or additional supplemental instrumentation, which might include vacuum and inert-atmosphere systems (e.g., Schlenk line, dry box), thermal analysis (e.g., DSC, TGA), x-ray diffraction, or imaging and microscopy methods (e.g., electron microscopy, scanning probe microscopy, confocal microscopy), or biochemical instrumentation (e.g., thermocyclers, centrifuges, gel electrophoretic systems).

In all cases, the institution must maintain the instrumentation in adequate operating condition.

4.3 Computational Capabilities and Software. The ability to compute chemical properties and phenomena complements experimental work by enhancing understanding and providing predictive power. Students should have access to computing facilities and use computational chemistry software.

4.4 Chemical Information Resources. A broad range of the peer-reviewed chemical literature must be readily accessible to both faculty and students.

- An approved program must provide immediate institutional access to no fewer than 14 current and archival, peer-reviewed journals whose subject matter spans the chemical sciences. At least three of the journals must have a general focus (for example, *Science, JACS, Angewandte Chemie International Edition, Chemistry – A European Journal, Chemical Communications,* etc.), and at least one must come from each area of analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical chemistry, and chemistry education. In addition, the library must provide timely access to journal articles that are not available on site by a mechanism such as interlibrary loan or a document delivery service.
- Students must have access to technical databases and other resources that enable development of skills in searching the literature, including structure-based searching, and support research and instructional activities.

4.5 Laboratory Safety Resources. The program must be conducted in a safe environment that is consistent with the following features:

- There must be a written chemical hygiene plan consistent with OSHA and state standards. A mechanism for harmonizing this plan with the teaching and research activities of the program is required for the establishment of a safety culture.

- Laboratory safety plans need to recognize hazards encountered in the instructional and research activities in the program. Common hazards include chemical hazards (health, physical, and environmental), extreme temperatures, high pressures and voltages, ionizing and non-ionizing

radiation, and intense light sources.
- For materials and equipment that present particular hazards, specific standard operating procedures (SOPs) should be developed and incorporated into the chemical hygiene and chemical safety plans of the program.
- Hazardous waste management must be part of the chemical hygiene plan and adhere to institutional, federal, and state regulations regarding hazardous waste management and laboratory safety. This includes maintenance of proper facilities for chemical waste disposal and personnel to address this task.
- Safety information and reference materials, such as Safety Data Sheets, should be accessible from or available in the laboratories.
- Appropriate personal protective equipment must be readily available to students, staff, and faculty.
- Regularly tested and inspected eyewash and shower stations must be located in all laboratories in which such safety devices are mandated.
- Regularly tested and inspected fume hoods must be present in all laboratories that involve the use of potentially hazardous materials.
- The chemistry program must promote a safety culture by coordinating safety inspections of laboratories, receiving and analyzing accident reports, receiving emergency response training and assuring that everyone working in instructional and research laboratories is properly educated on safety issues. The mechanism for promoting a safety culture, which will often include a safety committee or safety officer, should be a collaborative endeavor with the institutional environmental health and safety office (if one exists) and the chemical hygiene officer.

4.6 Support and Resources for Transfer Students. Many students transfer among institutions during their undergraduate education, including those who start their course work at community colleges. Approved programs should be aware of the educational backgrounds and unique challenges facing transfer students. Programs should provide an advisor to assist transfer students with orientation, academic advising, and successful integration into their new institution. They should also engage in activities to encourage and ease transfer student matriculation and provide a vibrant, supportive framework for their success.

5. Curriculum

The curriculum of an approved program provides both a broad background in chemical principles and in-depth study of chemistry or chemistry-related areas that build on this background. These guidelines describe the chemistry curriculum in terms of content and development of student skills. The content areas encompass five of the traditional subdisciplines of chemistry: analytical, biochemistry, inorganic, organic, and physical, and include both small molecules and macromolecules. Student learning progresses from beginner to expert knowledge and comprises introductory, foundation, and in-depth experiences. Beyond the *introductory* chemistry experience, *foundation* experiences provide breadth of coverage across the traditional subdisciplines. Rigorous *in-depth* experiences build upon the foundation. Furthermore, because chemistry is an experimental science, substantial laboratory work is integral to these three levels of experience. Programs have the opportunity to design innovative curricula that meet the needs and interests of their students by defining degree tracks or concentrations requiring specified in-depth course work. The curriculum must also include experiences that develop student skills essential for their effective performance as scientific professionals (see Section 7).

5.1 Content Requirements. To provide students with an intellectual framework that covers the breadth of modern chemistry, the foundation experience of the curriculum must cover the five subdisciplines listed above. Student laboratory experiences must include at least four of the five subdisciplines.

Recognizing that the synthesis, analysis, and physical properties of small molecules give an incomplete picture of the higher order interactions that occur in macromolecular, supramolecular, mesoscale, and nanoscale systems, the principles that govern these systems must be part of the curriculum required for certified graduates. This instruction must cover the preparation, characterization, and physical properties of such systems. At least two of the following four types of systems must be covered: synthetic polymers, biological macromolecules, supramolecular aggregates, meso- or nanoscale materials. Coverage of these topics may be distributed across multiple courses, in which case it should constitute the equivalent of approximately one-fourth of a standard semester course.

5.2 Introductory or General Chemistry. The introductory or general chemistry experience plays a vital role in educating all students. The purpose of

introductory chemistry course work for those students pursuing a degree in chemistry is preparation for the foundation course work. This introduction provides students with basic chemical concepts such as stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics. The diversity of institutions and students requires a variety of approaches for teaching general or introductory chemistry. Possible approaches range from a full-year course to a one-semester course to waiving the introductory course requirement for very well-prepared students. To accommodate all these situations, these guidelines focus on the requirements and characteristics of experiences beyond the introductory level.

To prepare students properly for the foundation laboratories, laboratories in introductory or general chemistry courses must be primarily hands-on, supervised laboratory experiences. Students need to be instructed in basic laboratory skills such as safe practices, keeping a notebook, use of electronic balances and volumetric glassware, preparation of solutions, chemical measurements using pH electrodes and spectrophotometers, data analysis, and report writing.

5.3 Foundation Course Work. Foundation course work provides breadth and lays the groundwork for the in-depth course work. Certified graduates must have instruction equivalent to a one-semester course of at least three semester credit hours in each of the five traditional subdisciplines of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. Programs operating on the quarter system can achieve this breadth with at least eight three-credit one-quarter courses that include the equivalent of at least one quarter of coverage in each of the five areas.

Foundation course work builds on the introductory chemistry experience. Foundation course work uses specialized books or materials that serve as an introduction to each field, rather than a general chemistry textbook. Exam questions should cover concepts in greater detail than in an introductory or general chemistry course. A student completing a foundation course should have mastered the vocabulary, concepts, and skills required to pursue in-depth study in that area.

Some areas, particularly organic and physical chemistry, have traditionally been taught as year-long courses. In these cases, the first-semester course in the sequence can be used as a foundation course and the second-semester course as an in-depth course. Integrated foundation course work may provide exposure to multiple foundation areas of chemistry or a group of topics organized by overarching themes (for example, synthesis, characterization, and reactivity) rather than by the traditional organization of chemistry subdisciplines.

5.4 In-Depth Course Work. The curriculum required for certification must also include a minimum of the equivalent of four one-semester or six one-quarter in-depth courses and correspond to at least 12 semester or 18 quarter credit hours. Because in-depth courses build on prerequisite foundation course work, the goals of in-depth courses are both to integrate topics introduced in the foundation courses and to investigate these topics more thoroughly. Exams and other assignments associated with in-depth courses should require critical thinking and problem-solving skills. The second semester in a two-semester course sequence such as organic or physical chemistry can be considered an in-depth course.

In-depth course work could focus on content that increases a student's understanding of one or more of the foundation areas. It could also include courses that support a specialized degree track (see Section 5.8). One or more of the in-depth courses may be taught in another department, but they must contain significant chemistry or chemistry-related content at a level beyond the foundation. The Committee encourages programs to integrate modern topics in chemistry such as catalysis, environmental chemistry, green/sustainable chemistry, materials science, and toxicology into the in-depth courses.

Laboratory courses provide an important aspect of in-depth course work for certified graduates. In general, associated classroom and laboratory courses (e.g., the second semester of organic chemistry lecture and laboratory) count as a single course in satisfying the requirement for four in-depth courses even if they have separate course numbers. Likewise, a laboratory that represents the first laboratory exposure to a foundational area is not considered an in-depth course. For a laboratory course to be considered as one of the four in-depth courses required for certification, it must represent an advanced laboratory experience that includes the integration of student skills and builds on the foundation laboratory experiences. In-depth laboratory experiences involve experiment design, execution, data analysis, and use of the chemical literature. In these courses, students are typically in the laboratory for at least six hours per week. Such courses may have an accompanying classroom component. No single laboratory or lecture course can be used to satisfy both foundation and in-depth requirements.

5.5 Frequency of Course Offerings. The most effective programs teach five foundation courses annually. Approved programs must teach at least four foundation courses annually, covering at least four of the five foundation areas. For programs on the quarter system, this requirement translates to teaching at least six of eight foundation courses every year. Each foundation course must be taught at least once in any two-year period. If any foundation courses are not taught annually, the program must make arrangements to ensure that students can complete the requirements for certification in four years.

While permanent full-time chemistry faculty usually teach all of the foundation courses, in some cases it may be appropriate to include courses taught by faculty outside the chemistry department. For example, a student might obtain a foundation biochemistry experience through a course taught in a biochemistry or biology department. In cases where course work in one of the foundation areas is taught by another department, the chemistry faculty must teach all of the remaining foundation courses annually.

Because in-depth courses determine the rigor of the undergraduate experience, the chemistry faculty must teach at least four semester-long or six quarter-long in-depth courses annually, exclusive of research. These courses must correspond to at least twelve semester or 18 quarter hours. The frequency of the in-depth course offerings must allow students to complete the requirements for a certified chemistry degree in four years. Although courses taken outside the chemistry program may be used to satisfy an individual student's in-depth course requirements, the program is still required to teach at least four in-depth semester (six quarter-long) courses, as defined in Section 5.4, in each academic year.

5.6 Laboratory Experience. The certified graduate must have 400 hours of laboratory experience beyond the introductory chemistry laboratory. Laboratory course work must cover at least four of the five traditional chemistry subdisciplines and may be distributed between the foundation and in-depth levels. Laboratory course work is an ideal place in the curriculum to develop the student skills described in Section 7. The laboratory experience must include synthesis of molecules, measurement of chemical properties, determination of structures, hands-on experience with modern instrumentation such as that listed in Section 4.2, data analysis, and computational modeling. Laboratory experiences should be designed to teach students to understand the operation and theory of modern instruments and use them to solve chemical problems. In a computational chemistry laboratory experience, the students would be expected to use the same principles of experiment design, execution, and data analysis characteristic of hands-on laboratory experiences. In contrast, virtual laboratory experiences that replace activities that are traditionally performed hands-on cannot be used as part of the 400 laboratory hours.

5.7 Cognate Courses. Certified graduates must complete course work equivalent to two semesters of calculus and two semesters of physics with laboratory. The Committee strongly recommends a calculus-based physics curriculum and study of multivariable calculus, linear algebra, and differential equations.

5.8 Degree Tracks or Concentrations. A degree track used to certify graduates is a specialized, faculty-designed curriculum meeting the foundation, in-depth, and laboratory requirements. Degree tracks offer the opportunity to incorporate emerging areas of chemistry, make use of local expertise, and align with faculty and student interests. The faculty is responsible for defining degree tracks for its program. While the ACS approves chemistry programs, it does not approve specific degree tracks developed by individual chemistry programs. Consequently, if programs develop additional degree tracks, they may certify graduates from these tracks so long as the students meet the requirements for certification.

A degree track can broadly cover the field of chemistry or focus on a specific chemistry subdiscipline or chemistry-related multidisciplinary area. A chemistry degree track might require the second semesters of organic and physical chemistry, along with the equivalent of two semesters of in-depth electives (which can include undergraduate research). More specialized tracks might provide greater depth of instruction focused on a chemistry area such as advanced organic synthesis, computational chemistry, biochemistry, or chemical measurement science. Examples of multidisciplinary tracks include chemical education, chemical physics, environmental chemistry, forensic chemistry, materials science, medicinal chemistry, polymer chemistry, or other specialties. Degree tracks might also require additional courses, either within the chemistry program or offered in another department, which would not count as in-depth courses because they do not have sufficient chemistry content that builds on the foundation course work.

5.9 Pedagogy. An approved program should use effective pedagogies in classroom and laboratory course work. Programs should teach their courses in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles. Additionally, a program should provide opportunities for faculty to maintain their knowledge of effective practices in chemistry education and modern theories of learning and cognition in science. An approved program should regularly review its pedagogical approaches to ensure that they promote student learning and build the skills needed to be an effective professional.

Faculty should incorporate pedagogies that have been shown to be effective in undergraduate chemistry education. Examples include problem- or inquiry-based learning, peer-led instruction, learning communities, and technology-aided instruction such as the use of personal response systems and flipped or hybrid classes. Laboratory work provides a particularly attractive opportunity for inquiry-driven and open-ended investigations that promote independent thinking, critical thinking and reasoning, and a perspective of chemistry as a scientific process of discovery.

5.10 Capstone Experiences. Certified graduates should be provided with an integrative experience that requires them to synthesize the knowledge and skills introduced across the curriculum. Such experiences provide a bridge between the students' academic and future professional activities. These experiences can take many different forms. An important aspect of this integrative experience is the opportunity it provides programs to assess the ability of students to integrate knowledge, use the chemical literature, and demonstrate effective communication skills. Such assessments typically involve some combination of written or oral exams, required presentations, and written reports.

These integrative experiences could be provided in an existing upper-level, designated capstone course (e.g., senior seminar) or distributed among several courses taught in the chemistry department. Typically, a stand-alone capstone course could not be used to fulfill the in-depth course requirement. Mentored teaching also provides an excellent opportunity for students to integrate their knowledge and skills, as does an independent research experience that also requires a research report and presentation of the student's results.

5.11 Online and Virtual Instruction. Classes taught partially or wholly online should provide at least the same skill development and content as the corresponding wholly face-to-face experience. Programs should ensure that students in such courses have adequate access to faculty and instructors and opportunities for collaboration with peers. Faculty contact-hour credit for virtual and online instruction should be at least equivalent to the corresponding classroom experience.

Chemistry is an empirical science that requires the safe and effective physical manipulation of materials, equipment, and instrumentation. This hands-on expertise cannot be developed through virtual laboratory exercises. Virtual labs may supplement hands-on laboratory exercises, but they must not replace them (see also Section 5.6).

6. Undergraduate Research

Undergraduate research allows students to integrate and reinforce chemistry knowledge from their formal course work, develop their scientific and professional skills, and create new scientific knowledge. A vigorous research program is also an effective means of keeping faculty current in their fields and provides a basis for acquiring modern instrumentation. Original research culminating in a comprehensive written report provides an effective means for integrating undergraduate learning experiences and allows students to participate in the advancement of science.

Conducting undergraduate research with a faculty advisor allows the student to draw on faculty expertise and encourages a student-faculty mentor relationship. The research project should be envisioned as a component of a publication in a peer-reviewed journal. It should be well-defined, stand a reasonable chance of completion in the available time, apply and develop an understanding of in-depth concepts, use a variety of instrumentation, promote awareness of advanced safety practices, and be grounded in the primary chemical literature.

Research can satisfy up to four semester credit hours or six quarter credit hours of the in-depth course requirement for student certification and can account for up to 180 of the required 400 laboratory hours. A student using research to meet the ACS-certification requirements must prepare a well-written, comprehensive, and well-documented research report, including safety considerations where appropriate. Thorough and current references to peer-reviewed literature play a critical role in establishing the overall scholarship of the report. Although oral presentations, poster presentations, and journal article co-authorship are valuable, they do not substitute for the student writing a comprehensive report.

Research performed during the summer or performed off-campus, even though it might not receive academic credit, may count toward student certification. In such cases, the student must prepare a comprehensive written report that a faculty member of the home institution evaluates and approves.

7. Development of Student Skills

In order to prepare students to enter the workforce or postgraduate education, programs must provide experiences that go beyond chemistry content knowledge to develop competence in other critical skills necessary for a professional chemist. Faculty mentoring is another key component of student development because it helps students gain confidence and provides guidance about career planning and networking. Approved programs should have an established process by which they assess the development of student skills. A capstone experience (as described in Section 5.10) provides an excellent opportunity for this assessment. In addition, either dedicated courses or integration of learning opportunities throughout the curriculum can be used to develop and assess student skills.

7.1 Problem Solving Skills. An important goal of chemistry education is to provide students with the tools to solve problems. Students should be taught how to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions. Throughout the curriculum, students should be challenged to apply their understanding of all chemistry subdisciplines and use appropriate laboratory skills and instrumentation to solve problems.

7.2 Chemical Literature and Information Management Skills. Essential student skills include the ability to retrieve information efficiently and effectively by searching the chemical literature, evaluate technical articles critically, and manage many types of chemical information. Students must be instructed in effective methods for performing and assessing the quality of searches using keywords, authors, abstracts, citations, patents, and structures/substructures.

The program should provide ready access to technical databases with sufficient depth and breadth of the chemical literature for effective searching. Students' ability to read, analyze, interpret, and cite the chemical literature as applied to answering chemical questions should be assessed throughout the curriculum. Instruction should also be provided in data management and archiving, record keeping (electronic and otherwise), and managing citations and related information. This includes notebooks, data storage, information and bibliographic management and formatting. Undergraduate research and/or individual or group projects provide excellent opportunities for development and assessment of literature searching and information management skills. A stand-alone course can be an effective means of imparting information-retrieval skills, though such a course usually would not qualify as an in-depth course.

7.3 Laboratory Safety Skills. Programs must instruct students in the aspects of modern chemical safety appropriate to their educational level and scientific needs. Approved programs need to promote a safety-conscious culture in which students demonstrate and apply their understanding of the concepts of safe laboratory practices. The promotion of safety awareness and skills must begin during the first laboratory experience and should be incorporated into each lab experience thereafter. Students must undergo general safety instruction as well as lab-specific instruction before beginning undergraduate research. Classroom and laboratory discussions need to stress safe practices and should actively engage students in the evaluation and assessment of safety risks associated with laboratory experiences. Safety understanding and skills must be developed and assessed throughout the curriculum.

Programs should provide students with training that allows them to
- carry out responsible disposal techniques
- comply with safety regulations
- properly use personal protective equipment to minimize exposure to hazards
- understand the categories of hazards associated with chemicals (health, physical, and environmental)
- use Safety Data Sheets (SDSs) and other standard printed and online safety reference materials

- recognize chemical and physical hazards in laboratories, assess the risks from these hazards, know how to minimize the risks, and prepare for emergencies.

7.4 Communication Skills. Effective communication is vital to all professional chemists. Speech and English composition courses alone rarely give students sufficient experience in oral and written communication of technical information. The chemistry curriculum should include critically evaluated writing and speaking opportunities so students learn to present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in their communications. Because chemistry is a global enterprise, knowledge of one or more foreign languages or an international experience can be a valuable asset to chemistry students and add greatly to a student's ability to communicate with other chemists worldwide.

7.5 Team Skills. Solving scientific problems often involves multidisciplinary teams. The ability to work in such teams is essential for a professional chemist. Programs should incorporate team experiences into classroom and laboratory components of the chemistry curriculum, thus providing opportunities for students to learn to interact effectively in a group to solve scientific problems and work productively with a diverse group of peers. Effective group experiences provide students with the opportunity to develop both leadership and team skills.

7.6 Ethics. Ethics should be an intentional part of the instruction in a chemistry program. Students should be trained in the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results. The curriculum should expose students to the role of chemistry in contemporary societal and global issues, including areas such as sustainability and green chemistry. As role models, faculty should exemplify responsible conduct in their teaching, research, and all other professional activities.

8. Program Self-Evaluation

An approved program should regularly evaluate its curriculum and pedagogy, faculty development opportunities, and infrastructure needs relative to the program's teaching and research mission. Self-evaluation is a continual process that enables programs to both introduce change in a deliberate way and improve overall effectiveness. Steps in the self-evaluation process include identifying the goals of the program, collecting and analyzing data to determine if these goals are being met, implementing changes as needed to meet the program goals, and then, after an appropriate period of time, beginning the process anew. Thoughtful and thorough self-evaluation can lead to improved or modernized course content or pedagogy, identification of areas in which the curriculum may be strengthened and student outcomes improved, and increased support for professional development and scholarly activities of faculty. Such evaluation can also provide a strong infrastructure to support the educational and scientific missions of the program.

9. Certification of Graduates

The chair of an approved program certifies those graduates receiving a baccalaureate degree consistent with these guidelines. Students usually receive certification when they complete the baccalaureate degree. It is also possible to certify students who initially obtain a non-certified baccalaureate degree from an approved program and subsequently complete additional study in an ACS-approved program to qualify for certification. The Office of Professional Training provides certificates for certified graduates.

II. APPROVAL PROCESS AND REVIEW PROCEDURES

1. Membership of the Committee

The CPT has 17 members. The ACS Board of Directors and the president of the Society with the advice of the ACS Committee on Committees jointly appoint 16 voting members. There is also one nonvoting staff Secretary. One voting member serves as an appointed chair and one serves as an elected vice chair. Initial appointments are usually for a three-year term, and reappointment for up to a total of three 3-year terms of service is possible. The Committee typically retains one or more former members or appoints individuals with special expertise as nonvoting consultants. Members of CPT are experienced educators and scientists from all areas of the country, chosen to represent different fields of chemistry and reflect much of the breadth of the chemistry community. The Secretary communicates the results of all reviews conducted by CPT and consults with faculty and administrators about guidelines and procedures related to ACS approval.

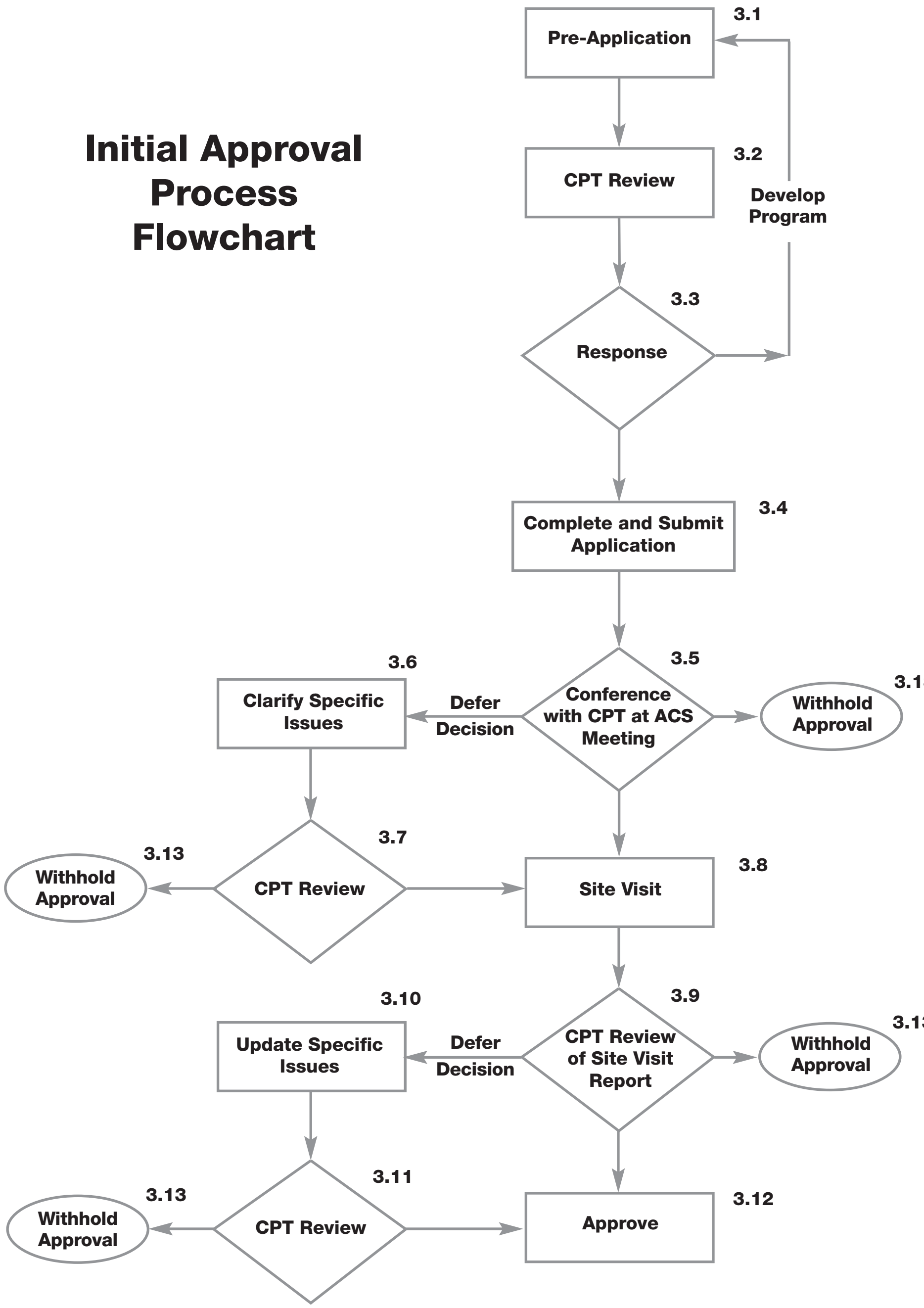
2. Costs Associated with the CPT and the Approval Program

The Society does not charge academic institutions for the evaluation of the chemistry program, including site visits by Visiting Associates of CPT (Section 8).

3. Initial Approval Process

The ACS, through CPT, establishes the recommendations and requirements for approval of bachelor's degree programs in chemistry and policies for administering the approval process. The chemistry faculty should conduct a self-study to determine the program's readiness to begin the approval process. The following flowchart summarizes the steps of the initial approval process, and the accompanying text describes each of the steps in the flowchart.

Initial Approval Process Flowchart



3.1 Pre-Application. The chemistry program completes a pre-application form, which is available on the CPT website, and submits it during the time periods identified on the pre-application web page.

3.2 CPT Review. The Committee reviews the pre-application form within two months of the submission deadline.

3.3 Response. The Secretary of the Committee reports the outcome of the review to the department chair by letter. Two outcomes are possible.

1) *The program does not meet* the requirements for ACS approval that are covered by the pre-application form. The letter identifies the deficiencies and instructs the program to submit a new pre-application form after addressing the areas of noncompliance.
2) *The program meets* the requirements for ACS approval covered by the pre-application form. The Committee invites the department to submit a full application package.

3.4 Complete and Submit Application Package. The program completes a comprehensive self-study questionnaire and provides supporting documentation including course syllabi, examinations, and student research reports (when research is required). The ACS staff check the package for completeness and assign the application for review by the Committee at the next ACS national meeting.

3.5 Conference with CPT. The chair of the department applying for approval is expected to meet with the Committee to discuss the chemistry program and answer questions about certain aspects of the application package. If the chair of a combined department is not a chemist, a chemistry faculty member must attend the conference. Additional chemistry faculty members or administrators may also meet with the Committee. The Secretary of CPT communicates the outcome of CPT's review to the chair of the department that administers the chemistry program. Three outcomes are possible.

1) *The Committee agrees that the program is ready for a site visit* (Section 3.8) by Visiting Associates. (Section 8)
2) *The Committee defers a decision* pending clarification of certain aspects of the application. (Sections 3.6, 3.7)
3) *The Committee withholds approval of the program.* (Section 3.13)

3.6 Clarify Specific Issues. The program must clarify the specific issues identified in the letter from the Secretary of CPT and submit a response by the deadline given in the letter. This step may only be taken once following submission of an application for approval.

3.7 CPT Review. ACS staff verifies that the information submitted by the applicant is complete and schedules the application for review at the next regular CPT meeting. Two outcomes are possible.

1) *The Committee agrees that the program is ready for a site visit* (Section 3.8) by Visiting Associates. (Section 8)
2) *The Committee withholds approval of the program.* (Section 3.13)

3.8 Site Visit. The Secretary of CPT reports the decision to proceed with a site visit by letter to the chair of the department that administers the chemistry program. The president (or chief administrative officer) of the institution must then invite ACS to make a site visit. Two Visiting Associates will make the site visit, which typically is spread over two days. The ACS pays all expenses of the site visitors. ACS staff provide the site visitors with background information and instructions from the Committee. The president or chief administrative officer of the institution must be available to meet with the site visitors. The site visitors submit a written report to the Secretary of CPT within one month following the visit. For more information on Visiting Associates, see Section 8.

3.9 CPT Review of Site Visit Report. CPT reviews the written report on the site visit at the first regular meeting after it is received. Three decisions are possible after this review.

1) *The Committee approves the chemistry program.* (Section 3.12)
2) *The Committee requests additional or updated information.* (Sections 3.10, 3.11)
3) *The Committee withholds approval of the program.* (Section 3.13)

3.10 Update Specific Issues. The program must clarify or update the specific issues identified in the letter from the Secretary of CPT to the chair of the department administering the chemistry program and submit a response by the deadline given in the letter. This is not an iterative step and occurs only once following the site visit.

3.11 CPT Review. CPT reviews the program's report describing the resolution of the specific issues. Two decisions are possible after this review.

1) *The Committee approves the chemistry program.* (Section 3.12)
2) *The Committee withholds approval of the program.* (Section 3.13)

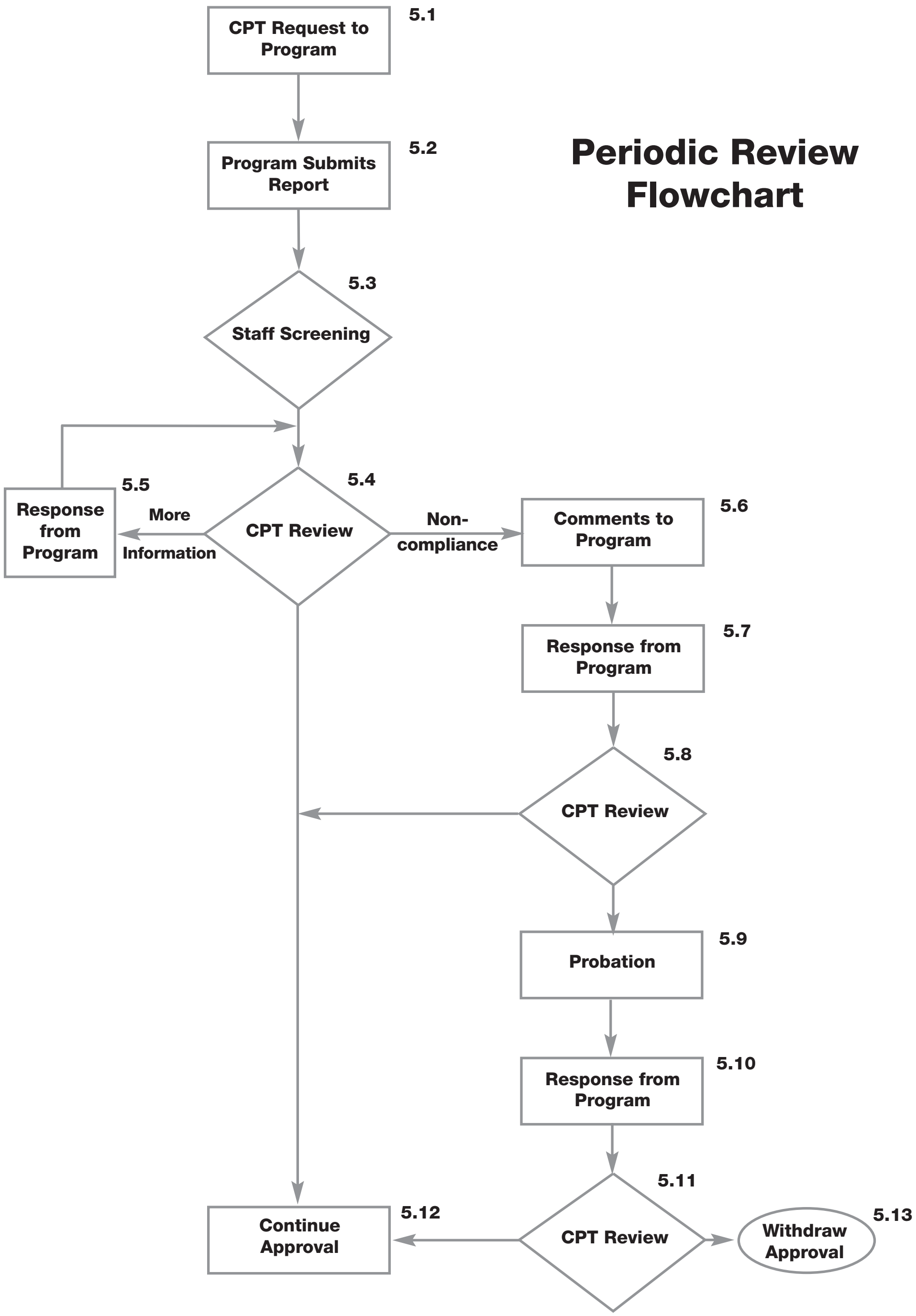
3.12 Approve. The Secretary of CPT writes to the president of the institution and the chair of the department that administers the chemistry program to report this decision. The Committee will post the name of the institution on the list of ACS-approved programs on the ACS website. An approved program must satisfy the reporting requirements described in Sections 4 and 5. Failure to comply with the annual and periodic review requirements will lead to probationary action. (Section 6)

3.13 Withhold Approval. The letter from the Secretary of CPT describes the areas of noncompliance. This letter is sent to the chair of the department administering the chemistry program with a copy to the president or chief administrative officer. After addressing these concerns, the program returns to the pre-application step of the approval process. The institution may appeal this decision as described in Section 7.

4. Annual Review

Approved programs must report annually to the Committee on the number of degrees granted by the chemistry program, information on graduates at all degree levels, the certification status of the baccalaureate graduates, and supplemental information on the curriculum and faculty. The Family Educational Rights and Privacy Act (FERPA) allows institutions to provide the names, gender, and graduation dates of all graduates to CPT. The Committee reviews the report for completeness and consistency with the guidelines and may request additional information from the program. The Committee summarizes and publishes the statistical information about the numbers of graduates at the various degree levels each year.

Periodic Review Flowchart



5. Periodic Review

To ensure compliance with the ACS guidelines, approved programs must submit a periodic report about their program using a form provided by CPT. The adjacent flowchart summarizes the steps of the review process, and the accompanying text describes each of the steps in the flowchart.

5.1 Request for Periodic Report. The Secretary of CPT contacts the chair of the department that administers the ACS-approved chemistry program with instructions for completing the report. A report form with questions on all components of the ACS guidelines, a checklist of supporting documents to be submitted, and a copy of the letter reporting the final outcome of the previous review will be provided. Among the supporting documents that may be requested are copies of specific course syllabi, examinations, and student research reports. Approved programs must submit a periodic report at least every six years. In cases where programs have been given an extended period of time to address significant issues, the next periodic report will be requested no sooner than 12 months after the outcome of the previous review has been communicated to the chair of the department.

5.2 Program Submits Report. The program must respond by the deadline provided in the letter from the Secretary.

5.3 Staff Screening. An ACS staff member checks the periodic report package for completeness and corresponds with the department chair to obtain any missing or other information as authorized by CPT.

5.4 CPT Review. The Committee reviews the periodic report at one of its three yearly meetings. Three outcomes are possible.

1) *The Committee requests more information.* This is not an iterative step and may occur only once following the initial submission of the periodic report. (Section 5.5)
2) *The Committee determines that the chemistry program is not in compliance* with the requirements specified in the guidelines or has not adequately addressed the recommendations from the previous periodic review. (Section 5.6)
3) *The Committee continues approval.* (Section 5.12)

5.5 Request more information. The CPT members may find that essential information is missing from the report package or clarification of ambiguous information is needed. The response is returned to CPT for review and a decision of continue approval or noncompliance is made.

5.6 Comments to Program. The Secretary of CPT identifies the area(s) of noncompliance in a letter to the chair of the department, including a reasonable timeframe for response as established by the Committee.

5.7 Response from Program. The program must report to CPT on the measures taken to address the deficiencies by the deadline provided in the letter from the Secretary.

5.8 CPT Review. The Committee reviews the program's response at the first possible meeting after receiving it. Two outcomes are possible.

1) *Continue approval.* (Section 5.12)
2) *Probation.* (Section 5.9)

5.9 Probation. If the deficiencies have not been corrected, CPT places the chemistry program on probation. The Secretary of CPT communicates this decision and the areas of noncompliance in a letter to the president (or chief administrative officer) of the institution and the chair of the department that administers the chemistry program. The probation decision is confidential between CPT and the institution. During probation, the institution remains on the list of ACS-approved schools, and the department chair may continue to certify graduates who have satisfied the requirements as specified in the guidelines.

5.10 Response from Program. The probationary period normally lasts from 12 to 18 months. The institution must provide a written report that describes how it has corrected all of the areas of noncompliance, including supporting documentation as appropriate. Either the chair of the department administering the chemistry program or a member of the administration may submit the response to the Secretary of CPT before the end of the probationary period.

5.11 CPT Review. The Committee reviews the program's response at the first regular meeting after receiving it. In some circumstances, CPT may request a site visit by Visiting Associates (Section 8). Two outcomes are possible.

1) *Continue approval.* (Section 5.12)
2) *Withdraw approval.* (Section 5.13)

5.12 Continue Approval. If CPT determines that the chemistry program meets all of the requirements for ACS approval and the spirit of the guidelines, the Committee continues approval of the program. The Secretary of CPT reports this outcome in a letter to the chair of the department responsible for administering the ACS-approved chemistry program, with a copy to the president (or chief administrative officer) of the institution. The Committee may identify aspects of the program that must be addressed as part of the next periodic review. Failure to respond adequately may lead to a determination of noncompliance in the future. The letter may also contain CPT's suggestions for further development of the chemistry program. Under certain circumstances, CPT may request a shorter review cycle.

5.13 Withdraw Approval. If the program does not meet all of the requirements for ACS approval by the end of the probationary period, CPT withdraws approval of the chemistry program. The Secretary of CPT reports this outcome in a letter to the president (or chief administrative officer) of the institution and the chair of the department responsible for administering the chemistry program. The institution may appeal this decision as described in Section 7. The name of the institution will be removed from the published list of ACS-approved schools, and the chair may no longer certify graduates after the period for submitting an appeal has elapsed.

If a previously approved program wishes to re-apply for ACS approval within 12 months following the letter withdrawing approval, the program is not required to follow the regular application procedure. The program must submit a request for reinstatement to the Committee accompanied by a completed periodic report package for the current year. The possible outcomes of this review will be approval or withhold approval. The normal appeal procedure will still apply. (See Section 7)

In cases where a chemistry program submits a request to have ACS approval withdrawn, CPT will act to withdraw approval at the next regular meeting of the Committee. No probation period will be imposed. The normal appeal procedure will still apply. (See Section 7)

6. Administrative Probation

The Committee may place an ACS-approved program on probation if it does not comply with any of the following administrative requirements for maintaining approval:

- Submission of a periodic review report by the deadline.
- Submission of additional information requested during CPT review of a periodic report.
- Completion of an annual report by the deadline.

The chair of the department responsible for administering the chemistry program receives two warnings that the program has missed the deadline before the Secretary of CPT contacts the president (or chief administrative officer) of the institution. The Secretary of CPT notifies the president that the chemistry program does not comply with the requirements for maintaining approval and allows 30 days to correct the situation before placing the program on administrative probation. Administrative probation lasts no longer than 60 days. During administrative probation, programs retain approval and may certify graduates. The Committee withdraws approval of any program that fails to submit the required report or information within the 60-day period.

7. Appeal of an Adverse Decision

An institution may petition for review of an adverse decision (withhold or withdrawal of approval) if it believes that the Committee did not have access to all of the necessary evidence, has not adhered to its own established policies and procedures, or has failed to consider all of the evidence and documentation presented during the evaluation. The petition must reach the Committee within 60 days following the date of the letter advising the institution of the adverse decision. Following the Committee's review of the petition, the institution must provide any additional information and documents in support of the petition by the provided deadline, typically no more than six months. After receiving the petition and supporting information, the Committee reviews the matter at its next regular meeting, which may include a conference with representatives of the institution if desired by either the institution or the Committee. After the meeting and deliberation, the Secretary of CPT reports the Committee's findings to the president of the institution and the chair of the department that administers the chemistry program.

Any action of any Society unit is always subject to review by the Society's Board of Directors, which has full legal responsibility for all Society activities.

7.1 Appeal of Withdraw Approval. A program undergoing its periodic review may follow the procedures described above to appeal this decision. Two outcomes of the appeal are possible.

1) The Committee continues approval. (Section 5.12)
2) The Committee affirms the decision to withdraw approval. (Section 7.3)

7.2 Appeal of Withhold Approval. A program applying for approval may follow the procedures described above to appeal this decision. Three outcomes of the appeal are possible.

1) The Committee approves the chemistry program. (Section 3.12)
2) The Committee agrees that the program is ready for a site visit (Section 3.8) *by Visiting Associates.* (Section 8)
3) The Committee affirms the decision to withhold approval. (Section 7.3)

7.3 Independent Appeals Board. Every institution has the right to appeal the Committee's final decision to an independent Appeals Board convened for that purpose. The Society's president and the chair of its Board of Directors will appoint an Appeals Board, consisting of three individuals who are not members of the Committee, to hear the appeal. No further appeal is available after the action of the Appeals Board.

8. Visiting Associates

The Committee selects Visiting Associates who are experienced educators and scientists familiar with the ACS guidelines and the administrative and technical aspects of conducting a successful chemistry program. In the selection of the Visiting Associates, the Committee makes every effort to eliminate any possibility of bias or conflict of interest. The Committee periodically holds meetings with Visiting Associates to brief them on guidelines policy and evaluation procedures. Visiting Associates receive comprehensive and detailed instructions on CPT's expectations for the site visit that also are sent to the chair of the department to aid in preparation for the visit. In addition, the Associates receive confidential comments from CPT that describe aspects of the program that should receive careful attention during the site visit and in the site visit report. Finally, Visiting Associates serve as fact-finders for CPT and do not fill the role of external consultants who might advise the faculty on the development of the chemistry program.

9. Confidentiality

The information provided to the Committee and all related discussions and correspondence between the Committee and an institution are solely for the confidential use of the Committee. In the event that an institution appeals a Committee decision, the Committee provides the information necessary for the proper conduct of the appeal to the Appeals Board.

The Committee communicates all decisions to the chair of the department that administers the chemistry program. In the case of initial approval, continued approval, report on a site visit, probation, withdrawal of approval, and appeals, the Committee also informs the president (or chief administrative officer) of the institution. These communications summarize the reasons for the decisions made by the Committee.

In its annual published reports, the Committee identifies those institutions whose programs are currently approved as meeting the ACS guidelines for undergraduate professional education in chemistry. These annual reports also summarize statistical information provided by each institution about its chemistry graduates. Otherwise, the Committee does not publish any additional information about a particular program or evaluation.

10. Complaints

Any administrative official of an institution, department chair, faculty member, student, or other person who disagrees with one or more of the policies, procedures, or activities of the Committee and who wishes to present a complaint should do so in an appropriately documented letter to the Committee Secretary. The same procedure is to be followed should the complaint allege failure of an approved institution to adhere to the ACS guidelines or allege that there is a situation tending to jeopardize the quality and vitality of a program at an approved institution. In both cases, the Committee will evaluate the matter and take actions where appropriate.

APPENDIXES

A. The Formal Mandate of the Committee on Professional Training

A resolution of the ACS Council established the Committee on Professional Training in 1936, and the Committee published the first edition of the guidelines for approval of undergraduate programs in 1939. In 1968, the Committee became a Joint Committee of the ACS Board and Council, reporting to both. In 1979, the Society codified the responsibilities of the CPT in ACS Bylaw III,3,(h):

1) The SOCIETY shall sponsor an activity for the approval of undergraduate professional programs in chemistry. The Committee on Professional Training, constituted as an Other Joint Board-Council Committee under this Bylaw, shall act for the Board and Council in the formulation and implementation of the approval program with published criteria and/or guidelines, as well as published evaluation policies and procedures.

2) The goals of the approval program shall be *inter alia:*

   a. promoting and assisting in the development of high standards of excellence in all aspects of postsecondary chemical education, and undertaking studies important to their maintenance,
   b. collecting and making available information concerning trends and developments in modern chemical education, and
   c. cooperating with the SOCIETY and other professional and educational groups having mutual interests and concerns.

3) Institutions may petition for review of adverse evaluation decisions to an established Appeals Board consisting of three members of the SOCIETY, not members of the Committee, appointed jointly by the President and the Chair of the Board.

B. Members of the Committee on Professional Training

CPT Members – 2015

Dr. Edgar A. Arriaga, *University of Minnesota-Twin Cities*

Dr. Ronald Brisbois, *Macalester College*

Dr. Michelle O. Claville, *Hampton University*

Dr. Ron W. Darbeau, *McNeese State University, Vice Chair 2013*

Dr. Steven A. Fleming, *Temple University (Committee Associate)*

Dr. Suzanne Harris, *University of Wyoming, Vice Chair 2009 (Consultant)*

Dr. Bob A. Howell, *Central Michigan University*

Dr. Jeffrey N. Johnston, *Vanderbilt University*

Dr. Kerry K. Karukstis, *Harvey Mudd College*

Dr. Laura L. Kosbar, *IBM T.J. Watson Research Center*

Dr. Clark R. Landis, *University of Wisconsin-Madison, Vice Chair 2015*

Dr. Cynthia K. Larive, *University of California, Riverside, Vice Chair 2007-08, Chair 2009-11 (Consultant)*

Dr. Stephen Lee, *Cornell University*

Dr. Anne B. McCoy, *The Ohio State University, Vice Chair 2011, Chair 2012-14*

Dr. Lisa McElwee-White, *University of Florida*

Dr. Christopher R. Meyer, *California State University, Fullerton*

Dr. Lee Y. Park, *Williams College, Vice Chair 2010 (Consultant)*

Dr. Richard W. Schwenz, *University of Northern Colorado*

Dr. Joel I. Shulman, *University of Cincinnati (Consultant)*

Dr. Greg M. Swain, *Michigan State University*

Dr. Thomas J. Wenzel, *Bates College, Vice Chair 2014, Chair 2015*

Dr. George S. Wilson, *University of Kansas (Consultant)*

Former CPT Members Who Participated in the Development of the Guidelines

Dr. Ron C. Estler, *Fort Lewis College, Vice Chair 2012*

Dr. Joseph S. Francisco, *University of Nebraska-Lincoln*

Dr. Carlos G. Gutierrez, *California State University, Los Angeles*

Dr. Scott C. Hartsel, *University of Wisconsin-Eau Claire*

Dr. John W. Kozarich, *ActivX Biosciences*

Dr. Nancy S. Mills, *Trinity University*

Dr. Jeanne E. Pemberton, *University of Arizona, Chair 2000-02*

Dr. William F. Polik, *Hope College, Vice Chair 2005, Chair 2006-08*

Dr. Barbara A. Sawrey, *University of California, San Diego*

Dr. Maria da Graca H. Vicente, *Louisiana State University*

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