Foundation and In-Depth Course Work

Introduction

The 2008 ACS Guidelines describe foundation and in-depth course work as the two categories of experiences (beyond the introductory experience) that approved programs provide their students (Sections 5.3 and 5.4). This supplement discusses several models for the combination of foundation and in-depth course work and describes a few examples. In all cases, these descriptions are of *minimum* experiences for a certified degree. The faculty of different institutions may determine that proper preparation requires additional course work as part of the required chemistry curriculum. Those choices rest with the institutions.

The purpose of the foundation course work is to provide breadth in chemistry by grounding students in the five subdisciplines: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. The purpose of the in-depth course work is to build on and integrate the student's knowledge of the foundation and to explore at least a portion of the discipline more thoroughly. The in-depth experience builds technical expertise, provides a more sophisticated view of the material, fosters critical thinking, and gives the student an opportunity for the intellectual growth and rigorous thinking that comes from engaging in topics at a high level. Research is a very useful component of the in-depth portion of the curriculum.

The following sections describe approaches to the combination of foundation and in-depth course work. These examples range from minimal changes to current approaches to radical restructuring of the path to a certified chemistry degree. There are many effective ways to structure the foundation and in-depth courses, and this discussion is not meant to be either exhaustive or prescriptive. The breadth of coverage in the foundation courses and coherence among the in-depth courses taken by the student are key to the approach described in the guidelines.

Models and Examples

Minimal Changes to Established Practice

In one approach to the foundation and in-depth experiences, the first semester of a traditional two-semester sequence is designated as the foundation course and the second semester as an in-depth course. The most familiar examples are organic chemistry and physical chemistry, although the common two-semester combination of quantitative analysis and instrumental analysis falls in the same category. Because the foundation and in-depth

material is spread between the two courses, a student must take both courses to achieve the requisite experience. Designating the first semester as “foundation” and the second semester as “in-depth” is solely a bookkeeping device.

A concrete example of such a scheme is a curriculum with five one-semester *foundation* courses [organic chemistry (semester 1), physical chemistry (semester 1), quantitative analysis, inorganic chemistry, and biochemistry] and four one-semester *in-depth* courses [organic chemistry (semester 2), physical chemistry (semester 2), instrumental analysis, and another in-depth course, such as advanced inorganic chemistry]. This scheme is similar to many current curricula, and it represents the smallest change from the approach that many institutions now use. It is a means of maintaining the familiar two-semester experience in several areas.

Restructured Foundation Courses

The essential concept of the foundation courses is that they provide the student with experience across the breadth of an area of chemistry. Providing that experience in a one-semester course requires a different structure than found in either semester of a traditional two-semester sequence. An ideal foundation course provides a portion of the content that appears in each of the semesters of such a two-semester sequence. The faculty should evaluate each foundation course, recognizing that it may be the only formal exposure of some students to that area. This type of foundation course is *not* simply the first semester of a traditional two-semester sequence. Examples of possible course content in one-semester organic, physical, and analytical chemistry courses are described in the topical supplements.

Integrated Courses

Individual courses built around the traditional areas of chemistry are not the only means of providing the foundation experience. The goal of the foundation courses is to provide breadth in chemistry, and departments may want to integrate several aspects together in foundation courses. For example, the foundation experience in inorganic and organic chemistry could come in two courses devoted to synthesis without either being solely devoted to organic or inorganic chemistry. The essential goal is to provide the student with the breadth to appreciate the discipline and to pursue advanced work. Integrating various content areas into individual courses can help students make connections among topics earlier in their careers. Integrating courses requires careful attention from the faculty to ensure that the five courses cover all of the areas of chemistry, as described above.

In-Depth Course Work

There are many possible approaches to providing the in-depth experience within the curriculum. The student might take a set of in-depth courses spanning all of the traditional areas of chemistry. Integrating chemistry content areas in the in-depth courses may also be desirable, with an obvious example being the combination of biochemistry and organic chemistry in an integrated in-depth course. Alternatively, the student might take a set of

courses that concentrate on a defined chemistry subdiscipline. For example, a concentrated sequence of in-depth courses could focus on organic and inorganic chemistry for a student interested in synthetic chemistry. Similarly, advanced courses in physical and analytical chemistry could constitute an appropriate in-depth experience for a student interested in instrument-based techniques such as spectroscopy. A student interested in chemical biology or biochemistry could take in-depth courses in biochemistry, bioinorganic chemistry, and organic chemistry along with additional work in biology, while a student interested in chemical physics could take in-depth courses in physical chemistry along with additional work in physics. Courses from other disciplines could be counted toward the in-depth chemistry course requirements only if they have an appropriate chemistry prerequisite and contained sufficient chemistry content. Several possible scenarios for providing the in-depth course work experience are described in the "Degree Tracks" supplement.

The variety of sensible paths through the in-depth course work is large, and it is essential that the department carefully consider its choices in order to create a coherent plan for each degree track. The faculty should provide a clear rationale for the collection of in-depth courses that contribute to a degree track to themselves and their students. It is likely that most departments will offer a relatively small number of distinct tracks, depending on the size and interests of the faculty and the mission of the institution. Careful thought about the structure of the in-depth experience and plans to offer the experience consistently are crucial.