

**Department of Chemistry, College of Letters and Science
University of Wisconsin, Madison**

Plan for Assessing the Undergraduate Major in Chemistry

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Introduction

The Department of Chemistry offers two degree programs in Chemistry, the Bachelor of Science in Chemistry and the American Chemical Society Certified Bachelor of Science in Chemistry. The differences between the two courses of study are small enough that we will not differentiate the two in assessing the undergraduate major. The destinations of chemistry majors divide into three primary categories: graduate study in chemistry or related areas, employment in industry and government, and medical or dental school. In addition, a small proportion use their chemistry degree as a springboard to advanced work in areas such as law or business. In the 2005-6 academic year, there were 160 declared chemistry majors and 77 graduates. These numbers have increased substantially in part because of changes in the undergraduate major that the Department implemented after its last large scale assessment.

The Department of Chemistry is committed to providing a sound foundation in chemical principles and a creative environment in which students participate in scientific inquiry. Chemistry majors are part of a scientific community where faculty, graduate students, and undergraduates conduct modern research that contributes to the fundamental basis of chemistry and its applications to the wider society.

Learning Objectives of the Chemistry Major

Students in the chemistry major will gain knowledge, skills, and experiences to address real world chemical problems. These skills include the ability to solve problems, think critically, and act ethically. Students pursuing a chemistry major will master

- basic chemical transformations, including the ability to make predictions of chemical reactivity and properties
- the relationship between structure, bonding, and the properties of molecules and materials
- the quantitative, mathematical, and computational skills required to model chemical systems and experimental data
- state-of-the-art synthetic and analytical laboratory procedures
- chemical and instrumental methods used for making chemical measurements and determining chemical structure
- skills needed to locate, evaluate, and use information in the chemical literature
- oral, written, and visual communication of chemical knowledge
- the ability to work collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge

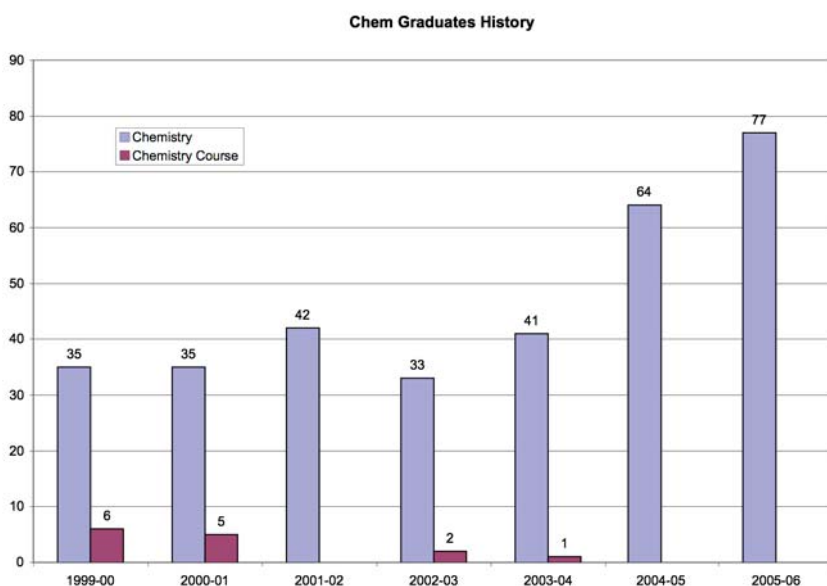
Chemistry majors have a series of experiences that span much of the scope of modern chemistry. All take classroom and laboratory courses in each of the traditional subdisciplines of chemistry (analytical, inorganic, organic, and physical) and many include a course in biochemistry. In addition, they take several courses in mathematics and physics that provide important background for their work in chemistry. The advanced undergraduate courses are not limited to majors and usually include significant populations of students with other majors such as biochemistry and chemical engineering.

The first few chemistry courses (typically taken in the freshman and sophomore years) have large sections with a population that is dominantly not chemistry majors. Because of the campus-wide service role of these courses, there is not a separate chemistry major track although there are honors sections that many chemistry majors take. These honors courses are neither limited to nor required for chemistry majors, however.

The upper level courses in chemistry are smaller and focus more sharply on chemistry majors, who are the dominant but not exclusive clientele. Students in the courses often prepare substantial written reports and present oral reports on literature or laboratory work. A significant fraction of chemistry majors join individual research groups and many complete senior theses. This exposure to research and direct interaction with graduate students is an important part of the education of chemistry majors, many of whom pursue advanced degrees in chemistry. These advanced classroom, instructional laboratory, and research experiences are the primary target of our assessment efforts.

Previous Evaluation of Student Achievement

Our previous extensive assessment in the Fall of 1999 provided the Department information and insights that formed the basis for restructuring and streamlining of the curriculum and for beginning new activities



for chemistry majors. Both seem to have succeeded well. As the figure shows, the number of chemistry graduates has roughly doubled in the last five years. The number of students participating in undergraduate research has risen as well, and we see the two as likely correlated. Students who participate in research also now have greater opportunity and motivation to present their work. The useful changes that grew out of the previous assessment encourage us to take a similar approach in the current plan. We hope to identify the factors that have increased the number

of majors and to use that information to help shape a program that serves our majors well. Understanding the motivations for majoring in chemistry and the most attractive aspects of our program will be important in our planning. One of our new goals is to create assessment structures that we can easily use on a continuing basis each year. It seems that surveys are the most sustainable approach, but we intend to explore several possibilities.

Assessment Methods

Statistical information

We are able to obtain much better statistical information on chemistry majors than in the past and will make that information an integral part of our assessment. We intend to collect information on grade point averages, courses taken, and the extent and duration of undergraduate research as the starting point of our analysis. We also need to understand which of our introductory courses generate chemistry majors, in what order they take the courses required for the major, and the number of transfer students. In developing the statistical aspects of the assessment, we will further refine the details of the information we need. We are in a position to obtain most of these data routinely.

Probes of Attainment of Learning Objectives

We found that a simple test containing questions sampling the breadth of undergraduate chemistry knowledge provides an informative view of the level of student achievement. The goal is to probe the qualitative and quantitative understanding of chemical phenomena that our majors have near the end of their undergraduate careers. We believe that the increased cohesiveness of our majors will make this a simpler task now. The increased emphasis we are placing on oral and written communication and use of the chemical literature requires that we assess those skills in ways that a simple test of content knowledge does not manage. We plan to evaluate examples of written and oral communication in order to sample the development of these skills in representative students as a way to assess their incorporation into the undergraduate experience. The other new feature we plan to develop is a means of assessing laboratory skills.

Surveys

We plan to conduct a survey of senior chemistry majors and intend to use methodology (likely a web based instrument) that will make it easy to repeat the survey each year. Our goal is to probe their satisfaction with their educational experience in the Department and to ascertain their future plans. In addition, we hope to begin tracking students with an eye toward obtaining their perspectives several years after graduation. A graduate student survey of this type was informative in the past, and we hope that the use of email and a web based survey will make it possible to do the same for undergraduates. Maintaining contact with our undergraduates during the first few years following their graduation is surprisingly difficult, and we plan to develop improved strategies for doing so. The other cohort we will survey is the faculty and laboratory directors, particularly with regard to the preparation of students when they enter courses at each level.

Interviews

Structured interviews with small groups of graduating students have proven to be an effective means of gauging their experience in and reaction to the undergraduate major. These interviews have helped shape changes in the Department over the last several years, and we intend to continue to use them. One of our goals is to create a system that makes these “group exit interviews” easy to maintain and repeat.

Using the Assessment

The Undergraduate Curriculum Committee will first evaluate the assessment data to identify strengths and weaknesses of the program along with opportunities for and threats to the program. This analysis will lead to proposals to the Department for potential responses to the information we obtain.

F. Fleming Crim for the Undergraduate Curriculum Committee