Undergraduate Program Assessment
Department of Chemistry

Vision

The Department of Chemistry recognizes the significance of how a molecular-level understanding of nature should change the way that students view the world. We build connections between sub-fields within the major, as well as connections between chemistry and society.

Student Learning Objectives

The overall learning objectives of an undergraduate education in Chemistry are to describe the structure and transformations of matter from a molecular perspective, and to develop and perform controlled experiments to test hypotheses. This encompasses the acquisition of concepts and experimental skills, as well as the perspectives to relate a molecular view of nature to fields as diverse as energy and biology.

Among the fundamental topics chemistry students learn about, in lectures, laboratories and by doing undergraduate research under the mentorships of professors, are atomic theory, stoichiometry, chemical bonding, molecular structure, gases, intermolecular forces, solids, liquids, solutions, equilibrium, kinetics, thermodynamics, electrochemistry, acids and bases, precipitation, descriptive chemistry, structure and synthesis of organic molecules, reactions of the principal functional groups, prediction of reaction products using reaction mechanisms, determination of organic structure via applied spectroscopy, stereochemistry in organic structure and reactions, synthetic transformations between functional groups, carbohydrates, peptides, nucleic acids, chemical periodicity, reaction behavior and structural interrelationships of the main group and transition elements, synthesis of inorganic materials and their characterization, macromolecules and networks of reactions of living cells, structure of proteins and nucleic acids, mechanisms of enzyme catalysis, metabolic reaction networks, transfer of genetic information, recombinant DNA technology, modern quantum chemistry and wave mechanics, spectroscopy, statistical mechanics, titrimetric methods, chromatography, and mass spectrometry.

Assessment tools

Prior to departmental implementation in AY 2012 - 2013 of the Integrative Experience requirement, our assessment tools were primarily 1) collection of data on number of undergraduate students conducting research, 2) use of OWL (Online Web-based Learning), particularly to evaluate effectiveness of an online chemistry preparatory course, and 3) SRTI results for individual courses. There was also occasional access to university-collected survey data, such as the recently supplied “Instructional Benchmarks” document from UMass’s OAPA (Office of Academic Planning and Assessment), which provides collected results for 3 surveys for the years 2010 - 2012: 1) Senior Survey, 2) SRTI course evaluations (at the department level) and 3) NSSE (National Survey of Student Engagement).

The Department of Chemistry is duly proud that all B.S. majors, and most of our (very small number) of B.A. majors perform substantial amounts of undergraduate research, under the mentorship of our faculty. However, our outreach rate does not accurately reflect our on-going outreach activities, such as Prof. Julian Tyson’s long running Arsenic Project, with its very extensive community involvement.
A more insightful and useful tool than the OAPA survey collection is now becoming available: the Integrative Experience (IE) in our department. The Integrative Experience for the Chemistry major achieves learning objectives through both Projects and the **Reflective Portfolio**, **vertically integrated** throughout the major. The Portfolio will be our major assessment tool going forward, for the reasons detailed below.

In Fall, 2012, an electronic portfolio was initiated in Sophomore Seminar (CHEM 291A), an existing course that is required for all students. The purpose of this portfolio is for each student to reflect on their learning, future goals, and changing perspectives of the world and their major. Students build professional portfolios as part of their group Projects. We envision these portfolios as evolving electronic documents in which the students will relate *who* they are and *what* they have learned to that which they wish to *become*. Each portfolio entry will achieve this in three parts. The first part will be a reflection upon how personal values impacted the choice of Project, and how this Project relates to broader societal impact. The second part will be a personal assessment of what the student learned during their Project. The critical third part will be a personal reflection of how specific skills or knowledge built during the Project may impact future career or educational directions.

The departmental vision for Portfolio building is such that students will add a new entry to their portfolio upon completion of each upper-level laboratory experience. A significant advantage of the electronic Portfolio is that the students can also upload their Project reports and data, and connect these personal artifacts to a professional resume that clearly documents personal growth as a scientist and scholar over their entire major course of study. Furthermore, this provides an outstanding opportunity to assess, in depth, student learning and satisfaction with their learning experiences, vertically integrated throughout their undergraduate careers.

The Department of Chemistry will also be closely examining the results achieved in the highly innovative iCons program, of which the department is a major contributor.

**Highlighted recent activities**

The following courses were significantly re-visioned in AY 2012 - 2013 in order to implement the IE:

- **CHEM 291** (Sophomore Seminar) Initiated reflective portfolios
- **CHEM 342** (Inorganic Chemistry Lab) Project - reflection on learning
- **CHEM 513** (Instrumental Analysis Lab) Project - reflection on learning

For AY 2013 - 2014, the following courses will achieve **vertical integration**:

- **CHEM 315** (Quantitative Analysis lab) Project - reflection on learning
- **CHEM 391A** (Junior Year Writing) Resume building within the portfolio
- **CHEM 477** (Physical Chemistry lab) Project - reflection on learning