Program
Chemistry BS
Department
Chemistry
College
Arts & Sciences
Year
2013-2014

Primary Faculty:
Bruce Ault
513 556-9238
bruce.ault@uc.edu

Faculty Committee:
Estel Sprague
513 556-9237
estel.sprague@uc.edu

David Smithrud
513 556-9254
david.smithrud@uc.edu

Pearl Tsang
513 556-2301
pearl.tsang@uc.edu

Anne Vonderheide
513 556-9331
anne.vonderheide@uc.edu

Jon Breiner
513 556-0713
jonathan.breiner@uc.edu
I. Program Overview

The B.S. Chemistry program provides students with a solid broad-based foundation in the fundamentals of chemistry along with advanced courses in specialized areas of chemistry. One semester of either undergraduate research or a library-based research project is required in the BS degree program; this satisfies the capstone requirement. This program is designed for students seeking a strong foundation in chemistry while providing sufficient flexibility and free electives to take needed coursework in outside fields, such as students interested in medicine and pharmacy. The math and physics requirements of this program are designed to meet the math and physics requirements for medical school and pharmacy school applications. At the same time, students graduating from this program are able to pursue careers in chemistry after graduation or continue on to graduate school in chemistry.
II. Program Outcomes

Please include in this section your program learning outcomes as they are listed in the P-1 form in eCurriculum. If you are already planning to revise those program learning outcomes, indicate in this section which ones might be changed, and what the new program learning outcomes are likely to be. In general, learning outcomes should be measurable, assessable, or observable in some way and aligned with national standards.

1. Be able to analyze chemistry problems, apply appropriate curricular knowledge, identify correct solution methods, and solve problems correctly.

2. Execute chemistry experiments.

3. Interpret data and draw appropriate conclusions from experiments or literature.

4. Demonstrate the ability to critically evaluate literature articles.

5. Identify and assess the impact of the fundamental uncertainties in experimental measurements.

6. Present data, calculations and/or conclusions in a clear, organized and scientifically appropriate manner.

7. Use a wide variety of laboratory techniques and instrumentation with accuracy, precision and safety.

8. Find, select, and use appropriate scientific information to support his or her work.

9. Understand and demonstrate the proper procedures and safety regulations for the safe handling and disposal of chemicals and procedures to follow in case of an emergency.

10. Understand the ethical, historical, and environmental issues facing chemists and the use of chemicals in society.
III. Curriculum/Program Map

Please include in this section a grid that identifies connections that exist between required courses in this program and the corresponding program-level learning outcomes. In other words: how will program outcomes be met? This grid should further indicate the expected levels of learning at each level (whether emerging, strengthening, or achieved). The CET&L web site includes templates that you might find useful in completing this grid.

See following page
<table>
<thead>
<tr>
<th>Required Courses Identified in the P-1</th>
<th>Elective</th>
<th>senior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Learning Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyze problems clearly, solve correctly</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Execute chemistry experiments</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Interpret data/draw appropriate conclusions</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Able to critically evaluate literature articles</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Uncertainties in measurements</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Present information in a clear manner</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Use a wide variety of laboratory techniques</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Find, select, and use appropriate information</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Proper procedures and safety</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Ethical, historical, and environmental issues</td>
<td>E</td>
<td>D</td>
</tr>
</tbody>
</table>

Key:
- E - Emerging
- D – developed
- A - Achieved
IV. Methods and Measures

Please include in this section a description of the assessment methods that your program plans to use in assessing each of its program learning outcomes. These methods ideally include both direct and indirect examples of student learning, with authentic, performance-based assessment performed at all levels. You may find it helpful to include the "Assessment Measures Alignment Matrix" from Activity 5.

Faculty in the Department of Chemistry use a wide range of assessment approaches. Different approaches have been adopted as a function of class type (lecture, laboratory or research), class size (large, introductory versus smaller upper division courses) and to some degree instructor style. These include:

Exams
Quizzes
Homework (online or written)
Oral presentations, individual
Group presentations
Written reports
Personal Response System (PRS) responses
Reflective essays
Lab reports
JITT (Just in Time Teaching) activities
• As a next step with this Checklist, identify what knowledge/skills students must be able to demonstrate at various levels at the end of each required course and upon graduation, verify that they align with your program outcomes, and describe how that alignment will be measured and assessed.

Please see following pages.

Note—before “expected levels of achievement” can be adequately defined we anticipate the need to collect assessment data for a period of 2-3 years to develop a baseline picture of student academic achievement (other than on nationally standardized exams which we currently collect – see below). After this period of baseline data the Curriculum Committee will meet to define expected levels of achievement for each PLO.
<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Assessment Tools</th>
<th>Course/ Experience</th>
<th>Time Line</th>
<th>Responsible Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze problems clearly</td>
<td>Initial assessment during a term is done by homework, quizzes, PRS and JITT tools. A final exam will then be given each time the course is taught to assess the “E” and “D” states. For CHEM1040, 1041 and 2041, a nationally normed test prepared by the American Chemical Society will be used. For the “A” stage, the written report and oral presentation by the student will be used to assess.</td>
<td>CHEM1040, 1041, 2040, 2041, 2050, 3010, 3040, 4020 and 5020/5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Execute chemistry experiments</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. The final report and oral presentation will be used to assess the “A” stage.</td>
<td>CHEM1040, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Interpret data and draw appropriate conclusions</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040L, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Demonstrate the ability to critically evaluate literature articles</td>
<td>A specific writing assignment in CHEM2080 will be used to assess the “E” stage. A writing</td>
<td>CHEM2080, 5080, 5020.5030</td>
<td>Annually with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Objective</td>
<td>Description</td>
<td>Methodology</td>
<td>Frequency</td>
<td>Responsible Parties</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>-------------</td>
<td>-----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Assignment in CHEM5080</td>
<td>Assignment in CHEM5080 will be used to assess the “D” stage. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Laboratory reports</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Present information in a clear, organized and scientifically appropriate manner</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Use a wide variety of laboratory techniques and instrumentation with accuracy, precision and safety.</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040, 1041L, 2040L, 2041L, elective lab, 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Find, select, and use appropriate scientific information to support his or her work</td>
<td>Exam questions will be used to assess the “E” stage. A writing assignment in each of CHEM2080 and 5080 will be used to assess the “D” stage, and the final report and oral presentation assess the “A” stage</td>
<td>CHEM1040, 2080, 5080 and 5020/5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Understand and demonstrate the proper procedures and safety regulations for the safe handling and disposal of chemicals and procedures to follow in case of an emergency</td>
<td>Laboratory reports, unique to each lab course used for the “E” and “D” stages, will be assessed each semester. Discussion in CHEM2080 and 5080 will also be used. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040L, 1041L, 2040L, 2041L, elective lab, CHEM2080, 5080 and 5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
<tr>
<td>Understand the ethical, historical, and environmental issues facing chemists and the use of chemicals in society.</td>
<td>Exam questions in CHEM1040 will assess the “E” stage. Writing assignments and in-class discussion in CHEM2080 and 5080 will be used to assess the “D” stage. The final report and oral presentation will be used to assess the “A” stage</td>
<td>CHEM1040, 2080, 5080, 5020/5030</td>
<td>Every term with annual summary to guide changes for upcoming academic year</td>
<td>Director of Undergraduate Studies, Members of the Undergraduate Curriculum Committee</td>
</tr>
</tbody>
</table>
V. Assessment Infrastructure

Please include in this section a description of the process by which your program intends to assess its learning outcomes.

- Describe which program faculty will be charged with overseeing the execution of the assessment plan as well as the ways in which they will carry out that charge, including a description of the planned timeline for assessment.
- Identify what kinds of administrative support will be available for those faculty.

Please note that assessment plans should be capable of producing reports annually based on their review of the relevant data from their programs. The work of your faculty might also be coordinated and aligned with similar assessment efforts at the college and institutional levels.

Instructors in the identified assessment courses (curriculum map, section II) will have a primary role in assessment of exams, papers and lab reports. All faculty active in undergraduate research will be involved with assessment of the final report and oral presentation in CHEM5020/5030. Feedback from these faculty will flow to the Undergraduate Curriculum Committee, chaired by the Director of Undergraduate Studies for evaluation. Major changes in curriculum as a result of this feedback will go the the full faculty for discussion and approval.

We have used nationally normed standardized tests developed by the American Chemical Society for the past 5 or so years. These are used in General Chemistry, Organic Chemistry and in select upper division courses. Results are used in aggregate in General Chemistry and Organic Chemistry. We are not able to separate out our majors from the large number of non-majors (e.g. biology, engineering) who take these courses. Also, our concern is the the learning of all of our students, not just our majors. Our students consistently score above the national average. We use their performance to determine areas of weakness so as to increase emphasis in subsequent years. The American Chemical Society also conducts a complete review every 6 years of the courses we offer for our majors, including assessment of content and rigor. This review, which has led to continuous certification since 1940 (when certification began) is for our majors.
VI. Findings

Here you will describe and explain in this section any multi-year patterns and trends that your assessment efforts have identified, including a description of any relevant relationships to national standards.

VII. Use of Findings

In this final section, you will describe how your program intends to make use of the program-level assessment data it has gathered.

- How will this information be presented to and discussed among the faculty?
- How might this data or these discussions result in review and possible revision of course or program learning outcomes and pedagogical strategies?

The Undergraduate Curriculum Committee will review the findings each year. If a problem is identified, one of the following actions is taken:

1) The committee does not have enough data to determine if this is just an anomaly or a trend. The committee will monitor the data.

2) The committee determines the problem is with the assessment method. The committee recommends an improved method to the faculty.

3) The committee identifies a possible problem specific to a division (undergraduate courses are largely set up along divisional lines). The committee refers the matter to the faculty of that division who must respond with a solution.

4) The committee identifies a possible problem with a course outside the department. The committee refers the matter to the appropriate department and asks them to respond with a solution.

5) The committee identifies a problem with the curriculum or course sequencing. The committee develops a solution to the problem.

6) The committee identifies a problem with a specific instructor. This is referred to the Unit Head for correction.

The Undergraduate Curriculum Committee issues a report each year on the assessment.