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

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I. Program Overview

The Ph.D. program in Chemistry aims to train the next generation of Ph.D. chemists with important skills demanded by all employers (industry, academia, government). These include technical expertise in their field, the ability to define, address, and solve research problems, technical and personal leadership, and the ability to communicate orally and in writing. The cornerstone of the Ph.D. degree is the dissertation research project. During the course of the PhD project, the student learns to demonstrate his or her capacity for original research that represents a significant contribution to knowledge in the field of chemistry. The written dissertation and its successful oral defense complete the PhD degree.
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. Apply a technical knowledge base with both breadth and depth to develop creative solutions to chemical problems
2. Be able to envision and execute independent research projects
3. Explain the importance of individual research projects in the context of advancing science and society
4. Employ effective scientific communication
5. Recognize and apply ethical behavior in the conduct of science
6. Make informed career development choices
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
## Curriculum Mapping Matrix: Linking Program Outcomes to Curriculum

<table>
<thead>
<tr>
<th>Key</th>
<th>Required Courses Identified in P-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>E: Emerging</td>
<td>core courses</td>
</tr>
<tr>
<td>D: Developing</td>
<td>7021-3</td>
</tr>
<tr>
<td>A: Achieved</td>
<td></td>
</tr>
</tbody>
</table>

### Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>core courses</th>
<th>scientific writing</th>
<th>scientific ethics</th>
<th>advanced courses</th>
<th>intro research</th>
<th>research</th>
<th>2nd year seminar</th>
<th>3rd year seminar</th>
<th>dissertation /defense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply a technical knowledge base with both breadth and depth to develop creative solutions to chemical problems</td>
<td>E</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Be able to envision and execute independent research projects</td>
<td></td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>D</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explain the importance of individual research projects in the context of advancing science and society</td>
<td>E</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employ effective scientific communication</td>
<td>E, D</td>
<td>E, D</td>
<td>D</td>
<td>D</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognize and apply ethical behavior in the conduct of science</td>
<td>E, D, A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make informed career development choices</td>
<td>E</td>
<td>E</td>
<td>D</td>
<td>D, A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

- One helpful guide for this section is the “Program Assessment Checklist” (also available on the CET&L web site), which lists and describes a variety of possible assessment measures. You might include that list and then check off any of the measures that you plan to use to assess the learning outcomes in your program.

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

- Exams
- Quizzes
- Homework (online or written)
- Oral presentations (literature or research)
- Group presentations
- Written reports
- Scientific essays or term papers
- Individualized Development Plan (IDP)

- 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.

See following pages
<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Assessment Measurements</th>
<th>Course/ Experience</th>
<th>Time Line</th>
<th>Responsible Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply a technical knowledge base with both breadth and depth to develop creative solutions to chemical problems</td>
<td>Exams and/or oral presentations, unique to each of the three core courses (7021-3), will be given to assess the &quot;E&quot; stage. For Chem7071, both a written report and an oral presentation will be used. For the &quot;A&quot; stage, the written dissertation and oral defense will be used to assess.</td>
<td>Chem7021, 7022, 7023, 8000-level courses, Chem7071-introduction to research, Chem9010-research, 2nd, 3rd year research talks, closed defense</td>
<td>Every semester with annual summary to guide changes for upcoming academic year</td>
<td>Faculty members teaching the courses, Members of the Graduate Curriculum Committee for reviewing coursework requirements, Graduate Program Directors and Dissertation Committee for research talks and defense</td>
</tr>
<tr>
<td>Be able to envision and execute independent research projects</td>
<td>For Chem7071, both a written report and an oral presentation will be used for the &quot;E&quot; stage. Annual research talks will be used for the &quot;E&quot; and &quot;D&quot; stages. For the &quot;A&quot; stage, the written dissertation and oral defense will be used to assess.</td>
<td>Chem7071-introduction to research, Chem9010-research, 2nd, 3rd year research talks, closed defense</td>
<td>After 1st semester, every semester with annual summary to guide changes for upcoming academic year</td>
<td>Graduate Program Directors and Dissertation Committee for research talks and defense</td>
</tr>
<tr>
<td>Explain the importance of individual research projects in the context of advancing science and society</td>
<td>For Chem7071, both a written report and an oral presentation will be used for the &quot;E&quot; stage. Annual research talks will be used for.</td>
<td>Chem7071-introduction to research, Chem9010-research, 2nd, 3rd year research talks, closed defense</td>
<td>After 1st semester, every semester with annual summary to guide changes for</td>
<td>Graduate Program Directors and Dissertation Committee for research talks and defense</td>
</tr>
<tr>
<td>Stage</td>
<td>Description</td>
<td>Assessment</td>
<td>Frequency</td>
<td>Responsibility</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------------</td>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>A</td>
<td>The “A” stage, the written dissertation and oral defense will be used to assess</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Employ effective scientific communication</td>
<td>For Chem7011, scientific essays or term papers will be used for the “E” and “D” stages. For Chem7071, both a written report and an oral presentation will be used for the “E” and “D” stages. Annual research talks will be used for the “D” stage. For the “A” stage, the written dissertation and oral defense will be used to assess</td>
<td>Chem7011-scientific writing, Chem7071-introduction to research, 2nd, 3rd year research talks, closed defense</td>
<td>Annually with annual summary to guide changes for upcoming academic year</td>
</tr>
<tr>
<td>E</td>
<td>Recognize and apply ethical behavior in the conduct of science</td>
<td>Individual and group presentations will be used to assess the “E”, “D”, and “A” stages</td>
<td>Chem7012-scientific ethics</td>
<td>Fall semester of 1st year</td>
</tr>
<tr>
<td>D</td>
<td>Make informed career development choices</td>
<td>Individualized Development Plan (IDP) will be used in Chem7071, Chem9083, research talks, and defense.</td>
<td>Chem7071-introduction to research, 2nd, 3rd year research talks, closed defense, Chem9083-life after graduate school (elective course)</td>
<td>Annually with annual summary to guide changes for upcoming academic year</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.

Assessment of individual students occurs first during the grading of the three core courses (Chem 7021, 7022, and 7023) during their first semester in the Ph.D. program. Subsequently, assessment occurs each year during in connection with their required research talks and meetings with their committee.

Core courses: after mid term, the instructors of each core course will be asked to provide preliminary assessment (through mid-term exams and/or oral presentations) to the graduate program directors. Students with deficiency in knowledge will be advised to take remedial courses or seek additional help from the instructors. At the end of each Fall semester the instructors for the three core courses, which are currently co-taught by two instructors each, will meet with the graduate program directors to discuss the grading scales for each course. At this time, discussion will occur regarding the quality of student performance in the courses as well as the instructors’ perception of the success of the courses themselves and any feedback they have received from the students. Notes regarding these discussions will be compared to the student evaluations of these courses and a report on the core courses, including any recommendations for changes, will be prepared by the graduate program directors to present to the Graduate Curriculum Committee and the faculty.

Annual research talks: Each year of their Ph.D. studies, students in the program present a talk on their research, followed by a discussion of their progress with their committee, as follows:

- First Year: Chem 7071 (Introduction to Research).
- Second Year: Part I of Candidacy Exam.
- Third Year: Part II of Candidacy Exam.
- Fourth and subsequent years: Annual post-candidacy research talks.

Currently, each member of the committee fills out a form with written assessment of the presentation and research progress, including answers to questions that specifically address different aspects of the student’s progress as appropriate to the student’s year in the program. These comments are combined by the committee chair into a consensus.
report to provide feedback to the student. In order to obtain quantitative data for program assessment, numerical scores will be added for those questions which assess aspects of the program Learning Outcomes. These numerical scores will be separate from the written feedback provided to the student and will be used for program assessment without individual student names associated with them. The collective data will be presented to the faculty at the annual faculty retreat by the graduate program directors to highlight which Learning Outcomes are being most successfully accomplished, and which may require changes to the program for further improvement.
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.

Almost all of our graduate students have presented posters or given oral presentations at regional and national meetings of the ACS, and at specialized meetings in Ohio, nationally, and internationally. On average, our students have 4-5 publications when they graduate, most of which are written wholly or in part by the students. Most of our Ph.D. students have been successfully employed by major research institutions, teaching colleges, government research labs, and private sectors. These outcomes are excellent.

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 graduate program directors will gather data associated with program-level assessments, and share them with the Graduate Curriculum Committee. If no immediate changes are recommended by this Committee, the committee chair will report trends in these data to the chemistry faculty at its annual retreat which usually occurs just prior to the beginning of the Fall Semester. The faculty will consider the data and discuss whether any changes to the program are needed. If the Graduate Curriculum Committee has specific suggestions for changes to any aspect of the program, these suggestions will be brought to the faculty at the next scheduled monthly faculty meeting for discussion.