Program (Major, Minor, Core): B.S. in Chemistry and Biochemistry  
Department: Chemistry  
College/School: Arts and Sciences  
Person(s) Responsible for Implementing the Plan: all Chemistry faculty participate; Serfis and Martin will oversee.  
Date Submitted: November 15, 2015

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<th>Program Learning Outcomes</th>
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<td>What do you expect all students who complete the program to know, or be able to do?</td>
<td>Where is the outcome learned/assessed (courses, internships, student teaching, clinical, etc.)?</td>
<td>How do students demonstrate their performance of the program learning outcomes? How does the program measure student performance? Distinguish your direct measures from indirect measures.</td>
<td>How does the program use assessment results to recognize success and “close the loop” to inform additional program improvement? How/when is this data shared, and with whom?</td>
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Students will identify the principles of modern chemistry and demonstrate their application to a range of common systems. This includes 1) being able to perform quantitative calculations using experimental data; 2) explain the physical and chemical properties of substances based on an understanding of atomic, molecular and supermolecular structure and 3) connect observations with prior information. This includes prediction and identification of chemical/biochemical reaction products.

All majors in key foundational lecture courses including, Organic Chemistry (CHEM 2420, 2440), Analytical Chemistry (CHEM 2200), and Physical Chemistry (CHEM 3330) are tested at the end of the course to determine if we are properly covering material and students are learning all the critical chemical principles, calculations, and models. Biochemistry majors in Biochemistry II (CHEM 4620) take an additional Biochemistry exam.

We administer standardized exams in key lecture courses throughout the curriculum. These examinations are provided by the American Chemical Society and are updated every three to six years. We compare student performance on these exams with national norms to assess our student teaching and learning outcomes. A benchmark is the 70th percentile.

The faculty meet regularly to discuss the results of all assessment exams. The faculty discuss whether there is a need to re-focus our courses based on ACS exam content and student performance.
Students will apply chemical principles and techniques in a laboratory setting.

a) All BS students do undergraduate research as a requirement for our ACS certification. Individual research groups provide records of undergraduate student research participation, student theses, and activities.

b) All laboratory courses are designed to apply chemical principles and techniques in a laboratory setting. These lab courses provide exposure to experiments in all divisions of chemistry.

a) Students carry out undergraduate research projects and submit their work for presentation at regional and national meetings and for publication (as co-authors) to scientific journals. In both of these avenues, the students undergo rigorous peer review of their work by national and international external reviewers. These students submit a final written thesis in their last year.

b) Each laboratory course except Analytical Chemistry I Lab (CHEM 2205) requires a written lab report where students are expected to write introduction, experimental, results/discussion and conclusion sections as well as analyze their collected data. CHEM 2200 stresses statistical analysis of data and students are graded upon accuracy.

a) The faculty discuss issues surrounding research opportunities for students: are there enough opportunities? Is the quality of research high and of sufficient impact? These are questions that derive from the assessment data. The American Chemical Society also reviews the senior theses and provides feedback on the quality of that work. We use that feedback to ensure quality of the written research component.

b) Faculty regularly assess the lab content to make sure students are being exposed to the latest technology and discipline trends. All lab reports are graded with a rubric to demonstrate achievement of program goals. Our ACS accreditation process provides oversight of our lab offerings and program reflection.
Students will recognize, process and use scientific literature as well as clearly articulate the importance of chemical issues in the context of its impact on society.

a) Students are required to take Introduction to Chemical Literature (CHEM 3100). They learn to find/read scientific journals, and develop their written and oral communication skills. This class culminates with a presentation attended by faculty and other students.

b) Students taking capstone laboratory courses such as physical chemistry lab (Chem and Biochem majors), inorganic lab (Chem majors), analytical chemistry III lab, (Chem majors) and Biochemistry 2 lab (Biochem majors) are required to write detailed lab reports where they are required to review the literature and place their experimental findings in context of previous works.

c) Students are interviewed during the second semester of their senior year. All students enrolled in CHEM 4950 are interviewed by the Department Chair before graduation (Indirect measure).

a) Students in CHEM 3100 are required to research a current topic and use the literature to explain a current topic. They present a seminar to the students and faculty in the department, and receive feedback as well as a grade. The seminar talk is graded with a rubric that relates to coursework goals.

b) Report is scored with a rubric to demonstrate achievement of program goals.

c) Indirect measure: We conduct individual exit interviews with our graduating seniors in order to get their perceptions on the course and laboratory content of our curriculum as well as things they feel we can do better.

a) The faculty give input on these student presentations (both the topics and the student performance).

b) Faculty regularly evaluate how introductory courses prepare students for writing of detailed lab reports for capstone courses.

c) Students are queried on specific coursework and laboratory courses, on how well these courses have prepared them to be scientists, professionals, and communicators of science as they go out into the world. The faculty review and discuss the exit interview responses at the annual retreat. We decide if there are changes we can make in the way we deliver our courses, especially if there is repetition in responses.
1. It is **not recommended** to try and assess (in depth) all of the program learning outcomes every semester. It is best practice to plan out when each outcome will be assessed and focus on 1 or 2 each semester/academic year. Describe the responsibilities, timeline, and the process for implementing this assessment plan.

   Our assessment plan takes place over the course of the students’ time in our department. The ACS exams are given by the teaching faculty in courses that students take sophomore through senior year; we are constantly receiving feedback on student performance and monitoring our courses, with the benchmark being a 70th percentile. If we find that a course dips below this level we will trigger a program review of the pre-requisite courses as well as the course in question to assess the reasons behind not meeting the benchmark.

   Students complete research projects generally in their senior year and submit a written thesis to the Associate Chair; these are collected and held in a central location, as they are also used for ACS re-certification of our program. The Associate Chair communicates with each faculty member about the quality and progress of participating students. Thus, we receive feedback from ACS on the quality of the theses as well. Exit interviews are conducted by the Chair at the end of each semester. A majority are in the spring, but we do make sure to include students graduating in summer and winter terms. All faculty participate in the overall assessment plan, we all discuss the results of the three assessment tools together on an annual basis.

   The faculty also do periodic (every 3 years) reviews of the coordination of lab and lecture as well a review of how pre-requisite courses are preparing students for the courses in question.

2. Please explain how these assessment efforts are coordinated with Madrid (courses and/or program)?

   Madrid does not have a bachelor’s degree in chemistry or biochemistry. We have talked with them about offering the ACS standardized exam for organic chemistry and compare their data to ours (one of our faculty members visited their campus and let them know this).

3. The program assessment plan should be developed and approved by all faculty in the department. In addition, the program assessment plan should be developed to include student input and external sources (e.g., national standards, advisory boards, employers, alumni, etc.). Describe the process through which your academic unit created this assessment plan. Include the following:

   a. Timeline regarding when or how often this plan will be reviewed and revised. (This could be aligned with program review.)
The assessment plan is on-going; we assess on an annual basis. We will be aligned with our re-certification efforts with the American Chemical Society. This re-certification takes place every five years. Since we receive feedback from ACS, we can couple that feedback with our assessment feedback.

b. How students were included in the process and/or how student input was gathered and incorporated into the assessment plan.

We used two methods to solicit undergraduate input on the undergraduate assessment plans. First, a version of the undergraduate assessment plan was emailed to the members of the Chemistry Club executive board, which consists of 10 undergraduates. They discussed the undergraduate assessment plan at their executive board meeting. The minutes from that discussion were passed on to the faculty committee working to construct the assessment plans. Second, a revised version of the undergraduate assessment plan was distributed to four students, two senior BA chemistry majors, one senior BS biochemistry major, and one junior BS biochemistry major. Dr. Brent Znosko met with these four students. Dr. Znosko first described the purpose of the assessment plan and quickly read over the plan with the students. Dr. Znosko then asked for feedback on the plan, noting any comments and suggestions. These notes were then shared with the faculty committee working to construct the assessment plans.

c. What external sources were consulted in the development of this assessment plan?

American Chemical Society feedback from our re-certification is used, and we use ACS standardized exams to evaluate key courses.

d. Assessment of the manageability of the plan in relation to departmental resources and personnel

The assessment plan is manageable. Faculty teaching the key courses administer the ACS standardized exams and report data to the Chair. The benchmark for these exams is the 70th percentile. We purchase the newest versions of these exams. The ACS updates these every ~3 years and our re-accreditation process assures that we are keeping up with the latest trends in chemistry. The faculty discuss the assessment results regularly, including the coursework content and lecture-lab integration. The Chair conducts exit interviews then our administrative assistant tabulates the data, which is distributed for review/discussion by all faculty. The Associate Chair collects research theses and monitors student research participation with each faculty member.