

UNDERGRADUATE PROGRAM ASSESSMENT PLAN DEPARTMENT OF CHEMISTRY

MISSION STATEMENT

- The Department of Chemistry provides training in chemistry for students planning to be professional chemists, for students planning careers in the medical professions and careers in teaching, students requiring a basic chemical science background for other majors, and students fulfilling their general education science requirements. The mission of the Department of Chemistry is to provide these students with the appropriate level of modern and comprehensive chemical education required for life and work in our technologically advanced society. Central to our mission is providing students with an awareness of the achievements and contributions of chemistry as a science that help them better understand their natural environment and life. A key feature of our mission is to develop all our students into lifetime learners
- This mission is fulfilled through a range of educational opportunities and laboratory experiences that allows students to learn, discover, and explore the major chemical concepts that contribute to their lives and the lives of others around the world.
- Advanced coursework and educational activities outside the traditional classroom, such as internships and independent research, provide students the opportunity to conduct individual research projects or participate as a member of a research team. The department recognizes that advanced activities including research provide students and faculty with a logical approach to problem solving, critical thinking and the use of analytical and deductive reasoning skills and produces students who are creative problem solvers, skilled scientists, and productive members of society.
- A major component of each student's program will be laboratory experiences that provide a hands-on knowledge of chemistry. Students will also be presented procedures and protocols to aid in making informed decisions about the value and consequences of handling chemicals.

SPECIFIC ASSESSMENT GOALS AND OBJECTIVES

Most of the goals and objectives described below apply to both the BS and BA chemistry majors, who take nearly all of the same classes. The BA is intended for students with an interest in health professions. Objective A1c, below, is specific to the BA.

ASSESSMENT PLAN

A three-member departmental Assessment Committee will be formed with yearly rotating membership. One new committee member will be added each year to replace the senior retiring member. This committee will coordinate and conduct the Department's assessment activities. The Assessment Committee will determine what materials (including copies of final exams, laboratory notebooks, laboratory and other reports, student oral and written reports, oral presentations and poster sessions, and the Alumni Survey results) will be collected each semester and evaluated, consistent with the assessment schedule. Assessments of student learning outcomes will primarily utilize materials generated by senior-level or "culminating (Chem 190, and special projects/ experiments in various upper-division classes)" individual student activities. The Assessment committee will summarize its assessment activities at the end of each academic year and will then report to the Chemistry Department at a special faculty meeting called for this purpose.

The Department chair plays a key role in the assessment process, ensuring that assessments are conducted in a timely manner and that reports of assessment activities are prepared and forwarded to faculty and appropriate administrators.

- The department chair will work with the assessment committee to develop a schedule of assessment activities. It is the chair's responsibility to ensure that the schedule is prepared in a timely manner.

- The department chair will be responsible for scheduling a staff meeting where the assessment committee reports to the department, and a date for submission of the committee's final report.
- The office staff, under the supervision of the department chair, will be responsible for maintaining records of all assessment data.
- The department chair will be responsible for reporting assessment activities and results in five-year program review reports and annual reports to the dean, if such reporting is required.

The Chemistry Department believes that Chemistry 190 independent study projects and the special or "culminating" projects assigned to finish out an upper division laboratory class are good indicators of a student's cumulative learning process. Such projects require the inclusion of subject matter material in a matrix that requires the generation of hypotheses, acquisition of factual (literature) and experimental information, and the synthesis of information and data so as to be able to generate conclusions. In addition these projects require demonstration of the ability to communicate technical information in specific written and/or oral formats. As a result, the Department will focus its assessments of student learning outcomes primarily on those materials generated by senior-level or "culminating (Chemistry 190 and special projects/experiments in various upper-division classes)" individual student activities. Scoring rubrics will be used to evaluate student overall performance on selected written and/or oral reports for independent study and "capstone-type" laboratory projects within upper level courses, as well as for overall performance on these projects. Examples of scoring rubrics are attached following the section on feedback of assessment activities.

While the phrasing of the various program objectives may imply that "all" students will meet every goal, the Department is aware that this is not a realistic goal. However, the Department does expect that the majority of students graduating from the Department will meet set standards for the majority of the stated goals.

Departmental goals, objectives, and assessment activities

Cognitive goal C1. Chemistry majors should have functional knowledge of the analytical, biochemistry, inorganic, organic, and physical areas of chemistry.

Objective C1a: Students completing our program will be able to master a broad set of factual chemical knowledge concerning the properties of substances, molecules, and atoms appropriate to a chemistry degree program. Such knowledge will be consistent with specifications in the American Chemical Society guidelines for degree programs in chemistry

Outcome Criteria: Students will be able to successfully complete advanced courses in analytical, biochemistry, inorganic, organic, and physical chemistry, and will successfully perform on national standardized assessment tools (e.g. ETS field exam in chemistry)

Assessment Method: Each division within the Department will review final exams in their subject area for appropriate coverage of chemical principles. The same faculty groups will review American Chemical Society standardized tests and develop sets of Departmental expectations for students taking these tests. The Department will then administer these exams and evaluate student performance relative to expectations, and report to the Department.

Cognitive goal C2. Chemistry majors shall have learned how to think critically and analyze chemical problems.

Objective C2a: Students completing our program will be able to critically evaluate chemical information.

Outcome Criteria: Students will be able to assimilate chemical information provided and critically evaluate it.

Assessment Method: Selected research reports from Chemistry 190 and other laboratory classes will be collected and, along with oral/poster presentations, evaluated according to the appropriate scoring rubric.

Cognitive goal C3. Chemistry majors shall become formal (abstract) thinkers as well as concrete thinkers.

Objective C3a: Students completing our program will be able to collect, interpret, and evaluate numerical data in the context of basic principles and theories.

Outcome Criteria: Students will be proficient in the collection, interpretation, and evaluation of numerical data. Students will also be proficient in relating these data to basic chemical theories and principles.

Assessment Method: Selected research reports from Chemistry 190 and other laboratory classes will be collected and, along with oral/poster presentations, evaluated according to the appropriate scoring rubric.

Objective C3b: Students completing our program will be able to solve problems competently using extrapolation, approximation, precision, accuracy, rational estimation, and statistical validity.

Outcome Criteria: Students will demonstrate their ability to solve problems competently using extrapolation, approximation, precision, accuracy, rational estimation, and statistical validity.

Assessment Method: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Cognitive goal C4. Chemistry majors should have the ability to use the power of computers in applications in chemistry

Objective C4a: Students completing our program will be able to describe the applications of computers and use available software in modeling and simulation of chemical phenomena.

Outcome Criteria: Students completing our program will be able to describe the applications of computers and use available software in modeling and simulation of chemical phenomena.

Assessment Method: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Objective C4b: Students completing our program will be able to describe the applications of computers in data acquisition and processing and use available software as a tool in data analysis.

Outcome Criteria: Students will be able to demonstrate the applications of computers in data acquisition and processing and use available software as a tool in data analysis.

Assessment Method: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Performance/Skill goal P1. Chemistry majors shall have the basic analytical and technical skills to work effectively in a contemporary laboratory environment.

Objective P1a: Students completing our program will be able to perform accurate quantitative measurements.

Outcome Criteria: Students will be able to demonstrate their proficiency in a number of laboratory techniques.

Assessment Method: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Objective P1b: Students completing our program will be able to explain in depth the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results, and draw reasonable, accurate conclusions.

Outcome Criteria: Students will be able to produce experimental laboratory reports of research quality including sections on Intro, Experimental, and Conclusions.

Assessment Method: Laboratory reports from capstone experiments and/or Chemistry 190 reports will be evaluated by the Assessment Committee

Objective P1c: Students completing our program will be able to synthesize, separate, and purify, and characterize compounds using published reactions, protocols, standard laboratory equipment, and modern instrumentation.

Outcome Criteria: Students will have practiced and demonstrated proficiency in a variety of synthetic operations

Assessment Method: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Performance/Skill goal P2. Chemistry majors shall have the ability to make effective use of the library and other information resources in chemistry.

Objective P2a: Students completing our program will be able to use information technology tools such as the Internet and computer-based literature searches as well as printed literature resources to locate and retrieve scientific information including safety information (MSDS).

Outcome Criteria: Selected capstone experiment and/or Chem 190 reports will be collected and evaluated.

Assessment Method: A portfolio of graded literature reports will be reviewed by the Assessment Committee.

Performance/Skill goal P3. Chemistry majors shall have the ability to communicate effectively in both oral speech and in writing.

Objective P3a: Students completing our program will be able to explain chemical concepts and results from laboratory experimentation through effective writing and oral communication skills.

Outcome Criteria: Students will be able to demonstrate their ability to communicate chemical concepts both orally and in writing

Assessment Method: Capstone experiment reports (from Chem 102, 106, 111, 129A, 129B) or Chem 190 reports will be evaluated. Student presentations associated with these reports will be evaluated.

Affective goal A1. Chemistry majors shall have the ability to successfully pursue their career objectives, a related career, a graduate program, or further professional training following graduation.

Objective A1a: Students completing our program will be able to identify current issues of safety, ethics, and society in the use of chemicals and apply ethical principles in their professional careers.

Outcome Criteria: Students will have become aware of current issues relating to chemistry.

Assessment Method: Chemistry instructors will be surveyed by the Assessment Committee to determine which issues they have discussed in their classes. Alumni will also be surveyed to determine how such exposure to issues has benefited them in their careers.

Objective A1b: Students completing our program will be able to identify the wide variety of activities in which chemists are employed.

Outcome Criteria: Graduating students will have been provided with an understanding of their career options.

Assessment Method: Alumni will be surveyed and asked whether they were aware of the various career options open to them. The Assessment Committee will prepare an alumni survey instrument with input from other Department members. This survey will be sent to all possible alumni and the results tabulated.

Objective A1c: BA students will be successful in gaining admission to and completing advanced education in the health professions.

Assessment Method: Alumni will be surveyed and asked what they are currently doing and whether it is related to their intended health profession. Data will be collected about the rate of admission of BA majors to health professional schools.

Time frame: according to assessment schedule (see end of document).

Feedback from Assessment Activities

A departmental Assessment Committee will be formed with yearly rotating membership. This committee will analyze exams, lab reports, student oral and written reports and presentations, and the Alumni Survey. The Assessment committee will summarize its assessment activities at the end of each academic year and will then report to the Chemistry Department at a special faculty meeting called for this purpose. The Department will decide upon and carry out appropriate follow-up to all assessment activities.

Summary of Assessment Activities and Learning Outcomes

Assessment Activities	Outcomes code	Learning Outcomes
Division reviews final exams in subject areas, reviews culminating exam, sets expectations for exams	C1a C2a	Demonstrated working knowledge of chemistry Demonstrate ability to critically evaluate chemical information
Review selected reports of capstone research projects, relate to rubric 102/106/111/156 and 190	C3a C3b P1a	Demonstrate ability to collect, interpret, and evaluate numerical data Demonstrate ability to perform various laboratory skills required for quantitative measurements
Review special project laboratory reports and oral presentations 102/106/111/129/156 and 190	P1b/P3a	Demonstrate ability to prepare research quality laboratory reports
Review selected reports of capstone research projects, relate to rubric 102/106/111/156 and 190	P1c	Demonstrate ability to synthesize, separate, purify, and characterize
Review student reports of computer modeling/ comprehension exercises, relate to rubric 102/106/111/129/156 and 190	C4a	Demonstrate use of software in modeling and simulation of chemical phenomena
Review reports of computer based data collection, analysis, and reporting 102/106/111/156 and 190	C4b	Demonstrate ability to use computers to input and process measurement data and report the results
Review selected reports of capstone research projects, related to literature reports 129B	P2a	Demonstrate ability to retrieve chemical information from printed and internet sources
Review special project laboratory reports and oral presentations 102/106/111/129/156 and 190	P3a	Demonstrate ability to communicate chemical concepts
Survey department regarding issues covered in current courses. Review alumni response as to whether	A1a	Demonstrate that coverage of such subjects has a long-term benefit

coverage of issues of safety, ethics, and society was sufficient to benefit them in their careers		
Review alumni response regarding teaching of potential career options	A1b	Demonstrate that various professional career options were covered
Review alumni survey response regarding career options in the health professions (BA students)	A1c	Demonstrate that BA students were successful in achieving their career goals

Assessment Schedule - Assessment activities will be conducted, three or four per year, on a revolving basis

Time Frame/ (Schedule)	Goal /Objectives	How will the assessment be done
2002	C2/C2a, P1/P1a, P2/P2a, P3/P3a	Chemistry 190 reports and Chemistry 129B capstone-type reports will be reviewed
2003	C3/C3b, C4/C4a, P1/P1b	Chemistry 190 reports and Chemistry 111 capstone-type reports will be reviewed
2004	C2/C2a, P1/P1a, A1/A1a	Chemistry 190 reports and Chemistry 124 and 156 capstone-type reports will be reviewed
2005	C3/C3a, C4/C4b, P1/P1a	Chemistry 190 reports and Chemistry 106 capstone-type reports will be reviewed
2006	C1/C1a, A1/A1a,A1b, A1c	Chemistry Department will utilize national exams in Chemistry 106 and 128A classes and evaluate performance against faculty determined expectations Chemistry Department will conduct alumni survey and tabulate/evaluate responses

Scoring Rubrics

Written report for independent study projects and laboratory projects

A written report should be written using clear and appropriate grammar and punctuation. A written report should include the following sections:

- Title, identifying the most important components of the work.
- Abstract, concisely indicating the nature of the project.
- Introduction, combining literature information and the major objectives of the project.
- Procedures, containing all pertinent experimental information.
- Results, summarizing the data generated.
- Discussion, providing interpretation, evidence and conclusions and integrating the results into a conceptual model.
- References, including all pertinent citations.

Oral Report for independent study projects and laboratory projects.

An oral report should be in a format similar to the written report with appropriate sections. The oral report should involve:

- Use of visual aids, such as blackboard, overheads, slides, Powerpoint or other computer graphics, videotapes.
- Handouts as appropriate.
- Concise presentation of charts and graphs.
- Presentation of the main concepts, rather than reading a written report.
- Clear speech and good eye contact.
- Invites questions.
- Reviews main conclusions as an end to the presentation.

The Research (independent study) Project. The student should:

Choose the project in consultation with a faculty member as an extension of student's previous work.

- Use literature information to formulate a research hypothesis.
- State the predicted outcome of the project.
- Identify the experimental design to be used to test the hypothesis.
- Describe the experimental protocol.
- Identify specific techniques and/or instrumentation to be used.
- Proceed to more sophisticated techniques as an outcome of the project.
- Execute the experimental protocol.
- Record and evaluate data generated in the experiments.
- State major conclusions of the experiments.
- Devise further experiments following from the data derived.
- Evaluate the original hypothesis according to the experimental data.
- Interpret the data as fitting into a conceptual model, modifying the model as appropriate.