

II. SUMMARY OF ASSESSMENT

BS/BA Programs

A. Program Learning Outcomes

Program Learning Outcomes (PLO) for BS/BA Chemistry and BS/BA Biochemistry:

1. Demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry (ILO 6).
2. Use quantitative reasoning to analyze and solve chemical/biochemical problems and evaluate chemical/biochemical data (ILO 1 & 6).
3. Work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments (ILO 6).
4. Design, carry out, record and analyze the results of chemical/biochemical experiments (ILO 6).
5. Communicate chemical and biochemical issues clearly (ILO 2 & 6).

B. Program Learning Outcomes Assessed

BS/BA Programs: Based on our long-term curriculum assessment plan, the assessment focus of the academic year 2021-2022 is PLO 4. Data for assessment were collected from 3 classes: Chem 332 (Organic Chemistry II), Chem 320 (Bioanalytical and Forensic Instrumentation), and Chem 420 (Instrumental Analysis).

Instrument: Submitted work (exams and assignments) by students.

Sampling Procedure: All submitted work.

Sampling Characteristics: Written products (lab reports or written exams).

Data Collection: The data was collected in Fall 2021 and Spring 2022.

Data Analysis: The submitted work was assessed for learning mastery by the instructor-in-charge.

C. Summary of Assessment Results

Main Findings

- i. **Chem 332 (Organic Chemistry II):** data collected was from a capstone laboratory experiment in Spring 2022 where the students had to utilize a variety of chemical techniques and analyze the data to elucidate the exact identities of 2 unknown chemical compounds. The submitted written laboratory reports that reflect the mastery of experiment recording and analysis were used to assign the scores awarded to the students.

	# of students	Both correct	At least one correct	None correct	% Both correct	% One or more correct
Chemistry and Biochemistry Majors	9	6	7	2	67%	78%

Analysis: Of the 9 chemistry and biochemistry majors who finished the lab, 78% identified at least one of the two unknowns and 67% identified both. Having over 75% of the chemistry and biochemistry majors able to satisfactorily complete the experiment and identify at least one of their unknowns leads us to believe that student learning objectives in the organic chemistry lab are being met.

- ii. **Chem 320 (Bioanalytical and Forensic Instrumentation):** data was collected from a capstone experiment where the students had to analyze chemical/analytical methods to isolate, characterize, and identify 3 unknown chemical compounds. Learning mastery was assessed based on successful isolation, characterization, and identification of the compounds. The submitted written laboratory reports that reflect the mastery of experiment recording and analysis were used to assign the scores awarded to the students.

	# of students	Successful identification of at least 2 compounds
Chemistry and Biochemistry Majors	9	6 (67%)

Analysis: All the students successfully characterized and identified at last one compound, and 6 out of 9 completed 2 compounds or all three. Since the experiment covered a variety of techniques and the identification of even just one compound required the mastery of the techniques, the data we collected indicates that the learning objective has been meet.

- iii. **Chem 420 (Instrumental Analysis):** learning mastery was assessed based on the completeness and thoroughness of submitted written laboratory reports that reflected their mastery of experiment and data recording and analysis. A total of 31 lab reports were assessed throughout the semester. Each report was assigned U (unsatisfactory) or S (satisfactory).

	# of students	% Satisfactory reports
Chemistry and Biochemistry Majors	11	80%

Analysis: As 80% of the submitted reports achieved 'Satisfactory', which indicates the successful mastery of the learning objective.

Reflections, Recommendation for Program Improvements, and Next Step for Closing the Loop
Majority of the students successfully completed the learning objectives in all 3 classes. Nevertheless, due to the 1.5 years of online learning we implemented during pandemic time, we observed a decrease in the level of proficiency and comfort of the students in performing hands-on laboratory work. We would also likely encounter a similar situation for the next 2 years, where the rising junior and senior level students

did not have the opportunity to attend lab sessions in-person as freshmen and sophomores. We plan to address this by providing more detailed and thorough introduction into laboratory work, which will hopefully lead to a higher number of students achieving the learning objectives.

D. Assessment Plan for Next Year

For the coming year, we plan to assess PLO 5 (communicate chemical and biochemical issues clearly) which aligns with ILO 2 & 6 (Written Communication and Specialized Discipline, respectively) using the data collected in Chem 320 (Bioanalytical and Forensic Instrumentation), Chem 420 (Instrumental Analysis), and Chem 443 (Biochemistry Lab I). To assess the level of mastery, we will implement the ILO written communication rubric.

Masters Program

A. Program Learning Outcomes

Students graduating with a Master of Science in Chemistry will be able to:

1. demonstrate mastery of specialized knowledge in the chemical sciences beyond the undergraduate level
2. work effectively and safely in a laboratory environment using chemistry laboratory techniques and chemical/biochemical instrumentation.
3. use theoretical and experimental chemistry methods to test hypotheses or analyze and design solutions to problems
4. research, understand, organize, and critically assess information from the chemical literature
5. present complex chemical information via oral and written reports

B. Program Learning Outcomes Assessed

We assessed PLO 1: demonstrate mastery of specialized knowledge in the chemical sciences beyond the undergraduate level. In order to assess this Learning Outcome, data were collected in Chem 651 – Graduate Physical Chemistry, which is a required course for all students completing a MS in Chemistry at East Bay. Chemistry 651 is a course covering Quantum Chemistry, Spectroscopy and an introduction to Group Theory and its application to solving problems of a chemical interest.

C. Summary of Assessment Results

This course covers quantum chemistry and Group Theory. The course is assessed using embedded exam questions over several exams. 19 students completed this course. All of the students were in the MS – Chemistry program.

Exam I – Quantum Basics

Minimum Percentage	Number of Students
100%	15
75%	17
50%	19
25%	19

Exam II – Rotational and Vibrational Structure

Minimum Percentage	Number of Students
100%	12
75%	18
50%	18
25%	18

Exam III – Electronic Structure

Minimum Percentage	Number of Students
100%	2
75%	12
50%	18
25%	19

Final Exam – Group Theory

Minimum Percentage	Number of Students
100%	10
75%	17
50%	19
25%	19

Main Findings

In addition to the exams, students were also given a major assignment to create a presentation of a paper from the chemistry literature that has some relevance to this course (and hopefully to their area of research interest.) Students did very well on this assignment, with no one earning a score lower than 90%. Overall, students demonstrated a high-level of mastery of course material.

Reflections and Recommendations for closing the Loop

Students did very well in the course, with no one earning a final grade lower than B+. Overall, the area with the largest potential for improvement (although it is still a small potential) is Electronic Structure. Students struggled (again, this is a relative term, as most of the “struggles” were minor) with some of the quantitative aspects of quantum theory and spectroscopy as applied to atomic systems. In future iterations of the course, more examples and worked problems will be covered and assigned to support learning in these areas.

D. Assessment Plan for Next Year

Next year, we plan to assess PLO 2: work effectively and safely in a laboratory environment using chemistry laboratory techniques and chemical/biochemical instrumentation.