ACADEMIC SENATE

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COMMITTEE ON ACADEMIC PLANNING AND REVIEW ANNUAL PROGRAM REPORT

College	CSCI
Department	Chemistry and Biochemistry
Program Unit	Chemistry and Biochemistry
Reporting for Academic Year	2015-2016
Department Chair	Ann McPartland
Date Submitted	12/22/16

1. SELF-STUDY (about 1 page)

A. Five-year Review Planning Goals

Our last five year program review was in 2012-2013. At that time CAPR agreed that the two department programs, Chemistry and Biochemistry, overlap to the extent that it does not make sense to review them separately. The goals listed in the plan for that review included course revisions and additions, improvements to the laboratory curriculum, tenure track faculty hiring, and staff replacement. The specific goals were:

1) Revise both the lecture and laboratory components of Introduction to College Chemistry (CHEM 1100) to better serve the liberal studies majors for whom the course is required
2) Teach the inorganic chemistry series (CHEM 4161-4162) every year instead of the current alternate year schedule to meet accreditation requirements and facilitate student graduation
3) Add the new Instructional Activities in Chemistry (CHEM 4400) course as a major elective to the B.S. Chemistry, B.A. Chemistry and B.A. Biochemistry degree programs, thereby allowing students to gain credit for service learning
4) Modify three of the degree programs to meet the CSU-wide goal of 180 maximum total units
5) Provide more 6000-level courses for the Master's program
6) Incorporate newly acquired instrumentation into the laboratory curriculum
7) Continue to upgrade the instrumentation used in teaching and research by seeking funding for new gas chromatographs and microwave synthesizers for the organic chemistry laboratory classrooms and a new high performance liquid chromatograph (HPLC) with fluorescence detection to be used in several laboratory classes and for research
8) Increase the number of biochemistry and chemistry courses taught by tenured or tenure track faculty by successfully completing current tenure track hires and continuing to apply for additional hires
9) Arrange for research laboratory space and office space for new faculty members
10) Hire a new Instructional Support technician to replace one of our classroom laboratory prep technicians who sadly passed away recently

B. Five-year Review Planning Goals Progress

The department has made significant progress toward achieving the stated goals. The laboratory curriculum of the Introduction to College Chemistry course was upgraded (by Dr. LeDuc). This course has been incorporated into two new freshman learning communities, "Humans in the Natural World," established in collaboration with the Liberal Studies faculty and the Department of Earth and Environmental Science, and "STEM Pathways," being piloted this year by the CSUEB STEM Collaborative/SUCCESS Program.

Because of the hiring of a new tenure track Inorganic Chemist in 2013, we are now offering the Advanced Inorganic Chemistry series (CHEM 4161-4162) every year as required for accreditation of our B.S. Chemistry degree. We offered CHEM 4161-4162 in 2015-16 and will again schedule it in 2016-17. We have not yet added Instructional Activities in Chemistry (CHEM 4400) as an elective for our B.S. Chemistry, B.A. Chemistry and B.A. Biochemistry degrees. Some faculty members are reconsidering the idea of including this course in the B.S. Chemistry degree. CHEM 4400 was developed for the B.A. Option in Chemistry Education degrees and is required for those programs.

The three degree programs that were over 180 units were modified to meet the 180 unit maximum dictated by amendments to Title 5 by the CSU Board of Trustees in 2013. In the case of the B.S. Chemistry program we were able to comply by reducing the elective units; the units for the B.S. Biochemistry degree were reduced by removing the computer science requirement; and, unfortunately, it was necessary to delete the statistics course from the B.S. Chemistry, Option in Forensic Science degree.

In terms of increasing the number of 6000-level courses for the Master's program, we added a new graduate-level Computational Chemistry course in 2014. One of our new faculty members developed the course, which is offered under the auspices of CHEM 6510, Advanced Topics in Physical Chemistry.

We have been able to incorporate our new instruments into the laboratory curricula. These included a spectrofluorimeter, a microplate spectrometer, 14 nanodrop spectrophotometers with laptops, and specialized chemistry software (CHEM Draw), all funded through the A2E2 Instructional and Research Equipment Program. We also obtained two refractometers through the College of Science. Dr. Kim designed a new experiment that employs the spectrofluorimeter for the Instrumental Methods of Analysis course, Dr. Sommerhalter designed experiments using the microplate spectrometer for the General Biochemistry Lab course, Drs. McPartland and Sommerhalter incorporated the Nanodrop Spectrophotometers into several lab courses and Drs. Groziak and Kotchevar used the new refractometers for the organic lab curriculum. Students are introduced to the CHEM Draw software in the first year organic laboratory classes and students use it for every lecture in Dr. Groziak's Advanced Organic Chemistry course.

Over the last three years we have continued to upgrade the instrumentation in our laboratory courses. We sought and obtained funding through the A2E2 Instructional Equipment program for new gas chromatographs (GC) and fourier transform infrared spectrometers (FT-IR) for the organic chemistry program. We also obtained a new high performance liquid chromatography (HPLC) instrument with fluorescence detection for our analytical chemistry and biochemistry courses, a new GC-Mass

Spectrometer for our analytical chemistry courses, and new Initiator Microwave Synthesizers for the organic chemistry program. The computer driven GC and FT-IR instruments have provided a much more modern and satisfying experience for the organic students and the use of the modern microwave synthetic methods have been incorporated into the organic chemistry lab courses. HPLC is now routinely used for various experiments in five different courses and students are gaining hands-on experience with GC-Mass Spectrometry in three courses. In 2015-16 we also added a replacement ice maker through A2E2 and were fortunate to also obtain an Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES). The latter is not yet incorporated into the curriculum but will be used in the analytical courses for elemental analysis as well as for research in environmental chemistry conducted by our Master's students.

We have made some progress toward our goal of increasing the number of chemistry and biochemistry courses taught by tenure track faculty members. The two 2012-2013 tenure track (TT) searches conducted by the department were both successful; we hired a new biochemist and a new inorganic chemist, both of whom joined the department in Fall 2013. In 2014 we hired a tenure track physical chemist. The new hires have allowed us to reduce the number of lecturers used for majors-level and graduate courses. However, another of our faculty members, also a physical chemist, resigned in 2015 and Dr. LeDuc also left to become the Interim Director of the STEM Institute in Fall 2014 (and Interim CSCI Associate Dean in 2016). The combination of increasing enrollments in the lower division chemistry courses and loss of faculty members through resignation, administrative assignments or release time has meant that the percentage of our FTES taught by tenured or tenure track faculty actually decreased in Fall 2015 (from 49.7 % in Fall 2014 to 37.2 %). We are still using an unacceptably high number of temporary faculty. However, the lecturers are being used mostly in the lower division and general education courses. Fortunately, we were approved to conduct a tenure track faculty search during 2015-2016 and a new analytical chemist, Dr. Ruth Tinnacher, will join our department in Fall 2016.

With respect to goal no. 9, locating new research and office space for new faculty, progress was made in 2015-2016. As the result of the move of some College of Science departments to the new SF building and the reassignment of space in the Science Building , the Chemistry and Biochemistry department gained an approximately 325 sq. ft. space (Sc S452) that can be converted to a research lab. This renovation will take place during 2016-2017. The department also gained two offices; these are being used for new faculty and lecturers. (Previously our 12 lecturers and 8 Teaching Associates were all crammed into one 280 sq. ft. room). Finally we did hire a new Instructional Support Technician.

C. Program Changes and Needs

Although no specific needs for changes in our Five Year Plan emerged during 2015-2016, the department engaged in a number of additional activities. Our faculty benefited from the Faculty Support Grant (FSG) programs. Five of the eight faculty members were awarded an FSG to support research activity. Several undergraduate and Master's students working on research projects with our faculty were awarded Research Scholarships from the campus Center for Student Research. Dr. Patrick Huang obtained a federal subcontract for collaborative research with Lawrence Livermore National Labs. The department also obtained an Enhanced Course Learning (ECL) grant (under A2E2) to defray some of the costs of innovative classroom laboratory experiments. We also secured funding for release time from the CSUEB administration for semester conversion work by the faculty.

The Semester Conversion/Transformation planning was a major undertaking for 2015-2016. Our Bachelor of Science degrees, the Master of Science program, and the Foundational Level General Science Certificate all underwent transformation while the Bachelor of Arts degrees were more or less directly converted to semester versions. While at the same time adhering to the requirements of our accrediting agency (American Chemical Society) for the B.S. Chemistry degree program, we made significant changes in the requirements for the B.S. degrees and developed outcomes for a number of new courses. Where appropriate we consulted with other departments that provide service courses for our majors. The M.S. program was completely revised with a view toward modernizing the program and making it a better fit for our students. A number of the current requirements were dropped and four new courses were added.

The semester conversion process included participation of the entire Chemistry and Biochemistry faculty. Together we decided on the transformations and conversions and elected a Semester Conversion Coordinator to organize the process. Each faculty member took responsibility for several courses and developed course outcomes and evidence of transformation (where appropriate) for the Semester Conversion New Course Requests. A subset of the faculty consulted with relevant departments regarding the chemistry service courses. They worked with those departments to effect transformation where appropriate and completed the New Course Requests for the services courses. Dr. LeDuc collaborated with three other departments to transform courses offered through the Foundational Level General Science Certificate to include the new State of California Next Generation Science Standards. All of our programs and new courses were approved by the College Curricular Committee by the end of the academic year 2015-2016.

In 2015 one of our faculty members, Dr. Anthony Masiello, resigned his position at CSUEB after a two year professional leave. Dr. Danika LeDuc served as Interim Director of the STEM Institute in 2014-2016 and in mid-2016 was chosen as Interim Associate Dean. The new Dean has expressed his desire that she continue as permanent Associate Dean and that will likely happen in 2017. We have been approved to conduct another tenure track faculty search in 2016-2017.

Besides the drop in % FTES taught by tenure track faculty, the department APR Standard Data show a few other relatively minor changes in the Student and Faculty statistics from 2014 to 2015. The number of undergraduate majors went from 199 in Fall 2014 to 193 in Fall 2015, and the number of graduate students decreased from 42 to 32. The drop in graduate students was due in part to stricter admission requirements. The number of degrees awarded in 2014-15 also decreased for both degree levels, from a total of 56 in 2013-14 to 42 in 2014-15. Total FTES for the department was up from 351.1 in 2014 to 373.1 in 2015, reflecting the continuing upward trend we have experienced over the last five years in service course enrollments. We offered one more class section in 2015 as last year and our Student/Faculty ratio was similar (22.7 vs. 22.8).

2. SUMMARY OF ASSESSMENT

A. Program Student Learning Outcomes

Students graduating with a B.A./B.S. in Chemistry or Biochemistry from Cal State East Bay will:

1. demonstrate knowledge in the various areas of chemistry, including inorganic chemistry,

analytical chemistry, organic chemistry, physical chemistry, and biochemistry.
2. work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments.
3. use quantitative reasoning to analyze chemical problems and evaluate chemical data.
4. write and speak clearly on chemical or biochemical issues.
5. work collaboratively in teams to solve chemical problems.

Students graduating with a Chemistry M.S. from Cal State East Bay will :

1. demonstrate specialized knowledge in the chemical sciences beyond the undergraduate level.
2. work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems.
3. understand, organize, and critically assess information from the chemical literature.
4. present complex chemical information via oral and written reports.
5. work collaboratively in teams to solve chemical problems.

B. Program Student Learning Outcome(s) Assessed

B.S./B.A. Chemistry or Biochemistry: This was the third year of the official five year assessment plan for the department. As planned for Year 3 we specifically concentrated on Program Learning Outcome #3 (PLO-3), assessment of quantitative reasoning. In addition we continued to assess program content through PLO-1 (demonstrates chemical knowledge) and PLO-2 (works effectively in a laboratory environment). Where possible comparisons were made with results from previous years.

M.S. Chemistry: As stated in the Assessment Plan, during 2015-2016 we specifically focused on PLO-3 which concerns understanding, organizing, and critically assessing information from the chemical literature. We also continued to assess PLO-1 (demonstrates specialized chemical knowledge beyond the undergraduate level) and PLO-2 (works effectively in a laboratory environment to test hypotheses or solve problems using instrumentation).

C. Summary of Assessment Process

Quantitative reasoning assessment for the undergraduate programs focused on specific learning outcomes in the areas of physical chemistry (CHEM 3512-3513), inorganic chemistry (CHEM 4161-4162), analytical chemistry (CHEM 4240), and biochemistry (CHEM 4430) using embedded exam questions and laboratory reports. For analytical, organic inorganic and biochemistry, general knowledge (PLO-1) was also assessed. Laboratory assessment (PLO-2) was conducted in capstone laboratory exercises measuring ability to critically analyze experimental results in CHEM 3303, CHEM 4240 (Instrumental Methods of Analysis) and CHEM 4430 (General Biochemistry Laboratory).

At the Master's level, the ability to critically assess information from the chemical literature was measured through the Seminar course CHEM 6820. Knowledge of chemical information and the ability to generate and critically analyze experimental results was conducted through capstone laboratory exercises in CHEM 6430 (Protein Chemistry Techniques) and CHEM 4240 (Methods of Instrumental Analysis).

D. Summary of Assessment Results

The detailed department assessment results for this reporting period are given in Appendix A. We were able to evaluate undergraduate student performance for PLO-3, this year's focus, in four areas of chemistry for the Chemistry majors and three areas for the Biochemistry majors. Assessment results for PLO-1 and PLO-2 are also reported for several areas. PLO-3 states that students will "use quantitative reasoning to analyze chemical problems and evaluate chemical data." The best data for this PLO are available for physical chemistry (CHEM 3512-3513) for both chemistry and biochemistry majors, analytical chemistry (CHEM 4240) for the chemistry majors, and biochemistry laboratory (CHEM 4430) for the biochemistry majors. In each case specific course learning outcomes that required quantitative reasoning were assessed. The results are a little disappointing and tend to indicate that the ability to master an outcome is quite dependent on the difficulty of that specific outcome.

In the second quarter of physical chemistry (Winter 2016) only 29% of the chemistry majors earned 75% or more of the possible points for “formulating a mathematical description of the motion of a particle,” although 71% earned 50% or more of the points. The biochemistry majors did better, with 57% achieving above 75% of the points and 86% achieving above 50% of the points. Similar results were seen in the third quarter of physical chemistry for the Student Learning Outcome (SLO) “be able to calculate reaction order,” with only 25% of the Chemistry majors able to do the calculation correctly and 50% of the biochemistry majors mastering the outcome. These SLOs are difficult quantitative challenges but we hope to see improvement next year. The instructors are introducing regular use of in-class, active, cooperative learning activities. Hopefully these will provide an opportunity for both students and instructors to emphasize quantitative SLOs.

The chemistry majors did well for PLO-3 in the analytical chemistry course (CHEM 4240). For course specific learning outcome “apply Beer’s Law for V/Vis spectroscopy,” 82% answered the question correctly and therefore mastered the outcome.

The biochemistry majors were challenged with a number of quantitative specific course outcomes in the General Biochemistry Laboratory course. The percentage of students who correctly mastered the outcomes ranged from 100% for protein purification calculations to 75% for enzyme kinetic calculations to 63% for buffer calculations to as low as 25% for calculation of enzyme activity from assays. The instructor will give special attention to analysis of enzyme activity data during the upcoming year.

From these assessment data for PLO-3, we are forced to conclude that while most of our chemistry and biochemistry majors are proficient in straightforward quantitative problem solving, a number of our majors are only partially mastering the more difficult challenge of using quantitative reasoning to analyze complicated chemical problems. We will work to provide the students with better explanations, more learning activities relating to quantitative problems, and more opportunities for one on one assistance on these difficult SLOs.

Assessment data were also collected for PLO-1 (demonstrate knowledge in various areas of chemistry) and PLO-2 (laboratory proficiency) for several advanced undergraduate courses. For PLO-1 the courses assessed were CHEM 3303 (Organic Chem), CHEM 4162 (Inorganic Chem), CHEM 4240 (Analytical Chem), and CHEM 4412 (Biochemistry Lecture II). The methods used were embedded exam questions or a standardized national exam. To measure mastery of PLO-2, specific course outcomes for the laboratory components of CHEM 3303 (Organic Chem), CHEM 4240 (Instrumental Methods) and CHEM 4430 (General Biochem Lab) were monitored using embedded exam questions or analysis of laboratory notebooks. The resulting data is summarized in the Appendix and a more detailed analysis can be found in the 2015-2016 Assessment Report for the Department of Chemistry and Biochemistry on the CSCI web site.

In the case of CHEM 3303 (the third quarter of a year-long organic chemistry series), where a standardized national exam prepared by the American Chemical Society was used to assess student knowledge, 9/23 of the Chemistry and Biochemistry majors were at or above the 40^{th} percentile in the nation, with the average percentile for all majors at 33%. Problem areas were identified by the instructors, who will give more emphasis to the theory and application of these topics next year. For the other undergraduate courses assessed for PLO-1 and PLO-2, student performance was variable and areas of strength and weakness were readily detected. As in the past, instructors will use these results to design innovative teaching strategies targeting areas of weakness.

For the Master's program we focused on PLO-3, which concerns the ability to understand, organize and critically assess information from the chemical literature. Assessment was conducted for CHEM 6820 (Graduate Seminar), CHEM 6430 (Protein Chemistry Techniques) and CHEM 4240 (Instrumental Methods). We were able to assess PLO-3 for all three courses and also PLO-1 and PLO-2 for CHEM 6430 and CHEM 4240.

CHEM 6820 is taken three times by the M.S. degree candidates. Each quarter they are required to critically analyze a paper from the chemical literature and give an oral presentation of their findings. The students are given guidance on how to analyze the scientific content of the paper and prepare an effective presentation. They receive peer critiques as well as feedback from the instructor. Our objective is to see the quality of the presentations improve as students progress through the three seminar courses. This year's data demonstrates that, on average, students improved from their first seminar to their last seminar in their ability to understand, organize and present a journal article (Table 7, Appendix). By their third seminar, more than 75% of the students gave a presentation that exceeded expectations, whereas only 43% exceeded expectations for their first seminar. This indicates that students are improving their analytical, organizational and presentation skills as they move through the three required CHEM 6820 courses.

Assessment of SLO-3 for the Protein Chemistry Techniques course (CHEM 6430) did not provide such encouraging results. Performance on embedded exam questions requiring critical analysis of experimental data was assessed for course student learning outcomes 1, 2 and 6 (Table 8). The student sample was unusually small this year, with only three M.S. Chemistry majors taking this class. None of the three mastered SLO-2 and two of the three mastered SLOs 1 and 6. Of eleven students who took the class, only 45% mastered SLO-2, the specific activity outcome. It is obvious that this topic needs more emphasis. A special exercise on analysis of protein purification data that includes calculation of specific activity will be assigned next year as a group activity with a subsequent discussion of the class results planned. All of the M.S. Chemistry majors mastered the chemical knowledge SLOs (#s 3,4,5), which assessed PLO-1 (Table 8), and analysis of the student notebooks indicated that all three students were able to effectively use instrumentation and biochemical methods to solve experimental problems and test hypotheses for at least two of the three SLOs monitored (Table 9).

Assessment of ability to critically analyze experimental results was based on student performance on laboratory notebooks for CHEM 4240 Instrumental Methods). Although the student sample was small (just two M.S. students), both students were able to master the two of the three course SLOs measuring PLO-3 (#3, 6, 7). Embedded exam questions were used to assess the chemical knowledge SLOs (#1,4) and the lab proficiency SLOs (#2,5) Student performance was acceptable for SLO-2. However, performance for SLO-5, which relates to advanced spectroscopy was disappointing (success rate 0%). The instructor will work to improve student learning in this area next year by developing special exercises on the analysis of data generated by nuclear magnetic resonance and other types of spectroscopy.

3. STATISTICAL DATA (about 1 page)

Academic Program Review (APR) Standard Data for College years 2011 to 2015 is provided in the table. This includes the number of student majors, degrees conferred, faculty and academic allocation data, student/faculty ratios and course history. The source for this information was: http://www.csueastbay.edu/ir/academic-program-review.html.

California State University, East Bay

APR Summary Data

Fall 2011 - 2015

Chemistry and Biochemistry					
	Fall Quarter				
	2011	**2012**	**2013**	**2014**	**2015**
A. Students Headcount					
1. Undergraduate	180	217	204	199	193
2. Post baccalaureate	2	0	0	0	0
3. Graduate	54	58	51	42	32
4. Total Number of Majors	236	275	255	241	225
	College Years				
B. Degrees Awarded	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**
1. Undergraduate	30	34	38	42	30
2. Graduate	13	10	13	14	12
3. Total	43	44	51	56	42
	Fall Quarter				
	2011	**2012**	**2013**	**2014**	**2015**
C. Faculty					
Tenured/Track Headcount					
1. Full-Time	7	7	9	9	8
2. Part-Time	0	0	0	0	0
3a. Total Tenure Track	7	7	9	9	8
3b. % Tenure Track	36.8%	38.9%	45.0%	40.9%	33.3%
Lecturer Headcount					
4. Full-Time	0	0	0	0	0
5. Part-Time	12	11	11	13	16
6a. Total Non-Tenure Track	12	11	11	13	16
6b. % Non-Tenure Track	63.2%	61.1%	55.0%	59.1%	66.7%
7. Grand Total All Faculty	19	18	20	22	24
Instructional FTE Faculty (FTEF)					
8. Tenured/Track FTEF	6.3	5.1	6.3	7.5	5.9
9. Lecturer FTEF	7.4	8.6	7.3	7.9	10.5
10. Total Instructional FTEF	13.6	13.7	13.7	15.4	16.4
Lecturer Teaching					
11a. FTES Taught by Tenure/Track	168.0	157.8	156.4	174.3	138.7
11b. % of FTES Taught by Tenure/Track	55.6%	46.8%	45.9%	49.7%	37.2%
12a. FTES Taught by Lecturer	134.2	179.2	184.0	176.7	234.5
12b. % of FTES Taught by Lecturer	44.4%	53.2%	54.1%	50.3%	62.8%
13. Total FTES taught	302.2	337.0	340.4	351.1	373.1

14. Total SCU taught	4533.0	5055.0	5106.0	5266.0	5597.0
D. Student Faculty Ratios					
1. Tenured/Track	26.7	31.1	24.7	23.2	23.3
2. Lecturer	18.3	20.8	25.1	22.4	22.4
3. SFR By Level (All Faculty)	22.2	24.6	24.9	22.8	22.7
4. Lower Division	22.1	25.4	27.8	26.5	26.1
5. Upper Division	23.6	25.7	24.4	20.5	20.1
6. Graduate	14.9	14.4	10.8	8.3	7.7
E. Section Size					
1. Number of Sections Offered	71.0	83.0	80.0	83.0	84.0
2. Average Section Size	32.5	32.9	33.2	30.7	32.3
3. Average Section Size for LD	32.7	33.3	34.4	34.1	36.0
4. Average Section Size for UD	32.4	31.9	32.1	26.5	27.8
5. Average Section Size for GD	27.5	33.5	22.5	17.0	14.5
6. LD Section taught by Tenured/Track	10	9	6	9	7
7. UD Section taught by Tenured/Track	15	12	17	18	18
8. GD Section taught by Tenured/Track	14	20	19	19	16
9. LD Section taught by Lecturer	25	32	34	34	35
10. UD Section taught by Lecturer	6	11	4	7	10
11. GD Section taught by Lecturer	1	0	1	0	1

Source and definitions available at: http://www.csueastbay.edu/ira/apr/summary/definitions.pdf

	Fall Quarter				
Headcount Enrollment	**2011**	**2012**	**2013**	**2014**	**2015**
Chemistry					
1. Undergraduate	76	90	89	81	86
2. Post baccalaureate	0	0	0	0	0
3. Graduate	54	58	51	42	32
4. Total Number of Majors	130	148	140	123	118
Biochemistry					
1. Undergraduate	104	127	115	118	107
2. Post baccalaureate	2	0	0	0	0
3. Graduate	0	0	0	0	0
4. Total Number of Majors	106	127	115	118	107

	College Years				
Degrees Awarded	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**
Biochemistry					
1. Undergraduate	23	25	28	26	17
2. Graduate	0	0	0	0	0
3. Total Number of Majors	23	25	28	26	17
Chemistry					
1. Undergraduate	7	9	10	16	13
2. Graduate	13	10	13	14	12

3. Total Number of Majors	20	19	23	30	25

Student Demographics of Majors:

A. Undergraduate Chemistry and Biochemistry Majors:

Gender: 40% Male, 60% Female
US Citizens: 73%
Non-Citizens: 27%
Ethnicities of US Citizens: African American 0%; Asian 34%; Hispanic 21%; White 38%; Other 7%.

B. Master's Students:

Gender: 69% Male, 31% Female
US Citizens: 38%
Non-Citizens: 62%
Ethnicities of US Citizens: African American 20%; Asian 40%; Hispanic 0%; White 40%; Other 0%.

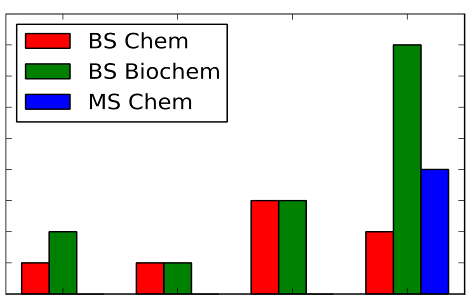
APPENDIX A - Assessment Data for 2015-2016

Undergraduate Programs - Chemistry and Biochemistry:

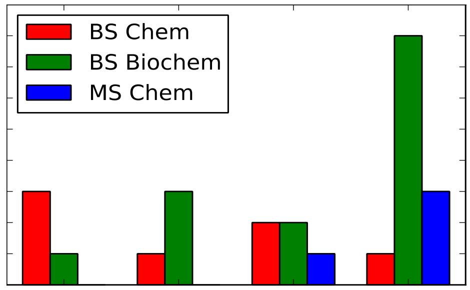
A. CHEM 3512: Embedded Exam Questions. Assessment of PLO-3 for Physical Chemistry II course.

Three specific course outcomes tested using embedded questions on the final exam. Learning outcomes and corresponding distributions of scores are given for B.S. Chemistry majors (7), B.S. Biochemistry majors (14) and Other (4).

Learning outcome 1: Formulate the mathematical description for the quantum mechanical motion of a particle.



Learning outcome 2: Model the vibration and rotational motion of molecules.



B. CHEM 3513: Embedded Exam Questions. Assessment of PLO-3 for Physical Chemistry III course.

Assessment criteria relevant for Chem3513	Questions embedded in the Final exam
1. understand the importance of rates of chemical reactions in the overall scheme of chemistry.	Not assessed
2. be able to calculate reaction order from the time dependence on concentration.	Final Question 10
3. be able to understand and describe transition state theory.	Final Question 7
4. understand how statistics and probability can be used to develop thermodynamic concepts.	Midterm Question 10
5. be knowledgeable about catalysis	Final Question 14

BS Chemistry Majors: 4 students

Assessment Criterion	Exam question	Number of correct answers*	Percentage with correct response
2	Q10	1	25%
3	Q7	2	50%
4	Midterm Q10	2	50%
5	Q14	1	25%

*Partial credit was applied. If 75% of all possible points were earned, the answer was counted as correct.

BS Biochemistry Majors: 21 students

Assessment Criterion	Exam question	Number of correct answers*	Percentage with correct response
2	Q10	8	38%
3	Q7	11	52%
4	Midterm Q10	14	67%
5	Q14	12	57%

*Partial credit was applied. If 75% of all possible points were earned, the answer was counted as correct.

C. CHEM 4240: Embedded Exam Questions. Assessment of PLO-3 and PLO-2 for Instrumental Methods of Analysis course.

Table 1. Assessment Results for 20-22 Undergraduate Chemistry Majors: Winter 2016*

Learning Outcome	Assessment Tool	Average % of students with correct answers
1 - Light and Matter	Midterm Q3	70
2 -Beer's Law	Final Q8	82
3 - Spectroscopy	Midterm Q8	50
4 - Optical Instrumentation	Final Q3 and Q4	39
5 - Nuclear Magnetic Resonance	Final Q1 and Q12	25
6 - Chromatographic Separations	Final Q7 and Q10	55

*Where partial credit was given the answer was counted as correct if at least 67% of the total possible points were awarded. Unfortunately, the midterms of two undergrads were never returned that their data were not recorded.

D. CHEM 4430: Laboratory notebook quality, experimental results and embedded exam questions. Assessment of PLO-3 and PLO-2 for General Biochemistry Laboratory course.

Table 2. Assessment Results for BS Chemistry Majors (2 Students) - Fall 2015

Learning Goal	Assessment Tool	% of students with correct analysis or answer*
2 - Perform assays, analyze data	Question 9	100
3 - Purification Table calculations	Question 8	100
4 - Enzyme kinetics data and graphs	Lab Notebook Analysis/Report	100
4 - Enzyme kinetics data and graphs	Multiple Choice Questions	100
6 - Perform electrophoresis	Gel Photograph,	100
6 - Perform electrophoresis	Question 12	50
7 - Develop appropriate notebook	Final Lab Notebook Score	100
1 - Prepare buffer	Questions 6,7	100, 100
5 – Liquid Chromatography	Question 10, 11	100

*Partial credit was applied to exam questions and lab notebook grading. If 75% off all possible points were earned, the answer was counted as correct.

Table 3. Assessment Results for BS Biochemistry Majors (8 Students) - Fall 2015

Learning Goal	Assessment Tool	% of students with correct

		analysis or answer*
2 - Perform assays, analyze data	Question 9	25
3 - Purification Table calculations	Question 8	100
4 - Enzyme kinetics data and graphs	Lab Notebook Analysis/Report	75
4 - Enzyme kinetics data and graphs	Multiple Choice Questions	50
6 - Perform electrophoresis	Gel Photograph	87.5
6 - Perform electrophoresis	Question 12	12.5
7 - Develop appropriate notebook	Final Lab Notebook Score	87.5
1 - Prepare buffer	Questions 6, 7	62.5, 37.5
5 – Liquid Chromatography	Question 10, 11	37.5, 50

Table 4. Assessment Results for BA Biochemistry Majors (3 Students) - Fall 2015

Learning Goal	Assessment Tool	% of students with correct analysis or answer*
2 - Perform assays, analyze data	Question 9	0
3 - Purification Table calculations	Question 8	100
4 - Enzyme kinetics data and graphs	Lab Notebook Analysis/Report	66
4 - Enzyme kinetics data and graphs	Multiple Choice Questions	66
6 - Perform electrophoresis	Gel Photograph	75
6 - Perform electrophoresis	Question 12	33
7 - Develop appropriate notebook	Final Lab Notebook Score	66
1 - Prepare buffer	Questions 6, 7	33, 33
5 – Liquid Chromatography	Question 10, 11	0, 33

*Partial credit was applied to exam questions and lab notebook grading. If 75% off all possible points were earned, the answer was counted as correct.

E. CHEM 3303: Capstone Lab Exercise (Identification of two unknown chemicals). Assessment of PLO-2 for Organic Chemistry III course.

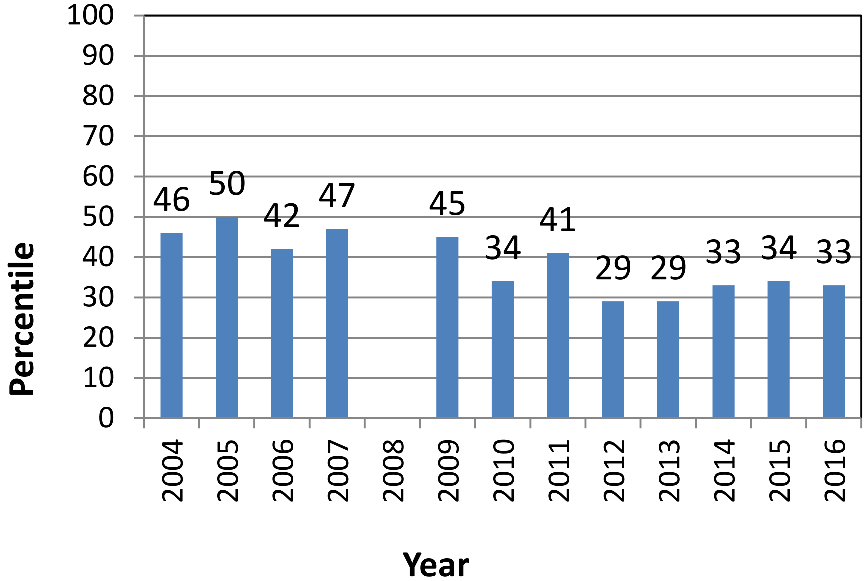
Table 5. Results of Capstone Organic Laboratory Assignment during 2010– 2016 for Chemistry and Biochemistry Majors

Year	# of Chem/Biochem Majors	# with both correct	% Both Correct	# with at least one correct	% At least one correct
Sp 2004	18	13	72	17	94
Sp 2005	22	9	41	22	100
Sp 2006	22	18	82	22	100
Sp 2007	12	5	42	10	83
Sp 2008	10	7	70	9	90
Sp 2009	17	10	74	14	95
Sp 2010	25	12	48	21	84
Sp 2011	26	15	58	23	88
Sp 2012	25	13	52	21	84
Sp 2013	32	21	66	29	91

Sp 2014	24	11	46	22	93
Sp 2015	26	16	62	25	96
Sp 2016	23	14	61	20	87

F. CHEM 3303: Standardized National Exam. Assessment of PLO-3 and PLO-1 for Organic Chemistry III course.

Figure 1. Results National Exam 2004 – 2016 for Chemistry and Biochemistry majors.



G. CHEM 4412: Embedded Exam Questions. Assessment of PLO-1 for General Biochemistry II course - Winter 2016

Course Learning Outcomes:

1. Distinguish the classes of lipids found in biological systems.
2. Demonstrate knowledge of biological membrane structure/function and mechanisms of active and passive membrane transport.
3. Explain the basic principles of bioenergetics and analyze the standard and actual free energy changes of biochemical reactions
4. Outline and summarize key cellular metabolic processes
5. Discuss the importance of metabolic regulatory mechanisms

Total number of students: 68 enrolled, 1 withdrew on February 10th 2016, one was assigned WU grade for missing the final exam.

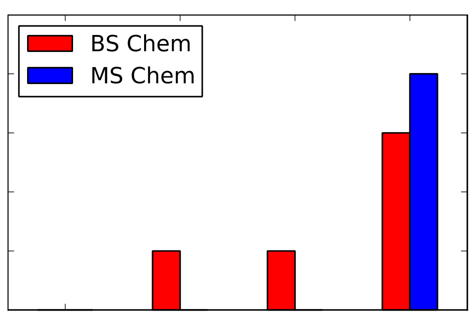
Results:

Learning Outcome	MS Chem (2 Students	BA/BS Chem (1 Student)	BA/BS Biochem (16 Students)	BA/BS Others (47 Students)	Total (all majors, 66 Students)	Question Source
#1 and #2, with >70% correct answer	1/2 (50%)	0/1 (0%)	6/16 (37.5%)	18/47 (38.3%)	25/66 (37.9%)	Final exam # 1 or #3
#4, with >80% correct answer	1/2 (50 %)	0/1 (0%)	5/16 (31.3%)	24/47 (51%)	30/66 (45.5%)	Final exam # 8
#5, With >50% correct answer	1/2 (50 %)	0/1 (0%)	7/16 (43.8%)	17/47 (36.2%)	24/66 (36.4%)	Final exam # 6 or # 7

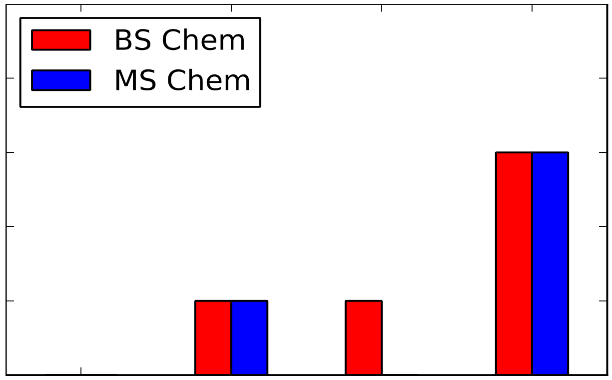
H. CHEM 4161-4162: Embedded Exam Questions. Assessment of PLO-1 for Advanced Inorganic Chemistry II course - Winter 2016.

Assessment focused on the 2nd quarter of the sequence, CHEM 4162, which builds on the foundation developed in CHEM 4161. Two specific course outcomes were tested with multi-part questions. Learning outcomes and corresponding distributions of scores are given for B.S. Chemistry majors (5) and M.S. Chemistry candidates (4).

***Learning outcome 1**: Illustrate and classify the structures of coordination complexes*



***Learning outcome 2**: Formulate and apply theories for the bonding and magnetic properties of* *coordination complexes.*



Graduate Program - M.S. Chemistry:

A. CHEM 6820 Graduate Seminar: Assessment of ability to understand, organize, and critically assess information from the chemical literature (PLO-3).

Table 6. Seminar Presentation Ratings for 2015-2016

Academic Year	**1st Seminar**		**2nd Seminar**		**3rd Seminar**	
	# of students	average score	# of students	average score	# of students	average score
2015-2016	7	82%	11	90%	12	92%

Table 7. Analysis of student improvement in consecutive seminars for 2015-2016.

First Seminar

Academic Year	**# of Students**	**Met Expectations***		**Exceeded Expectations**	
		#	%	#	%
2015-2016	7	7	100	3	43

Second Seminar

Academic Year	**# of Students**	**Met Expectations**		**Exceeded Expectations**	
		#	%	#	%
2015-2016	11	11	100	11	100

Third Seminar

Academic Year	# of Students	Met Expectations		Exceeded Expectations	
		#	%	#	%
2015-2016	12	12	100	9	75

*A score of 12/16 was defined as meeting expectations and a score of 14/16 was defined as exceeding expectations.

B. CHEM 6430: Assessment of demonstrated specialized knowledge (PLO-1), effective use of modern instrumentation (PLO-2), and ability to critically analyze experimental results (PLO-3).

Assessment Tool 1: Embedded Exam Questions

Table 8. Assessment Results for M.S. Chemistry Majors*: Winter 2016

Learning Outcome	Assessment Tool**	Average % of students with correct answers
1 -Differential Solubility	Exam I, Q4	67
2-Specific Activity	Exam I, Q 5	0
3-High Performance Liq. Chromat.	Exam I, Q11 Exam II, Q6	100 100
4-SDS-PA Electrophoresis	Exam II, Q7	100
5 - Isoelectric Focusing	Exam II, Q11	100
6 - Mass Spectrometry, Proteomics	Exam II, Q12	67

*3 students

**Credit was given for embedded exam questions if 75% of the possible points were earned.

Assessment Tool 2: Quality of laboratory notebooks.

Table 9. Notebook Assessment Results for M.S. Chemistry Majors*: Winter 2016

Laboratory Notebook Learning Goal	% Students Meeting Expectations**
1 - Effective use of instrumentation (HPLC) to solve experimental problem	67
2 - Effective use of biochemical method (affinity chromatography) to solve an experimental problem	100
3 - Effective use of biochemical method (IEF/SDS-PAGE) to test a hypothesis	100

*3 students

**A rating of Exemplary or Basic indicated the student met expectations

C. CHEM 4240: Assessment of demonstrated specialized knowledge (PLO-1), effective use of modern instrumentation (PLO-2), and ability to critically analyze experimental results (PLO-3).

Course Student Learning Outcomes:

Students who successfully complete this course will be able to:

1. Understand the fundamental principles behind various spectroscopic techniques.
2. Understand the concept of Beer's law and its application for UV/Vis spectroscopy.
3. Understand the principle behind LASER as a radiation source.
4. Acquire knowledge upon the basic components and the layout of optical instruments.
5. Understand the physical principles of NMR and analyze the first order NMR spectra of organic compounds for calculation of their mass percentages in a sample.
6. Understand the principles of chromatography and its application for analysis on a mixture of organic compounds.
7. Assess average sensitivity as well as limit of detection of an optical spectrometer.

Assessment Tool: Embedded Questions in the lab reports and the final exam

Embedded Question	SLO #	# of master's degree students	# of students with correct answer	% with correct answer*
Midterm Q4	1	2**	2	100
Final Q5	1	2	1	50
Midterm Q1	2	2	2	100
Midterm Q2	2	2	1	50
Final Q9	3	2	2	100
FT-IR Lab question	3	2	1	50
Final Q3	4	2	1	50
Final Q4	4	2	2	100
Final Q1	5	2	2	100
Final Q2	5	2	0	0
Final Q12	5	2	0	0
Final Q7	6	2	2	100
Final Q10	6	2	2	100
HPLC-lab question	6	2	2	100
Lab #7(building your own Spectrometer) question	7	2	2	100

Final Q3	7	2	1	50

*Where partial credit was given, the answer was counted as correct if at least 75% of the total possible points were awarded.

**Only two master's degree students took this course in 2016 winter quarter. More data points were needed for more meaningful assessment.

APPENDIX B - Curriculum Map for Student Learning Outcomes Assessment

Curriculum Map for Student Learning Outcomes Assessment, CSU East Bay

Degree: **B.A./B.S. Chemistry and Biochemistry Degrees** **Dept:** **CHEM**

Levels: **I**=Introduced; **P**=Practiced; **M**=Mastered (terms adopted from WASC recommendations)

Indicators Symbols: A=Assignments; E=Essays; R=Research Project/Papers; T=Objective Tests; X=Exams of Mixed Types (tests, short answers, essays); O=Other Types of Work e.g., **T50**=The indicator is an Objective Test, which constitutes 50% of the course evaluation

Reveal SLO/ILO text: Mouse over each SLO or ILO, the full text of that SLO/ILO will show on the screen.

Serial #	Course Prefix	Course #	SLO1	SLO2	SLO3	SLO4	SLO5		ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	Note
01	CHEM Indicators	1101	I	I	I	I	I		I	I		I	I	I	
02	CHEM Indicators	1102	P	P	P	P	P		P	P		P	P	P	
03	CHEM Indicators	1103	P	P	P	P	P		P	P		P	P	P	
04	CHEM Indicators	2200	P	P	P	P	P		P	P		P	P	P	
05	CHEM Indicators	3200	P	P	P	P	P		P	P		P	P	P	
06	CHEM Indicators	3301	P	P	P	P			P	P			P	P	
07	CHEM Indicators	3302	P	P	P	P			P	P			P	P	
08	CHEM Indicators	3303	M T/O	M	M T/O	M			M T/O	M			M	M T/O	
09	CHEM Indicators	3400	M		M				M					M	
10	CHEM Indicators	3501	M		M				M					M	

11	CHEM 3511 Indicators	M T		P T	P			P T	P				M T	
12	CHEM 3512 Indicators	M T		P T	P			P T	P				M T	
13	CHEM 3513 Indicators	M T		M T	M			M T	M				M T	
14	CHEM 3531 Indicators	P	P	P	P	P		P	P		P	P	P	
15	CHEM 3532 Indicators	M	M	M	M	M		M	M		M	M	M	
16	CHEM 4161 Indicators	P		P				P					P	
17	CHEM 4162 Indicators	M T		M T				M T					M T	
18	CHEM 4180 Indicators	M	M	M	M			M	M			M	M	
19	CHEM 4240 Indicators	M T	M	M T	M	M		M T	M		M	M	M T	
20	CHEM 4311 Indicators	M		M	M			M	M				M	
21	CHEM 4400 Indicators	M			M				M				M	
22	CHEM 4411 Indicators	M T		P T	P			P T	P				M T	
23	CHEM 4412 Indicators	M T		P T	P			P T	P				M T	
24	CHEM 4413 Indicators	M T		M T	P			M T	P				M T	
25	CHEM 4430 Indicators	P T/O	P	P T/O	P	P		P T/O	P		P	P	P T/O	
26	CHEM 4431 Indicators	M T/O	M	M T/O	M	M		M T/O	M		M	M	M T/O	
27	CHEM 4440 Indicators	M		M	M	M		M	M		M		M	
28	CHEM 4450 Indicators	M		M				M					M	
29	CHEM 4460 Indicators	M		M				M					M	
30	CHEM 4521 Indicators	M		M				M					M	
31	CHEM 4601 Indicators	P	P	P	P	P		P	P		P	P	P	
32	CHEM 4602 Indicators	M	M	M	P	P		M	P		P	M	M	

Serial #	Course Prefix	Course #	SLO1	SLO2	SLO3	SLO4	SLO5		ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	Note
33	CHEM Indicators	4700	M		M	M			M	M				M	
34	CHEM Indicators	4810	M	M	M	M	M		M	M		M	M	M	
35	CHEM Indicators	4811	M		M	M	M		M	M		M		M	
36	CHEM Indicators	4830	M			M				M				M	
37	CHEM Indicators	4900													

Curriculum Map for Student Learning Outcomes Assessment, CSU East Bay

Degree: **M.S. Chemistry and Biochemistry Degrees** **Dept:** **CHEM**

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01	CHEM Indicators	3531	P	P	P	P	P		P	P		P	P	P	
02	CHEM Indicators	3532	P	P	P	P	P		P	P		P	P	P	
03	CHEM Indicators	4161	P		P				P					P	
04	CHEM Indicators	4162	M		M				M					M	
05	CHEM Indicators	4180	M	M	M	M			M	M			M	M	
06	CHEM Indicators	4240	M T	M	M T	M	M		M T	M		M	M	M T	
07	CHEM Indicators	4311	M		M	M			M	M				M	
08	CHEM Indicators	4411	P		P	P			P	P				P	
09	CHEM Indicators	4412	P		P	P			P	P				P	

10	CHEM 4413 Indicators	P		P	P			P	P				P	
11	CHEM 4430 Indicators	P	P	P	P	P		P	P		P	P	P	
12	CHEM 4431 Indicators	P	P	P	P	P		P	P		P	P	P	
13	CHEM 4440 Indicators	M		M	M	M		M	M		M		M	
14	CHEM 4450 Indicators	M		M				M					M	
15	CHEM 4460 Indicators	M		M				M					M	
16	CHEM 4521 Indicators	M		M				M					M	
17	CHEM 4601 Indicators	P	P	P	P	P		P	P		P	P	P	
18	CHEM 4602 Indicators	P	P	P	P	P		P	P		P	P	P	
19	CHEM 4700 Indicators	M		M	M			M	M				M	
20	CHEM 6310 Indicators	M		M	M			M	M				M	
21	CHEM 6410 Indicators	M		M	M			M	M				M	
22	CHEM 6430 Indicators	M T/O	M	M T/O	M	M		M T/O	M		M	M	M T/O	
23	CHEM 6510 Indicators	M		M	M			M	M				M	
24	CHEM 6521 Indicators	M T		M T				M T					M T	
25	CHEM 6820 Indicators	M O		M O	M O			M O	M O				M O	
26	CHEM 6830 Indicators	M	M	M	M	M		M	M		M	M	M	
27	CHEM 6850 Indicators	M		M	M			M	M				M	
28	CHEM 6901 Indicators	M T		M T				M T					M T	
29	CHEM 6910 Indicators	M		M	M			M	M				M	