COMMITTEE ON ACADEMIC PLANNING AND REVIEW ANNUAL PROGRAM REPORT

College	CSCI
Department	Chemistry and Biochemistry
Program Unit	Chemistry and Biochemistry
Reporting for Academic Year	2014-2015
Department Chair	Ann McPartland
Date Submitted	11/20/15

1. SELF-STUDY (about 1 page)

A. Five-year Review Planning Goals

Our last five year program review was in 2012-2013. 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 made reasonable progress toward achieving the stated goals over the past two years.

Dr. LeDuc worked on revision of the Introduction to College Chemistry course, concentrating during the past year on upgrading the laboratory curriculum. She worked with the Liberal Studies faculty and the Department of Earth and Environmental Science to establish a new freshman learning community featuring Introduction to College Chemistry as one of the discipline courses. The new cluster, called "Teaching in the 21st Century" was approved by the General Education subcommittee. It is aimed at Liberal Studies majors matriculating in the Teacher Preparation Option, as well as other students with an interest in teaching, particularly the teaching of middle school to discuss conversion of the Intro to College Chemistry course to a semester version for Fall 2018. A tentative agreement was reached on the organization of the course content and the semester units and these were accepted by the Chemistry faculty as a whole.

Because of the hiring of a new tenure track faculty member in 2013, we are now in a position to offer 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 2014-15 and will again schedule it in 2015-16. 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. The department will use the change to the semester system as an opportunity to make more dramatic changes in the M.S. Chemistry program. We plan to establish a core curriculum for our M.S. Chemistry and M.S. Chemistry, Option in Biochemistry programs, in order to offer a better balance between the various disciplines of chemistry than now exists. This will involve both the development of several new 6000-level courses and the elimination of some existing courses.

We have been able to incorporate our new instruments into the laboratory curricula. These included a spectrofluorimeter, a microplate spectrometer, 14 nanodrop spectrophotometers 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 Dr. Groziak has students use it for every lecture in his Advanced Organic Chemistry course.

Over the last two 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. The computer driven GC and FT-IR instruments have provided a much more modern and satisfying experience for the organic students and HPLC is now routinely used for various experiments in five different courses.

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, left the department in 2015. As exciting as it is to have new faculty members on board, the combination of increasing enrollments in the lower division chemistry courses and loss of faculty members through resignation or administrative assignments has meant that the percentage of our FTES taught by tenured or tenure track faculty has increased only marginally since 2012 (from 46.8% to 49.7%). We are still using an unacceptably high number of temporary faculty. Fortunately, during 2015-2016 we will conduct a tenure track search for an analytical chemist.

We were able to find research and office space for the new faculty members by rearranging the distribution of space in the department. However, there is no more space to rearrange so we will look to the College of Science for help in finding space for the tenure track faculty member to be hired for Fall 2016. Finally we did hire a new Instructional Support Technician.

C. Program Changes and Needs

Although no needs for specific changes in our Five Year Plan have emerged, the looming Semester Conversion/Transformation to be implemented for Fall 2018 obviously requires major planning and will involve significant changes in our curriculum. The planning includes participation of the entire chemistry and biochemistry faculty and we have elected a Semester Conversion Coordinator to organize the process. Once the guidelines for the General Education program were approved by the Academic Senate, our department faculty worked to formulate conversions and transformations for each of our undergraduate degrees. This required consultation with several departments that provide service courses for our majors. We have divided the work for conversion/transformation of the undergraduate courses and this is in progress. We are planning a complete revision of the M.S. program and are now working to hammer out a plan to modernize this program and make it a better fit for our students. The Chair has consulted with relevant departments regarding the chemistry service courses we provide. Specific faculty have been assigned to work on the conversion of these courses, or to work with the relevant department to effect transformation where appropriate.

In 2015 one of our faculty members, Dr. Anthony Masiello, resigned his position at CSUEB after a two year professional leave. This meant that our tenures/tenure track faculty count remained the same (i.e. did not increase) after the Fall 2014 hire.

The department APR Standard Data show only minor changes in the Student and Faculty statistics from

2013-14 to 2014-15.The number of undergraduate majors went from 204 in Fall 2013 to 199 in Fall 2014, and the number of graduate students decreased from 51 to 42. However, the number of degrees awarded in 2013-14 increased for both degree levels, from a total of 51 in 2012-13 to 56 in 2013-14. Total FTES for the department was up from 340.1 in 2013 to 351.1 in 2014, reflecting the continuing upward trend we have experienced over the last five years. We offered a few more class sections in 2014 than last year and our Student/Faculty ratio dropped a little, from 24.9 to 22.8. The statistics indicate that the decrease was due to smaller average section sizes for the upper division and graduate courses. Average section size for the lower division courses remained constant.

2. **SUMMARY OF ASSESSMENT** (about 1 page)

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 second year of the official five year assessment plan for the department. SLO-2 was assessed as planned for Year 2 but data for SLOs 1 and 4 was also collected. Where possible comparisons were made with results from previous years.

SLO-2. Work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments.

SLO-1. Demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry.

M.S. Chemistry: SLO-2 was assessed as planned for Year 2 but data for SLOs 1 and 4 was also collected.

SLO-2. Work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems.

SLO-1. Demonstrate specialized knowledge in the chemical sciences beyond the undergraduate level.

SLO-4. Present complex chemical information via oral and written reports.

C. Summary of Assessment Process

The undergraduate assessment focused on specific learning outcomes in the areas of organic (CHEM 3301-02-03), physical (CHEM 3511-12-13), inorganic (CHEM 4161 and 4162) and biochemistry (CHEM

4411,4412 and CHEM 4430). Assessment of the Master's program focused on student performance in analytical chemistry (CHEM 4240), biochemistry (CHEM 6430) and seminar presentations (CHEM 6820) in every area of chemistry. The methods included use of standardized national exams, capstone laboratory exercises, embedded exam questions, analysis of ability to critically analyze experimental results and critiques of oral presentations of complex information.

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 SLO-2, this year's focus, in three areas of chemistry. Assessment results for SLO-1 are also reported, in that case for all four areas of chemistry. SLO-2 states that students should "work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments." The best data for this SLO are available for CHEM 3303, the third quarter of the organic chemistry series. For over 10 years students have been required to perform a capstone lab exercise in this course where they use knowledge gained during the year-long series to attempt to identify two unknown chemicals. They must come up with a plan for identification and look up the experimental procedures to carry it out. At each stage they need to critically analyze their results and make decisions for the next experiments. Table 1 of the Appendix gives the student results for the last 6 years. Performance has been fairly consistent and we are happy to report that 2015 saw the highest percentage of students able to solve the identity of one of the unknowns (96%) and nearly the highest percentage able to identify both (62%). We conclude that the majority of our chemistry and biochemistry majors have achieved reasonable proficiency in the organic laboratory in terms of using the methods and instruments, and also in terms of independent problem solving.

The lab proficiency results for analytical chemistry (CHEM 4240) were based on imbedded exam questions covering lab techniques. Student performance was acceptable or almost acceptable for the simpler course learning goals (83%, 67% and 56% of the students achieving goals 1, 2 and 6, respectively). However, performance for the goals relating to advanced spectroscopy was disappointing (success rate below 50%). 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.

SLO-2 assessment results were available for the biochemistry majors for two quarters, since CHEM 4430 (Biochemistry Laboratory) was taught both in Fall 2014 and Winter 2015. A comparison of the results for the two sections is interesting, with the Fall students clearly out-performing the Winter students. For both groups the majority of the students were able to correctly interpret experimental data and write a proper analysis in a laboratory notebook (89-100%). However, weakness was detected for some specific types of analysis, most prominently analysis of enzyme kinetics data. Weakness in this area was also apparent from embedded exam questions. Most students (83-100%) did well in experimental proficiency as evidenced by the ability to successfully complete an electrophoresis experiment. It is difficult to interpret the data for the other specific learning goals since the Fall class performed very well (>75% of the students achieving all the goals) and the Winter class was weaker. The instructor will give special attention to analysis of enzyme kinetics data during the upcoming year and will again compare the Fall and Winter classes to determine whether or not this year's results are an anomaly.
SLO-1 assessment data were collected for several advanced undergraduate courses as part of an ongoing effort to monitor performance of chemistry and biochemistry majors from year to year. SLO-1 speaks to chemistry knowledge. The courses assessed were CHEM 3303 (Organic Chem), CHEM 3511 and CHEM 3512 (Physical Chem), CHEM 4162 (Inorganic Chem), CHEM 4240 (Analytical Chem), and CHEM 4411 and 4412 (Biochemistry). The resulting data is summarized in the Appendix and a more detailed analysis can be found in the 2014-2015 Assessment Report for the Department of Chemistry

and Biochemistry on the CSCI web site. The chemistry and biochemistry majors matriculating in CHEM 3303 achieved an average percentile of 34 on the national standardized organic exam, a little better than in 2014 but still below our high performance in 2009 of 45. Interestingly, this year's average percentile for the chemistry majors was 44 and several students scored 70 or above.
In general student performance for the measured learning goals under SLO-1 was variable for the other undergraduate courses and areas of strength and weakness were readily detected. Where a comparison of results from one or more previous years could be made, this year's students performed as well or better than students in earlier classes, indicating that faculty efforts to improve performance have been successful. However, there is clearly more work to be done.
During 2014-2015 we assessed student performance in our M.S. Chemistry program for SLOs 2, 4 and 1. This year's emphasis was on SLO-2, which states that students should "work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems." However, we also collected data for SLOs 4 and 1. SLO-4 relates to ability to " present complex chemical information via oral and written reports" and SLO-1 challenges students to "demonstrate specialized chemical knowledge beyond the undergraduate level." In each case student learning was assessed for specific course objectives relating to the program SLO.

SLO-2 was assessed for graduate students matriculating in CHEM 4240 using embedded exam questions and for CHEM 6430 by analyzing experimental results presented in student notebooks. As can be seen in Table 9, the results for Instrumental Methods of Analysis (CHEM 4240) were mixed. Most students did well on course learning outcomes 1,2, 4 and 6, but the majority of the students failed to master the outcomes for advanced spectroscopy (3, 4 and 7). A similar result was obtained for the assessment of undergraduate performance in this course (see above). Advanced spectroscopy covers several difficult topics; the instructor will put special emphasis on this area next year by developing new practice exercises on how to utilize the relevant instruments to test hypotheses and solve experimental problems.

Assessment of SLO-2 for the Protein Chemistry Techniques course (CHEM 6430) provided more encouraging results. Analysis of the laboratory notebooks indicated that the majority of the Master's students (83-100%) achieved all three experimental learning outcomes, meaning they were able to effectively use instrumentation and biochemical methods to solve experimental problems and test hypotheses (see Table 11). SLO-1 was also assessed for CHEM 6430, using embedded exam questions (Table 10). The majority of the students mastered the specific course outcomes (67-83%). The areas of weaker student performance (outcomes 1 and 4) were noted; more emphasis will be placed on these during the upcoming year.

For the second year in a row we assessed program SLO-4, the ability to convey complex chemical information via an oral presentation, for the graduate program. The student sample was those students who took CHEM 6820, the Graduate Seminar course. Master's candidates are required to take this course three times and each time they are required to give an oral presentation in which they describe and analyze a literature article in detail. The students are given guidance on how to prepare and execute an effective presentation and receive peer critiques as well as feedback from the instructor. Student performance is assessed for each of a set of presentation goals (organization, subject knowledge, mechanics, presentation) and our objective is to see the quality of the student presentations improve as they progress through the three seminar courses.

The results for 2014-2015 clearly show an improvement in ability to present complex chemical information in a seminar format as the students proceed from their first presentation to the third seminar (Table 12). Whereas the average student rating was 70.6% for students giving the first presentation, it rose to 80.0% for the second and to 82.5% for the third. Overall the numbers are a little lower than the ratings for 2013-2014, but the upward trend is the same. Since our department goal is for students to master at least 75% of the learning outcomes for each course, we are reasonably pleased with these results but will of course continue to work with the students and aim for even better achievement.

3. STATISTICAL DATA (about 1 page)

Academic Program Review (APR) Standard Data for College years 2010 to 2014 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://www20.csueastbay.edu/ir/academic-program-review/standard-data.html.

California State University, East Bay

APR Summary Data

Fall 2010 - 2014

Chemistry and Biochemistry					
	Fall Quarter				
	2010	**2011**	**2012**	**2013**	**2014**
A. Students Headcount					
1. Undergraduate	150	180	217	204	199
2. Postbaccalaureate	8	2	0	0	0
3. Graduate	44	54	58	51	42
4. Total Number of Majors	202	236	275	255	241
	College Years				
B. Degrees Awarded	**09-10**	**10-11**	**11-12**	**12-13**	**13-14**
1. Undergraduate	22	30	34	38	42
2. Graduate	15	13	10	13	14
3. Total	37	43	44	51	56
	Fall Quarter				
	2010	**2011**	**2012**	**2013**	**2014**
C. Faculty					
Tenured/Track Headcount					
1. Full-Time	7	7	7	9	9
2. Part-Time	0	0	0	0	0
3a. Total Tenure Track	7	7	7	9	9
3b. % Tenure Track	53.8%	36.8%	38.9%	45.0%	40.9%
Lecturer Headcount					
4. Full-Time	0	0	0	0	0
5. Part-Time	6	12	11	11	13
6a. Total Non-Tenure Track	6	12	11	11	13
6b. % Non-Tenure Track	46.2%	63.2%	61.1%	55.0%	59.1%
7. Grand Total All Faculty	13	19	18	20	22
Instructional FTE Faculty (FTEF)					
8. Tenured/Track FTEF	5.6	6.3	5.1	6.3	7.5
9. Lecturer FTEF	6.2	7.4	8.6	7.3	7.9
10. Total Instructional FTEF	11.8	13.6	13.7	13.7	15.4
Lecturer Teaching					
11a. FTES Taught by Tenure/Track	158.3	168.0	157.8	156.4	174.3
11b. % of FTES Taught by Tenure/Track	58.9%	55.6%	46.8%	45.9%	49.7%
12a. FTES Taught by Lecturer	110.6	134.2	179.2	184.0	176.7
12b. % of FTES Taught by Lecturer	41.1%	44.4%	53.2%	54.1%	50.3%

13. Total FTES taught	269.0	302.2	337.0	340.4	351.1
14. Total SCU taught	4034.5	4533.0	5055.0	5106.0	5266.0
D. Student Faculty Ratios					
1. Tenured/Track	28.3	26.7	31.1	24.7	23.2
2. Lecturer	18.0	18.3	20.8	25.1	22.4
3. SFR By Level (All Faculty)	22.9	22.2	24.6	24.9	22.8
4. Lower Division	26.8	22.1	25.4	27.8	26.5
5. Upper Division	23.0	23.6	25.7	24.4	20.5
6. Graduate	7.0	14.9	14.4	10.8	8.3
E. Section Size					
1. Number of Sections Offered	63.0	71.0	83.0	80.0	83.0
2. Average Section Size	33.7	32.5	32.9	33.2	30.7
3. Average Section Size for LD	36.6	32.7	33.3	34.4	34.1
4. Average Section Size for UD	32.5	32.4	31.9	32.1	26.5
5. Average Section Size for GD	15.3	27.5	33.5	22.5	17.0
6. LD Section taught by Tenured/Track	4	10	9	6	9
7. UD Section taught by Tenured/Track	14	15	12	17	18
8. GD Section taught by Tenured/Track	16	14	20	19	19
9. LD Section taught by Lecturer	23	25	32	34	34
10. UD Section taught by Lecturer	6	6	11	4	7
11. GD Section taught by Lecturer	0	1	0	1	0

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

	Fall Quarter				
Headcount Enrollment	**2010**	**2011**	**2012**	**2013**	**2014**
Chemistry					
1. Undergraduate	62	76	90	89	81
2. Postbaccalaureate	4	0	0	0	0
3. Graduate	44	54	58	51	42
4. Total Number of Majors	110	130	148	140	123
Biochemistry					
1. Undergraduate	88	104	127	115	118
2. Postbaccalaureate	4	2	0	0	0
3. Graduate	0	0	0	0	0
4. Total Number of Majors	92	106	127	115	118

	College Years				
Degrees Awarded	**09-10**	**10-11**	**11-12**	**12-13**	**13-14**
Biochemistry					
1. Undergraduate	18	23	25	28	26
2. Graduate	0	0	0	0	0
3. Total Number of Majors	18	23	25	28	26
Chemistry					
1. Undergraduate	4	7	9	10	16
2. Graduate	15	13	10	13	14

3. Total Number of Majors	19	20	19	23	30

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 2014-2015

Undergraduate Programs - Chemistry and Biochemistry:

A. CHEM 3303: Capstone Lab Exercise (Identification of two unknown chemicals). Assesses Chemistry SLO 2.

Table 1. Results of Capstone Organic Laboratory Assignment for 2010– 2015

Year	# of Chem/Biochem Majors	# with both correct	% Both Correct	# with at least one correct	% At least one correct
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

B. CHEM 3303: Standardized National Exam. Assesses Chemistry SLO-1 for Organic Chemistry.

Table 2. Results of Capstone Organic Lecture Assessment for 2009 – 2013 for Chemistry and Biochemistry majors

Year	Percentile
2009	45
2010	34

2011	41
2012	28
2013	29
2014	33
2015	34

C. CHEM 3511: Embedded Exam Questions. Assess Chemistry SLO-1 for Physical Chemistry I

Table 3. Results of Physical Chemistry I Lecture Assessment for 2014

Question #*	% Correct, Chemistry Majors**	% Correct, Biochemistry Majors***
P1	67	57
P2	89	93
P3	56	43
MC13	72	79
MC15	22	21
TF8	56	36
TF9	56	71
TF10	56	79

*P = problem (> 50% of possible points scored as correct); MC = multiple choice; TF = True or False.

**18 students

***14 students

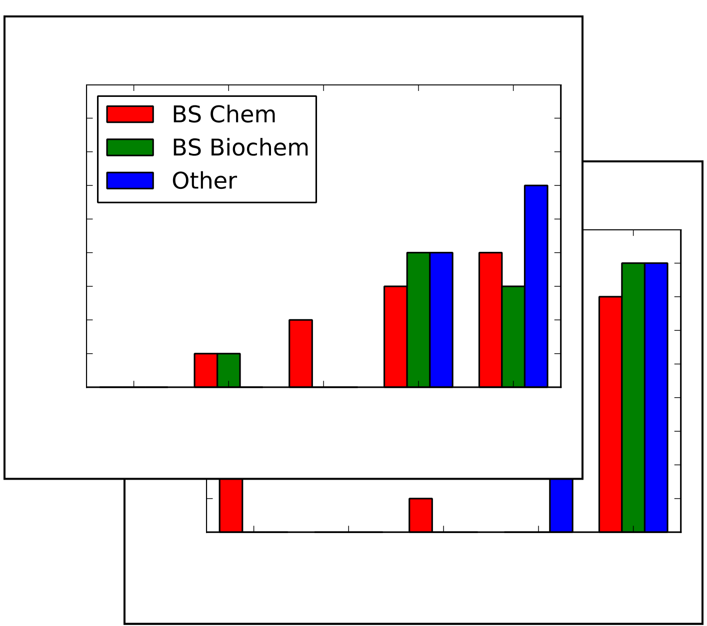
D. CHEM 3512: Embedded Exam Questions. Assess Chemistry SLO-1 for Physical Chemistry (Part II)

Three specific course outcomes tested with multi-part questions. Learning outcomes and corresponding distributions of scores are given for B.S. Chemistry majors (10), B.S. Biochemistry majors (8) and Other (6 M.S. Chemistry, 3 B.S. Biology, 1 cross enrollment with Mills College).

***Learning outcome**: Formulate the mathematical description for the quantum mechanical motion of a particle: translations, vibrations, and rotations.*

***Learning outcome**: Depict orbital angular and radial distribution functions.*

***Learning outcome**: Classify molecular orbitals by their nodal structure, shape, and symmetry; quantify bonding in terms of the bond order.*



E. CHEM 4411: Embedded Exam Questions used to assess performance in General Biochemistry I (Program SLO-1)

Table 4. Assessment Results for Chemistry and Biochemistry Majors: Fall 2013 and Fall 2014

Biochemistry Learning Outcome*	% Students with Correct Answer - Fall 2013**	% Students with Correct Answer - Fall 2014***
2 - Amino Acid Structure	59	75
4 - Protein Structural Motifs	67	56
4 - Protein Regulation	72	75
5 - Properties Enzymes	51	65
5 - Enzyme Kinetics	58	55

*Numbers represent Specific Course Outcomes tested with a total of 13 questions.
**34 students
***17 students

F. CHEM 4412: Embedded Exam Questions used to assess performance in General Biochemistry II (Program SLO-1)

Table 5. Assessment Results for Biochemistry Majors: Winter 2014 and Winter 2015

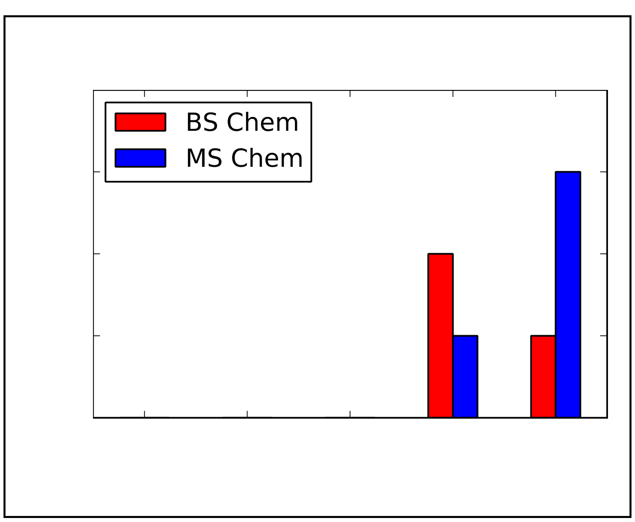
Biochemistry Learning Outcome*	Average % of students with correct answers-Winter 2014**	Average % of students with correct answers-Winter 2015***
6 - Bioenergetics	69	79
7 - ATP Chemistry	73	54
8 - Carbohydrates	69	64
9 - Metabolic Pathways	-	45

*Specific Course Outcomes tested with 1-3 questions each for a total of 7 questions.
**26 students
***14 students

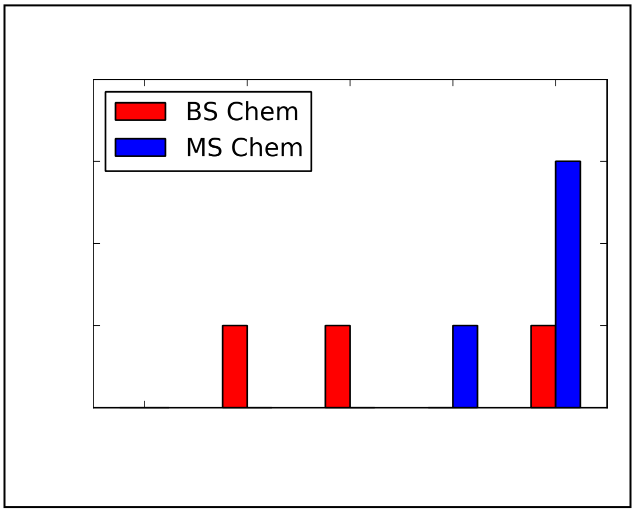
G. CHEM 4161-4162: Embedded Exam Questions. Assess Chemistry SLO-1 for Advanced Inorganic Chemistry

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 (3) and M.S. Chemistry candidates (4).

***Learning outcome**: Describe and classify isomeric coordination complexes.*



***Learning outcome**: Apply simple models for bonding in coordination complexes: crystal field theory, ligand field theory, and the angular overlap method.*



H. CHEM 4430: Laboratory notebook quality, experimental results and embedded exam questions used to assess performance in General Biochemistry Laboratory (Program SLO-2)

Table 6. Assessment Results for Biochemistry Majors - Fall 2014

Learning Goal	Assessment Tool	% of students with correct analysis or answer*
2 - Perform assays, analyze data	Lab Notebook Analysis 1	100
3 - Purification Table calculations	Lab Notebook Analysis 2	83
4 - Enzyme kinetics data and graphs	Lab Notebook Analysis 3	83
6 - Perform electrophoresis	Gel Photograph	83
7 - Develop appropriate notebook	Final Lab Notebook Score	100
1 - Prepare buffer	Questions 7, 8	75, 75
3 - Purification Table calculations	Questions 9	83
4 - Enzyme kinetics data and graphs	Questions 10	33
5 - Liquid Chromatography	Questions 11, 12	66, 100
6 - Perform electrophoresis	Questions 14, 15	92, 42

Table 7. Assessment Results for Biochemistry Majors - Winter 2015

Learning Goal	Assessment Tool	% of students with correct analysis or answer*
4 - Enzyme kinetics data and graphs	Lab Notebook and Report Analysis	56
6 - Perform electrophoresis	Gel Photograph	100
7 - Develop appropriate notebook	Final Lab Notebook Score	89
1 - Prepare buffer	Questions 7, 8	44, 67
3 - Purification Table calculations	Question 9	44
2 - Perform assays, analyze data	Question 10	44
5 - Liquid Chromatography	Questions 11, 12	22, 89
6 - Know electrophoresis theory	Questions 14, 15	44, 22

Table 7. Assessment Results for Biochemistry Majors - Winter 2015

4 - Enzyme kinetics data and graphs	Multiple Choice 5-10	22

*12 student responses were scored

J. CHEM 4240: Embedded Exam Questions used to assess performance in Instrumental Methods of Analysis (Program SLO 2)

Table 8. Assessment Results for 18 Undergraduate Chemistry Majors: Winter 2015

Learning Outcome	Assessment Tool	Average % of students with correct answers
1 - Light and Matter	Midterm Q2	83
2 -Beer's Law	Final Q1- (a) to (c)	67
3 - Spectroscopy	Midterm Q7	39
4 - Optical Instrumentation	Final Q7 and Q8	47
5 - Nuclear Magnetic Resonance	Final Q6 – (a) & (b)	33
6 - Chromatographic Separations	Final Q12 (a) to (f)	56

Graduate Program - M.S. Chemistry:

A. CHEM 4240: Embedded Exam Questions used to assess performance in Instrumental Methods of Analysis (Program SLO-2)

Table 9. Assessment Results for M.S. Chemistry Majors*: Winter 2015

Learning Outcome	Assessment Tool	Average % of students with correct answers
1 - Light and Matter	Midterm Q4, Final Q4	63
2 - Beer's Law	Final Q1- (a) to (e)	75
3 - Spectroscopy, Atomic vs. Molec.	Final Q5	0
4 - Optical Instrumentation	Final Q7 and Q8	63
5 - Nuclear Magnetic Resonance	Final Q6 – (a) to (d), Lab #5	38
6 - Chromatographic Separations	Final Q12 (a) to (i)	75
7 - Sensitivity Optical Spectrometer	Lab #7	38

*8 students

B. CHEM 6430: Embedded Exam Questions used to assess performance in Protein Chemistry Techniques (Program SLO-1)

Table 10. Assessment Results for M.S. Chemistry Majors*: Winter 2015

Learning Outcome	Assessment Tool	Average % of students with correct answers
1 - Ion Exchange Chromatography	Exam I, Q7	67
2 - High Performance Liq. Chromat.	Exam I, Q11	83
3 - Polyacrylamide Gel Electrophor.	exam II, Q6	83
4 - Isoelectric Focusing	Exam II, Q9	67
5 - Mass Spectrometry, Proteomics	Exam II, Q12	83

*6 students

C. CHEM 6430: Laboratory Notebook Assessment Results for Protein Chemistry Techniques (Program SLO-2)

Table 11. Notebook Assessment Results for M.S. Chemistry Majors*: Winter 2015

Laboratory Notebook Learning Goal	% Students Meeting Expectations
1 - Effective use of instrumentation (HPLC) to solve experimental problem	83
2 - Effective use of biochemical method (affinity chromatography) to solve an experimental problem	83
3 - Effective use of biochemical method (IEF/SDS-PAGE) to test a hypothesis	100

*6 students

D. CHEM 6820 Graduate Seminar: Assessment of ability to convey complex chemical information via an oral presentation (Program SLO-4)

Table 12. Seminar Presentation Ratings for 2013-2014 and 2014-2015

Academic Year	1st Seminar		2nd Seminar		3rd Seminar	
	# of students	average score	# of students	average score	# of students	average score
2013-2014	12	74.7%	13	80.3%	18	85.9%
2014-2015	12	70.6%	12	80.0%	13	82.5%

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

Instructions:

1) Enter a course ONLY if that course is part of the requirement of the relevant major (either core, option requirement, or elective). Enter the course according to the course number, from smallest to the largest numbers).

2) For each course, for the course line (see example 01), use the pull down list (click the cell, and the downward arrow will show) to indicate at what level the material is addressed for each SLO. For the Indicators line, enter the symbols, such as T50, O35, etc., to indicate the type of work and the % of its weight of the course evaluation (Round to every 5%, e.g., 15, 20, 25, etc.)

3) If the SLO maps to any ILO, enter the same values under that ILO for the same course (see example 01). Map ALL relevant ILOs when appropriate.

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	1101	I	I	I	I	I		I	I		I	I	I	
	Indicators														
02	CHEM	1102	P	P	P	P	P		P	P		P	P	P	
	Indicators														
03	CHEM	1103	P	P	P	P	P		P	P		P	P	P	
	Indicators														
04	CHEM	2200	P	P	P	P	P		P	P		P	P	P	
	Indicators														
05	CHEM	3200	P	P	P	P	P		P	P		P	P	P	
	Indicators														
06	CHEM	3301	P	P	P	P			P	P			P	P	
	Indicators														
07	CHEM	3302	P	P	P	P			P	P			P	P	
	Indicators														
08	CHEM	3303	M	M	M	M			M	M			M	M	
	Indicators		T/O		T/O				T/O					T/O	
09	CHEM	3400	M		M				M					M	
	Indicators														
10	CHEM	3501	M		M				M					M	
	Indicators														
11	CHEM	3511	M		P	P			P	P				M	
	Indicators		T		T				T					T	
12	CHEM	3512	M		P	P			P	P				M	
	Indicators		T		T				T					T	

13	CHEM Indicators	3513	M T		M T	M			M T	M				M T	
14	CHEM Indicators	3531	P	P	P	P	P		P	P		P	P	P	
15	CHEM Indicators	3532	M	M	M	M	M		M	M		M	M	M	
16	CHEM Indicators	4161	P		P				P					P	
17	CHEM Indicators	4162	M T		M T				M T					M T	
18	CHEM Indicators	4180	M	M	M	M			M	M			M	M	
19	CHEM Indicators	4240	M T	M	M T	M	M		M T	M		M	M	M T	
20	CHEM Indicators	4311	M		M	M			M	M				M	
21	CHEM Indicators	4400	M			M				M				M	
22	CHEM Indicators	4411	M T		P T	P			P T	P				M T	
23	CHEM Indicators	4412	M T		P T	P			P T	P				M T	
24	CHEM Indicators	4413	M T		M T	P			M T	P				M T	
25	CHEM Indicators	4430	P T/O	P	P T/O	P	P		P T/O	P		P	P	P T/O	
26	CHEM Indicators	4431	M T/O	M	M T/O	M	M		M T/O	M		M	M	M T/O	
27	CHEM Indicators	4440	M		M	M	M		M	M		M		M	
28	CHEM Indicators	4450	M		M				M					M	
29	CHEM Indicators	4460	M		M				M					M	
30	CHEM Indicators	4521	M		M				M					M	
31	CHEM Indicators	4601	P	P	P	P	P		P	P		P	P	P	
32	CHEM Indicators	4602	M	M	M	P	P		M	P		P	M	M	
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	4811	M		M	M	M		M	M		M		M	

Serial #	Course Prefix	Course #	SLO1	SLO2	SLO3	SLO4	SLO5		ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	Note
	Indicators														
36	CHEM	4830	M			M				M				M	
	Indicators														
37	CHEM	4900													
	Indicators														

Curriculum Map for Student Learning Outcomes Assessment, CSU East Bay

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

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

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Serial #	Course Prefix	Course #	SLO1	SLO2	SLO3	SLO4	SLO5		ILO1	ILO2	ILO3	ILO4	ILO5	ILO6	Note
	CHEM	3531	P	P	P	P	P		P	P		P	P	P	
	Indicators														
	CHEM	3532	P	P	P	P	P		P	P		P	P	P	
	Indicators														
	CHEM	4161	P		P				P					P	
	Indicators														
	CHEM	4162	M		M				M					M	
	Indicators														
	CHEM	4180	M	M	M	M			M	M			M	M	
	Indicators														
	CHEM	4240	M	M	M	M	M		M	M		M	M	M	
	Indicators		T		T				T					T	
	CHEM	4311	M		M	M			M	M				M	
	Indicators														

	CHEM 4411 Indicators	P		P	P			P	P				P	
	CHEM 4412 Indicators	P		P	P			P	P				P	
	CHEM 4413 Indicators	P		P	P			P	P				P	
	CHEM 4430 Indicators	P	P	P	P	P		P	P		P	P	P	
	CHEM 4431 Indicators	P	P	P	P	P		P	P		P	P	P	
	CHEM 4440 Indicators	M		M	M	M		M	M		M		M	
	CHEM 4450 Indicators	M		M				M					M	
	CHEM 4460 Indicators	M		M				M					M	
	CHEM 4521 Indicators	M		M				M					M	
	CHEM 4601 Indicators	P	P	P	P	P		P	P		P	P	P	
	CHEM 4602 Indicators	P	P	P	P	P		P	P		P	P	P	
	CHEM 4700 Indicators	M		M	M			M	M				M	
	CHEM 6310 Indicators	M		M	M			M	M				M	
	CHEM 6410 Indicators	M		M	M			M	M				M	
	CHEM 6430 Indicators	M T/O	M	M T/O	M	M		M T/O	M		M	M	M T/O	
	CHEM 6510 Indicators	M		M	M			M	M				M	
	CHEM 6521 Indicators	M T		M T				M T					M T	
	CHEM 6820 Indicators	M O		M O	M O			M O	M O				M O	
	CHEM 6830 Indicators	M	M	M	M	M		M	M		M	M	M	
	CHEM 6850 Indicators	M		M	M			M	M				M	
	CHEM 6901 Indicators	M T		M T				M T					M T	
	CHEM 6910 Indicators	M		M	M			M	M				M	