ANNUAL PROGRAM REPORT

College	College of Science
Department	Chemistry and Biochemistry
Programs	BS/BA Chemistry, MS Chemistry & BS/BA Biochemistry
Reporting for Academic Year	2016-2017
Last 5-Year Review	2012-2013
Next 5-Year Review	This year (2017-2018). We are submitting both the Annual Review for 2016-2017 and the Five Year Review for 2012-2017 this year (2017-2018).
Department Chair	Ann McPartland
Date Submitted	Oct. 20, 2017

I. SELF-STUDY

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. This year (2017-2018) we will submit both a five year program review and an annual review. The five year review will again cover both the Chemistry and the Biochemistry programs. The annual review will follow the annual review template and include a tenure track position request as well as a discussion of space and staff issues. The specific goals for our 2012-2013 five year program review were:

1) Revise both the lecture and laboratory components of the Introduction to College Chemistry course (CHEM 1100) to better serve the liberal studies students 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 curriculum
7) Continue to upgrade the instrumentation used in teaching and research by seeking funding for new gas chromatographs and microwave synthesizers for 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 chemistry and biochemistry 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 laboratory prep technicians who sadly passed away recently.

B. Progress Toward Five-Year Review Planning Goals

We have completed each of the goals listed above except no. 3, which has been changed, as explained below. Improvements in the curriculum for the Introduction to College Chemistry course were spearheaded by Dr. Danika LeDuc before she became Associate Dean of the CSCI. Dr. LeDuc revised the laboratory component of the course to better serve the non-majors who now dominate the course enrollment. The current instructors have revised the lecture to make the topics more accessible to the student clientele. Over the last several years CHEM 1100 has been incorporated into two new freshman learning communities (FLC), “Humans in the Natural World” and “STEM PATHWAYS.” As we move into the semester system, CHEM 1100 will become CHEM 100 and will continue as a component of the proposed “Humans in the Natural World” FLC, which is designed to integrate humanities, social science and natural science courses for freshman Liberal Studies majors planning to become teachers. The “STEM PATHWAYS” FLC is proposed to morph into a “Science and Humanity” FLC for students who are interested in majoring in a science such as Biology, Chemistry, Biochemistry or Physics but prefer a gradual transition into the courses required for those majors.

Since hiring a new Inorganic Chemist in 2013 (Patrick Huang), we have been offering Advanced Inorganic Chemistry every year, thus meeting our accreditation requirement and facilitating student graduation in a timely fashion. Goal 3, adding the CHEM 4400 course as an elective to the B.S./B.A. Chemistry and B.A. Biochemistry degree programs, was unfortunately not achieved. Although in theory developing the CHEM 4400 course "Instructional Activities in Chemistry" as an elective for those programs was a promising idea, in practice several issues emerged that made it difficult to implement. Because the number of students matriculating in the Chemistry Education Options has been small, CHEM 4400 was taught on an Independent Study basis (as CHEM 4900), with arrangements made with individual high school teachers for the practical field experience component of the course. Without the base of Chemistry Education students to run a regular CHEM 4400 course it was not practical to make it an elective for our other degree programs. Then, in designing the semester versions of the Chemistry Education Concentration degree programs we found there were enough core chemistry and/or biochemistry courses essential for the degrees that the specialized Chemistry Education course units had to be trimmed to 14, leaving room only for those courses most relevant for single subject credentialing in chemistry. This meant CHEM 4400 had to be eliminated as a requirement.

Although the low number of students choosing the Chemistry Education Options (or Concentrations) is disappointing, our overall program is not adversely affected by maintaining these degrees. All of the courses required for the Education Concentrations are routinely offered (either by Chemistry and Biochemistry or by other departments). Since there is a shortage of qualified high school science teachers in California, we think we are providing a valuable service to the state by having these degrees in place for the students who do choose them and for future recruits to the teaching profession.

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 has been offered under the auspices of CHEM 6510, Advanced Topics in Physical Chemistry. As we move to semesters this will become a stand-alone Computational Chemistry course.

We were able to incorporate the new instruments we had acquired by 2013 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. 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, and Drs. Fleming, McPartland, Sommerhalter, and Pizzini incorporated the Nanodrop Spectrophotometers into several lab courses. Students are introduced to the CHEM Draw software in the first year organic laboratory classes and use it for every lecture in Dr. Groziak's Advanced Organic Chemistry course.

Over the last four years we have continued to upgrade the instrumentation in our laboratory courses. We sought and obtained funding through the A2E2 Instructional Equipment program and from the College of Science for new gas chromatographs (GC), fourier transform infrared spectrometers (FT-IR) and microwave synthesizers 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 an inductively coupled plasma-optical emission spectrometer (ICP-OES) for the analytical and environmental chemistry courses. The College of Science also helped with the purchase of 2 refractometers, 10 melting point probes with LabQuest computer interfaces, and a replacement ice maker for the department. The computer driven GC, FT-IR and melting point 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. The ICP-OES will soon be used for classroom elemental analysis. We are committed to providing hands-on training for our students on the types of chemistry instrumentation now commonplace in the workplace.

We have made progress towards increasing the number of chemistry and biochemistry courses taught by tenure track faculty as a result of new hires over the past four years. In Fall 2013 two new tenure track faculty joined the department, with specialties in biochemistry and inorganic chemistry, respectively. In Fall 2014 we hired a tenure track physical chemist and in Fall 2016 a new analytical chemist joined the department. Unfortunately, another of our faculty members (Tony Masiello), resigned in 2015 and Dr. Danika LeDuc left to become the Interim Director of the STEM Institute in 2014 and CSCI Associate Dean in 2017. The net increase of two faculty members allowed us to reduce the number of lecturers used for majors-level and graduate courses. However, during 2016-2017 we still employed part-time lecturers to teach 17 lecture sections of majors-level courses. Moreover, increasing enrollments in the lower division chemistry courses has meant that the percentage of our FTES taught by tenured or tenure track (TT) faculty remains low (50.6% in Fall 2016). Consequently, most of our service courses and all of our non-majors GE courses are also taught by temporary faculty. Fortunately, we were approved to conduct a tenure track faculty search during 2016-2017 and a new chemist, Mark Borja, joined our department in Fall 2017.

With respect to goal no. 9, locating new research and office space for new faculty, progress has been made. As the result of the move of some College of Science departments to the new SF building in 2015-2016 and the reassignment of space in the Science Building, the Chemistry and Biochemistry department gained an approximately 325 sq. ft. space (Sc S452). Over the last year the room underwent renovation and has been converted to a research lab for new faculty members. The department also gained two offices which are being used for new tenure track 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

Overview: No changes in our Five Year Plan were implemented during 2016-2017, except for the decision to eliminate CHEM 4400 from the curriculum for the semester system (discussed above)**.** However, the department engaged in a number of additional activities and some emerging needs appeared.

SB1440: Our B.A. Chemistry degree is approved as an SB1440 program. This seems to be working well. No student issues have arisen with respect to completion of the degree at CSUEB.

Curriculum: The Semester Conversion/Transformation planning that took place in 2015-2016 was finalized in 2016-2017. The Chemistry and Biochemistry Bachelor of Science degrees, the Chemistry Master of Science program, and the Foundational Level General Science Certificate all underwent transformation in 2015-2016 while the Bachelor of Arts degrees were more or less directly converted to semester versions. All semester programs and courses, including service courses, were approved by the College Curricular Committee in 2015-2016. Most of these were approved by the Dean, APGS, CIC, ExComm, the Academic Senate and the President in 2016-2017. A few are still pending. GE status for a number of Chemistry semester courses was requested and granted during 2016-2017.

The department contributed courses for six freshman learning community applications in June,

2017. These were for proposed semester FLCs entitled “Humans in the Natural World,” “Science and Humanity,” “Healthier Living,” “Diversity of Life,” “Breaking Bad” and “Energy, Molecules and Living Things.” The latter is designed for Chemistry and Biochemistry majors and Diversity of Life is amenable for Biochemistry majors who need to take College Algebra before General Chemistry.

Students: Fall FTES dipped slightly in 2016-17 compared with 2015-16 (366.9 vs. 376.9). In terms of student success, several undergraduate and Master's students working on research projects with our faculty were awarded Research Scholarships from the campus Center for Student Research.

Faculty: In Fall 2016 Ruth Tinnacher, an Analytical Chemist, joined the Chemistry and Biochemistry faculty, and in Fall 2017, biochemist Mark Borja was added, bringing the number of tenured or tenure track faculty to nine. No retirements or separations occurred during 2016-17. Three of our faculty members were awarded Faculty Support Grants to support research activity. Dr. Patrick Huang obtained a federal subcontract for collaborative research with Lawrence Livermore National Labs. Dr. Tinnacher and several colleagues applied for and were awarded a large grant ($663,268) from the U.S. Department of Energy for research on the Sorption of Uranium VI onto Bentonite. The Chemistry and Biochemistry Department also obtained an Enhanced Course Learning (ECL) grant (under A2E2) to defray some of the costs of innovative classroom laboratory experiments.

Staff: In 2010 we lost a 3/4 staff position in the department office and a year later an Instructional Support Technician III retired and was not replaced. These staff members are sorely missed. The department office is now manned by only one staff person (an ASC II) and she is constantly overworked. Our Dean has occasionally allowed us to hire temporary help for the office but that is only an interim solution. Our instructional support staff are also struggling to manage chemical solution preparation and equipment set-up for the many lab sections we offer each quarter (and will continue to offer under semesters). We are currently hiring graduate students to aid our instructional support staff and our instruments are being neglected because of staff shortages. We are hoping that the improved economy will soon lead to the budgeting of additional staff.

Resources: As explained under Progress Toward Five Year Planning Goals, we did gain lab research space during 2016-2017. We also gained needed new office space. Both were sorely needed and their acquisition has provided some breathing space for the department. During 2016-17 we participated in the planning and design process for the new STEM Research Area being created by renovation of space in one wing of the first floor of the Science Building. This project includes construction of a much needed Chemistry Instrument Room to be shared by all faculty and students using chemical instruments for research or classroom experiments. There will also be a large shared research laboratory and we are hoping the new faculty member we have been approved to hire for Fall 2018 will be able to utilize one of the benches in the shared lab for research experiments. In recent years we have experienced large increases in enrollment in our service courses and this had led to maximum usage of our assigned laboratory classrooms.

SUMMARY OF ASSESSMENT

Each of our three types of degree programs was assessed separately and the reports sent to the CSCI Educational Effectiveness Task Force. Summaries of the reports for the BS/BA Chemistry, BS/BA Biochemistry and MS Chemistry programs follow, each in the format requested. The length of each report is 2-3 pages.

Assessment Summary for BS/BA Chemistry Programs:

A. Program Learning Outcomes (PLO)

Students graduating with a Chemistry B.A./B.S. 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. (ILO 6)
2. work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments. (ILO 6)
3. use quantitative reasoning to analyze chemical problems and evaluate chemical data. (ILO 1 & 6)
4. write and speak clearly on chemical or biochemical issues. (ILO 2 & 6)
5. work collaboratively in teams to solve chemical problems. (ILO 4 & 6)

B. Program Learning Outcome(s) Assessed

As stated in our five-year assessment plan, in 2016-2017 we specifically concentrated on **Program Learning Outcome #4** which concerns oral and written communication. Written communication assessment was conducted in Bioanalytical and Forensics Laboratory (CHEM 3200). In addition, we continued to assess program content through Program Learning Outcome #1 (Demonstrate knowledge in the various areas of chemistry) and Program Learning Outcome #2 (Work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/ biochemical instruments). Demonstrating knowledge in the various areas of chemistry was conducted in the courses Organic Chemistry (CHEM 3303), Instrumental Analysis (CHEM 4240), Physical Chemistry (CHEM 3511 and CHEM 3512), and Inorganic Chemistry (CHEM 4162) through the use of standardized national exams and embedded exam questions. The laboratory assessment was conducted in capstone laboratory exercises in CHEM 3303 and CHEM 4240.

C. Summary of Assessment Process

Instrument(s): For CHEM 3200 (Bioanalytical and Forensics Laboratory) a rubric was used to analyze the capstone laboratory project lab reports.

Sampling Procedure: The instructor rated lab reports using a defined rubric that scored the following characteristics: report organization, visualization, mechanics, subject knowledge, and overall communication.

Sample Characteristics: Undergraduate chemistry students

Data Collection: Data was collected Spring 2017

Data Analysis: 56% of the students scored exemplary in all categories and 100% scored satisfactorily. More than 75% were exemplary in report organization, visualization, and mechanics. Students had the most difficulty with subject knowledge and overall communication.

Instrument(s): For CHEM 3303 (Organic Chemistry) a standardized national exam was given as the final exam and the capstone laboratory project lab report was analyzed.

Sampling Procedure: Our students' performance on the ACS organic chemistry standardized exam was compared to students nationwide. Our goal is for our students to be at or above the 40th percentile in the nation. The capstone laboratory project lab reports were analyzed for the students' ability to identify two unknowns which required them to do purifications, classification tests, spectroscopic analysis, and functional group transformations.
Sample Characteristics: Undergraduate students
Data Collection: Data was collected Spring 2017
Data Analysis: The average score was 29th percentile. 5/19 (26%) of our majors accomplished the goal of 40th percentile or better. 3/19 (19%) of our majors were at or above the 70th percentile which we consider outstanding. Analysis of the most frequently missed questions by our chemistry and biochemistry students determined that the most problematic areas were in determining the difference between nucleophilic and electrophilic aromatic substitution reactions and predicting reagents and products of radical reactions. In the laboratory portion, 89% of the students identified at least one of the two unknowns, and 74% identified both.

Instrument(s): For CHEM 3511 and CHEM 3512 (Physical Chemistry) embedded questions in the final exams were used to evaluate specific learning goals.
Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the final exams that mapped to four of the course SLOs in CHEM 3511 (applying the fundamental postulates of kinetic molecular theory, modeling heat and work flow using the first law of thermodynamics, relating thermochemical properties to chemical systems, and describing phase equilibrium) and two of the course SLOs in CHEM 3512 (formulating the mathematical description for the quantum mechanical motion of a particle, and modeling the vibrational and rotational motion of molecules).
Sample Characteristics: Undergraduate students
Data Collection: Data was collected Fall 2016 (CHEM 3511) and Winter 2017 (CHEM 3512)
Data Analysis: In CHEM 3511, a majority of students were able to demonstrate mastery of SLO #1, applying the fundamental postulates of kinetic molecular theory, and SLO#5, relating thermochemical properties to chemical systems, close to half were able to accomplish SLOs #6, describing phase equilibrium. Assessments results indicated that students had the most problems with SLOs#2, modeling heat and work flow using the first law of thermodynamics. In CHEM 3512, the majority of students were able to accomplish the first SLO (formulating the mathematical description for the quantum mechanical motion of a particle) but only about half were proficient on the second SLO (modeling the vibrational and rotational motion of molecules).

Instrument(s): For CHEM 4162 (Inorganic Chemistry) embedded questions in the final exam were used to evaluate specific learning goals.
Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the final exams that mapped to two of the course SLOs (illustrating and classifying the structures of coordination complexes, and formulating and applying theories for the bonding and magnetic properties of coordination complexes).
Sample Characteristics: Undergraduate students
Data Collection: Data was collected Winter 2017
Data Analysis: The majority of students were able to accomplish the first SLO (illustrating and classifying the structures of coordination complexes) but less than half were proficient on the second SLO (formulating and applying theories for the bonding and magnetic properties of coordination complexes).

Instrument(s): For CHEM 4420 (Instrumental Methods of Analysis), embedded questions in the final exam were used to evaluate specific learning goals.

Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the midterms and final exam that mapped to the course SLOs.
Sample Characteristics: Undergraduate chemistry students
Data Collection: Data was collected Winter 2017
Data Analysis: The SLOs in this course include the ability to explain the principles and applications of various spectroscopic and chromatographic techniques. The students were satisfactory in accomplishing SLOs #1, #2, and #4 (explaining the basic nature of light and its interaction with matter, the concept of Beer's law and its application for UV/Vis spectroscopy, and the basic components and the layout of optical instruments). Students were less than satisfactory on SLOs #3, #5, and #6 (explaining the difference between atomic Spectroscopy and molecular spectroscopy, the physical principles of NMR and the fundamental principles and application of chromatography).

D. Summary of Assessment Results

Main Findings: In the assessment of PLO #4, based on the data collected in CHEM 3200, most of the students are able to write and present chemical data clearly. Therefore we do not plan any major changes in this aspect of laboratory classes. The undergraduate students are generally able meet expectations in the laboratory (PLO#2) as demonstrated in CHEM 3303. However, in demonstrating knowledge in the various areas of chemistry (PLO#1), the number of students meeting expectations in some of the course learning outcomes assessed was lower than we would like to see.
Recommendations for Program Improvement: We do not plan major changes in the Program for next year because there will be a revision of the undergraduate program when we move to semesters in the Fall of 2018. However we will continue to make improvements in some of the courses. In the future more laboratory class time in CHEM 3200 will be devoted to an in-class writing exercise. In CHEM 3303, the instructors will keep in mind the topics of the most missed questions for greater emphasis. Because close to 90 % of the majors were able to satisfactorily complete the laboratory assessment in CHEM 3303, we have no plans to make changes in the laboratory portion of the course. In CHEM 3511, more time and practice problems will be devoted to using the first law of thermodynamics and conceptual partial pressures in gas-phase equilibrium problems. In CHEM 3512 it is planned to further develop and improve upon the open educational resources for the course. In CHEM 4162, the regular use of in-class, active, cooperative learning activities will be further developed. In CHEM 4240, the instructor will keep in mind the SLOs in which students were less successful, and incorporate more practice problems to address those topics.
Next Step(s) for Closing the Loop: We will re-evaluate the courses at the end of next year to determine how effective our planned changes were.
Other Reflections:

E. Assessment Plans for Next Year

Next year we will focus on Program Learning Outcome #1: demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry. We do not plan to modify the current (quarter-based) assessment plan. However, in the conversion to semesters we have developed a new assessment plan that will be in line with the all of the program modifications that will be implemented at that time (Fall 2018).

Assessment Summary for BS/BA Biochemistry Programs:

A. Program Learning Outcomes (PLO)

Students graduating with a Biochemistry B.A./B.S. 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. (ILO 6)
2. work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments. (ILO 6)
3. use quantitative reasoning to analyze chemical problems and evaluate chemical data. (ILO 1 & 6)
4. write and speak clearly on chemical or biochemical issues. (ILO 2 & 6)
5. work collaboratively in teams to solve chemical problems. (ILO 4 & 6)

B. Program Learning Outcome(s) Assessed

As stated in our five-year assessment plan, in 2016-2017 we specifically concentrated on **Program Learning Outcome #4** which concerns oral and written communication. Written communication assessment was conducted in General Biochemistry Laboratory (CHEM 4430). In addition we continued to assess program content through Program Learning Outcome #1 (demonstrate knowledge in the various areas of chemistry) and Program Learning Outcome #2 (work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/ biochemical instruments). Demonstrating knowledge in the various areas of chemistry was conducted in the courses Organic Chemistry (CHEM 3303), Physical Chemistry (CHEM 3511 and CHEM 3512), and Biochemistry (CHEM 4412) through the use of standardized national exams and embedded exam questions. The laboratory assessment was conducted in capstone laboratory exercises in CHEM 3303 and CHEM 4430.

C. Summary of Assessment Process

Instrument(s): For CHEM 4430 (General Biochemistry Laboratory), a rubric was used to analyze the written notebook and the final included embedded questions

Sampling Procedure: The instructor rated each notebook with respect to two learning goals: know how to develop a well-written laboratory notebook, and know how to perform enzyme kinetic data analysis and how to present this data in graphical format. The instructor also recorded whether students were able to answer selected questions on the final exam that mapped to six of the course SLOs: preparing a laboratory buffer, calculating protein and enzyme activity, interpreting Protein Purification Tables, performing enzyme kinetic data analysis, explaining theory behind chromatographic procedures, and explaining electrophoresis.

Sample Characteristics: Undergraduate biochemistry students

Data Collection: Data was collected Fall 2016 and Winter 2017

Data Analysis: 88% (in the Fall quarter) and 100% (in the Winter quarter) of the students were able to demonstrate mastery of SLO #7, know how to develop a well-written laboratory notebook which maps to Program Learning Outcome #4 concerning written communication. Assessments results indicated that students had the most difficulty in calculating protein and enzyme activity (SLO #2) and explaining electrophoresis (SLO#2).

Instrument(s): For CHEM 4412 (General Biochemistry) embedded questions in the midterm and final exams were used to evaluate five specific learning goals.

Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the midterm or final exam that mapped to five of the course SLOs: distinguishing the classes of lipids found in biological systems, explaining biological membrane structure and function, explaining bioenergetics, summarizing key cellular metabolic processes, and discussing metabolic regulatory mechanisms. A greater than 70% correct answer was considered satisfactory.

Sample Characteristics: Undergraduate biochemistry students

Data Collection: Data was collected Winter 2017

Data Analysis: Fewer than 25% of the students were able to demonstrate mastery of SLO #3, explaining bioenergetics, about one third were able to accomplish SLOs #4 and #5, summarizing key cellular metabolic processes, and discussing metabolic regulatory mechanisms. Assessments results indicated that students were fairly proficient at SLOs#1 and 2, distinguishing the classes of lipids found in biological systems, explaining biological membrane structure and function.

Instrument(s): For CHEM 3303 (Organic Chemistry) a standardized national exam was given as the final exam and the capstone laboratory project lab report was analyzed.
Sampling Procedure: Our students' performance on the ACS organic chemistry standardized exam was compared to students nationwide. Our goal is for our students to be at or above the 40th percentile in the nation. The capstone laboratory project lab reports was analyzed for the students' ability to identify two unknowns which required them to do purifications, classification tests, spectroscopic analysis, and functional group transformations.
Sample Characteristics: Undergraduate students
Data Collection: Data was collected Spring 2017
Data Analysis: The average score was 29th percentile. 5/19 (26%) of our majors accomplished the goal of 40th percentile or better. 3/19 (19%) of our majors were at or above the 70th percentile which we consider outstanding. Analysis of the most frequently missed questions by our chemistry and biochemistry students determined that the most problematic areas were in determining the difference between nucleophilic and electrophilic aromatic substitution reactions and predicting reagents and products of radical reactions. In the laboratory portion, 89% of the students identified at least one of the two unknowns, and 74% identified both.

Instrument(s): For CHEM 3511 and CHEM 3512 (Physical Chemistry) embedded questions in the final exams were used to evaluate specific learning goals.
Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the final exams that mapped to four of the course SLOs in CHEM 3511 (applying the fundamental postulates of kinetic molecular theory, modeling heat and work flow using the first law of thermodynamics, relating thermochemical properties to chemical systems, and describing phase equilibrium) and two of the course SLOs in CHEM 3512 (formulating the mathematical description for the quantum mechanical motion of a particle, and modeling the vibrational and rotational motion of molecules).
Sample Characteristics: Undergraduate students
Data Collection: Data was collected Fall 2016 (CHEM 3511) and Winter 2017 (CHEM 3512)
Data Analysis: In CHEM 3511, a majority of students were able to demonstrate mastery of SLO #1, applying the fundamental postulates of kinetic molecular theory, and SLO#5, relating thermochemical properties to chemical systems, close to half were able to accomplish SLOs #6, describing phase equilibrium. Assessments results indicated that students had the most problems with SLOs#2, modeling heat and work flow using the first law of thermodynamics. In CHEM 3512, the majority of students were able to accomplish the first SLO (formulating the mathematical description for the quantum mechanical motion of a particle) but only about half were proficient on the second SLO (modeling the vibrational and rotational motion of molecules).

D. Summary of Assessment Results

Main Findings: In the assessment of PLO #4, based on the data collected in CHEM 4430, most of the students are able to write and present biochemical data clearly. Therefore we do not plan any changes in this aspect of laboratory classes. The undergraduate students are generally able meet expectations in the laboratory (PLO #2) as demonstrated in CHEM 4430 and 3303. However, in demonstrating knowledge in the various areas of chemistry (PLO #1), the number of students meeting expectations in some of the learning outcomes assessed was lower than we would like to see.

Recommendations for Program Improvement: We do not plan major changes in the Program for next year because there will be a revision of the undergraduate program when we move to semesters in the Fall of 2018. However we will continue to make improvements in some of the courses. In the future more laboratory class time in CHEM 4430 will be devoted to analyzing data and doing the appropriate calculations. In CHEM 4412, more time will be devoted to a short review of the principles behind SLOs #3, 4, 5 and additional graded assignments covering these concepts will be added. In CHEM 3303, the instructors will keep in mind the topics of the most missed questions for greater emphasis. Because close to 90 % of the majors were able to satisfactorily complete the laboratory assessment in CHEM 3303, we have no plans to make changes in the laboratory portion of the course. In CHEM 3511, more time and practice problems will be devoted to using the first law of thermodynamics and conceptual partial pressures in gas-phase equilibrium problems. In CHEM 3512 it is planned to further develop and improve upon the open educational resources for the course.

Next Step(s) for Closing the Loop: We will re-evaluate the courses at the end of next year to determine how effective our planned changes were.

Other Reflections:

E. Assessment Plans for Next Year

Next year we will focus on Program Learning Outcome #1: demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry. We do not plan to modify the current (quarter-based) assessment plan. However, in the conversion to semesters we have developed a new assessment plan that will be in line with the all of the program modifications that will be implemented at that time (Fall 2018).

Assessment Summary for MS Chemistry Program:

A. Program Learning Outcomes (PLO)

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. (ILO 6)
2. work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems. (ILO 1 & 6)
3. understand, organize, and critically assess information from the chemical literature. (ILO 1 & 6)
4. present complex chemical information via oral and written reports. (ILO 2 & 6)
5. work collaboratively in teams to solve chemical problems. (ILO 4 & 6)

B. Program Learning Outcome(S) Assessed

As stated in our five-year assessment plan, in 2016-2017 we specifically concentrated on **Program Learning Outcome #4** which concerns oral and written communication. Written communication assessment was conducted in Seminar (CHEM 6820) and in Protein Chemistry Techniques (CHEM 6430). In addition we continued to assess program content through Program Learning Outcome #1 (demonstrate specialized knowledge in the chemical sciences beyond the undergraduate level) and Program Learning Outcome #2 (work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems). Demonstrating knowledge in the various areas of chemistry was conducted in the courses Advanced Topics in Organic Chemistry (CHEM 6310) through the use of embedded exam questions. The laboratory assessment was conducted in Protein Chemistry Techniques (CHEM 6430) and Methods of Instrumental Analysis (CHEM 4240).

C. Summary of Assessment Process

Instrument(s): For CHEM 6820 Seminar, a rubric was used to evaluate student seminars with respect to the organization of scientific content, oral presentation, proper use of visual-aids, and the ability to answer questions about the topic using a common rubric. Assessment was measured by the number of students presenting a seminar that met or exceeded the expectations by their third seminar presentation.
Sampling Procedure: Each faculty member coordinating the Seminar course evaluated each student seminar following the common rubric.
Sample Characteristics: MS Chemistry students
Data Collection: Data was collected Fall, Winter, and Spring quarters and was sorted by whether it was the students' first, second or third seminar.
Data Analysis: During the 2016-2017 academic year, 11 students gave their first seminar. The average score for these students was 11.4/16. The average score for the 14 students giving their second seminar was 13.2/16. The average score for the 11 students giving their third seminar was 13.3/16. A score of 12/16 was defined as meeting expectations and a score of 14/16 was defined as exceeding expectations. By their third seminar, 82% of the graduate students enrolled in the seminar class gave a seminar that met expectations. And almost half gave seminars that exceeded expectations. On average, students improved the most between their first seminar and their second seminar.

Instrument(s): For CHEM 6830 Protein Chemistry Techniques, a rubric was used to analyze student laboratory notebooks for three specific learning goals.
Sampling Procedure: The instructor rated each notebook as exemplary, basic, or insufficient with respect to three learning goals: effective use of instrumentation to solve an experimental problem, effective use of a biochemical method to solve an experimental problem, and effective use of a biochemical method to test a hypothesis.
Sample Characteristics: MS Chemistry students
Data Collection: Data was collected Winter 2017
Data Analysis: Using the lab notebook criteria given above for documentation and analysis of methods for solving experimental problems and testing hypotheses, this year's M.S. students generally met expectations and several did exemplary work. Two students failed to meet expectations for one of the learning goals (testing a hypothesis), but these same students did well for the other goals. While we are happy with these results, there is room for improvement.

Instrument(s): For CHEM 6310 Advanced Topics in Organic Chemistry, embedded questions in the final exam were used to evaluate three specific learning goals.
Sampling Procedure: The instructor recorded whether students were able to answer selected questions on the final exam that mapped to three of the course SLOs: predict conformational preference of organic molecules and the stereochemical preference in reactions (SLO#4), evaluate and apply different techniques for the determination of mechanisms of organic reactions (SLO#2), and design syntheses to introduce or interconvert different functional groups and to form carbon-carbon bonds (SLO#5).
Sample Characteristics: MS Chemistry students
Data Collection: Data was collected Fall 2016
Data Analysis: Close to 100% of the students were able to meet the expectation for SLO#4, so SLO #4 appears to have been mastered adequately by the majority of students. About 50% of the students were able to meet the expectation for SLO#2. SLO#2 builds on principles that were expected to have been learned in previous undergraduate courses that are prerequisites to this graduate class. Approximately 20% of the students met expectations for SLO#5.
Instrument(s): For CHEM 4420 Instrumental Methods of Analysis, embedded questions in the Final exam were used to evaluate three specific learning goals.

Sampling Procedure: The instructor recorded whether students were able to answer selected questions that mapped to the course SLOs taken from the midterms, final exam, or in the lab reports.
Sample Characteristics: MS Chemistry students
Data Collection: Data was collected Winter 2017
Data Analysis: A majority of the students accomplished satisfactory performance on all of the course SLOs, which are the ability to explain the principles and applications of various spectroscopic and chromatographic techniques, with the exception of SLO #3, which was explaining the principles of FT-IR.

D. Summary of Assessment Results

Main Findings: In the assessment of PLO #4, based on the data collected in CHEM 6820, students exhibited improvement as they move through the MS program in their ability to understand information from the chemical literature, organize and critically assess the information and present it clearly via an oral seminar. Therefore we do not plan any changes to the seminar class at this time. The MS students were generally able meet expectations in the laboratory. In the advanced topics in organic chemistry course, students were meeting expectations in only two of the three learning outcomes assessed.
Recommendations for Program Improvement: We do not plan major changes in the Program for next year because there will be a major revision of the graduate program when we move to semesters in the Fall of 2018. However we will continue to make improvements in some of the graduate courses. In the future more laboratory class time in CHEM 6430 will be devoted to explaining the value of thorough analyses of experimental results, with proper display of data in the form of tables or graphs where appropriate. Students will be asked to share the elution profiles from their column chromatography experiments with the class as a whole. These presentations will form the basis for class discussions of proper methods for data documentation and analysis. Students will be encouraged to provide more detailed evidence for the conclusions listed in their lab notebooks. In CHEM 4240 more time will be devoted to the principle of FT-IR. In CHEM 6310, more time will be devoted to a short review of the principles behind SLO #2 in order to bring students up to speed and enable them to learn the more advanced material. Because only about 20% of the students were able to meet the expectation for SLO#5, more practice problems will be provided on these concepts and more time will be devoted on how to develop strategies to solve these kinds of problems
Next Step(s) for Closing the Loop: We will re-evaluate the courses at the end of next year to determine how effective our planned changes were.
Other Reflections:

E. Assessment Plans for Next Year

Next year we will focus on Program Learning Outcome #1: demonstrate specialized knowledge in the chemical sciences beyond the undergraduate level. We do not plan to modify the current (quarter-based) assessment plan. However, in the conversion to semesters we have developed a new assessment plan that will be in line with the all of the program modifications that will be implemented at that time (Fall 2018).

III. <u>DISCUSSION OF PROGRAM DATA & RESOURCE REQUESTS</u>

A. Discussion of Trends & Reflections

Supplemental data provided through CAPR discussed below are not attached to this report, as suggested by the Chair of CAPR.

Notable Trends: Department FTES trended slightly upward over the past five years, from 344.7 in Fall 2012 to 366.9 in Fall 2016. Correspondingly, the number of class sections offered increased slightly, from 104 in 2012 to 110 in 2016. The number of full-time tenured or tenure track faculty increased from seven in 2012 to nine in 2016, with a dip to eight in Fall 2015, but back up to nine for Fall 16 after a new hire. The combined FTEF for part-time lecturers and teaching associates was about the same as the FTEF for tenured/TT faculty, ranging from 8.8 in Fall 2012 to 11.1 in Fall 2015 and back to 8.8 in Fall 2016. In 2016 values, only 50.6% of the department FTEF is tenured or TT faculty and 49.5% of the class sections are being taught by part-time lecturers or TAs. Department Instructional SFR remained relatively constant at 22-23 over the last three years but was a little higher in 2012 and 2013 (~25). The SFR for chemistry and biochemistry lecture classes averaged 59-63 for the last four years, but the SFR for the lab sections is necessarily lower. The number of chemistry undergraduate majors remained relatively constant over the last five years (81-90) while the number of biochemistry undergraduate majors trended slightly downward from 127 in Fall 2012 to 106 in Fall 2016. As a percentage of students taught, the majors constituted between 34.6 and 39.0 over the last five years. This low number is primarily because we have a large service component for students in other majors as well as GE offerings. The number of Chemistry Master's students has decreased significantly over the last five years from a high of 58 in Fall 2012 to 23 in Fall 2016.

Our majors are fairly evenly divided with respect to gender, with 56.4% female and 43.6% male in Fall 2016, and constitute a very diverse group in terms of race and ethnicity. In Fall 2016 Asians accounted for 35.8% of the biochemistry majors and Hispanics comprised 29.2%; the other large groups were African Americans at 11.3% and whites, also at 11.3%. Asians and Hispanics were also the largest groups among the chemistry majors, but there were 22.7% whites and only 12.7% African Americans.

Data for student graduation rates was provided for the years 2006 through 2010. The categories were EFR-4 yr., EFR-6 yr., transfer-2 yr., transfer-4 yr., grad students-2 yr. and grad students-4 yr. For the chemistry and biochemistry majors the raw numbers were relatively small and the percentages in each category over the five year period were highly variable, with no logical trend discernable. However, the data did indicate that, over the five year period, between 25% and 56.3% of the EFR graduated in 6 years, between 50% and 100% of the transfer students graduated in 4 years and between 12.5% and 100% of the graduate students finished in 4 years. There appear to be achievement gaps between under-represented minority (URM) students and non-URM students but because the percentages are based on such small numbers, it's hard to derive sweeping conclusions.

Reflections on Trends and Program Statistics: We continue to be concerned that such a high percentage of our courses are taught by part-time lecturers and teaching associates. We are especially unhappy because we still have majors courses being taught by part-time lecturers. The accrediting agency for our BS Chemistry degree (the American Chemical Society) requires major courses to be taught by tenured or TT faculty. Because of recent hires we now have at least one section for each of the courses required for the BS Chemistry degree taught by regular faculty. However, since students can take any section some students do not have a tenured or TT faculty for their required major courses for our accredited degree.

It should be pointed out that even though our SFR, at 22-23, is lower than the campus average of 29, it is fairly typical or even high for a Chemistry program. The SFR at UC San Diego is 19 and the SFR for the Chemistry program at UC Berkeley is 17. The low SFR comes from the limited number of students who can work in a laboratory classroom. Chemistry classroom laboratories are generally designed for about 24 students and safety considerations require maintaining relatively small classes. On the other hand our department SFR for lecture classes is quite high, at 59-63, and this is because a number of our faculty are teaching very large courses and handling all the concomitant work involved.

Another concern reflected in the CAPR data is the decreasing number of students in the graduate (M.S.) program in Chemistry. Back in Fall 2012 the graduate student headcount was 58 and the faculty consensus was that we had too many graduate students to be mentored by the 7 regular faculty present in the department at that time. Since there was a perception that some of the M.S. students we admitted were a little weak, the entrance requirements were made more stringent. That decision and subsequent improvements in the economy have apparently caused the precipitous drop (to 23 in Fall 2016) in the number of students matriculating in the M.S. Chemistry program. A major goal for the upcoming years is to increase the graduate program. We now have nine faculty members, all able to mentor graduate students, and would like to bring the number of students back up to about 40-45.

The graduation rate data does indicate that we could do a better job in helping our students complete their degrees. The 4 year graduation rates are quite poor for both chemistry and biochemistry undergraduates, at 5.6-16.7% for chemistry and 18.8-33.3% for biochemistry. As noted above, the 6-year graduation rates are better but quite up and down for the years 2006-2010. The transfer student data is based on very small numbers but does indicate we could do better in graduating these students as well. The 2-year rate ranged from 0 to 60% for chemistry majors and 20 to 50% for biochemistry transfer students but as noted above the 4-year rate was considerably higher for both groups (50-100%). The data also show achievement gaps between URM and non-URM students but these are quite variable and hard to quantify accurately with small numbers. In some cases the data show a reverse achievement gap, where URM students graduated at a higher rate than non-URM. Perhaps we can conclude that there are achievement gaps for URM students in our programs but the extent of the problem is difficult to gauge from relatively small numbers that translate to large percentage gaps .

To work on both the total graduation rates and the achievement gaps, the College of Science has recently worked with Student Center for Academic Achievement to introduce more Supplemental Instruction for chemistry. The Student Center in Science is now doing significant advising for chemistry and biochemistry majors. These measures should help with student success but other policies such as mandated advising appointments, development of get-to-know-the-department events, and more involvement of student majors in undergraduate research are being considered by the Chemistry and Biochemistry faculty as ways to engage students and hopefully improve student success.

B. Request for Resources

1. Request for Tenure Track Hire in Organic Chemistry

This is a request for a tenure track faculty position in organic chemistry at the Assistant Professor level. In 2011, one of the organic chemistry faculty members in the Department of Chemistry and Biochemistry retired and was not replaced. His departure has necessitated the hiring of part-time lecturers to teach majors-level organic chemistry courses for the past six years. During those six years we experienced faculty shortages in other areas of chemistry as well because of earlier retirements and more recent separations. These other shortages led to delays in requesting a new organic chemist. For instance, in 2013 we initially submitted a request for a tenure track organic chemist but after submission one of our two Physical Chemists announced he would leave CSUEB. This was a crisis because not many lecturers can teach physical chemistry. So we asked and received permission to switch the specialization area from organic to physical chemistry. Other similar concerns have prevented us from attempting to replace our organic chemist until now.

The department offers seven undergraduate degree options in Chemistry and Biochemistry, and a Master of Science degree in Chemistry. All of the students matriculating in these programs take organic chemistry courses. Moreover, courses in organic chemistry are required for the Biological Sciences undergraduate degrees, for some Health Sciences majors, and for all Pre-Health Professional students (pre-Medical, Pre-Dental, Pre-Pharmacy, etc.). Over 250 students take an organic chemistry course series each year. This translates to four lecture series and about 27 laboratory sections per year on the quarter system (or 18 on the semester system). Due to the specialized nature of organic chemistry laboratory work and the safety concerns involved, both lecture and lab should be taught by tenured or tenure track (TT) faculty or by very experienced lecturers. Currently some of the lecture courses are being taught by part-time lecturers and about half the lab sections are taught by lecturers or TAs. A new TT faculty member is necessary not only to teach organic chemistry lecture and lab, but also to help maintain and build upon the instrumentation used in the organic courses, to teach in other areas of chemistry, to help improve the department general education curriculum and to supervise projects for Master's candidates in chemistry.

Currently only 50.6 % of our course sections are taught by tenured or tenure-track faculty. With a tenure track search in progress during 2017-18, we hope to increase this percentage a few points by Fall 2018. However, we will still not have recovered from the severe faculty shortage we experienced during the 2006-2010 period which resulted from a combination of retirements, increasing enrollments and faculty separations. Eleven years ago, in 2006, our FTES was 245.3, lecturers accounted for 30.3% of the FTEF and there were 8.5 TT faculty. Ten years later, in Fall 2016, our FTES was 366.9, lecturers and TAs accounted for 49.5% of the FTEF, and there were 9 tenure track faculty. Thus our ability to properly fulfill our department mission of a quality education for all chemistry students remains in jeopardy.

In practical terms, the current higher FTEF for lecturers and TAs translates to a significant number of important courses being taught by part-time lecturers. For example during 2016-

2017, seventeen majors-level and graduate lecture course sections were taught by lecturers. For some of these courses the clientele included not just Chemistry and Biochemistry majors but also other science majors, including students matriculating in Biological Sciences, Environmental Science, Physics, Engineering, and Heath Sciences. Additionally, four lecture sections for service courses and six General Education lecture courses for non-majors were taught by part-time lecturers. Moreover, 77 of the 108 laboratory sections offered were taught by part-time lecturers or TAs as well. Some students who took several chemistry courses never had a tenure track instructor, either for lecture or lab. This heavy reliance on lecturers is negatively affecting our program. A new organic chemist will be able to not only teach majors-level and graduate organic chemistry courses, but also cover other types of chemistry courses currently taught by lecturers. We hope to be able to improve the chemistry experience not only for chemistry and biochemistry majors but also for students from other disciplines taking chemistry as a major requirement or for general education credit. This is important since more than half of our FTES represents students from other disciplines. We think it is essential to provide all students taking chemistry courses with a quality learning experience. We hope a new hire will bring us closer to this goal.

2. Request for Other Resources

We have been fortunate to obtain much needed space in the Science building over the last year as the result of the move of some Science departments to the SF building and the renovation of the west wing of the first floor of the Science building. We have no additional request for space at this time.

We do urge the university to consider increasing funding to the colleges for staff positions. The staff was cut severely during the recession of 2008-2011 and the lost positions have not been restored. In our case staff shortages in the department office and in the instructional support staff are compromising our ability to serve our students effectively. We have a very strong need for two half-time positions: an Administrative Support Assistant (ASA) and an Instructional Support Technician (IST).