California State University, East Bay

Five Year Program Review for
Department of Chemistry and Biochemistry

2017-2018

Self Study and 5-Year Plan approved by faculty: December, 2017 by a vote of 9 to 0.

External Reviewer Report received by the program on: March 16, 2018

Program's Response to External Reviewer's Report completed on: May 10, 2018

5-Year Plan Amended: May 11, 2018

Complete 5-Year Program Review Report submitted to CAPR on: May 15, 2018

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1. Summary

The Department of Chemistry and Biochemistry offers seven undergraduate degrees and an M.S. degree. The B.S. Chemistry degree is accredited by the American Chemical Society (ACS). The ACS authorizes the chair of an ACS-approved program to certify graduating students who complete a bachelor's degree meeting the ACS guidelines. A certified degree signifies that a student has completed an integrated, rigorous program which includes introductory and foundational course work in chemistry and in-depth course work in chemistry or chemistry-related fields. The ACS does not have an accreditation process for our other degree programs, and the other degree programs are not accredited by an external agency. As we have done in the past to simplify the review process, we include all eight degrees in this Five Year Review following the CAPR format for Academic Programs without external accreditation.

Self-Study

The Department of Chemistry and Biochemistry accomplished most of the plans outlined in the previous Five Year Plan (2012). Changes were made to improve and update the curriculum. The department acquired several new instruments for research and for use in the teaching laboratories. Research activity by the faculty and their students also remained high. Not foreseen in the 2012 Plan was the move from quarters to semesters, so a great deal of time and energy was placed on transforming the curriculum for a semester-based system.

Curriculum changes implemented during the past five years included reducing the total number of units of three of the degree programs to be in compliance with the mandated maximum of 180 quarter units. The Introduction to College Chemistry course, CHEM 1100, was revised to become part of a new cluster, called "Teaching in the 21st Century" which is aimed at Liberal Studies majors with an interest in teaching. Changes to lab curriculum included new experiments in nearly all of the laboratory courses to make use of newly obtained instruments or to introduce students to new techniques.

New instrumentation acquired during the last five years included an inductively coupled plasma-optical emission spectrometer (ICP-OES) and a new high performance liquid chromatography (HPLC) instrument with fluorescence detection. A couple of instruments were upgraded: a stopped-flow attachment was added to the spectrofluorimeter, and a multi-channel probe was obtained for the NMR. New instrumentation purchased to improve and modernize the organic teaching laboratories were microwave synthesizers, infra-red spectrometers, gas chromatographs interfaced to laptop computers, and digital melt stations. The biochemistry labs introduced the use of a new ChemDoc Molecular Imager to photograph and analyze electrophoresis gels, and nanodrop spectrophotometers for protein, enzyme, and DNA measurements. The physical chemistry labs were improved with emission spectrometers, conductivity probes, and gas sensor probes.

The plan to hire several new tenure-track faculty members was realized with the addition of a physical chemist, an inorganic chemist, an analytical chemist, and two biochemists. A request for one more position was approved and a search is in progress this year, for another physical chemist. During the last five years, research and professional activities of the department faculty continued at a high level. Cumulatively, during the last five years, the faculty of the Chemistry and Biochemistry

Department were awarded 38 extramural and CSU or CSUEB grants, and published 23 articles. The faculty also supervised the research projects of approximately 60 undergraduate and 35 Masters students.

The department worked to achieve its mission of preparing the chemistry and biochemistry majors for work or advanced study, providing a foundation in chemistry or biochemistry for students in related majors, and making chemistry accessible to non-majors in the General Education courses. We monitored and assessed the performance of our major students to determine how well they were accomplishing our Program Learning Objectives. The assessment data demonstrates that our students, for the most part, are meeting the standards set by the goals in our assessment plan. The requirements of our degree programs are similar to those of chemistry departments at other CSU and UC institutions.

Statistics for the last five years indicate that the number of Chemistry and Biochemistry majors has been level. There was no discernable trend from year to year in the ethnicity of the majors. Total instructional FTEF numbers have remained fairly constant over the last five years. Total FTES has increased slightly but the overall SFR for the department has also remained fairly constant. The number of course sections offered by our department every year and the average section size for all courses was also about the same during the last five years.

Plan

Over the next five years the major change to our curriculum will be the conversion to semesters. The undergraduate chemistry and biochemistry degree programs will be restructured, balancing the need to maintain content and, for the BS Chemistry degree, to fulfill the accreditation requirements of the American Chemical Society, with the maximum credits allowed. To improve student success in achieving our program learning objective of using quantitative reasoning to analyze chemical problems and evaluate chemical data, all of the degrees will have increased math requirements. The Masters degree program will retain the basic format of chemistry or biochemistry concentrations, each with a thesis or non-thesis track, but the curriculum has been completely redesigned so that it will have a core curriculum containing graduate level courses in organic chemistry, physical chemistry, analytical chemistry, and biochemistry. The concentrations will be distinguished through elective courses. Three new 600-level core curriculum courses and two new 600-level electives will be developed.

With the elimination of the ELM placement exam by executive order 1110, we plan to revise the prerequisites for our introductory courses. Currently the prerequisite for several introductory courses relies on the ELM math score. We will be working closely with the Math Department to identify appropriate co-requisites for those courses.

We plan to continue to upgrade the laboratory curriculum and instrumentation for our major classes. The new Inductive Coupled Plasma-Optical Emission Spectrometer (ICP-OES) will be incorporated into the Instrumental Methods of Analysis laboratory and the Environmental Chemistry laboratory. New experiments are also planned for the Biochemistry and Inorganic Chemistry laboratory courses, and for the laboratory components of Organic Chemistry and Quantitative Analysis due to their expansion on the semester system. We also plan to continue to acquire new instrumentation for use in teaching and research, such as a Liquid Chromatograph-Mass Spectrometer (LC-MS) to be used in the Instrumental Analysis, Biochemistry and Forensic Chemistry teaching laboratories, and in research. In addition, we will seek to upgrade the computers and software in our computer room. Funding for service contracts to support the maintenance of the new instruments, as well as for the continued maintenance of existing instruments, will be requested.

One of our on-going goals has been to increase the number of biochemistry and chemistry courses taught by tenured or tenure-track faculty and we will continue this goal. We also need more tenure track faculty to provide adequate research opportunities for our undergraduate and graduate student majors. We are currently conducting a search for a new faculty member in the area of physical chemistry. Over the next five years, we plan to submit requests for additional faculty, particularly in the area of organic chemistry. Suitable research laboratory space and office space will be needed for the new faculty hires. It is also necessary to implement the proposed College of Science plan to provide all tenured and tenure-track faculty with release time to mentor undergraduate and graduate research students and to advise Plan B (non-thesis) graduate students. Additionally coordination units should be provided for faculty who are charged with the coordination of multiple lab sections associated with their lecture courses.

In addition to faculty hires, we need to hire an equipment and stockroom manager. This position was eliminated after the retirement of the previous stockroom manager in 2010. The absence of a person in this position has had a negative impact on our ability to maintain and update instrumentation, and improve our laboratory curriculum. We also have need of an additional part time office position.

2. Self-Study

2.1. Summary of Previous Review and Plan

Over the last five years, significant progress toward the goals outlined in our 2012-2013 CAPR Review and Plan has been made. The Plan noted the trend of an increasing student population and laid out plans to accommodate this increase in terms of space, resources and curriculum. These plans also contained modifications to the curriculum that considered changes in the field to ensure that our students were gaining the theoretical and practical knowledge needed for employment or further education. The Plan also recognized the need to hire more tenure track faculty due to the increase in undergraduate and M.S. students majoring in chemistry and biochemistry. This summary outlines the major goals of the 2012-2013 Plan and the progress made toward its implementation.

a) Curriculum

As delineated in the 2012-2013 Plan, we modified three of our degree programs to meet the CSU-wide goal of 180 maximum total units. The total number of required units was above 180 for the B.S. Chemistry, B.S. Chemistry-Option in Forensic Science, and B.S. Biochemistry degrees. To bring these degree programs in accordance with CSU policy, we reduced the major requirements for these degrees. In the B.S. Chemistry degree, we decreased the number of required electives in this program from eleven to eight. For the B.S. Chemistry-Option in Forensic Science, we eliminated the requirement of Statistical Methods in Biology. For the B.S. Biochemistry degree program we dropped the Introduction to Computers requirement.

Also as planned, we increased the number of undergraduate biochemistry and chemistry courses taught by tenured or tenure track faculty. This was made possible by the addition of several new tenure-track faculty over the last five years. The hiring of two new biochemists has reduced, although not eliminated, the number of upper division biochemistry courses being taught by part-time lecturers. The additional biochemists will also help to provide research opportunities for our undergraduates and M.S. students, of which more than half earn degrees in biochemistry. In addition, we have also been able to teach inorganic chemistry on a yearly basis as planned. This has been possible due to the relatively high number of students registering for the inorganic classes because of an increase in enrollment in B.S. chemistry degree program and the popularity of Inorganic Chemistry as an elective for the M.S. program, as well as the hiring of a new tenure track faculty member with expertise in this area of chemistry.

The Introduction to College Chemistry course was revised, upgrading both the lecture and laboratory curriculum as planned. With the Liberal Studies faculty and the Department of Earth and Environmental Science, a new freshman learning community was established 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.

Although we planned to introduce the "Instructional Activities in Chemistry" course as a service learning component for more of our degree programs, we did not do that. On further reconsideration, many of the faculty felt that the course was not an appropriate elective for the BA and BS degrees. It continues to be a requirement for the BA Chemistry and Biochemistry, Option in Chemistry Education.

A part of our 2012-2013 Plan was to encourage faculty to modernize course content, and to continue to upgrade laboratory curriculum and instrumentation. By a careful survey of the course contents, we have attempted to implement new emphasis on areas where recent developments have occurred. For example, a new module on inorganic nanostructures was added to the Advanced Inorganic Chemistry course. Students were introduced to the use of software tools for the analysis of protein structures in the Protein Structure class and a course project was added where they apply these skills. Several faculty members have been engaged in redesigning aspects of their courses to use new teaching techniques. For example, an effort has been made to integrate group problem solving activities into the General Chemistry lab sessions, on-line quizzes have been added to the General Biochemistry courses, and the use of case studies has been added to Bioanalytical and Forensic Instrumentation. In addition, a greater emphasis on science writing was added to several of the laboratory courses. The use of a Writing Associate (peer mentor from SCAA) and peer feedback assignments was added the General Biochemistry lab class where students write four scientific reports and each report builds on the previous report. A requirement for formal lab reports was added to the Quantitative Analysis course.

New experiments have been added in nearly all of the laboratory classes. The General Biochemistry lab course was completely redesigned so that all of the experiments are connected into one project. Multiple new experiments were introduced to Bioanalytical and Forensic Chemistry Instrumentation course such as analysis of gunpowder residue, fingerprint residue, drug molecules, fibers and dye composition, making use of a variety of chemical instrumentation. A new experiment separating and analyzing peptides by HPLC was added to the Advanced Biochemistry lab. New software to model chemical speciation was introduced in Environmental Chemistry. Students then used it to evaluate a research question during a group project. A new qualitative experiment investigating the spectrochemical series of cobalt was added in the Inorganic Chemistry laboratory.

Unforeseen by the 2012-13 Plan was the decision by the University to move to a semester-based system as of Fall 2018. Due to the complete curriculum transformation that this requires, we put off any other curriculum modifications in the interim. A major focus of the past two years has been revising and transforming all of our degree programs and courses for semesters. Program learning outcomes were modified; and new curriculum maps and assessment plans for the Masters and undergraduate degrees were developed.

The undergraduate chemistry and biochemistry degree programs have undergone significant restructuring for the conversion to semesters in order to maintain content and, for the BS Chemistry degree, to fulfill the accreditation requirements of the American Chemical Society with regard to laboratory courses. Three specialized one-quarter lab courses (Quantitative Analysis, Instrumental Analysis, and Inorganic Chemistry Lab) and two two-quarter lab series (Physical Chemistry Lab and Environmental Chemistry) were reorganized into single semester lab courses without reducing the total laboratory hours required for accreditation and without increasing the total number of semester units for the degree beyond 120. In Quantitative Analysis and Inorganic Lab, the number of lab periods was increased (from 20 to 30) and new experiments will be added. The number of lab periods in Environmental Chemistry was decreased from 20 to 15 and the lab experiments will be restructured. In the biochemistry degrees, the biochemistry laboratories have been reorganized and expanded. The number of total biochemistry laboratory hours will be greater after semester conversion and will run over the course of one year compared to the present two quarters. New experiments are being added and with more time available, an effort is being made to integrate some of the individual experiments into a larger project driven by a concrete question. All of the degrees have been made more rigorous by the requirement of more math units and, for the B.S. degrees, by requiring calculus-based physics courses.

The MS chemistry degree program has undergone substantial restructuring for the conversion to a semester curriculum. The program retains the basic format of chemistry or biochemistry concentrations each with a thesis or non-thesis track, but the curriculum has been redesigned from its present form to have a core curriculum with a balance between the different chemistry disciplines. This new core curriculum will contain graduate level courses in organic chemistry, physical chemistry, analytical chemistry, and biochemistry. All students will be required to take one laboratory course in their concentration with the students in the non-thesis tracks required to take two laboratory courses. At least 60% of the degree requires 600-level coursework. Through additional electives students will be able to tailor their programs to be more in-depth in their area of interest. Three new 600-level core curriculum courses and two new 600-level electives were designed. Laboratory courses in biochemistry and analytical chemistry were transformed by a redesign of the laboratory portion to fit the changed number of lab hours in a semester schedule. In some cases experiments were added or replaced to include modern techniques relevant to today's chemical and biochemical industry. The implementation of a core curriculum with distinct leaning outcomes will provide uniformity in the chemical knowledge the students gain and a make it possible to do a more comprehensive assessment. Assessment will be conducted in the core curriculum courses and in capstone experience courses (Review Paper, Thesis, and Seminar).

b) Concord Campus

Basic Chemistry for Health Sciences (CHEM 1610) has been taught every year on the Concord Campus to support the Pre-Nursing curriculum as part of the Concord arm of the Nursing Program.

c) Faculty

At the time of the 2012-2013 Review, the department consisted of seven tenure track faculty members. We have made some progress toward our goal of increasing the number of tenure track faculty members. The two 2012-2013 tenure track 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 new tenure track physical chemist, in 2016 we hired a new tenure track analytical chemist, and in 2017 we hired another tenure track biochemist. The new hires have allowed us to somewhat reduce the number of lecturers used for majors-level and graduate courses. However, another of our faculty members, a physical chemist, resigned in 2015, and Dr. LeDuc also left to become the Director of the STEM Institute in Fall 2014 and then CSCI Associate Dean in 2016. The combination of increasing enrollments in the lower division chemistry courses and loss of faculty members through resignation, administrative assignments or release time has meant that the percentage of our FTES taught by tenured or tenure track faculty has remained below 50% for most of the past five years (Appendix H). Although the lecturers are being used mostly in the lower division and general education courses, we are still using an unacceptably high number of temporary faculty to cover all of our classes. Fortunately, we were approved to conduct a tenure track faculty search during 2017-2018 and we currently have an ongoing search for a physical chemist who would start Fall 2018.

d) Equipment and Facilities

The 2012-2013 Plan identified a critical need for additional research and equipment space due to an increase in research active faculty. A shortage of space has been an on-going problem in the College of Science that also affects other departments. With respect to locating new research and office space for new faculty, some progress has been made. As the result of the move of some College of Science departments to the new SF building and the reassignment of space in the Science Building, the Chemistry and Biochemistry department gained an approximately 325 sq. ft. space (Sc S452) that was converted to a research lab in 2017. The department also lacked space for instrumentation. Many of the shared instruments are located in the back of teaching laboratories which limits their accessibility for research to times when classes are not in session, drastically restricting the utility of these instruments. Our plans to acquire new instruments had become severely limited by the lack of space to house them. Due to renovation of space on the ground floor of the science building, we will be able use some space there for instruments and research. The department also gained two offices; these are being used for new faculty and lecturers. (Previously our 12 lecturers and 8 Teaching Associates were all crammed into one 280 sq. ft. room).

Over the last five 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 to replace older versions that had become unrepairable. A new gas chromatograph mass spectrometer (GC-MS) for our analytical chemistry courses was also purchased to replace one that had become obsolete. We also obtained new Initiator microwave synthesizers for the organic chemistry program and a new high performance liquid chromatography (HPLC) instrument with fluorescence detection for our analytical chemistry and biochemistry courses. The use of the modern microwave synthetic methods has been incorporated into the organic chemistry lab courses. HPLC is now routinely used for various experiments in five different courses. We obtained an inductively coupled plasma-optical emission spectrometer (ICP-OES) which will be used in the analytical and environmental chemistry courses for elemental analysis as well as for research in environmental chemistry conducted by our Master's students. A ChemDoc molecular imager was obtained with A2E2 funding and was used in both the General and Advanced Biochemistry lab courses to photograph and analyze protein and DNA electrophoresis gels. Finally, an FPLC instrument was also obtained with A2E2 funding. Smaller equipment used to upgrade and modernize the teaching labs included melt stations, emission spectrometers, conductivity probes, and gas pressure sensor probes, all of which are operated with a "Lab Quest" interface. We also increased the number of laptops available for classroom use from 14 to 40 with funds from the College of Science.

Start-up funds to individual faculty members have also added to the instrumentation available in the department for research and teaching. A 32-core computing cluster (abacus) and desktop work stations was purchased by Dr. Huang. In addition to research, he has incorporated its use into the graduate-level Computational Chemistry course. Dr. Fleming obtained a UV-vis spectrometer that students also use in the Physical Chemistry Laboratory course. Dr. Tinnacher purchased a liquid scintillation counter and a total organic carbon/total inorganic carbon analyzer, the latter of which she plans to use in an experiment in the laboratory portion of the Environmental Chemistry class.

During the last five years, we developed new experiments to incorporate previously obtained instruments into the laboratory curriculum. These instruments included a spectrofluorimeter, a microplate spectrometer, nanodrop spectrophotometers and specialized chemistry software (ChemDraw), previously funded through the A2E2 Instructional and Research Equipment Program. A new experiment that employs the spectrofluorimeter was designed for the Instrumental Methods of Analysis course. The microplate spectrometer was used in an experiment in General Biochemistry Laboratory to determine protein concentration, and the Nanodrop spectrophotometers were incorporated into several biochemistry lab courses for protein, enzyme, and DNA measurements, and into the Quantitative Analysis course for colorimetric measurements. Students are introduced to the ChemDraw software in the first year organic laboratory classes and subsequently students use it in the Advanced Organic Chemistry course.

Finally, we were able to hire a new Instructional Support Technician (Chung Ting Kuo) in 2013 to replace one of our classroom laboratory prep technicians who sadly passed away. We also hired a new administrative assistant (Kelley Ramos) to replace the administrative assistant who retired in 2014, and a part time purchasing person (Rhonda Sorenson) to replace the previous ASA II who resigned in 2016.

e) Research and Other Professional Activities

Research activity in the department during the past five years has continued at a high level. Drs. Fleming, Groziak, Halim, Huang, Kim, Kotchevar, McPartland, Sommerhalter, and Tinnacher have all held multiple CSU Faculty Support Grants during this five year period. Dr. Tinnacher obtained a Department of Energy (DOE) grant of $785K to study the effects of calcite impurities on uranium sorption. Dr. Halim had a CSUPERB New Investigator Grant. Dr. Huang has obtained funding from the ACS Petroleum Research Foundation ($55K) and is a co-PI on the previously mentioned DOE grant. He has also obtained funding from subcontracts with Lawrence Livermore National Lab ($140K total) and supercomputing time at the National Energy Research Scientific Computing Center. Cumulatively, the Department of Chemistry and Biochemistry faculty published 23 papers in the last five years.

Student involvement in undergraduate research and graduate research for Plan A (thesis option) M.S. degrees has remained high. During the past five years, approximately 60 undergraduates have participated in undergraduate research with a faculty advisor. Approximately 35 M.S. students conducted research with a faculty member. This research activity has led to 65 student presentations at national and local scientific meetings.

The Faculty of Chemistry and Biochemistry Department have also been very active in external professional activities. Dr. Groziak was a reviewer for the NIH Synthetic and Biological Chemistry Study section. Dr. Sommerhalter organized three invited lectures and meetings on campus for the ACS Women's Chemist Committee (in 2014, 2016 and 2017). Drs. Halim, Huang, Kotchevar, and Tinnacher served as reviewers for chemistry journals in their areas of expertise. Drs. Groziak, Halim, Huang, and Sommerhalter gave invited talks at various other Bay Area Universities.

In addition to scientific research, the Department has been professionally active in chemical educational activities. Drs. Sommerhalter, McPartland, and Kim had an A2E2-EIRA grant to introduce novel HPLC experiments into teaching labs. Dr. McPartland has also obtained four A2E2 Enhanced Course Learning (ECL) grants ($114K total). Dr. Fleming was awarded a grant for the East Bay Science Project from the Regents of the University of California, Office of the President, for $37K. Dr. Huang held a grant from the CSU Chancellors Office for Course Redesign with Technology to develop virtual labs for general chemistry.

f) Student Achievement

During the past five years our undergraduate and Master's level students have continued to demonstrate impressive achievements. Each year several of our students were admitted to Ph.D. programs or professional schools. Approximately 30 students received fellowships from the Center for Student Research Scholars Program. One student won the Harrington award for outstanding M.S. thesis. Three students participated in the CSU Research Competition.

2.2. Assessment and Curriculum

a) Program Learning Outcomes (PLOs)

A copy of the program's Outcomes Assessment Plan can be found in Appendix A. As indicated in the department mission statement, our primary function is to provide a strong education in chemistry and biochemistry that prepares students to work and thrive in society.

The Undergraduate Program Learning Outcomes are as follows:
Students graduating with a BS /BA degree in Chemistry or Biochemistry will be able to:

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.

The Graduate Program Learning Outcomes are as follows:
Students who graduate with an MS degree in Chemistry will be able to:

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) Curriculum maps of alignment of courses to PLOs

R = required course, E = elective course
I = introduced, D = developed, M = mastered, A = assessed

Undergraduate Degrees

Course	Required/Elective (degree)	PLO #1	PLO #2	PLO #3	PLO #4	PLO #5
1101	R (all)	I	I	I	I	I
1102	R (all)	D	D	D	D	D
1103	R (all)	D	D	D	D	D
2200	R (all)	D	D	D	D	D
3200	R (BS Chem Forensics)	M, A	M, A	M, A	M, A	D
3301	R (all)	D	D	D	D	
3302	R (all)	D	D	D	D	
3303	R (all)	M, A	M, A	M, A	P	
3400	R (BS Chem)	D		D		
3501	R (BA Chem, Biochem)	D		D		
3511	R (BS Chem, Biochem)	M, A		M, A		
3512	R (BS Chem, Biochem)	M, A		M, A		
3513	R (BS Chem, Biochem)	M, A		M, A		
3531	R (BS Chem)	D	D	D		
3532	R (BS Chem)	M	M	M		
4161	R (BS Chem)	M, A		M, A		
4162	R (BS Chem)	M, A		M, A		
4180	R (BS Chem)	M	M	M		
4240	R (BS Chem)	M, A	M, A	M, A	M, A	M, A
4311	E	M		M		
4411	R (BS/BA Biochem)	M		M		
4412	R (BS/BA Biochem)	M, A		M, A		
4413	R (BS/BA Biochem)	M		M		
4430	R (BS/BA Biochem)	M, A	M, A	M, A	M, A	M, A

4431	R (BS/BA Biochem)	M	M	M	M	M
4440	E	M		M		
4450	E	M		M		
4460	E	M		M		
4521	E	M		M		
4601	E	D	D	D	D	
4602	E	M	M	M	M	
4700	R (BA Chem, Biochem)	D			D	

Graduate Degrees

Course	Required/Elective (degree)	PLO #1	PLO #2	PLO #3	PLO #4	PLO #5
4161	E	D				
4162	E	M				
4180	E	M	M			
4240	R (MS Plan B)	M, A	M, A		M, A	M, A
4311	E	M				
4411	E	D				
4412	E	D				
4413	E	D				
4430	E	D	D		D	
4431	E	D	D		D	
4440	E	M				
4450	E	M				
4460	E	M				
4521	R (all)	M				
4601	E	D	D		D	
4602	E	M	M		M	
4700	R (MS Plan B)	D		D	D	
6310	R (all)	M, A		M		
6410	R (MS Biochem Option)	M, A		M		
6430	R (MS Biochem Option)	M, A	M, A		M, A	M, A
6510	R (all)	M, A		M		
6521	R (all)	M				
6820	R (all)	M, A		M, A	M, A	

c) Assessment Measures for each PLO

Appendix A contains the department's detailed assessment plan and student learning outcomes for each of the classes assessed. The following table summarizes the assessment measures for each PLO.

Undergraduate Programs

PLO	**Course Assessed**	**Assessment Measurement Method**
1	CHEM 3200	Embedded exam questions
1	CHEM 3303	National exam

1	CHEM 3511, 3512, 3513	Embedded exam questions
1	CHEM 4431	Embedded exam questions
1	CHEM 4161, 4162	Embedded exam questions
1	CHEM 4240	Embedded exam questions
1	CHEM 4411, 4412, 4413	Embedded exam questions
2	CHEM 3200	Rubric for capstone lab report
2	CHEM 3303	Rubric for capstone lab report
2	CHEM 4431	Rubric for capstone lab report
2	CHEM 4240	Rubric for capstone lab report
3	CHEM 3200	Embedded exam questions
3	CHEM 3303	National exam
3	CHEM 3511, 3512, 3513	Embedded exam questions
3	CHEM 4430	Embedded exam questions
3	CHEM 4161, 4162	Embedded exam questions
3	CHEM 4240	Embedded exam questions
3	CHEM 4411, 4412, 4413	Embedded exam questions
4	CHEM 3200	Rubric for capstone lab report
4	CHEM 4240	Rubric for capstone lab report
4	CHEM 4430	Rubric for capstone lab report
5	CHEM 4240	Evaluation of capstone project
5	CHEM 4430	Evaluation of capstone project

Graduate Programs

PLO	Course Assessed	Assessment Measurement Method
1	CHEM 4240	Embedded exam questions
1	CHEM 6310	Embedded exam questions
1	CHEM 6410	Embedded exam questions
1	CHEM 6430	Embedded exam questions
1	CHEM 6510	Embedded exam questions
1	CHEM 6820	Rubric for seminar
2	CHEM 4240	Rubric for capstone lab report
2	CHEM 6430	Rubric for capstone lab report
3	CHEM 6820	Rubric for seminar
4	CHEM 4240	Rubric for capstone lab report
4	CHEM 6430	Rubric for capstone lab report
4	CHEM 6820	Rubric for seminar
5	CHEM 4240	Evaluation of capstone project
5	CHEM 6430	Evaluation of capstone project

d) Summary of Findings from the PLO Assessment

In addition to focusing on the assessment of a particular PLO every academic year, PLOs #1 and #2 were also assessed on an annual basis for both the undergraduate and graduate programs. The assessment data in detail, broken down by year, can be found in Appendix B. A summary of the major findings appears here.

Five Year Assessment Plan – Undergraduate Programs

Academic year	PLO assessed	Courses
2013-2014	1	CHEM 3303, 3511, 3512, 4411, 4412, 4430
2014-2015	2, 1	CHEM 3303, 4430, 4240, 3511, 3512, 4411, 4412, 4162
2015-2016	3, 1, 2	CHEM 3303, 4430, 4240, 3512, 3513, 4412, 4162
2016-2017	4, 1, 2	CHEM 3303, 4430, 4240, 3511, 3512, 4412, 4162, 3200
2017-2018	5, 1, 2	CHEM 3303, 4430, 4240, 3511, 3512, 4412, 4162, 3200

Five Year Assessment Plan – Graduate Programs

Academic year	PLO assessed	Courses
2013-2014	1	CHEM 6820
2014-2015	2, 1	CHEM 6820, 6430, 4240
2015-2016	3, 1, 2	CHEM 6820, 6430, 4240
2016-2017	4, 1, 2	CHEM 6820, 6430, 4240, 6310
2017-2018	5, 1, 2	CHEM 6820, 6430, 4240

To measure students' demonstrable knowledge in the various areas of chemistry: inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry, we assessed key classes taken by undergraduate students in those disciplines. The data for the organic lecture series is obtained from the standardized ACS organic exam, which is given as the final exam for the third course in the series. This allows us to compare results from one year to the next and to compare our results to the national norms. Data collected over the last five years reveals that although our averages have some variability from year to year, the average (between 29th and 34th percentile for the last five years) is well below where we would like to be. However, many of our students do exceed the national average. Typically more than 25% exceed the 40th percentile and around 15% typically exceed the 70th percentile. Organic laboratory skills were assessed through a capstone experiment involving identification of two unknown compounds. Results have also varied somewhat over the past five years, but the majority of students have been able to identify one of the two unknowns.

Assessment for the biochemistry lecture material is based on answers to specific questions embedded into course exams for the General Biochemistry lecture series and for the Biochemistry Laboratory course. Comparable questions are used each year. Over the past five years student performance on a several outcomes representing a broad spectrum of topics in biochemistry was monitored. In CHEM 4412, less than 50% of the majors were meeting expectations for several of the course learning outcomes assessed. This is well below our goals for this course. However, student performance in the biochemistry lab course CHEM 4430 was markedly better both in terms of mastering concepts as well as experimental technique. The percentage of students able to demonstrate the measured analytical skills was near 80%, with a range of 74% to 83%.

Assessment of analytical chemistry in CHEM 4240 and CHEM 3200 also demonstrated that in terms of lab performance, our students are meeting and often exceeding expectations. When specifically assessing the undergraduate students' ability to write clearly on topics in chemistry or biochemistry, we found that the students also performed very well. This program learning outcome was primarily assessed in lab courses through the use of rubrics for written lab reports and lab notebooks.

The physical chemistry and inorganic chemistry assessment measured specific learning outcomes through embedded questions in the final exams of these courses. Over the past five years, the percentage of students able to demonstrate mastery of these outcomes varied depending on the specific topic and from year to year. However, the majority of the students were able to satisfactorily demonstrate mastery of almost all of the specific learning outcomes.

Our assessment results identified that Program Learning Outcome #3 (use quantitative reasoning to analyze chemical problems and evaluate chemical data) was the most challenging for our majors irrespective for which class the assessment was conducted during 2015-2016. Quantitative reasoning was assessed in several courses which had student learning outcomes that required using quantitative methods to solve problems. The results were a little disappointing. For example, in the second quarter of physical chemistry (Winter 2016) only 29% of the chemistry majors earned 75% or more of the possible points for "formulating a mathematical description of the motion of a particle," although 71% earned 50% or more of the points. The biochemistry majors did better, with 57% achieving above 75% of the points and 86% achieving above 50% of the points. Similar results were seen in the third quarter of physical chemistry for the Student Learning Outcome "be able to calculate reaction order," with only 25% of the Chemistry majors able to do the calculation correctly and 50% of the biochemistry majors mastering the outcome. The biochemistry majors were challenged with a number of quantitative specific course outcomes in the Biochemistry Laboratory course. The percentage of students who correctly mastered the outcomes ranged from 100% for protein purification calculations to 75% for enzyme kinetic calculations to 63% for buffer calculations to as low as 25% for calculation of enzyme activity from assays. From these assessment data for PLO #3, we are forced to conclude that while most of our chemistry and biochemistry majors are proficient in straightforward quantitative problem solving, a number of our majors are only partially mastering the more difficult challenge of using quantitative reasoning to analyze complicated chemical problems. Most of our planned improvement actions as discussed below focus on this issue.

In the graduate program, the assessment of students' ability to demonstrate specialized knowledge in the chemical sciences (PLO #1) is difficult to measure. Students take very few common courses as the program is made up of mostly elective and topic courses which change on a yearly basis. Assessment of electives and topics courses was most useful in informing the instructor of specific areas or concepts that were or were not well understood by the students, but could not be used to reach conclusions for the overall program. As we move to semesters, we have transformed the graduate program to include a core set of courses taken by all students that should make the program easier to assess and make the assessment results more meaningful.

The graduate program assessment for understanding, organizing, and critically assessing information from the chemical literature (PLO #3) and presenting complex chemical information via oral and written reports (PLO #4) has been conducted in CHEM 6820, a course that all students take three times. Data from the past five years demonstrates that, on average, students improved from their first seminar to their last in ability to understand, organize and present a journal article. By their third seminar, typically more than 75% of the students were able to give a presentation that exceeded expectations. PLO #2,working effectively and safely in a laboratory environment using modern chemical or biochemical instrumentation and methods to test hypotheses or design solutions to problems, was assessed in CHEM 4240 and CHEM 6430 (for students in the biochemistry option). Through assessment of lab notebooks and lab reports, as well as embedded exam questions, for PLO #2, we found that over the last five years, the M.S. students generally met expectations and a number did exemplary work in the lab.

e) Program Improvement Actions Taken

Although we are generally pleased with the results of the program assessment and feel that our chemistry and biochemistry majors are mastering most of the learning objectives, we identified the quantitative reasoning program learning outcome as the most problematic. Therefore, we will be instituting several changes to our program in order to address this issue. We will be increasing the number of math classes taken by the students in all of our undergraduate degree programs. The BS chemists will be required to take four semesters of math (as opposed to the current four quarters), the BS biochemists will take three semesters (as opposed to the current one year), the BA chemists and biochemists will take one year of math (as opposed to the current two quarters). We believe that this greater emphasis on math and more time to practice math problems will lead to the ability to be better able to solve quantitative chemistry and biochemistry problems. In addition, BS chemists and biochemists will take the calculus-based physics series. We believe this will also provide additional practice in using math to solve problems. While the BA chemists and biochemists will have the choice between the caluclus- and algebra-based physics series, we will encourage them to take the series with a greater math emphasis.

2.3. Student Success

a) Graduation Rates

Graduation rates for first-time Freshmen (4- and 6-year rates) starting in 2007 and Transfer students (2- and 4-year rates) starting in 2009 are summarized in tables in Appendix C. The 4-year graduation rate for Freshmen ranged from 14% to 42% for biochemistry majors and from 6% to 17% for chemistry majors. The 6-year graduation rate for Freshmen ranged from 50% to 62% for biochemistry majors and from 33% to 50% for chemistry majors. These rates compare well to the College (10% to 13% for 4-year and 34% to 46% for 6-year) and the Campus averages (10% to14% for 4-year and 38% to 48% for 6-year) for the same time period. The 2-year graduation rate for Transfer students ranged from 17% to 50% for biochemistry majors and from 0% to 33% for chemistry majors. The 4-year graduation rate for Transfer students ranged from 50% to 62% for biochemistry majors and from 50% to 71% for chemistry majors. This also compares well to the College (27% to 37% for 2-year and 69% to 78% for 4-year) and the Campus averages (29% to 37% for-2 year and 68% to 76% for 4-year) during the same time period. The percent of students who entered as Freshmen as biochemistry majors and eventually graduated in the major ranged from 15% to 67%, for entering chemistry majors the range was 0 % to 17%. The percent of students who entered as Transfer students as biochemistry majors and eventually graduated in the major ranged from 50% to 80%, for entering chemistry majors the range was 33% to 80%. It is not surprising that more Freshmen switched majors than Transfer students because it is during the first two years of College that many students are still exploring their interests and may not have firmly decided on a major. Most of the students who started as biochemistry students and eventually graduated with a different major switched to biology. Most of the students who started as chemistry students and eventually graduated with a different major switched to biochemistry.

Graduation rates for Masters students (2- and 4-year rates) starting in 2006 are also summarized in tables in Appendix C. A large percentage of the graduate students in our program are working full time so, as expected, only rarely does a student complete the M.S. program in two years. The four year rate is so variable (varying from a low of 12.5% to a high of 100%) and the number of students is small, therefore it is difficult to draw any conclusions without more data detailing why individual students didn't complete the program in four years.

b) Achievement Gaps

Comparisons of the achievement gaps between URM (under-represented minority) students vs non-URM students, where URM students are African-American, American Indian, or Latino, are displayed in tables in Appendix C. The largest gaps in chemistry or biochemistry courses occurred in the introductory courses and non-major courses (CHEM 1610/15, CHEM 1000, CHEM 1101, and CHEM 1100). The smallest gaps were found in the upper division major courses of physical chemistry and biochemistry (CHEM 3511, CHEM 4412, CHEM 4413, CHEM 4430, and CHEM 4431). In these courses the GPA gaps were less than 0.1. In fact, the achievement gaps in most of the upper division major courses were relatively small compared to lower division courses. Achievement gaps in the introductory courses may be more dependent on differing levels of preparation for college courses and mastery of the math prerequisite (determined by Math ELM score). Because our General Chemistry series for majors (CHEM 1101, CHEM 1102, CHEM 1103) was also identified among the bottleneck courses, different methodologies are being executed to address this problem (*vide infra*).

c) Bottleneck Courses

All courses in the Chemistry and Biochemistry department at CSU East Bay had an average non-passing rate below 25%. But the General Chemistry series (CHEM 1101, CHEM 1102, CHEM 1103 labelled 1, 2, 3 in the chart in Appendix C) had the most students with non-passing grades and therefore the highest impact score (where impact score = % non-passing x enrollment). These courses are taken by a large number of non-major students as well as our chemistry and biochemistry majors so the data does not necessarily reflect the number of majors who have difficulty with these courses. However, because this is a bottleneck course, the General Chemistry instructors have worked with the Student Center for Academic Achievement (SCAA) to introduce Supplemental Instruction for general chemistry to assist students in these courses.

We also widely advertise the SCAA tutoring schedule so that students know where to obtain help when they need it.

d) Advising

We continue to emphasize advising in our department. Every student is assigned a major advisor based on the first letter of their last name and this list is posted in the department office and on the department web site. The department has “road-maps” for each of the degree programs offered at both the undergraduate and graduate level posted on the Department of Chemistry and Biochemistry web site and available in the department office (see Appendix D). These help students to determine course requirements and prerequisites and serve as a guide for long-term planning towards graduation. The department coordinates with the College of Science Student Center which also advises Chemistry or Biochemistry majors or Chemistry minors at any stage in their programs. Additionally the department office keeps students up-dated through targeted emails about information on required course offerings and about important dates such as the timing of graduation checks. Faculty teaching upper division classes such as Organic Chemistry, Biochemistry and Physical Chemistry also make periodic announcements in their classes with advising reminders and information.

Students entering the Master’s program get individualized advising from the Graduate Coordinator about what courses they should take. Undergraduate grades and GRE scores are used to determine if our entering M.S. students are at the level to begin graduate work or if there is an area in which they have deficiencies and need remediation. Plan A (thesis option) students work closely with their research advisor to complete their theses and also receive advising from the Graduate Coordinator about required coursework. Supervision of Plan B (non-thesis option) students working toward the completion of their comprehensive literature review paper is delegated over all full-time tenured/tenure-track faculty members. This allows each student individualized attention and help in completing his or her paper. The Graduate Coordinator supervises the Plan B comprehensive review exams.

2.4. External Comparisons

Comparison of Degree Programs and Course Offerings to Other Institutions

The Department of Chemistry and Biochemistry offers a B.S. degree in Chemistry (ACS certified), a B.S. in Chemistry with a Forensic Science Option, a B.S. degree in Biochemistry, a B.A. in Chemistry, a B.A. in Biochemistry, a B.A. in Chemistry with a Chemistry Education Option, a B.A. in Biochemistry with a Chemistry Education Option, and a Minor in Chemistry. The Department also offers the following M.S. degree options in Chemistry: the Plan A (Thesis), an M.S. degree in Chemistry with a Biochemistry Option – Plan A (Thesis), an M.S. degree in Chemistry – Plan B (Comprehensive Review), and an M.S. degree in Chemistry with a Biochemistry Option – Plan B (Comprehensive Review).

Comparisons of the requirements of these degree programs with those of other CSU institutions and one nationally recognized program at the University of California, Santa Barbara campus are given in Appendix E. The three California State Universities were chosen because they have similar degree programs and award a similar number of undergraduate and M.S. degrees annually. University of California, Santa Barbara was also chosen for comparison because it has nationally recognized programs in chemistry and biochemistry and, unlike many other larger universities, it also awards a B.S. Biochemistry degree through the chemistry department. The number of Bachelor and M.S. degrees awarded by the comparison universities is shown in the table below.

Number of degrees awarded 2013 – 2014[a]

Institution	Chemistry and Biochemistry Bachelor Degrees	M.S. Degrees
California State University, East Bay	42	15
California State University, Los Angeles	26	14
California State University, Sacramento	55	3
San Jose State University	43	3
University of California, Santa Barbara	72	2

a. As published by the American Chemical Society https://www.acs.org/content/acs/en/about/governance/committees/training/reports/degreesreport.html (accessed September 29th, 2017)

As can be seen from the tables in Appendix E, our degree programs have requirements similar to those of programs at other universities with corresponding degrees. CSU Los Angeles, CSU Sacramento, San Jose State, and UC-Santa Barbara all offer B.S. and B.A. degrees in Chemistry and a B.S. degree in Biochemistry. CSU Sacramento offers a B.A. degree in Chemistry, with a Concentration in Biochemistry. CSU Sacramento also offers a B.A. degree in Chemistry with a Concentration in Forensic Science, while we offer a B.S. degree in Chemistry with an Option in Forensic Science (comparisons shown in Appendix E). None of the comparison universities has a B.A. Chemistry or Biochemistry Option in Chemistry Education.

The course requirements for an M.S. degree in chemistry are more variable than those for the B.S or B.A. degrees in order to provide freedom for students to concentrate in the area of greatest interest to them. The number of core and elective course units required in our M.S. degrees is 36 with the remainder of the 45 units coming from completion units such as units for the thesis (Plan A), seminar, and comprehensive review exam and paper (Plan B). As can be seen from Appendix E, these requirements are typical across all of the CSU comparison institutions. Only UC Santa Barbara requires fewer total units for the M.S. degree in Chemistry.

The tables in Appendix E also contain our degree program requirements after semester conversion in Fall 2018. The number of units and course requirements are also consistent with those in the comparison programs.

A list of our course offerings is provided in Appendix F. In addition to the core courses of General Chemistry, Organic Chemistry, Quantitative Analysis, Physical Chemistry, Inorganic Chemistry, Biochemistry, Instrumental Analysis, and the associated labs, we also offer a variey of major electives, general education, and service courses. There is a broad range of electives available for students depending on their interests. These include courses in Environmental Chemistry, Bioanalytical and Forensic Instrumentation, Advanced Organic Chemistry, Protein Structure, Nucleic Acid Chemistry, Major Organ Biochemisty, and Protein Chemistry Techniques. Through the graduate level Advanced Topics in Organic, Physical, and Biochemistry courses, cutting edge topics such as nanotechnology, toxicology, membrane biochemistry, drug design, molecular spectroscopy and bioorganic chemistry have been offered. Different topics are offered every year so that the student can repeat the same course number but cover different subjects. The number and variety of electives and special topics compares well with the offerings of corresponding programs at other universities.

General education offerings include basic chemistry courses such as Introduction to College Chemistry, Basic Chemistry for Health Sciences, and Foundational Chemistry, as well as special topics courses. Popular Topics in Chemistry, which has covered subjects such as energy, has been available as a general education course for non-science majors. The Making of Wine is an upper division general education chemistry course that includes both a lecture and lab component. The number and variety of general education courses that the Department offers also compares well with the course offerings of corresponding departments at other institutions.

2.5. General Program Discussion

a. Student Level

Statistics for the Department of Chemistry and Biochemistry on the number of degrees awarded, number of undergraduate and graduate majors, and options of student majors are displayed in tables in Appendix G. This data was obtained from the CSUEB Office of Planning and Institutional Research.

The number of undergraduates majoring in Chemistry or Biochemistry has decreased slightly, from 234 students in Fall 2012 to 218 students in Fall 2016, with decreases in both the Biochemistry and Chemistry tracks. The number of bachelor’s degrees conferred by the department has remained fairly constant over the last five years, averaging around 39 per academic year. We anticipate that the number of degrees will slightly decrease over the next five years to reflect the decreasing number of majors.

The number of BS biochemistry degrees awarded was consistently greater than the number of BA biochemistry degrees over the past five years. The same is true for the number of BS chemistry degrees awarded vs BA chemistry degrees. However, the number of BS chemistry degrees awarded vs BS chemistry with the forensic science option varied from year to year but was roughly equal over the five year period.

Enrollment in our graduate program has also decreased over the last five years. This is due in part to the implementation of more stringent admission requirements. We now require applicants to take the GRE subject test in chemistry or biochemistry and use that as a basis for admission. The number of Masters' degrees conferred was fairly constant at about 15 per year from 2013 to 2016, decreasing to 8 in 2017. The number of MS chemistry degrees awarded with the biochemistry concentration was almost twice as many as the number of MS chemistry degrees over the last five years.

b. Student Demographics

Statistics for the Department of Chemistry and Biochemistry on the ethnicity of student majors and graduates, and whether they started as native or transfer students, are displayed in tables in Appendix G. This data was obtained from the CSUEB Office of Planning and Institutional Research.

Our student profile reflects the diversity of the student body at CSUEB. The majority of our undergraduate majors identify as Asian, although as a percentage this population has shrunk over the past five years (from 30% in 2012 to 24% in 2016 for chemistry majors and from 50% in 2012 to 26% in 2016 for biochemistry majors). The percentage of chemistry and biochemistry majors self-identifying as Hispanic or Black has varied slightly from year to year but overall has remained relatively constant (about 24% Hispanic and 12% Black). However, the number of majors listed as multiple ethnicities has increased. Over the last five years, the chemistry majors have ranged over 47-64% female and 36-53% male, and the biochemistry majors have ranged over 46-65% female and 35-54% male. The ethnicity and gender of students earning degrees reflects the ethnicity and gender of students enrolled.

Over the past five years, the number of graduates in our undergraduate degree programs who start as Transfer students has been greater than those starting as Freshmen. Approximately 62% of those graduating with a bachelor's degree in chemistry or biochemistry started as a Transfer student. The overwhelming majority of our undergraduate majors in both biochemistry and chemistry are full-time students.

The largest ethnic group in our Master's program is also Asian, representing about one-third of our students. The percent of Black and Hispanic students in our Master's program has remained fairly constant over the past five years with no discernible trend. Over the last five years, the M.S. students have ranged from 51-59% female and 41-49% male, also without any trend. International student enrollment also makes up a large percentage of Master's graduates, averaging about 27% over the last five years.

c. Faculty and Academic Resource Allocation

Statistics for the Department of Chemistry and Biochemistry on the number of faculty and lecturers, ethnicity of faculty and lecturers, number of sections, average section size, FTES, FTEF, and SFR for undergraduate and graduate courses are displayed in tables in Appendix H. This data was obtained from the CSUEB Office of Planning and Institutional Research.

Our total tenured/tenure-track faculty count was seven in Fall 2012 and was at nine in Fall 2016. Our reliance on part-time lecturers varied slightly between 11 and 16. Based on Fall data, over the past five years the percent FTES taught by Lecturers has varied from a high of 66.7% in 2015 to a low of 55% in 2013.

The tenured/tenure-track faculty is composed of six White members, two Asian, and one Other. The ethnic composition of lecturers has varied over the last five years although the ethnic composition of the current lecturers is more diverse. Over the past five years, the faculty has remained roughly 50:50 in terms of gender.

d. Course Data

Statistics for the Department of Chemistry and Biochemistry on the number of courses and sections, average section size, FTES, FTEF, and SFR for undergraduate and graduate courses are displayed in tables in Appendix H. This data was obtained from the CSUEB Office of Planning and Institutional Research.

The FTES for the Chemistry and Biochemistry Department has slightly increased since 2012, from 344.7 in Fall 2012 to 366.9 in Fall 2016. This rise can be attributed mainly to the increase in the number of Health Science and Biological Science students who are also required to take chemistry courses for their major.

Total instructional FTEF numbers for the department have remained fairly constant over the last five years. The total Instructional SFR for the department has also remained constant over the past five years. The Instructional SFR numbers for tenured/tenure-track faculty are typically higher (27.2 to 32.6) than for lecturers (10.1 to 12.3). As is typical, the Instructional SFR values for lower division courses are higher than for upper division courses, with a range of 35.6 to 41.5 for the former and 24.8 to 30.9 for the latter over the past five years. Graduate Instructional SFR varied from 9.0 to 16 over the past five years. The total Instructional SFR for the department was 22.3 in Fall, 2016.

The number of course sections offered by our department remained fairly constant during the last five years, averaging around 104. The average section size for all courses also remained fairly constant at around 28. During the last five years, the average section size was 58.5 for lecture classes and 23.7 for laboratory classes. The size of the laboratory classes is limited by space and safety considerations. The average graduate class size during the same time period was 17.8.

2.6. Faculty

Our goal has been to maintain a good balance of expertise in the various disciplines of chemistry among our faculty and to hire individuals with research programs attractive to undergraduate and Master's students. The following table summarizes our search efforts and results from the last five years. Copies of the requests for tenure-track faculty searches from the last five years are located in Appendix I.

New Tenure Track Faculty Hires 2012-2017

Tenure Track Search Year	Position No.	New Hire	Specialization of New Hire	Start Date
2012-2013	#12-13 CHEM-BIOCHEMISTRY-TT-Rolled Over from 2011-2012	Marlin Halim	Biochemistry	09/01/2013
2012-2013	#13-14 CHEM-INORGANIC /ANALYTICAL-TT	Patrick Huang	Inorganic Chemistry	09/01/2013
2013-2014	#14-15 CHEM-PHYSICAL-TT*	Patrick Fleming	Physical Chemistry	09/01/2014
2015-2016	#16-17 CHEM-ANALYTICAL /PHYSICAL/BIOPHYS-TT	Ruth Tinnacher	Analytical Chemistry	09/01/2016
2016-2017	#17-18 CHEM-CHEMISTRY-TT**	Mark Borja	Biochemistry	09/01/2017
2017-2018	#18-19 CHEM-PHYSICAL-INORG-TT***	Unknown	Physical or Inorganic Chemistry	09/01/2018

*Original request was for an Organic Chemist. Change in specialty to Physical Chemistry approved after a Physical Chemist in the department announced he was leaving.
**Originally requested a Physical or Analytical Chemist - later decided to hire the best candidate since the need was for a ½ faculty member in each of four areas of specialization.
***Original request was for a Physical Chemist; expansion of the area of specialization was subsequently approved.

2.7. Resources

The chemistry department makes use of the IT department for maintenance of faculty and staff computers, the computers in the chemistry computer lab, and the computers used to run chemical instrumentation. The computers in the chemistry computer lab run specialized chemistry course-specific software such as Chemdraw, Spartan, the Trinity software IOC (Identification of Organic Compounds) computer program, Gaussian, WinCoot (Crystallographic Object-Oriented Toolkit for Windows), Discovery Studio Visualizer from Accelrys and the MSDS ChemWatch software. The library staff has assisted us with obtaining resources such as the database searching programs Web of Science and SciFinder. The Chemistry department also relies on Environmental Health and Safety for hazardous waste collection and disposal.

2.8. Units Requirements

All of the seven baccalaureate degrees offered by the department currently require no more than 180 quarter units. During the past five years, we took a close look at our degree requirements and reduced the number of units required in three of the degrees to 180 without diminishing the quality of the programs (see section 2.1 of the Self Study).

3. Five Year Plan

3.1. Curriculum

a) The undergraduate majors program

We will undergo a conversion from the current curriculum to a semester based curriculum starting in Fall 2018. Implementation of the planned semester conversion final development of the transformed courses will occupy approximately the next two years. A few of the most significant goals relating to the switch to semesters are outlined below, along with other general plans for the next five years. Plans for expanding the transformed one quarter lecture/lab and lab courses for semesters will be implemented by the individual faculty teaching those courses. As the semester curriculum becomes established, we will closely monitor the assessment results to ensure that the majority of our majors are successfully reaching the program learning outcomes in chemistry and biochemistry. Over the next five years, we will use the assessment data to inform us of any needed curricular improvements to keep our programs and course content up-to-date, and help our students maintain a high level of achievement.

As described in the Self Study, the number of Chemistry and Biochemistry undergraduate majors has been fairly level over the last five years. However, the department FTES has risen due to the growth of students from other departments who take our classes, most notably students majoring in Biological Science, Nursing and Health Science. In proposing changes to our curriculum, we have been and will continue to be mindful of the potential impact not only on our majors, but also on the other science students who take our courses.

Revise the prerequisites for introductory courses. The executive order 1110 has mandated elimination of the ELM exam. This creates an issue for our department since we have used passing ELM scores as a prerequisite for most of our introductory courses. The ability to understand concepts in chemistry and to learn how to solve chemical problems relies heavily on the understanding and ability to apply math concepts. Given the time constraints, it is not possible to teach the necessary math skills during these chemistry courses. Therefore we will work closely with the Math Department to identify appropriate math co-requisites and change the prerequisites to these introductory courses accordingly. The following courses had an ELM requirement: CHEM 100, CHEM 110, CHEM 111, and CHEM 161.

Increase the number of undergraduate biochemistry and chemistry courses taught by tenured or tenure track faculty. At present only about 50% of the undergraduate course sections offered by the department are taught by tenured or tenure track faculty, which is below the CSU system goal of 75%. Even if the tenure track search we are conducting during 2017-18 is successful, it will shift this percentage by only a few points. Over the next five years it will be our goal to continue to submit applications for tenure track faculty positions to reverse the trend of using high turnover part-time lecturers and teaching associates for so many of our classes. We need additional faculty in all the sub-disciplines of Chemistry, with the most urgent needs in Organic Chemistry.

Continue to upgrade laboratory curriculum. Over the last five years, we have dramatically improved our laboratory curricula in all of the disciplines. In an on-going effort to keep our laboratory curriculum current, new experiments incorporating new instruments and techniques are planned for existing laboratory courses. A new protein purification experiment is planned by Dr. Sommerhalter to introduce the new fast protein liquid chromatograph (FPLC) into the biochemistry lab courses. FPLC is a highly efficient method for separating macromolecules and is commonly used in industry. Dr. McPartland plans to add an experiment where a coding sequence would be inserted into a plasmid expression vector in the graduate biochemistry lab. She also plans to add a new lab experiment on IgG immunoglobin proteins. Dr. Tinnacher plans to make changes to the Environmental Chemistry lab course by adding an experiment in which students analyze the total organic and inorganic carbon in field samples of water from various sources using the TOC/TIC analyzer. They will also determine concentrations of common metals in the same water samples using the new ICP-OES instrument. Dr. Huang is working to update the labs in General Chemistry to better align with the lecture content by developing an in-house lab manual.

Continue to upgrade instrumentation. We plan to continue to update the instrumentation used in the teaching laboratories and in research. We would like to acquire an LC/MS (liquid chromatograph/mass spectrometer) that would be able to obtain mass spectra of liquid samples. The approximate cost for a slightly used instrument would be about $200,000. Drs. McPartland Halim will take responsibility for obtaining quotes, and selecting the vendor and model. We also plan to upgrade the computers and software in our computer lab. Drs. Huang and Groziak will be looking into the operating system and software that would best suit the needs of all of the users.

Vital to the use of state-of-the-art instrumentation in research and in the teaching laboratories is the continued maintenance of the instruments. Service contracts will continue to be requested to support the NMR, HPLC, and GC-Mass Spectrometer. As the warranties on new instruments expire, we plan to request funds to purchase service contracts to cover their maintenance and repair.

Develop a department policy to standardize lab mechanisms for student safety training and waste handling in research labs. A safety policy for research labs has always been important and our faculty currently train research students in appropriate safety measures. Research students are also required to attend a hazardous chemicals training session once a year. However, a formalized written policy for the department is needed. Donna Placzek, the Director of Environmental Health and Safety Department, will work with the department to provide advice on how to formulate the written policies for chemistry.

Establish forums for sharing student research activities. Studies listing high impact teaching methods invariably include student participation in an independent research project. Additionally, employers in chemical and biochemical industries, as well as graduate program admission committees, look very favorably upon applications with student research experience. All of the department faculty members supervise student research, both at the undergraduate and graduate level. As indicated in the Self Study, the department faculty have supervised close to one hundred students on research projects over the last five years. Many of those students have presented their work at scientific conferences and have co-authored scientific articles in peer-reviewed journals. Students from the department routinely present posters at the CSUEB Week of Excellence sponsored by the Center for Student Research on campus. To facilitate better communication among the students participating in a research project, and to foster learning and enthusiasm, we plan to provide a mechanism for students working with different professors to discuss their projects with their peers. To this end, we will organize forums in which students will explain their projects to other students either formally or informally. Newer students can provide short descriptions while the more experienced students might present a brief power point talk. We envision these forums as primarily for student to student interactions with a few faculty members involved to help organize the event and to participate in the discussions. Ideally we will schedule the forums twice a semester, with an early Spring semester session possibly used by students to prepare for the CSUEB Week of Excellence presentations.

Develop new service courses for the Engineering Department and the Earth and Environmental Science Department. As requested by the Engineering Department, we will develop a new one semester three unit general chemistry course that will be required for some of the engineering majors. Currently, engineering majors take the first quarter of the general chemistry series (CHEM 1101) which does not most suitably provide the content needed for their degree program. This new course will be comprised of two hours of lecture and one two and a half hour lab session per week. It will cover the material from general chemistry that is the most relevant for engineering majors. The Department of Earth and Environmental Science has also requested a specialized course in organic chemistry to be required for their new Environment Health program. We will develop a new one semester three unit course, Fundamentals of Organic Chemistry, which will have three hours of lecture per week. This course will cover organic chemistry while focusing on its application to environmental health.

b) The General Education (GE) Curriculum

Develop two new general education courses that also meet the sustainability overlay requirement. We plan to develop one new lower division GE course called Chemistry and Society, and one new upper division course called Green Chemistry and Sustainability. The Chemistry and Society course will cover basic chemistry concepts and chemistry applications in everyday life. Topics will include energy production, drugs, pesticides, plastics and polymers, the impact of chemicals on the environment, and sustainable chemistry practices. The Green Chemistry and Sustainability course will be an introduction to the principles and fundamental concepts of general and green chemistry with an emphasis on relevant sustainability implications for the environment, technology, and public policy.

c) Master's Degree Program

Develop new graduate-level classes. As explained in the Review, the MS chemistry degree program has undergone substantial restructuring during the conversion to a semester curriculum. To support this new curriculum, we will develop new core courses in organic chemistry, physical chemistry, and biochemistry. In addition new electives will be designed in computational chemistry and molecular spectroscopy.

Increase the number of graduate students through a greater emphasis on recruitment. The number of students in the graduate (M.S.) program in Chemistry has decreased over the past five years. In Fall 2012 the graduate student headcount was 68 and the faculty consensus was that we had too many graduate students to be mentored by the seven tenured/tenure-track faculty present in the department at that time. There was also a concern that some of the M.S. students we admitted were a little weak; therefore the entrance requirements were made more stringent. That decision and subsequent improvements in the economy have apparently caused the precipitous drop (to 32 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 number of students in the graduate program. We now have ten faculty members, all able to mentor graduate students, and would like to bring the number of students back up to about 40-45. We plan to advertise our program by sending brochures to colleges and universities in the area such as UC Berkeley, US Davis, and Mills College. We will improve the department website by adding more information about the Master's program emphasizing the research opportunities available in the Department. We will also add links that more clearly explain how to apply to the graduate program, what is required for admission, application deadlines, and who to contact.

3.2. Assessment

a) Program Learning Outcomes

Our revised Program Learning Outcomes effective Fall 2018 are as follows:
Students graduating with a B.S./B.A. degree in Chemistry or Biochemistry from Cal State East Bay will be able to:

1. demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry.
2. use quantitative reasoning to analyze and solve chemical/biochemical problems and evaluate chemical/biochemical data.
3. work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments.
4. design, carry out, record and analyze the results of chemical/biochemical experiments.
5. communicate chemical and biochemical issues clearly.

Students graduating with a Chemistry M.S. degree from Cal State East Bay will be able to:

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

b) Curriculum Maps for semester-based courses

R = required course, E = elective course
I = introduced, D = developed, M = mastered, A = assessed

Undergraduate Degrees

Course	Required/Elective (degree)	PLO #1	PLO #2	PLO #3	PLO #4	PLO #5
111	R (all)	I	I	I	I	I
112	R (all)	D	D	D	D	D
220	R (all)	D	D	D	D	D
320	R (BS Chem Forensics/BA Chem)	M, A	M, A	M, A	M, A	M,A
331	R (all)	D	D	D	D	D
332	R (all)	M, A	D	M, A	M,A	D
340	R (BS/BA Chem)	D	D			
350	R (BA Chem, Biochem)	D	D			
351	R (BS Chem, Biochem)	M, A	M, A			
352	R (BS Chem, Biochem)	M, A	M, A			
355	R (BS Chem)	M	M	M	M, A	M, A
410	R (BS Chem)	M, A	M, A			
415	R (BS Chem)	M		M	M	M
420	R (BS Chem)	M, A	M, A	M, A	M	M, A
425	E	M	M	M	M	M
430	E	M				
441	R (BS/BA Biochem)	D	D			
442	R (BS/BA Biochem)	M, A	M, A			
443	R (BS/BA Biochem)	M, A	M, A	M, A	M	M, A
444	R (BS/BA Biochem)	M	M	M	M	M
445	E	M				
446	E	M				
447	E	M				
450	E	M				
470	R (BA Chem, Biochem)	D				D

Graduate Degrees

Course	Required/Elective (degree)	PLO #1	PLO #2	PLO #3	PLO #4	PLO #5
410	E	D				
415	E	M	M	M		
420	R (all)	M, A	M, A	M, A	M, A	M, A
425	R (MS Plan B)	D	D	D	D	D
430	E	M				
445	E	M				

446	E	M				
447	E	M				
450	E	M				
470	R (MS Plan B)	D			D	D
621	E	M		M		
631	R (all)	M, A		M		
641	R	M, A		M		
645	R (MS Biochem Option)	M, A	M, A	M, A	M, A	M, A
651	R (all)	M, A		M		
652	E	M		M		
680	R (all)	M, A			M, A	M, A
691	R (MS Plan A)	M		M	M, A	M, A
692	R (MS Plan B)	M			M, A	M, A

c) Assessment measures for each PLO

The following table summarizes the assessment measures for each PLO.

Undergraduate Programs

PLO	Course Assessed	Assessment Measurement Method
1	CHEM 320	Embedded exam questions
1	CHEM 332	National exam
1	CHEM 351, 352	Embedded exam questions
1	CHEM 410	Embedded exam questions
1	CHEM 420	Embedded exam questions
1	CHEM 442	Embedded exam questions
1	CHEM 443	Embedded exam questions
2	CHEM 320	Embedded exam questions
2	CHEM 351, 352	Embedded exam questions
2	CHEM 443	Embedded exam questions
2	CHEM 410	Embedded exam questions
2	CHEM 420	Embedded exam questions
2	CHEM 442	Embedded exam questions
3	CHEM 320	Rubric for capstone lab report
3	CHEM 332	Rubric for capstone lab report
3	CHEM 420	Rubric for capstone lab report
3	CHEM 443	Rubric for capstone lab report
4	CHEM 320	Rubric for capstone lab report
4	CHEM 332	Rubric for capstone lab report
4	CHEM 420	Rubric for capstone lab report
4	CHEM 443	Rubric for capstone lab report
5	CHEM 420	Rubric for capstone lab report
5	CHEM 443	Rubric for capstone lab report

Graduate Programs

PLO	Course Assessed	Assessment Measurement Method
1	CHEM 420	Embedded exam questions
1	CHEM 631	Embedded exam questions
1	CHEM 641	Embedded exam questions
1	CHEM 643	Embedded exam questions
1	CHEM 651	Embedded exam questions
1	CHEM 680	Rubric for seminar
2	CHEM 420	Rubric for capstone lab report
2	CHEM 645	Rubric for capstone lab report
3	CHEM 420	Rubric for capstone lab report
3	CHEM 645	Rubric for capstone lab report
4	CHEM 480	Rubric for seminar
4	CHEM 691	Rubric for Thesis
4	CHEM 692	Rubric for capstone paper
5	CHEM 480	Rubric for seminar
5	CHEM 691	Rubric for Thesis
5	CHEM 692	Rubric for capstone paper

d) Five Year Assessment Plan

Five year assessment plan – undergraduate programs

Academic year	PLO assessed	Courses
2018-2019	1	CHEM 320, 332, 351, 352, 410, 420, 442, 443
2019-2020	2	CHEM 332, 351, 352, 410, 420, 442, 443
2020-2021	3	CHEM 320, 332, 420, 443
2021-2022	4	CHEM 320, 332, 420, 443
2022-2023	5	CHEM 420, 443

In addition we will continue to assess PLO #1 and PLO #3 every year to ensure that the content and lab skills are being adequately mastered.

Five year assessment plan – graduate programs

Academic year	PLO assessed	Courses
2018-2019	1	CHEM 420, 631, 641, 645, 651, 680
2019-2020	2	CHEM 420, 645
2020-2021	3	CHEM 420, 645
2021-2022	4	CHEM 680, 691, 692
2022-2023	5	CHEM 680, 691, 692

In addition we will continue to assess PLO #1 every year to ensure that the program content is being adequately mastered.

Over the next five years will collect feedback from faculty to determine what changes are needed to make the assessment results more meaningful and useful.

3.3. Students

a) Enrollment Growth, Outreach and Program Resources

The number of undergraduates majoring in chemistry or biochemistry stayed relatively flat from Fall 2012 to Fall 2016 and then decreased in Fall 2017. It is unclear if this is a fluctuation or the start of a decreasing trend. Because chemistry and biochemistry are laboratory sciences, most of our courses are designed with an accompanying lab component. In recent years, space in the labs has become the limiting factor for offering more sections or larger sized classes. At this point we are not able to accommodate many more students taking chemistry courses unless additional resources become available. The classroom laboratories are full essentially all the daytime hours. To run evening labs, the main resource needed is another Instructional Support Technician (IST). An IST is needed to prepare and set out the chemical solutions and set up equipment. The IST is also needed during the lab period to handle reagent shortages, chemical spills, equipment malfunctions, and to assist in case of an accident.

b) Changing Career Opportunities for Students

Employment for chemists and biochemists has improved slowly since the economic crisis in 2008 and has continued over the last few years. Most of our recent graduates have found work, but often it took time. The latest data from the US Bureau of Labor Statistics estimates that employment of chemists and materials scientists is projected to grow 3 percent from 2014 to 2024, slower than the average for all occupations. On the other hand, employment of biochemists and biophysicists is projected to grow 8 percent from 2014 to 2024, about as fast as the average for all occupations. The better outlook for biochemists is due, in part, to the expansion of the biotechnology field. While the job growth data looks better for biochemists, a large portion of basic research in biochemistry is dependent on funding from the federal government through the National Institutes of Health and the National Science Foundation. Therefore, federal budgetary decisions will have a large impact on future job prospects in basic research.

Jobs in chemistry-related fields in manufacturing appear to be declining. Chemical equipment operator jobs are projected to fall by 8.3% over the next decade. In addition, an 11.5% decline in chemical plant system operators is anticipated, while basic chemical manufacturing jobs are projected to drop by about 12%. Some chemical manufacturing industries, such as pharmaceutical manufacturing, are increasingly outsourcing their R&D activities, rather than doing the research in-house. This outsourcing strategy is likely to cause faster growth in the employment of chemists in small, independent research-and-development firms than in the more traditional large manufacturers.

According to a recent survey of American Chemical Society members, unemployment among chemists hovers around 3.1%, with new grads more likely to be unemployed (currently around 12.5%). However, there should be jobs available in Bay Area industry for our graduates over the next five years, because this is one of the areas in the country with a high concentration of chemical and biochemical industries. It is incumbent upon us to properly train our students to support the Bay Area companies in which they will likely be employed. To ensure our students are competitive for the job market, we need to provide the best training possible. We must ensure that our graduates have the knowledge and skills employers expect. And we need to continue to improve the department instrumentation so students can train on modern equipment representative of what they will find in industry. Strong workplace performances by our graduates will help to build the local reputation of CSU East Bay, and this, in turn, will help newer graduates to get jobs.

Many of our biochemistry majors are planning on advanced study in a health profession. The B.S. Biochemistry curriculum includes the courses required for admission to programs in medicine, dentistry, pharmacy and optometry, and is also good preparation for other health fields, such as physical therapy and physician assistant. The Bureau of Labor Statistics predicts higher growth for all of these fields over the next five years. We hope to do our part to prepare students for the health professional schools by maintaining a high quality of instruction and keeping our course content current as new discoveries are made in the biomedical area.

The Bureau of Labor Statistics also predicts new and replacement jobs in the teaching profession. We hope to help fill the need for quality secondary school science teachers by promoting the Chemistry Education degree options we have developed for our chemistry and biochemistry majors. The degrees have the advantages of training students both as chemists/biochemists and also preparing them for earning a teaching credential. Thus students majoring in these degrees will have the opportunity to work in industry or go into a health profession in addition to preparing for a career in teaching.

Finally, the B.S. Chemistry and B.S. Biochemistry degrees continue to provide good preparation for graduate study, and we anticipate that some of our students will go on to Master's or Ph.D. programs. We have a good success rate for admission of our graduates to both types of graduate programs. These individuals will go on to work at higher levels in industry or obtain academic positions.

c) Advising and Retention

Advising and retention are both high priorities for our department. Our full-time faculty split advising duties at the undergraduate level by each taking a portion of the alphabet. This gives our students a consistent “go-to person” throughout their time in the department, regardless of the degree option with which they eventually graduate. To improve the effectiveness of our retention and advising activities, we plan to meet regularly with a General Education representative to ensure that our Freshmen majors are getting into the proper classes during their first year. We will also up our coordination with the College of Science Student Center to make sure they know all the requirements and understand the importance of prerequisites and transfer equivalency courses. We will continue to make use of the SI program (supplemental instruction) for bottleneck courses and make a greater effort to inform students where they can go to obtain tutoring resources.

As part of the University's Graduation Initiative, we have several strategies to improve graduation rates. We plan to improve our department website so that it clearly links to road maps and advisor information. The website will also contain links that can help direct students to different student organizations such as the pre-health club. We will also encourage undergraduates to become involved in research with faculty members by making students aware of the research description pages on our website and providing links to research funding programs through the Center for Student Research. This mentoring relationship is an important aspect of advising and retention for our undergraduate students who conduct research. We will also make students aware of internship opportunities and provide links to the Career Center.

At the graduate level, to improve retention and time to graduation, the graduate coordinator will meet with graduate students at least once a year to ensure that they are making consistent progress towards graduation. Because the MS degree program will undergo substantial transformation in Fall 2018, this will be particularly important during the transition to ensure that students select appropriate courses. In addition we will continue to provide each graduate student with an individual faculty advisor. Plan A students conduct research in a faculty member's lab and get extensive mentoring from their faculty mentor, not only with respect to their research project, but also regarding career goals. Plan B MS students are assigned a faculty member who guides them toward the completion of their final literature review paper. Increasing our number of faculty members will lead to greater research opportunities for both our undergraduate and graduate students, allowing for closer, one-on-one mentorship of a greater proportion of our students.

3.4. Faculty

The department is now relying on part-time instructors to teach the majority of sections offered. In addition, the number of undergraduate majors and graduate students who would like research opportunities is greater than the current faculty can supply. After the current search for a tenure track faculty member in the area of physical chemistry is complete, we anticipate the need to hire in the area of organic chemistry. A number of organic chemistry courses are taken by students in other degree programs such as Biological Sciences, Earth and Environmental Science, and Health Science. Growth in these programs has led to significant increases in enrollments in organic chemistry courses. Over 200 students take the year-long majors-level organic chemistry course series each year. We also offer an upper division elective in organic chemistry, a graduate organic chemistry course, and several organic chemistry courses tailored for non-majors (required by some Biology concentrations and one of the degrees offered by the Department of Earth and Environmental Science). This translates to about 18 laboratory sections (nine per semester). Due to the specialized nature of organic chemistry lab, these sections should be taught by tenured or tenure track faculty or by experienced lecturers. Any new faculty hires will also need a suitable research lab and office space.

Beyond the need for another organic chemist on our faculty, we anticipate changing needs over the next few years and **will develop a five year plan for hiring tenure track faculty that maintains balance among the sub-disciplines of chemistry and takes into account the majors courses that need to be taught by TT faculty to meet the ACS accreditation requirements for the B.S. Chemistry degree.**

Mentorship of undergraduate and Master's level research projects is an important function of the full-time tenured and tenure track faculty. However, directing student research requires a large time commitment from faculty both to train the students in the experimental methods and to supervise them in potentially hazardous laboratory situations. In order for our majors to be competitive for entry into the job market or graduate and professional schools, they need to have the opportunity to demonstrate independent research skills. The only way to do that is for the faculty to be granted time to supervise them. A mechanism for supervisory units for faculty who mentor research students is needed and we are hopeful that funding will be available to implement the proposed College of Science Workload Plan. This plan acknowledges the effort involved in student supervision and would provide faculty release time for mentoring student research projects.

In addition, faculty who teach the large lecture classes that have multiple lab sections associated with them, need coordination units to reflect the amount of time and work that goes into coordinating the labs. The lab sections are most often taught by graduate student TAs or part-time temporary lecturers. The instructor of the lecture is additionally responsible for developing the lab syllabus, coordinating with the stockroom staff to ensure the chemicals and instrumentation needed for the labs are prepared, reviewing details of the experiments with the lab instructors (often times teaching them how to do the experiment or how to operate a specific instrument), obtaining grades from the lab instructors, and ensuring that grading and other policies are fair across multiple sections. The coordination all of the lab sections greatly adds to the lecture instructor's workload but is not reflected in the WTUs assigned to the lecture class.

Finally, faculty members need to have private offices. Due to the experimental nature of our research and the need to be on campus to supervise students in research laboratories, the Chemistry Department faculty members are generally on campus all day, every day. It is extremely difficult to work effectively in shared offices when the other faculty member is holding office hours, advising students, or meeting with research students. Yet, it is impossible to work elsewhere and still be available to students engaged in research.

3.5. Resources

Develop a plan for staff support, including office, stockroom and Facilities Management support. With increased enrollment growth over the last 10 years coupled with decreased staffing, it has become necessary to attempt to acquire new staff and to plan for the best utlization of the staff we now have. We will re-examine our staffing needs and define the areas where i) new staff is needed; ii) work distribution can be re-organized for efficiency.

One of the most pressing needs is to be able to hire a stockroom and instrument manager. This is a position that was eliminated in 2009 when the then stockroom manager retired. In addition to supervising the stockroom staff, he played a critical role in equipment maintenance and instrument training. We need one person to coordinate the care of laboratory equipment and instruments used in common; to initiate and monitor repairs and preventive maintenance, to develop basic protocols, and to support faculty in the development and execution of new classroom experiments using the instruments. This person would check and calibrate instruments prior to classroom usage as well as provide routine services such as adding liquid nitrogen to the NMR weekly and making sure gases and other supplies required to keep other instruments running are available. In addition, this person could serve as a liaison for the department with the Facilities Department. Because Chemistry and Biochemistry are laboratory sciences, we rely heavily on Facilities to maintain the infrastructure in the labs, such as the fume hoods, electrical outlets, and plumbing of the sinks and ice machines. For example, the quality of the electrical outlets has proven to be a limiting factor in our efforts to modern equipment in the teaching labs. A stockroom/instrument manager would potentially be able to work with Facilities to find a solution to our need for stable electrical output.

Equally urgent is the need for additional department office staff. Currently the department has one permanent staff position for the department office. This level of staff support has become inadequate due to the increase in student enrollment and to the additional administrative computer and paperwork duties for which department office staff have become responsible. The department office needs at least another half-time staff member.

4. External Reviewer's Report

External Review: CSEUB Department of Chemistry and Biochemistry

Reviewer: Jennifer Whiles Lillig, Department of Chemistry, Sonoma State University

On-Site Visit: January 26, 2018

Submitted: March 16, 2018

The review follows the rubric categories outlined on page 23 of the CSUEB Academic Review Procedures and is based on the following and a summary of recommendations can be found on the last page of the report:

1. Department Five-Year Program Review (including self-study and plan)
2. Principles Regarding Faculty Participation in Tenure-Track Allocation Procedures
3. Annual Reports (past 5-years)
4. University and Program Mission Statements
5. Tour of department facilities and labs
6. Meeting with all tenure-track faculty
7. Meeting with lecturer faculty
8. Meeting with administrative and technical staff

9. Meeting with undergraduate and graduate students
10. Meeting the Department Chair
11. Meeting with College Dean

Program Summary

The department offers eight degrees, including a B.S. Chemistry certified by the American Chemical Society (ACS) and an M.S. degree. These multiple degrees choices are appropriate for a commuter campus of their size and location within the Bay Area and offer many opportunities for students to pursue their passions in chemistry and find their path into the California workforce. The department is thoughtful and intentional in all aspects of its operation including: 1) continual curriculum assessment and modernization, 2) student training and mentorship utilizing hands-on learning and high impact practices, 3) tenure-track faculty hiring and research activities, 4) teamwork between tenure-track (TT) faculty, adjunct faculty, and staff, and 5) resource acquisition and management. The department is highly inclusive with teamwork at the forefront of everyone's thoughts so that they can provide the best chemical education for their diverse student population.

Summary of Previous Review/Five Year Plan

Per last the last program review and plan, the department brought all of its programs into compliance with the CSU-mandate of 180 maximum quarter units. This significant undertaking was accomplished through stream-lining the degree requirements while maintaining the rigor required by the ACS for degree certification. Many of the curricular improvements were possible through significant instrument purchases enabled by department chair and faculty proposal submissions and funding wins through a variety of sources including extramural grants and the A2E2 Instructional Equipment funding source through CSUEB.

Unexpectedly, the department was also required to prepare for a CSU-mandated quarter-semester conversion for implementation in Fall 2018. This required complete restructuring of the undergraduate and graduate degree options to maintain educational content and ACS certification requirements. The department employed an impressive level of thoughtfulness, starting with revision of program learning outcomes and curriculum maps and finishing with assessment plans. During this time, the department also significantly restructured the M.S. program so that all students would benefit from a core curriculum that spanned all chemistry sub-disciplines in conjunction with electives tailored to each student's specific interests. A more in-depth analysis of the department's curriculum is described later.

The previous plan also highlighted the need to identify new spaces for instrumentation and research active faculty as well as new instrumentation and better instrument maintenance. The department benefited recently from some space reassignments and renovations. New lab space on the first floor of the science building (STEM Research Space) and renovations of space for new TT faculty have provided areas for instrumentation and student training. As mentioned earlier, the department proceeded to obtain A2E2 funding to replace outdated instrumentation. Individual TT faculty utilized start-up funds and grants to purchase additional instruments. Together, these acquisitions significantly enhanced the department curriculum and research activities. However, increased TT hiring coupled with the large number of lecturer faculty, as well as recent acquisition of significant instrumentation, highlights the continued space crunch.

The 2012-2013 plan sought to increase departmental productivity in the realm of faculty-lead research activities. This activity manifested in the acquisition of several extramural and competitive research grants and the publication of 23 papers over five years. This is significant for a department of this size, especially considering four of the TT faculty are recent hires. Faculty also won grant awards for teaching activities, solidifying their commitment as teacher-scholars.

While these general topics will be discussed in detail throughout the remainder of this review, overall, the department utilized its previous program review and five-year plan to guide its operational processes from curriculum development to faculty hiring. The department also remained flexible within its plan to accommodate unforeseen requirements, such as the quarter-to-semester conversion. It is clear the department takes program review seriously and I commend them for their thoughtful planning, execution of action items, and adaptability.

Program Learning Outcomes Assessment Plan

The department is methodical and consistent in its course-level and program-level assessment processes. Both the undergraduate and graduate programs have five program learning outcomes (PLOs) which are simplistic, appropriate, and assessable for the degree level. These PLOs are clearly mapped to course offerings and have dedicated measurement tools such as embedded exam questions or evaluation rubrics that are regularly used by the faculty teaching in those courses. The department has a dedicated assessment officer (Dr. Anne Kotchevar) and regularly assesses institutional and program outcomes as dictated by the university as well as discipline specific learning outcomes. Most assessment activities take place within individual courses since there is no defined capstone experience for undergraduates and lack of dedicated time to track students post-graduation.

Overall, since the last review, assessment results centered on PLO#3 in the undergraduate curriculum have caused the department to be most concerned about student ability to utilize quantitative reasoning to solve complex chemical problems. To address this issue, the department has increased the math classes required by all undergraduate degree with the hope that the additional math practice will help in later application to chemical problems. It will be important to assess the effectiveness of this new course implementation and to consider tracking student performance in math classes for comparison to department PLO assessments. It was notable that biochemistry undergraduate majors tended to score higher overall on PLO assessment than chemistry majors. It may be interesting for the department to consider this result and what training these students may be receiving in their major-specific coursework compared to the chemistry majors. However, it could also be simple student self-selection. It would also be useful to consider assessment of PLOs via student success after graduation. This could be tracked by looking quantitatively at successes in job placement, post-baccalaureate school admissions, and student satisfaction with preparedness. Finally, in the undergraduate curriculum, it might be useful for the department to look at individual PLOs that distinguish individual degree paths.

With regards to the M.S. curriculum, the department did find increases in student ability to utilize the scientific literature and to communicate accurate science effectively. In addition, the department found that student lab skills and safety also met or exceeded expectations. These are excellent learning outcomes to assess for the M.S. degree and excellent results. The department did find that assessment of student specialized knowledge in the sub-disciplines of chemistry was difficult to measure due to lack of a common student experience within the program. Transformation of the M.S. curriculum to include core-courses, as described below, should facilitate this assessment in the future.

The department also found that at one point, the M.S. program had grown to a point that it was unmanageable to provide adequate course and research opportunities to meet student need. To address this issue, the department changed some admissions requirements. This, coupled with a positive turn in the economy leading to more students taking industrial positions, resulted in a smaller than anticipated program size of about 26 students. Both the department and college agree that the program would be healthier with 40-50 students, which would be appropriate given the strong thesis component for the research track.

Course Offerings

As mentioned earlier, over the last five years the department updated its curriculum twice to bring all programs into the maximum unit requirement for the quarter system followed by creation of a semester-based curriculum to be implemented in Fall 2018. Despite the difficulty of these tasks, the department still managed to increase hands-on learning by including expanded laboratory access across the undergraduate degrees. They also increased the rigor of the degrees by requiring additional math and physics supporting course work. High impact practices (HIPs) in addition to lab work, such as group problem solving activities, case-studies, and the "Teaching in the 21st Century" student learning community, were also incorporated into the curriculum. Lab experiments were modernized using relevant lab instrumentation such as microwave synthesizers in organic chemistry lab and NanoDrop spectrophotometers for biochemistry labs. Smaller instrumentation, such as additional LabQuest probes and melt stations, were also included to improve student access. Incorporation of more industry-specific skills in general is relevant for the student population that attends CSUEB in chemistry and biochemistry. This is particularly true for the M.S. students since they are typically returning for an advanced degree to improve their current job prospects. In addition to modernized lab curricula, the M.S. program was completely transformed for the upcoming semester system with core-curriculum to provide students with advanced study across the sub-disciplines. Students will then specialize in areas of interest through elective coursework.

It is clear that the department approached the curriculum revisions necessary to meet the 180-unit quarter mandate followed by the quarter-semester revision as opportunities to thoughtfully consider their program goals and best-practices to educate chemistry students rather than just a task to be completed. The resulting curricula provide a variety of relevant chemistry options to provide students with a solid foundation in the chemical sciences as well as topical selections to allow students advanced course work in areas they find interesting and for specialty training. Despite a reduction in units, the department maintained or increased rigor through additional lab experiments and additional supporting math courses. The department should be commended not only for engaging in these daunting process, but also for the resulting curriculum they produced. Future work for the department in curriculum development will include working with the math department to find an appropriate replacement for the ELM, on which a passing score is currently required for entry into the introductory chemistry course work.

GE Course Assessment

The department offers a variety of general education (GE) courses in both lower and upper division categories, with and without lab components. The department also develops and offers service courses for other science-based majors such as chemistry for nursing majors and engineering majors. Individual instructors assess their courses for the freshman learning communities program. In light of the recent Executive Orders regarding GE reform, it will be important for the department to consider its role in GE as the campus makes sure it is in compliance.

Students

The department reports graduation rates slightly higher than campus averages for both chemistry and biochemistry majors which is impressive given the rigor of the programs. It's somewhat difficult to assess actual values for graduation rates as students switching between the chemistry and biochemistry majors can skew the data. Graduation rates are also particularly impressive since most students in the program are commuters with significant work commitments. The largest achievement gaps within the department occurred in the larger introductory courses. This is not surprising given the broader variety of majors represented in the lower division courses and the more HIPs included in upper division coursework. Given the scarcity of resources, it may be helpful for the department to consider relative populations of the multiple undergraduate degree options to see if any are under-populated or if there are differences in graduation rate or student performance in PLOs amongst those tracks. This may help the department focus in a few areas.

Six students of various level, major, and background participated in the external review process and satisfaction amongst them was high. All students interviewed felt comfortable in the department and fully supported by the faculty and staff. They noted the helpfulness of the faculty in all areas from lab work to advising. Students felt a connection to the faculty and felt that their individual success was important to them. They appreciated the selection of classes offered and the thoughtfulness put into scheduling in that not only do chemistry courses not conflict with each other, but also do not conflict with supporting course work. Students felt well-trained by the department's lab curriculum and felt like they had opportunities to utilize all of the instruments at some point. In particular, they felt that after training, that faculty trusted students to use the instruments. Students also felt supported in their studies through the campus via Supplemental Instruction and tutoring opportunities such as the TriO Center.

M.S. students commented on the feel of a cohort since they all take the same classes together. This cohort feeling should grow with implementation of the new core-curriculum. Undergraduate students mentioned that they tried to work together to form study groups and utilize open classrooms and lab space for work. They felt current extra-curricular activities were enough since most undergraduates were commuters with high work commitments outside of school.

Undergraduates also commented that some research groups provided a sense of community and were hopeful for more undergraduate research opportunities in general. Students recognized that although not a requirement for undergraduate degrees, research experiences were a staple for students. They brought up that students with undergraduate research experience were finding jobs faster and undergraduate research was used in screening for students applying to post-baccalaureate health programs. Students were committed to getting these research opportunities and were hopeful for more information about faculty research programs, open research positions, and applications. This recognition of undergraduate research by the students themselves is supported by the American Association of Colleges and Universities (AACU) reports on the undergraduate research as a HIP and mechanism to narrow the achievement gap. Its value has also been acknowledged by the CSU Chancellor's Office. Therefore, it will be important for the department and administration to work together to find ways to continually support undergraduate research opportunities. Incorporation of undergraduate research into the curriculum should also be considered.

Some areas of improvement noted were small and easily addressed. For example, students were in disagreement about the frequency and availability of seminars by internal and external speakers, and whether or not students were invited, which suggests an advertising push on this front might be useful. However, students agreed seminar timing was difficult considering the varied work schedules of the student population. Students also felt a stronger alumni connection might be helpful as they progress through the major and into the workforce. An option on both fronts would be to bring in alums for seminars a few times a year followed by an opportunity for students to interact with them.

Faculty

The department has been working to increase its TT faculty population across the sub-disciplines of chemistry with five successful faculty searches spanning four sub-disciplines over the past five years. A sixth search is currently in progress. During the selection processes, the department has clearly been successful in hiring team members that fit into a supportive and collaborative culture. Conversations with TT faculty indicated this was clearly an intentional process, with collegiality, compassion, and principle being at the forefront of desired candidate characteristics along with competency and expertise. Gender balance within the faculty is good and the department continues to work hard to increase its overall diversity. The supportiveness and comradery amongst the TT faculty, as well as lecturers and staff, was palpable.

These TT hires have permitted increased coverage of upper division coursework as required by the ACS. However, ACS certification requires all upper-division coursework be staffed by TT faculty and CSUEB is not close to reaching this requirement. Failure to meet requirements can result in probationary status and loss of certification if progress does not continue to be made on this front. Faculty-student contact hours are also still higher than dictated by ACS certification requirements. This is due in part to CSU contract requirements as well as unsupported time for student research mentorship. Solutions to the latter problem are in progress and will be discussed later. In addition, chemistry faculty provide significant service to other university stakeholders through GE and service coursework, which is expected to grow in the future with growth in other majors such as engineering and biology. It is important for the chemistry department and college to consider these needs in future hiring plans. Overall, TT faculty coverage for courses and general departmental workload is improving as is the distribution of faculty at different ranks. This allows the department to more easily spare faculty for buyout and committee work which is vital for their professional development.

TT faculty run active research labs with graduate and undergraduate students. Continued growth in this area is vital, particularly if the department works to grow its M.S. program as mentioned earlier. In this regard, some faculty commented on feeling somewhat overloaded when trying to balance teaching and research obligations since there has been no direct support mechanism in the past. Some CSUs utilize contract courses and the 0.5/0.3 WTU support mechanism per graduate and undergraduate student, respectively. Others assign regular lab classes per faculty as research. The department chair and college dean have indicated that research support mechanisms are currently in negotiation to address this issue and it is important that a fair agreement be reached in order to support graduate and undergraduate levels of research. Research expectations for tenure should match with support opportunities. This support mechanism seems to be exacerbated by students signing up for research at the last minute and it seems to be difficult to plan for funding when it's not clear students will show up. A solution to this issue may need to be found. Regardless, TT faculty indicated the importance of both graduate and undergraduate opportunities for research and the necessary support to make it an enriching experience.

Lecturer faculty report similar positive experiences within the department including overall feelings of inclusion and consultation. They report a collaborative teaching experience with strong support from staff as well as pride in the thoughtful development of the department's curriculum.

A shared TT and lecturer faculty concern is that of lab coordination. Multiple large lectures of the same course, like General Chemistry, running concurrently with multiple breakout labs each require significant coordination in order to ensure no undue hardship on the stockroom for laboratory preparation and to make sure each student has the same general experience and learning outcomes. Currently, there is loose coordination between faculty teaching the lectures to utilize one lab manual so that it is manageable for the stockroom and groups of participating faculty get together to talk and try experiments out. Faculty report this has been an acceptable and effective practice so far with progress forward in course development. Faculty are adaptable to laboratory updates and new equipment. However, a lab coordinator position can really facilitate this process by ensuring consistent materials for lab preparation, consistent grading mechanisms across sections, and sharing of ideas to enhance the learning experience of all students. The department has indicated that the dean is working to support these uses of faculty time through a proposal process and this is a positive step forward.

Campus Resources

Department Chair

The department chair, Dr. Ann McPartland, is regarded across the board as supportive for the department and instrumental in its progress forward. She is seen to nurture the professional development of faculty and staff through thoughtful distribution of work load and general mentorship. She is also proactive in obtaining funding sources to support curriculum and research development. She clearly puts the department first and is a thoughtful and respectful colleague. Good support for course distribution and taking care of people.

Department Staff

Department staff overall report a harmonious relationship between and with staff members, commenting that all members work incredibly hard and classroom preparation takes place without a hitch. However, there are areas of concern connected with increased student enrollments in service courses and the significant number of lecturer faculty. There are significant add-slips and enrollment issues at the beginning of each quarter and a large number of contract issues as lecturer faculty must be rehired at the beginning of each quarter and cleared at the end. Due to confidentiality, student assistants cannot assist with these processes so there is an additional staff member with a 4-week appointment at the beginning of each quarter. However, this staff member must also be rehired, processed, receive computer privileges and then terminated every quarter. To this end, the department chair, college dean, and staff should work together to make sure processes are streamlined and adequate support is available in the office so that time is used in the most efficient manner possible.

Stockroom staff were also positive with regards to new changes with faculty hiring, modernization of experiments, and incorporation of new instruments and technology. The ability to hire student assistants was viewed as positive and necessary although the required repetitive training could also be a time drain, particularly after the loss of the stockroom manager position as a result of retirement. Student availability to assist also impacts general planning for material and equipment deployment. Increases in enrollments across labs have been noticeable and it was important to note that instruments are currently in top condition since they are mostly new. However, general usage will eventually lead to maintenance and repair needs. Additional lab sections, for example in the evening, to deal with increasing enrollments in service courses are currently not possible without extra technician support due to preparation and safety concerns.

Space

As is the case in all departments across the country, space is at a premium. The department, staff, and administration agree that the department uses its space creatively. Renovations have made space available for the training of students in research methods with newly hired faculty and renovated shared lab space on the first floor will provide a collaborative work space for chemists/biochemists with other departments. This will free up some space in the chemistry department. The faculty have embraced the teacher-scholar model and shared instrumentation for formal classes and student research activities are spread throughout the laboratory spaces. There is widespread concern about the ability to attract future hires without clear wet lab space and hood access for research activities with students as well as concern about growing needs in the lower division, particularly for large courses (like General Chemistry) that serve the college and university as a whole.

In addition, all of the faculty share office space with partners either inside or outside the department. This arrangement has pros and cons. Benefits can include productive conversations, sharing of opinions, and witnesses to monitor student interactions. Problems can include coordination of office hours, student privacy issues, and distracting work habits. Sharing of offices appears to occur because of space necessity and at this time, the location of future faculty, TT or lecturer, is unknown. Discussion of office options as well as faculty needs for general workspaces should be discussed within the department and college as a whole.

Facilities

Despite the resulting functional and beautiful lab renovations, faculty and staff across the board reported numerous problems in working with facilities. Some of the issues reported included: 1) broken hoods over the summer taking an abnormally long time to repair and still lacking professional certification to ensure proper function to keep fumes out of the lab, 2) long wait times (>6 months) for small jobs such as installation of an electrical outlet, 3) laboratories with buckets for leaks when it rains, 4) facilities' representatives more than an hour late for appointments with visiting instrument installation representatives, 5) four month wait times for service for windows that didn't close properly in a lab space with instrumentation then informed the problem couldn't be fixed (required dean intervention), 6) floor installation that took four months past the arrival of the new faculty member in the fall when the request was put in the previous spring, and 7) overall general unresponsiveness to tickets requesting assistance. These issues can result in serious safety hazards and damage to expensive instrumentation, not to mention loss of faculty and staff time in dealing with these issues. It is important that facilities collaborate with the department, college, and other CSUs to learn and implement best practices that serve the needs of all parties.

Library

Both the library, faculty, and students report sufficient access to the chemical literature. In particular, SciFinder Scholar, Web of Science, and ACS journals are widely available, and vital for the scholarly activity level of the department. These current holdings seem financially secure and interlibrary loan has proved sufficient for journals not within the library's holdings. The library counts on the department to be forthcoming with its needs. The science librarian is proactive in her work with the department and interacts frequently with chemistry and biochemistry students who make appointments for assistance. Faculty work with B.S. students on library skills during the Survey of Chemical Literature class. Some research groups are utilizing the scientific literature for presentations. Further collaborations with the library, perhaps through seminar series that the library would also enjoy participating in would be a welcome addition and further strengthen the robustness of the library collection. This could be in conjunction with possible seminar activities described earlier. General consensus in the department appears to be that expecting undergraduates to read the scientific literature is a high expectation. However, given that scientific literature is being incorporated into the undergraduate curriculum across the nation and in other sister CSU departments, this is a learning objective that could be discussed further within the department in order to make sure students are adequately prepared for the next stage of their career. The library could also assist in this endeavor, particularly given that all students are required to take an Introduction to Literacy course which could become more discipline specific as well as connect the discipline to larger areas such as information ethics and cultural literacy.

Safety

Outside of concerns with slow repairs from facilities, there were no other safety concerns noted. The department has general policies that are common amongst institutions including no night work, no working alone, etc. However, it is important that the department make sure they do have a safety policy written down and that all students, particularly research students who may not be enrolled in a class, are trained properly and given the policy. This ensures consistent safety practices across the department and a departmental record for protection of the faculty and institution. Finally, lack of air conditioning in the building is somewhat concerning particularly with the acquisition of new instrumentation and general chemical storage. The department should discuss any potential impacts.

Unit Requirements and Transfer Model Curriculum:

As the Golden Handshake and SB1440 is just beginning implementation across the state, this was not a focus of this review.

5 Year Plan- Curriculum:

As described above, the department will be focusing on TT staffing issues, implementation and assessment of the semester-based curriculum, revision of math prerequisites for general chemistry, increased research opportunities for undergraduates, and continued iterative modernization of laboratories and curriculum. The department also plans development of new GE courses. These plans are all appropriate based on the different levels of program review. The department is encouraged to be mindful of staffing issues and ACS contact hour requirements during the development of new courses outside the major.

5 Year Plan- Students:

In the student arena, the department is focusing on recruitment efforts to increase enrollment in the M.S. program. As part of the graduation initiative, the department is also focused on advising strategies for all students and undergraduate research as an HIP for student success. These plans are in line with the observations described above.

5 Year Plan- Faculty:

The department is sensitive to a need to increase TT faculty density in order to address: ACS requirements for student contact hours and coverage of upper division courses, increased enrollments in service courses, increased diversity, and mentorship of graduate and undergraduate students in research. The department also recognizes current space considerations for current and new faculty for offices and research. A more defined planning strategy in terms of numbers and sub-disciplines of TT faculty necessary and definitive space needs in order to meet departmental and college-based goals may help the department progress forward on this issue.

5 Year Plan- Resources:

As described earlier, the department has a staff need to support increased enrollment growth. As with TT faculty recruitments, to further facilitate this process a definitive plan for staff support should be developed demonstrating work distribution and streamlining of processes, including work with facilities. Plans for possible uses of current and new spaces should also be further discussed and developed in consultation with the rest of the college.

Summary of Recommendations:

1. Continue participation in the A2E2 funding process in order to support iterative development and modernization of lab curriculum.
2. Develop defined plans for TT and staff hiring as well as current and future space needs for teaching, research mentorship, and offices while keeping in mind ACS certification requirements and faculty diversity.

3. Continue to work with the college to find an adequate support mechanism for lab coordination and mentorship of graduate and undergraduate research students that matches with 1) student training needs, 2) the use of HIPs for retention and graduation, and 3) congruence with RTP requirements for scholarship.
4. Consider incorporation of research and science literacy requirements into the undergraduate curriculum. Consider the role of a seminar series in student education and increasing collaboration with alums and other members of the university and surrounding community.
5. Work with the college to find mechanisms to improve the utilization of Facilities personnel for repairs and renovations.
6. Consider CSU best practices for tracking student placements post-graduation for assessment purposes and relationships with alums.
7. Focus on advertising and recruitment strategies to increase and stabilize enrollment for the MS program.
8. Develop a department policy to standardize lab mechanisms for student training, safety, and waste handling in research labs. Work with the college and university as a whole to address the deficiency in support from facilities.

Overall, the CSU East Bay is a model chemistry program focused on the training of Bay Area students for California jobs. It is clearly an enriching and inclusive place to learn, practice and collaborate in chemistry and biochemistry for students, faculty, and staff.

5. Program Response to External Reviewer's Report

On January 26, 2018, Dr. Jennifer Whiles Lillig, Professor and former Chair of the Department of Chemistry at Sonoma State University, visited the Hayward campus of CSUEB to perform an on-site review of our department. She met with the Dean of the College of Science, the Department chair, Department faculty, including part-time lecturers, Department staff, Chemistry and Biochemistry students, and the Library Liaison representative for Science. Department faculty have considered the External Review Report submitted by Dr. Lillig. Our responses to various components of the Report follow.

Introduction

The External Reviewer's report describes the current state of affairs in the Department of Chemistry and Biochemistry, pointing out many strengths and providing suggestions for improvements and/or new directions. At the end of the report Dr. Lillig makes a series of specific recommendations for the future. The topics covered in the department response are organized according to the outline of Dr. Lillig’s report.

A. Program Summary

Dr. Lillig's Program Summary is complimentary, stating that the department is providing an appropriate set of degree options for students and thoughtfully working in key areas such as curriculum assessment and modernization, student training and mentorship, and resource acquisition and management. She also commented on the highly inclusive environment in the department and the obvious teamwork between faculty, lecturers and staff. The department is appreciative of her overall positive assessment of our operation.

B. Summary of Previous Review/Five Year Plan

Dr. Lillig noted that the department followed and executed its previous Five Year Plan over the last few years and at the same time maintained adaptability as unexpected issues arose. The later parts of her report give more detail on her analysis of recent department activities.

C. Program Learning Outcomes Assessment Plan

The External Reviewer's report provides positive feedback on department assessment work, citing the appropriateness of the Program Learning Outcomes, the consistency of the course-level and program-level assessment processes, and the designation of a dedicated faculty assessment officer. The undergraduate assessment results presented in the Self Study are reasonably encouraging, but identify PLO#3, student ability to utilize quantitative reasoning to solve complex chemical problems and analyze chemical data, as the most problematic. To address this issue the department has increased the math classes required for all the undergraduate degrees beginning in Fall 2018 in hopes of improving student proficiency in handling quantitative problems in the upper division courses. Dr. Lillig states that it will be important to assess the effectiveness of the new course implementation and suggests we consider tracking student performance in math classes for comparison to department PLO assessments. We will certainly continue to monitor the quantitative reasoning PLO in our upper division courses and will look for improvement when incoming transfer students and freshman reach the assessed upper division courses. In terms of correlating student performance in math with PLO#3 assessments for chemistry courses, this might be possible for a relatively small student sample for a selected course with high quantitative expectations, e.g. CHEM 351 (Physical Chemistry I), where the assessment is done by hand and student names are available. The instructor will be encouraged to attempt this type of analysis. Dr. Lillig also suggested assessing PLOs via student success after graduation. The department is enthusiastic about attempting this type of assessment. We are generating contact information for our graduates but do not currently have the personnel to implement an actual post-graduate assessment program.

Assessment results for the M.S. curriculum indicated that the majority of the students met or exceeded expectations for several PLOs, including critically analyzing the chemical literature, presenting chemical information via oral or written reports, and working effectively in a laboratory environment. Dr. Lillig noted that difficulties in assessing specialized knowledge due to lack of commonality in the curriculum will be corrected by the transformation of the M.S. curriculum for semesters to include core courses. We concur and are looking forward to the new M.S. curriculum.

D. Course Offerings

The external reviewer's report is quite positive in describing the department curricular updates that have been implemented over the past five years, primarily those for semester conversion but also the earlier reductions in units for some degree options undertaken to meet the CSU mandate of 180 quarter units maximum. She states that it is clear the department used these revisions "as opportunities to thoughtfully consider their program goals and best-practices to educate chemistry students, rather than just a task to be completed." In describing her impression of the semester curriculum Dr. Lillig especially notes efforts to increase hands-on learning with expanded laboratory access across the undergraduate degrees, augmented by the department's acquisition of significant instrumentation over the past five years. She also notes the added rigor in the areas of math and physics for the undergraduate degrees as well as complete transformation of the M.S. degree program to include a core curriculum across chemistry sub-disciplines, with specialization through elective courses.

Dr. Lillig also praised department faculty for introducing high impact practices such as group problem solving activities, case studies and student learning communities into the classroom. We hope to do more of these types of activiies in the future. Many of our undergraduates also work with a faculty member on a research project and we find this builds enthusiasm for chemistry and biochemistry among the student majors.

As are all of us in the CSU, Dr. Lillig was aware of the recent elimination of use of the Entry Level Math (ELM) exam requirement for incoming CSU students. In her report she mentions the issue of finding an appropriate replacement for the ELM exam, which was used to place students into introductory chemistry courses. Since Dr. Lillig's report was written, the department has developed math co-requisites for the beginning chemistry courses: Pre-Calculus for General Chemistry (CHEM 111), College Algebra or Statistics for Basic Chemistry for the Health Sciences (CHEM 161), and College Algebra or Math for the Arts and Humanities for Introduction to College Chemistry (CHEM 100).

E. GE Course Assessment

The department offers a variety of General Education (GE) courses in Area B, Scientific Inquiry and Quantitative Reasoning (B1, B3, B6). We have added one new GE course going into semesters and transformed two others. After conversion or transformation, all of our semester GE offerings have been reviewed and approved by the appropriate individuals and campus committees through the Curriculog system. While the department developed course learning outcomes for each course, it is the GE program level outcomes in each GE sub-area that will be used for asssessment. Sample student work as described in GE area proposals will be used to assess GE program level outcomes. As noted by Dr. Lillig, in the past instructors have assessed their lower division courses for the freshman learning communities and a simliar process may be utilized going forward. We plan to also assess our B6 courses as directed by the GE department and to also assess course learning outcomes for selected GE courses to measure our effectiveness in providing basic physical science education for non-science majors.

F. Students

The report compliments the department on having student graduation rates slightly higher than those of other CSU campuses for both chemistry and biochemistry. This is of course gratifying for us and we credit the determination of our student majors, especially transfer students, the quality of our teaching faculty, our high impact practices and the inclusive environment we try to foster. Dr. Lillig pointed out that the largest achievement gaps within the department occurred in the larger introductory courses, where the students are often experiencing their first college chemistry course. We have been trying various new approaches in the introductory chemistry classes, including more practice exercises, breakout sessions, review sessions, online homework and quizzes, East Bay Replay, and Supplemental Instruction.

Dr. Lillig thought it might be worthwhile to consider relative student populations in the undergraduate degree options to see if any are underpopulated or exhibit differences in graduation rates. In general the B.S. Chemistry, B.A. Chemistry and B.S. Chemistry, Concentration in Forensic Science degrees have about equal numbers of majors and similar graduation rates. Granted the numbers are not large but each of these degree options suits students with particular interests and goals. The B.A. Biochemistry degree is admittedly much less popular than the B.S. Biochemistry degree, with only about 20% of the students choosing the B.A. Nevertheless, we are happy to offer this option to students who need solid training in biochemistry but prefer to leave room in their programs for coursework in other fields. Two of the B.A. degrees are Chemistry Education Options which are part of a larger effort by the College of Science to promote the training of future secondary school science teachers. These degree programs are definitely underpopulated but are part of a larger effort by the College of Science to promote quality training of future secondary school science teachers. Our B.A. Chemistry Education programs include courses in Geology, Environmental Chemistry, Philosophy, Teacher Education and Biology required as prerequisites for a Secondary School Teacher Credential program in Chemistry. These degrees are paired with B.A degrees offered by the Departments of Biological Sciences and Physics that provide Options in Biology Education and Physics Education, respectively. The College does not have a Natural Sciences Department to offer teacher preparation in the sciences and therefore the Chemistry, Biological Sciences and Physics Departments have decided to take up this mission. So, while our Chemistry Education degree programs are underpopulated we are happy to maintain them in the hopes of encouranging more students to go into Science Education. These degrees do not require any special chemistry courses beyond those used for our other degrees.

On the day of the site visit Dr. Lillig met with six chemistry and biochemistry majors who voiced satisfaction with the education they are receiving at CSU East Bay. These students felt comfortable with and supported by the department faculty and staff, appreciated the selection of courses offered and were appreciative of the research opportunites available in the department. Some of the undergraduate students mentioned that better advertising of weekly seminars and the opportunity to speak with alumni would be desirable. While we do advertise the weekly seminars given by the graduate students, we are hopeful that our planned Student Forums will be more appropriate for undergraduates.

G. Faculty

The external reviewer was complimentary in summarizing department efforts to increase the number of faculty over the last five years and in describing the quality of the current members of the department. She mentioned the five successful tenure track (TT) faculty searches over the last five years and the supportiveness and comradery among the tenure track faculty, lecturers and staff. She also noted the gender diversity in our faculty and our continued efforts to increase overall diversity. Some specific issues she identified are the need to cover upper division major courses with tenured or TT faculty for ACS accreditation, the importance of research support for both the undergraduate and MS programs, the need for teaching credit for faculty research mentorship, and the absence of classroom lab coordination units. As indicated below under Summary of Recommendations, we will continue to apply for TT positions and develop a plan for the types of sub-disciplines of most pressing need; the plan will include projected office and research space requirements for new faculty. Also described under Summary of Recommendations are the recent actions of our Dean in providing faculty support for research mentorship and assigned time for classroom lab coordination.

H. Campus Resources

Department Chair: Dr. Lillig concluded that the current chair has the support of the department faculty and staff, and is regarded as working to move the department forward.

Department Staff: The department office has one Administrative Support Coordinator (ASC II) who handles everything relating to office management and administrative support with grace and efficiency. A particular concern with the office voiced by Dr. Lillig after speaking with faculty and staff is work created for the ASC II by the hiring of so many part-time lecturers and teaching associates. Some examples are contracts that must be prepared each quarter (or semester) and cleared at the end, general orientation of new lecturers to teaching at CSUEB, help with procedures for copying and key requests, maintenance and distribution of desk copies of textbooks, requesting CVs to be updated, general questions, etc. Additionally, with the large number of students from other majors taking service courses in chemistry and the multiple lab sections associated with the large lecture courses, the number of adds, drops and swamps easily reaches 50 during the first two weeks of each quarter (or semester). Because Chemistry is required for several other majors, e.g. Biological Sciences, Health Science, the number of advising questions that come to the office is amazingly high, maybe 15 per week. These are generally questions the Science Student Center advisors can't answer so each has to be handled by the ASC II in some way, either by sending the student to a faculty advisor, to the department chair or by contacting another office on campus. In recognition of the volume of work in the Chemistry Office the Dean has approved the hiring of a part-time temporary Administrative Support Assistant I for 4 weeks each quarter. This is helpful but does not provide sufficient support. A permanent part-time employee is needed.

Dr. Lillig also commented that the stockroom staff had positive things to say about the newer faculty hires, the recently acquired equipment for the teaching program, and the department policy of hiring student assistants to help in the stockroom. Although not complaining much, the stockroom staff are extremely busy. As mentioned above there has been an approximately 55 % increase in lab enrollments over the last 10 years and this has created a large increase in workload for a smaller stockroom staff.

Space: The external reviewer's report notes recent increases in space available for department use, including a newly renovated individual faculty research space, a new instrumentation room and a collaborative research area.

Facilities: In her report Dr. Lillig describes an across the board dissatisfaction of the Chemistry and Biochemistry faculty with Facilities Management in responding to requests for maintenance, repair and renovation activities. In the Summary of Recommendations (see below) she suggests that the department work with the college to find ways to improve the utilization of Facilities personnel. Please see that section for the department response.

Library: The library is well equipped to provide access to the chemical literature. Dr. Lillig noted that the SciFinder, Web of Science and the ACS journals available in the library are particularly important. She met with the Science Librarian and found her to be very proactive in her work with the department. Dr. Lillig mentions that introduction of the scientific literature into the undergraduate curriculum is very desirable and suggests that this objective could be discussed further within the department. As described below under Summary of Recommendations we will require the Chemical Literature course for all of our B.A. degrees on the semester system but could not fit it into the B.S. degrees because of added math and/or physics requirements. Nevertheless, this is an important issue and we will work on methods for introducing all undergraduates to the scientific literature.

Safety: Dr. Lillig did not note any safety concerns and saw that the department has general policies that are common among chemistry departments at academic institutions. She did however recommend that the safety policy for research students be provided in written form. We have added the goal of developing a written policy for research student safety to the Plan section (3.1) and addressed it again under Summary of Recommendations.

I. Five year Plan:

Dr. Lillig concluded that the department plan for the next five years is appropriate. She suggests adding a more defined set of goals for tenure track hiring over the next few years that includes sub-discipline and space considerations, and we have added this as a goal to the Amended Five Year Report (see section 3.4). Regarding resources, Dr. Lillig states that a definitive plan for staff support should be developed. We have also included this as a goal in the Plan of our Report (section 3.5) and have also addressed it below under Summary of Recommendations.

J. Summary of Recommendations:

At the end of her report Dr. Lillig lists eight specific recommendatons for the Department of Chemistry and Biochemistry. These are listed below along with the department perspectives and responses to each of the recommendations.

1. **Continue participation in the A2E2 equipment funding process to support the lab curriculum.** The department faculty are in full agreement and will continue to submit proposals for modern lab instruments and equipment. We have included "Continue to upgrade instrumentation" in the Plan portion of this Program Review (section 3.1) as one of the goals for the upcoming five years and will also work to upgrade smaller equipment used by students in our lab classes.

2. **Develop defined plans for tenure track and staff hiring as well as future space needs, keeping in mind ACS certification requirements and faculty diversity.** Although we have hired five new TT faculty members over the last five years and have another joining the department in Fall 2018, we are still operating with only about half of our course sections taught by tenured or TT faculty. This will increase to about 57% with the arrival of the new faculty member in Fall 2018 but still falls far below the statewide CSU academic senate goal of 75%. So it is appropriate for the department to continue to seek tenure track positions over the next five years, both to replace any faculty who retire or resign and to increase the overall percentage of TT faculty teaching our courses. The accrediting agency for our B.S. Chemistry degree, the American Chemical Society (ACS) does require upper division courses to be taught by tenured or TT faculty and we have not yet quite achieved that for all sections of those courses (but have been able to somehow maintain accreditation).

   In accordance with Dr. Lillig's suggestion we will develop a five year plan for hiring tenure track faculty that maintains balance among the sub-disciplines of chemistry and takes into account the courses required for the B.S Chemistry degree that need to be taught by TT faculty to meet the ACS accreditation requirements. The plan will include mechanisms for providing appropriate research and office space. We will also develop a document explaining the reasons additional staff are needed and a plan for the best utlization of the staff we now have. At this writing the CSCI Dean has approved the replacement of two Instructional Support Technicians (ISTs) who will soon leave the department. Those positions are essesntial for the maintenance of our laboratory curriculum; one will be at the IST III level and hopefully the person hired will have large instrument skills and experience. Still, because of an approximately 55 % increase in chemistry lab course sections over the last 10 years those ISTs will be kept very busy with classroom preps and will have only a little time to maintain and repair equipment. We really need an additional technical staff person for at least 50% time. We will continue to request additional office staff and justify our requests with written materials and data.

3. **Continue to work with the College to find support mechanisms for lab coordination and mentorship of research students.**

   The department will certainly follow this suggestion. The College Dean is working to provide some relief for faculty in these areas. After this report was submitted, the Dean solicited proposals for assigned time for 2018-2019. We requested 14 lab coordination WTU and were given 6 WTU. This is enough to provide one coordination WTU to each lecturer-in-charge for our General Chemistry and Organic Chemistry courses for one semester. This is definitely a positive development and we hope to obtain more lab coordination units in the future. In a few weeks the Dean will solicit proposals for units for research mentorship. Last year the department requested 9 WTU for 5 faculty members and received all 9 WTU. Hopefully a similar scenario will take place for 2018-2019.

4. **Consider incorporation of research and science literacy requirements into the undergraduate curriculum; consider a seminar series.** The department faculty have considered adding a research requirement to the undergraduate curriculum in the past and have decided against making this mandatory. At present, essentially all chemistry and biochemistry undergraduates who wish to do so are working on a research project under the direction of one of our faculty. The faculty are very welcoming of undergraduates interested in research projects. The training of these students is both rewarding and time consuming. Because of the time involved for training and the time-consuming nature of experiments in chemistry and biochemistry, most of our faculty require students to spend about 10 hours per week on the research project. It's not really feasible to accomplish anything in less time. Because a high percentage of our undergraduate majors must work at an outside job, working 10 hours a week on research plus carrying a full class load in order to maintain financial aid, can be a heavy burden. For this reason we have decided not to push all the students to participate in research, although in truth many of our majors decide to participate anyway.

   We would certianly like to incorporate science literacy requirements into the curriculum and moving into semesters have required a Chemical Literature course (CHEM 470) for all the B.A. degree concentrations. Unfortunately CHEM 470 could not fit into any of the B.S. degree programs without raising them above 120 units. All three B.S degrees simply have too many other requirements, including the added semester of calculus (and the added semester of Physics for the B.S. Chemistry program). After moving to semesters we will institute a faculty supervised bi-semester Student Forum for students working on research projects. We envision this as a kind of a seminar but with the students themselves providing the topics emanating from their projects. For those students choosing not to become involved in research we do now familiarize them with the scientific literature in some of the advanced courses, usually through literature assignments. Nevertheless we do recognize that a formal science literacy course or format will now be missing from our B.S. degree programs and will try to correct this omission after we adjust to the semester system.

5. **Work with the college to find ways to improve response from Facilities for repairs.** As described by Dr. Lillig in her report, the department faculty are dismayed and appalled by some of the delays by Facilities personnel in responding to requests for

maintenance, repair and renovation activities. Over time we have come to think this is a combination of shortage of personnel in Facilities Management and a culture of slow action by some of those who are employed there. Dean Singley has been meeting with Facilities supervisors and has assigned one of the college staff members to facilitate faculty and staff interactions with Facilities and this has helped somewhat. A new director of Facilities Management was recently hired. We are hopeful that she will be able to affect some changes. However, this is a problem we can't solve easily. We certainly will work with the college and especially the Dean's designated go-between staff member in approaching Facilities personnel to discuss the relevant issues.

6. **Consider tracking student placements post-graduation for assessment purposes and relationships with alumni.** As stated above, the department is now keeping a list of recent graduates with contact information. We have always encouraged our former students to keep in touch and have close ties with many of them. Although we are enthusiastic about generating post-graduation assessment results in the future, at the moment it is hard to see who would do this work. The faculty are steeped in the multi-course assessment we are already doing and the staff are currently overwhelmed with work. We agree with Dr. Lillig that post-graduate assessment would be extremely valuable and will make it a goal for the future. However, at the moment we do not have the personnel to implement a formal post-graduate assessment program.

7. **Focus on advertising and recruitment strategies to increase enrollment for the MS program.** This is a very good suggestion and we have included a similar goal in the Plan section of our report (section 3.1). Our Master's program enrollment was at 26 as of Fall 2017. Ideally it should be between 40 and 45. Our current graduate coordinator is working on advertisement strategies. These and other recruitment efforts will be a priority for the department faculty over the next several years.

8. **Develop a department policy to standardize lab mechanisms for student safety training and waste handling in research labs.** This is an excellent suggestion and we have added it to the Plan section of our Five Year Report (section 3.1). A safety policy for research labs has always been important and our faculty currently train research students in appropriate safety measures. Research students are also required to attend a hazardous chemicals training session once a year. However, a formalized written policy for the department is needed. Donna Placzek, the director of the CSUEB Environmental Health and Safety Department, will be working with the departments to provide advice on how to formulate the written policies for chemistry.

6. Dean's Acknowledgement

Appendix A

Department of Chemistry and Biochemistry Program Assessment Plan

The Department strives to provide a strong education in chemistry and biochemistry that prepares its students to function and thrive in our society. The Department attempts to increase the problem solving and critical thinking skills of all students. Non-science students will learn about the scientific and chemical aspects of everyday life that allow them to understand issues related to the environment, energy production, disease prevention and nutrition. Students of the sciences will learn the fundamentals of chemistry that control the interactions of elements and molecules that form the building blocks in nature. Chemistry majors will receive extensive instruction in predicting chemical reactivity. Building on an understanding of mathematics, physics, and biology, chemistry majors will receive a background in the major disciplines of chemistry including inorganic, analytical, organic, physical and biochemistry. Students will learn the protocols and techniques for working safely with chemicals. All chemistry majors should have the ability to search the chemical and scientific literature. The Department recognizes the importance of the pursuit of new knowledge through research in the development of skilled scientists and productive members of society and encourages its students to participate in research projects and cooperative educational opportunities.

BA/BS-Chemistry Degrees and BA/BS-Biochemistry Degrees

Undergraduate Program Learning Outcomes:

Students graduating with a Bachelor's degree in Chemistry or Biochemistry from Cal State East Bay will be able to:

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.

A variety of methods will be used in chemistry lecture and lab courses to assess these student learning outcomes. For the B.A. and B.S. Chemistry Programs, the lecture classes in the organic, inorganic and physical chemistry series will be assessed. For the B.A. and B.S. Biochemistry Programs, the general biochemistry, organic chemistry and physical chemistry series will be assessed. In addition, the organic chemistry lab and biochemistry lab will be assessed. The assessment methods for each course are outlined under the individual courses.

CHEM 3303 Organic Chemistry

Students who successfully complete the Organic Chemistry series should be able to:

1. predict bonding, nomenclature, chemical properties and some physical properties of organic compounds if the molecular structure is known.

2. identify common organic functional groups and demonstrate a knowledge of the chemistry and reactivity of each functional group.
3. use the results of the common spectroscopic methods (NMR, IR, UV and mass spectroscopy) to determine the structures of simple organic compounds.
4. explain the common reaction mechanisms of organic reactions, and be able to indicate the mechanism and type of intermediate involved in the reactions.
5. safely carry out standard laboratory techniques for the purification of organic compounds, including distillation, recrystallization, column chromatography, thin layer chromatography, and extraction.
6. measure the infrared spectrum of an unknown solid or liquid and identify the functional groups present.
7. carry out standard functional group transformations of organic compounds, and isolate and characterize the resulting products.

Outcomes 1-4 will be assessed by the score obtained on the ACS standardized organic chemistry exam, given as the final exam in CHEM 3303. Outcomes 5-7 will be assessed by a capstone eperiment in CHEM 3303 lab. Students will identify two unknown organic compounds, requiring purification by distillation, the knowledge of chemical classification tests, the ability to obtain spectroscopic data, and the ability to interpret the results. Derivatives will be required, requiring a chemical transformation, purification and characterization of the product.

CHEM 3511, 3512, 3513 Physical Chemistry

Students who successfully complete this series of courses should be able to:
1. explain the properties of the gas phase and the relationship to energy.
2. correlate bond energies with macroscopic energy determinations.
3. recognize the driving force for chemical reactions and explain the concept of equilibrium as it is applied to various reactions.
4. explain the origin of quantum theory.
5. describe the nature of the electron in the hydrogen atom.
6. describe the building up of the periodic table by electron configuration.
7. correlate the changes observed in spectroscopic methods in terms of quantum theory.
8. explain the importance of rates of chemical reactions in the overall scheme of chemistry and calculate reaction order from the time dependence on concentration.
9. describe transition state theory.
10. explain the nature of solids in terms of their nature, bonding, and properties.
11. demonstrate the use of statistics and probability in developing thermodynamic concepts.

The outcomes criteria will be based on the answers obtained for specific embedded questions on the Final exams in CHEM 3511, 3512, or 3513.

CHEM 4161, 4162 Advanced Inorganic Chemistry

Students who successfully complete this series of courses should be able to:
1. relate atomic structure to spectra and orbitals, ionization energy, electron affinity, shielding, and effective nuclear charge.

2. describe covalent molecular substances in terms of geometries, valence bond theory, and molecular orbital theory.
3. describe the main group elements in terms of vertical and horizontal trends in the Periodic Table, and know their typical synthesis, structure, physical properties, variations in bonding motifs, acid-base character, and reactivities.
4. explain transition elements and coordination chemistry by an analysis of ligands, coordination number, stereochemistry, bonding motifs, nomenclature.
5. explain ligand field and molecular orbital theories as it relates to Jahn-Teller effects, magnetic properties, electronic spectroscopy, thermodynamic and kinetic aspects, and lanthanides and actinides.
6. describe organometallic chemistry in terms of metal carbonyls, hydrocarbon and carbocyclic ligands, the 18-electron rule, synthesis, properties, and patterns of reactivity.
7. explain solid state materials such as close packing in metals and other compounds, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects.

The outcomes criteria for the above objectives will be based on questions from Final Exams.

CHEM 4411, 4412, 4413 General Biochemistry

Students who successfully complete this course should be able to:

1. explain buffer theory and the preparation of laboratory buffers.
2. explain the structures, properties and chemistry of amino acids and peptides.
3. recognize the common structural motifs found in proteins - including the alpha-helix, the beta-sheet, and other structural features.
4. explain the properties of enzymes and the basics of enzyme kinetics including the Michaelis-Menten equation, Lineweaver-Burke graphs, and enzyme inhibition.
5. explain the basic principles of bioenergetics including standard and actual free energy changes and the calculation of these energy changes in biochemical reactions.
6. explain the structure and properties of biologically-important carbohydrates and understand the basic details of the major metabolic pathways found in the cell
7. describe the structure and properties of purine and pyrimidine nucleotides, DNA and RNA.
8. explain the details of DNA replication, RNA synthesis and processing, and how proteins are synthesized in the cell using ribosomes, tRNA, and mRNA.

Specific questions will be embedded into the final exams of CHEM 4411, 4412, or 4413. These questions will be multiple choice, short answer/essay, or problem solving questions.

MS-Chemistry and MS-Chemistry Option-Biochemistry Degrees

Graduate Program Learning Outcomes:

Students who graduate with a Master of Science degree in Chemistry will be able to:

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.

Depending upon the Degree Plan/Option, chemistry graduate students complete coursework in thermodynamics, the chemical bond, biochemistry, and various advanced topics in chemistry (organic chemistry, physical chemistry, and/or biochemistry). Assessment for the graduate programs will be through assessment of the required seminars and of individual graduate lecture and laboratory classes. Courses that will be assessed are CHEM 6820 (Seminar), CHEM 6430 (Protein Chemistry Techniques), CHEM 4240 (Instrumental Methods of Analysis) and the Advanced Topics courses.

CHEM 6820 Seminar

All chemistry graduate students must complete three separate Chemistry Seminar courses (CHEM 6820). Students are expected to select a topic in chemistry or biochemistry, search the literature, develop and deliver an oral presentation (using PowerPoint), and answer questions. The seminar is presented to fellow students and to the faculty. These seminars will be used to assess the students' ability to understand, organize, and critically assess information from the chemical literature, and to present complex chemical information via oral and written reports.

Students who successfully complete this course three times should:
1. be able to understand information from the chemical literature.
2. be able to organize and critically assess information from the chemical literature.
3. be able to present complex chemical information via an oral seminar.

The faculty member coordinating the Seminar course will evaluate each student seminar 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 the rubric shown below. Assessment will be measured by the number of students presenting a seminar that meets or exceeds the expectations by their third seminar presentation.

CHEM 6820 Seminar Rubric for Assessment:

Criteria	1	2	3	4
Organization	Audience can't understand presentation because there is no sequence of information	Audience has difficulty following presentation because speaker jumps around	Speaker presents information in logical sequence which audience can follow	Speaker presents information in logical, interesting sequence which the audience can follow

Subject Knowledge	Speaker does not have grasp of information; student cannot answer any questions about subject	Speaker is uncomfortable with information and is able to answer only rudimentary question	Speaker is at ease with expected answer's to all question but fails to elaborate	Speaker demonstrates full knowledge by answering all class questions with explanations and elaboration
Mechanics	Presentation has superfluous graphics or too few graphics or four or more misspelling/ grammatical errors or graphics which are too small	Presentation has an occasional graphic that doesn't support presentation or three misspelling/ grammatical errors or graphics which are too small	Presentation graphics relate to text and presentation but has one or two misspelling/ grammatical errors or graphics which are too small	Presentation graphics relate to text and has no misspelling/ grammatical errors and no graphics which are too small
Presentation	Speaker reads all of report or mumbles, or speaks too quietly to hear in the back of the room	Speaker reads most of report, or has a voice is too low so audience has trouble hearing all of the presentation	Speaker occasionally reads from notes and audience can hear all of the presentation	Speaker doesn't read from notes and uses a clear voice so that audience can hear all of the presentation

CHEM 4240 Instrumental Analysis

Students who successfully complete this course should:

1. be able to understand the strength and the limitation of various analytical methods.
2. be able to explain the roles of five basic components in optical instruments.
3. be able to explain the physical origin of various spectroscopic techniques.
4. be able to understand Beer's law and use it to calculate the concentration of an unknown sample in both UV/Vis spectroscopy and Atomic Absorption Spectroscopy.
5. be able to explain the fundamental differences between NMR and other spectroscopic methods.
6. be able to explain the differences in currently available ionization methods and mass analyzers in Mass Spectrometry.
7. be able to calculate important parameters for column performance in liquid chromatography.

The instructor will utilize embedded exam questions to assess the specific student learning objectives.

CHEM 6430 Protein Chemistry Techniques

Students who successfully complete this course will be able to:

1. Work cooperatively with a lab partner to execute multi-period experiments.
2. Develop a scientific laboratory notebook that includes a record of the experiments performed, the data collected, relevant data analysis and conclusions that can be drawn from the results obtained.
3. Fractionate proteins from cell extracts using sequential steps involving multiple techniques and explain the rationale for the use of differential solubility in protein purification.
4. Explain the theoretical basis for ion exchange chromatography with gradient elution and be able to predict protein behavior on ion exchange columns and perform a column chromatography experiment using a group specific stationary phase and gradient elution.
5. Measure enzyme activity using spectrophotometric assays and analyze linear reaction rates.
6. Analyze the effectiveness of a chromatographic protein purification technique using a column profile plot and calculation of specific activity and fold purification.
7. Explain the rationale for the various steps involved in an immunoblotting experiment.
8. Describe the principles underlying non-denaturing and denaturing gel electrophoresis (PAGE) and use SDS-PAGE and immunoblot detection to confirm induction of specific protein synthesis from an expression vector.
9. Explain the theoretical basis for affinity chromatography, describe the chemical reactions required to produce an affinity resin and use affinity chromatography to purify a hybrid protein in reasonable quantities.
10. Explain the theoretical basis for the high separation efficiencies obtained with HPLC and FPLC and use an HPLC instrument to identify and quantify a mixture of biomolecules using ultraviolet or fluorescence detection.
11. Describe the principles underlying isoelectric focusing (IEF) and apply the techniques of IEF and SDS-PAGE to the two dimensional separation of a complex protein mixture.
12. Explain the principles of mass spectrometry as applied to the analysis of peptides derived from proteins identified in proteomics experiments; describe the methods of operation for the ionizers and mass analyzers commonly used for peptide separations.

Achievement of learning outcomes involving theoretical concepts, quantitative reasoning and the significance of experimental results will be assessed through specific questions embedded into exams and quizzes. Certain outcomes will be monitored each year to provide comparison data while others will be assessed periodically to develop a profile of achievement for the spectrum of outcomes. Where partial credit is given, the answer to an embedded question will be counted as correct if at least 75% of the total possible points are awarded.

Outcomes involving data analysis and written presentation of biochemical information will also be assessed via a laboratory notebook each student is required to develop. Outcomes for mastering laboratory techniques will be monitored by assessing the data generated for specific experiments (e.g. see outcomes 6, 7, 13 and 15) as presented in the laboratory notebook. The effectiveness of student teamwork will be assessed by a combination of the instructor's evaluation of laboratory performance and the quality of the data and calculations achieved by the team and presented in the laboratory notebooks.

Appendix B

Assessment Data 2016-2017

Undergraduate Program

As stated in our five-year assessment plan, in 2016-2017 we specifically concentrated on PLO #4 which concerns oral and written communication. In addition we continued to assess program content through PLO #1 (Demonstrate knowledge in the various areas of chemistry) and PLO #2 (Work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/ biochemical instruments). Written communication (PLO #4) was assessed in General Biochemistry Laboratory (CHEM 4430) for biochemistry majors and in Bioanalytical and Forensic Chemistry Laboratory (CHEM 3200) for chemistry majors. Demonstrating knowledge in the various areas of chemistry (PLO #1) was conducted in Organic Chemistry (CHEM 3303), Physical Chemistry (CHEM 3511, 3512), Advanced Inorganic Chemistry (CHEM 4162), and Biochemistry (CHEM 4412) through the use of standardized national exams and embedded exam questions. The laboratory assessment was conducted in capstone laboratory exercises for the ability to critically analyze experimental results (PLO #2) in CHEM 3303, CHEM 4430 and CHEM 4240.

CHEM 4430 - General Biochemistry Laboratory (PLO #4 and PLO #2)

Assessment Tool: Analysis of written notebook and embedded questions on final exam

Learning Goals	Embedded Questions on Final Exam or other Assessment tool
know buffer theory and how to prepare a laboratory buffer.	Questions 5 & 6
know how to perform protein and enzyme activity assays and how to calculate results from laboratory-derived data.	Question 8& 9
know how to calculate data commonly found in Protein Purification Tables and how to interpret this information.	Question 7
know how to perform enzyme kinetic data analysis and how to present this data in graphical format.	Multiple Choice Questions 5-10 & Analysis in lab notebook
know theory and practical details of chromatographic procedures	Question 10
know the theory and practical details of electrophoresis of proteins and DNA.	Question 12 and photograph of a successful SDS-PAGE protein gel.
know how to develop a well-written laboratory notebook.	Laboratory notebook score

Fall 2016 data BS Biochemistry Majors:16 students

Goal	Assessment tool	Number of correct answers*	Percentage
1	Q5 Final	13	81%
1	Q6 Final	9	56%

2	Q8 Final	14	88%
2	Q9 Final	3	19%
3	Q7 Final	11	69%
4	Analysis in lab notebook and report	11	69%
4	MC 5-10 Final	6	38%
5	Q10 Final	6	38%
6	Q12 Final	3	19%
6	Gel photograph	14	88%
7	Final lab notebook score	14	88%

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

The embedded questions Q9 and Q12 resulted in a very low number of correct answers. Q9 addressed learning goal 2 in a quantitative manner. Students had to calculate quantities of chemicals to prepare a buffer. Students performed much better on the qualitative Q8 that covered the same learning goal. The low score on Q12 is unexpected as it is a simple recall question. Nevertheless 88% of students were able to master the practical side of learning goal 6. 88% of the students were also able to demonstrate mastery of SLO #7, know how to develop a well-written laboratory notebook which maps to PLO #4.

Winter 2017 data BS Biochemistry Majors: 8 students

Goal	Assessment tool	Number of correct answers*	Percentage
1	Q5 Final	6	75%
1	Q6 Final	4	50%
2	Q8 Final	5	62.5%
2	Q9 Final	4	50%
3	Q7 Final	6	75%
4	Analysis in lab notebook and report	7	87.5%
4	MC 5-10 Final	5	62.5%
5	Q10 Final	4	50%
6	Q12 Final	5	62.5%
6	Gel photograph	8	100%
7	Final lab notebook score	8	100%

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

BA Biochemistry Majors: 3 students

Goal	Assessment tool	Number of correct answers*	Percentage
1	Q5 Final	2	67%
1	Q6 Final	1	33%
2	Q8 Final	2	67%
2	Q9 Final	0	0%
3	Q7 Final	2	67%

4	Analysis in lab notebook and report	11	100%
4	MC 5-10 Final	3	100%
5	Q10 Final	2	67%
6	Q12 Final	1	33%
6	Gel photograph	2	67%
7	Final lab notebook score	3	100%

All learning goals reached scores of 50% or higher. This is an improvement compared to the previous quarter. However, the three students pursuing a BA Biochemistry degree were unable to answer Q9 correctly. This is disappointing, as problems similar to Q9 were practiced in lecture and in group work. The overall analysis has to be seen as tentative due to the low number of students pursuing either a BA or BS Biochemistry degree enrolled in the course. For the same learning goal number 1, embedded questions that addressed qualitative answers (Q5) rather than quantitative calculations (Q6) yielded higher scores in student exams. 100% of the students were also able to demonstrate mastery of SLO #7, know how to develop a well-written laboratory notebook which maps to PLO #4 concerning written communication.

CHEM 3200 Bioanalytical and Forensic Chemistry Lab Spring 2017 (PLO #4 and PLO #2)
Assessment tool: Analysis of laboratory reports of a capstone experiment using a defined rubric that scored the following characteristics on a scale of 1 to 3 (3 being the highest).

	No. of students scoring 3 in all assessed areas			
	BS Chem	BA Chem	BA Biochem	Total
Report organization	5/6 (83%)	2/2 (100%)	0/1 (0%)	7/9 (78%)
Visualization	6/6 (100%)	2/2 (100%)	0/1 (0%)	8/9 (89%)
Mechanics	6/6 (100%)	2/2 (100%)	1/1 (100%)	9/9 (100%)
Subject Knowledge	4/6 (67%)	1/2 (50%)	0/1 (0%)	5/9 (56%)
Overall Communication	4/6 (67%)	1/2 (50%)	0/1 (0%)	5/9 (56%)

Total number of students scoring 3 in all assessed areas (total 15 points): 5 out of 9 (56%). Total number of students scoring 13 points: 7 out of 9 (78%). Total number of students scoring 11 points and higher: 9 out of 9 (100%). Future plans include implementing an in-class writing exercise to improve lab writing skills.

CHEM 4412 Biochemistry Winter 2017 (PLO #1)
Assessment Tool: Embedded questions on midterm exams and the final exam

Learning outcome	BA Biochem (2 students)	BS Biochem (25 students)	BS Chem (2 students)	Total (29 students)	Question source
#1 with >70% correct answer	0/2 (0%)	14/25 (56%)	2/2 (100%)	16/29 (55%)	Midterm 1 #1
#2 with >70% correct answer	1/2 (50%)	11/25 (44%)	0/2 (0%)	12/29 (41%)	Midterm 1 #4 or #6 in versions A and B, respectively
#3 with >70% correct answer	1/2 (50%)	6/25 (24%)	0/2 (0%)	7/29 (24%)	Midterm 2 #2 or #4 in versions A and B, respectively
#4 with >70% correct answer	1/2 (50%)	8/25 (32%)	1/2 (50%)	10/29 (34%)	Final exam #10 or #11 in versions A and B, respectively
#5 with >70% correct answer	1/2 (50%)	8/25 (32%)	0/2 (0%)	9/29 (31%)	Final exam #4 or #7 in versions A and B, respectively

Plans for improvement to course includes adding additional graded assignments focusing on all SLOs, especially on #3, 4, and 5.

CHEM 3303 Organic Chemistry Spring 2017 (PLO #1 and PLO #2)
Assessment Tool: Standardized national exam taken as the final exam and analysis of capstone project lab reports (PLO 1)
American Chemical Society Standardized Organic Chemistry Exam Spring 2017 Data

	Average Percentile	# of students above 40 percentile	% of students above 40 percentile	# of students above 70 percentile	% of students above 70 percentile
Chemistry and Biochemistry Majors (19)	29	5	26%	3	16%

The ACS standardized exam allows us to compare our students' performance to students nationwide who have completed a year-long undergraduate organic chemistry series. Our goal is for our students to be at or above the 40th percentile in the nation. While our average score was only the 29th percentile, 5/19 (26%) of our Chemistry and Biochemistry 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. The instructors of the course will keep the topics of the most missed questions in mind during the next year and give more emphasis to these areas and also incorporate more of these types of questions in the quizzes as practice.
Lab Assessment Spring 2017 Data (PLO 2)

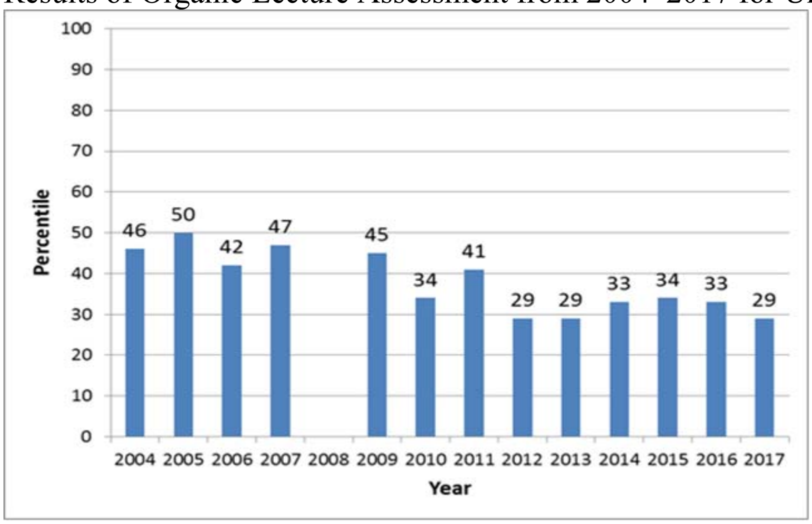
Correct identification of two unknown compounds during the Organic Chemistry Capstone Experience for 2017 is shown in the following table:

	# of students	Both correct	At least one correct	None correct	% Both correct	% One or more correct
Chemistry and Biochemistry Majors	19	14	17	2	74 %	89 %

Having close to 90% of the 19 chemistry and biochemistry majors able to satisfactorily complete the process and identify at least one of their unknowns leads us to believe that student learning objectives in the organic chemistry lab are being met. Therefore we have no plans to make changes in the lab portion of the course.

In an on-going effort to improve our students' success in meeting the student learning outcomes, we compare the results of this years' assessment data with previous years. As shown in the following graph and table, the results of this year's lecture assessment is on par with the results from recent years. The results of this year's laboratory assessment slightly better than last year and indicates that we are reaching our goals in demonstrating lab competence.

Results of Organic Lecture Assessment from 2004–2017 for Undergraduate Majors



Results of Organic Lab Assignment from 2012–2017 for Undergraduate Majors

Year	# of Chem/ Biochem Majors	# with both correct	% Both Correct	# with at least one correct	% At least one correct
Sp 2012	25	13	52	21	84
Sp 2013	32	21	66	29	91
Sp 2014	24	11	46	22	93
Sp 2015	26	16	62	25	96
Sp 2016	23	14	61	20	87
Sp 2017	19	14	74	17	89

CHEM 3511 Physical Chemistry Fall 2016 (PLO #1)
Assessment Tool: Embedded questions on final exam

Questions 1-4, 7-10, 14, and 15 on the final taken together assess SLOs 1, 2, 5, and 6 (i.e. explain and apply the fundamental postulates of kinetic molecular theory and apply them to gas-phase equations of state, model heat and work flow in chemical systems using the first law of thermodynamics, relate thermochemical properties to chemical systems at equilibrium, and synthesize and utilize quantitative descriptions of phase equilibrium).

The questions map to the SLOs according to the following table:

Question\SLO	1	2	3	4	5	6
1		X				
2		X				
3					X	
4						X
MC7	X					
MC14					X	
MC15					X	
TF8					X	
TF9					X	
TF10					X	

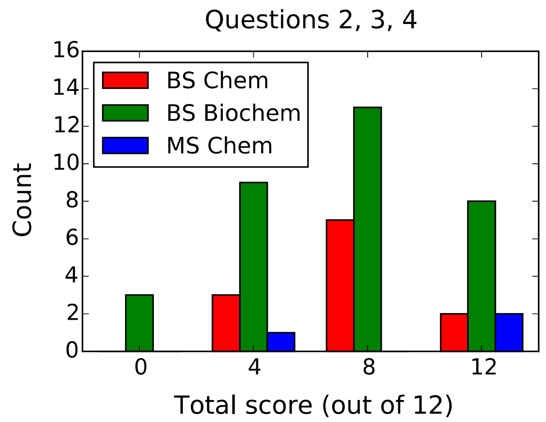
Entire class (50 students)

Question	Number (Percent) of students receiving at least			
	25%	50%	75%	100%
Q1	35 (70%)	28 (56%)	10 (20%)	9 (18%)
Q2	49 (98%)	48 (96%)	43 (86%)	18 (36%)
Q3	35 (70%)	28 (56%)	17 (34%)	8 (16%)
Q4	42 (84%)	37 (74%)	33 (66%)	20 (40%)
MC7				42 (84%)
MC14				39 (78%)
MC15				32 (64%)
TF8				29 (58%)
TF9				34 (68%)
TF10				28 (56%)

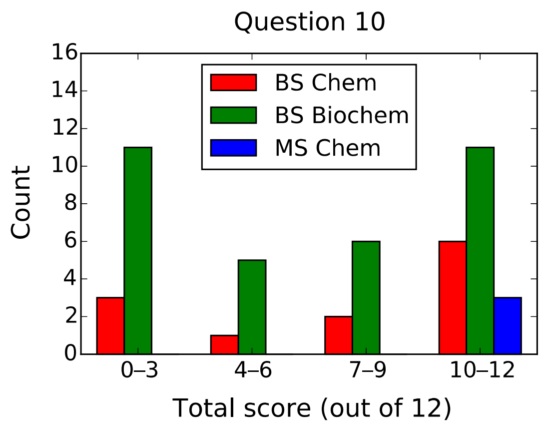
The fraction of students receiving at least 75% of the points on questions 1-3 is disappointing. Question 3 was particularly challenging to the class. Despite attempting to address this issue, the class continues to struggle on this question. Additionally, the results for question 15 indicate that students continue to struggle with the conceptual partial pressures in gas-phase equilibrium problems (although there has been some improvement.)

CHEM 3512 Physical Chemistry Winter 2017 (PLO #1)
Assessment Tool: Embedded questions on final exam

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

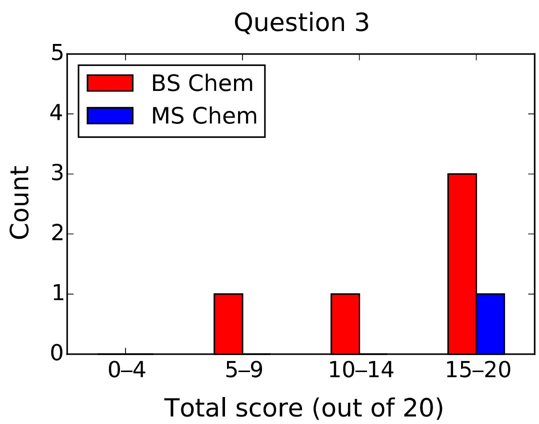


Learning outcome*: Model the vibrational and rotational motion of molecules.*

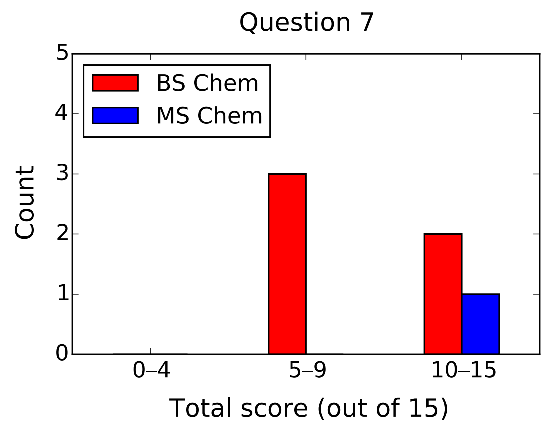


CHEM 4162 Advanced Inorganic Chemistry Winter 2017 (PLO #1)
Assessment Tool: Learning outcomes were assessed using embedded questions in the final exam.

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



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



Graduate Program

In 2016-2017 we specifically concentrated on PLO #4 which concerns presenting complex chemical information via oral and written reports. In addition we continued to assess program content through PLO 1 and 2 (demonstrate specialized knowledge in the chemical sciences and work effectively and safely in a laboratory environment using modern chemical/biochemical instrumentation and methods to test hypotheses or design solutions to problems). PLO-4 was assessed in Seminar (CHEM 6820) and in Protein Chemistry Techniques (CHEM 6430). PLO-1 was assessed in Advanced Topics in Organic Chemistry (CHEM 6310). PLO-2 was assessed in Protein Chemistry Techniques (CHEM 6430) and Instrumental Analysis (CHEM 4240).

CHEM 6820 Seminar (PLO-4)

During 2016-2017, 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.

Academic Year	1st Seminar		2nd Seminar		3rd Seminar	
	# of students	average score	# of students	average score	# of students	average score
2016-2017	11	11.4	14	13.2	11	13.3

Seminar	# of Students	Met Expectations		Exceeded Expectations	
		#	%	#	%
First	11	5	45	3	27

Second	14	11	79	6	43
Third	11	9	82	5	45

CHEM 6430 Protein Chemistry Techniques (PLO-2, PLO-4)

Laboratory Notebook Assessment Criteria:

Exemplary (90-100 points)	Basic (75-89 points)	Insufficient (0-74 points)
All observations are clearly presented. Experimental data is internally consistent. All calculations are correct and tables/ graphs are included with proper units. Results are analyzed critically, sources of error considered and conclusions written in a coherent manner.	Most observations are clearly presented. Experimental data is mostly consistent. Most calculations are accurate and tables/graphs are mostly included with proper units. Most of the results are analyzed critically, some sources of error considered and conclusions mostly written coherently.	Many observations are not clearly presented. Experimental data is not internally consistent. Many calculations are incorrect or missing. Many tables/graphs are missing or lack proper units. Many of the results are not analyzed critically, sources of error not considered or conclusions not written coherently.

Assessment Results for SLO-2: Eleven M.S. majors

Laboratory Notebook Learning Goal	No. Exemplary	No. Basic	No. Insufficient	% Students Meeting Expectations*
1 - Effective use of instrumentation to solve an expt'l problem	3	8	-	100
2 – Effective use of a biochemical method to solve an expt'l problem	4	7	-	100
3 – Effective use of a biochemical method to test a hypothesis	1	8	2	81.8

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

Using the lab notebook criteria 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. In the future more class time 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 experiments with the class. This 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 in their lab notebooks.

CHEM 6310 Advanced Topics in Organic Chemistry Fall 2016 (PLO #1)
Assessment Tool: Embedded questions in Final Exam that map to the course SLOs.

SLO#2. predict conformational preference of organic molecules and the stereochemical preference in reactions (Final Exam Questions #12, #13 and #14)

Question #12		Question #13		Question #14	
Meets expectation	Does not meet expectation	Meets expectation	Does not meet expectation	Meets expectation	Does not meet expectation
5/11 students	6/11 students	6/11 students	5/11 students	6/11 students	5/11 students

SLO#4. evaluate and apply different techniques for the determination of mechanisms of organic reactions (Final Exam Questions #16 and #17)

Question #16		Question #17	
Meets expectation	Does not meet expectation	Meets expectation	Does not meet expectation
10/11 students	1/11 students	11/11 students	11/11 students

SLO#5. design syntheses to introduce or interconvert different functional groups and to form carbon-carbon bonds (Final Exam Questions #20 and #21)

Question #20		Question #21	
Meets expectation	Does not meet expectation	Meets expectation	Does not meet expectation
2/11 students	9/11 students	3/11 students	8/11 students

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 the students. About 50% of the students met the expectation for SLO#2. SLO#2 builds on principles that were expected to have been learned in undergraduate courses that are prerequisites to this graduate class. Approximately 20% of the students met expectations for SLO#5. In the future, more time will be devoted to a short review of these principles behind SLO #2 in order to bring students up to speed and enable them to learn the more advanced material. Unfortunately only about 20% of the students were able to meet the expectation for SLO#5. In the future, 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.

CHEM 4240 Methods of Instrumental Analysis Winter 2017 (PLO #1, PLO #2)
Assessment Tool: Embedded questions in the lab reports and on the final exam

Embedded Questions in the lab reports and the final exam (accumulated)

Embedded Question	SLO #	# of master's degree students	# of students with correct answer	% with correct answer*
Midterm Q4	1	7	7	100
Midterm Q3	1	7	5	71
Midterm Q2	2	7	5	71
Final Q1	2	7	5	71
Final Q4	3	7	3	43

FI-IR Lab questions	3	7	3	43
Final Q9	4	7	5	71
Final Q8	4	7	7	100
Final Q3	5	7	5	71
Final Q5	5	7	5	71
Final Q6	5	7	2	29
Final Q7	6	7	6	86
Final Q11	6	7	5	71
Lab #7(building your own Spectrometer) question	7	7	5	71
Midterm Q7	7	7	4	57

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

A majority of the students accomplished most of SLO except for SLO #3, which was FT-IR lab along with its theoretical understanding. Last year, only two graduate students took this course, so it is a little hard to compare this with the result of the last year. But, compared to 2015 (8 graduate students), the students this year showed better performance in almost all SLOs except for SLO #2 which is about the same (75% for the 2015 class).

Assessment Data 2015-2016

Undergraduate Programs:

B.S./B.A. Chemistry or Biochemistry: As planned, we specifically concentrated on PLO-3, assessment of quantitative reasoning. In addition we continued to assess program content through PLO-1 (demonstrates chemical knowledge) and PLO-2 (works effectively in a laboratory environment). Quantitative reasoning assessment for the undergraduate programs focused on specific learning outcomes in the areas of physical chemistry (CHEM 3512-3513), inorganic chemistry (CHEM 4161-4162), analytical chemistry (CHEM 4240), and biochemistry (CHEM 4430) using embedded exam questions and laboratory reports. For analytical, organic inorganic and biochemistry, general knowledge (PLO-1) was also assessed. Laboratory assessment (PLO-2) was conducted in capstone laboratory exercises measuring ability to critically analyze experimental results in CHEM 3303, CHEM 4240 and CHEM 4430.

In the second quarter of physical chemistry only 29% of the chemistry majors earned 75% or more of the possible points for “formulating a mathematical description of the motion of a particle,” although 71% earned 50% or more of the points. The biochemistry majors did better, with 57% achieving above 75% of the points and 86% achieving above 50% of the points. Similar results were seen in the third quarter of physical chemistry for the SLO: “be able to calculate reaction order,” with only 25% of the chemistry majors able to do the calculation correctly and 50% of the biochemistry majors mastering the outcome. These are difficult quantitative challenges but we hope to see improvement next year. The instructors are introducing regular use of in-class, active, cooperative learning activities. Hopefully these will provide an opportunity for both students and instructors to emphasize quantitative reasoning. The chemistry majors did well for PLO-3 in the analytical chemistry course. For course specific learning outcome “apply Beer’s Law for UV/Vis spectroscopy,” 82% answered the question correctly. The biochemistry majors were challenged with a number of quantitative specific course outcomes in the General Biochemistry Laboratory course. The percentage of students who correctly mastered the outcomes ranged from 100% for protein purification calculations to 75% for enzyme kinetic calculations to 63% for buffer calculations to as low as 25% for calculation of enzyme activity from assays. The instructor will give special attention to analysis of enzyme activity data during the upcoming year.

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

Assessment data were also collected for PLO-1 (demonstrate knowledge in various areas of chemistry) and PLO-2 (laboratory proficiency) for several advanced undergraduate courses. For PLO-1 the courses assessed were CHEM 3303 (Organic Chem), CHEM 4162 (Inorganic Chem), CHEM 4240 (Analytical Chem), and CHEM 4412 (Biochemistry). The methods used were embedded exam questions or a standardized national exam. In the case of CHEM 3303 (the third quarter of a year-long organic chemistry series), where a standardized national exam prepared by the American Chemical Society was used to assess student knowledge, 9/23 of the Chemistry and Biochemistry majors were at or above the 40^{th} percentile in the nation, with the average percentile for all majors at 33%. Problem areas were identified by the instructors, who will give more emphasis to the theory and application of these topics next year.

To measure mastery of PLO-2, specific course outcomes for the laboratory components of CHEM 3303 (Organic Chem), CHEM 4240 (Instrumental Methods) and CHEM 4430 (General Biochem Lab) were monitored using embedded exam questions or analysis of laboratory notebooks. Student performance was variable and areas of strength and weakness were readily detected. As in the past, instructors will use these results to design innovative teaching strategies targeting areas of weakness.

CHEM 4240 Instrumental Methods of Analysis: Embedded Exam Questions. (PLO-3, PLO-2)

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

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

*Where partial credit was given the answer was counted as correct if at least 67% of the total possible points were awarded

CHEM 3303 Organic Chemistry: Capstone Lab Exercise. PLO-2

Year	# of Chem/Biochem Majors	# with both correct	% Both Correct	# with at least one correct	% At least one correct
2011	26	15	58	23	88

2012	25	13	52	21	84
2013	32	21	66	29	91
2014	24	11	46	22	93
2015	26	16	62	25	96
2016	23	14	61	20	87

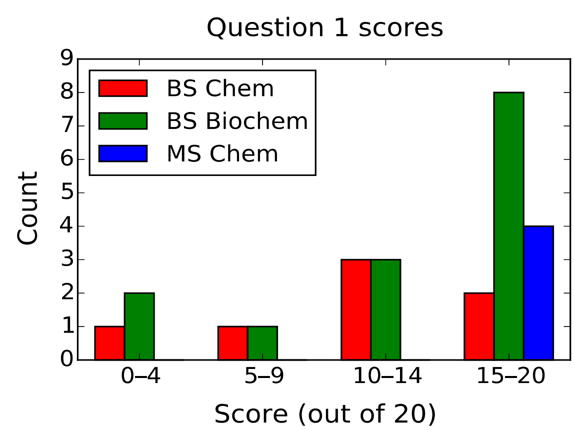
CHEM 3303 Organic Chemistry: Standardized National Exam. PLO-3 and PLO-1

Year	# of Chem/Biochem Majors	percentile
2011	26	41
2012	25	29
2013	32	29
2014	24	33
2015	26	34
2016	23	33

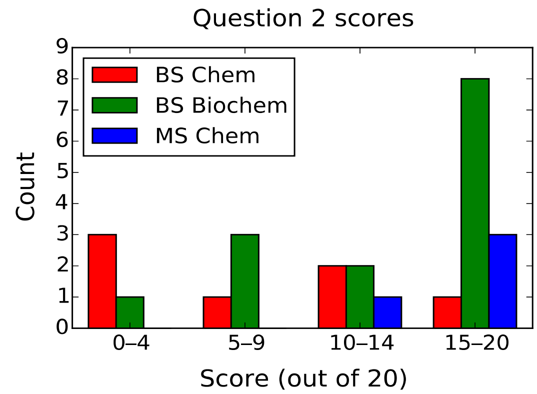
CHEM 3512 Physical Chemistry: Embedded Exam Questions. PLO-3

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

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



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



CHEM 3513 Physical Chemistry: Embedded Exam Questions. PLO-3

Assessment criteria relevant for CHEM 3513	Questions embedded in the Final exam
understand the importance of rates of chemical reactions in the overall scheme of chemistry.	Not assessed
be able to calculate reaction order from the time dependence on concentration.	Final Question 10
be able to understand and describe transition state theory.	Final Question 7
understand how statistics and probability can be used to develop thermodynamic concepts.	Midterm Question 10
be knowledgeable about catalysis	Final Question 14

BS Chemistry Majors: 4 students

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

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

BS Biochemistry Majors: 21 students

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

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

CHEM 4430 Biochemistry Lab: Laboratory notebook quality, experimental results and embedded exam questions. (PLO-3 and PLO-2)

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

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

*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

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

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

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

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

5 – Liquid Chromatography	Question 10, 11	0, 33

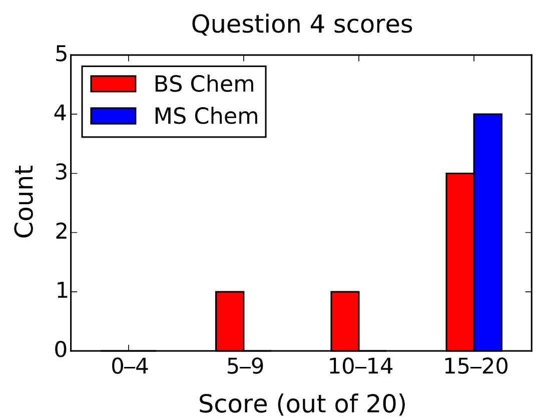
*Partial credit was applied to exam questions and lab notebook. 75% counted as correct.

CHEM 4412 Biochemistry: Embedded Exam Questions. PLO-1 Winter 2016

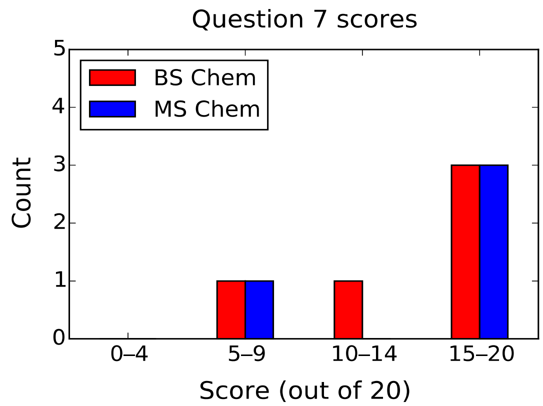
Course Learning Outcome	MS Chem (2 students)	BA/BS Chem (1 student)	BA/BS Biochem (16 students)	BA/BS Others (47 students)	Total (all majors, 66 students)	Question Source
#1 and #2, with>70% correct answer	1/2 (50%)	0/1 (0%)	6/16 (37.5%)	18/47 (38.3%)	25/66 (37.9%)	Final exam # 1 or #3
#4, with >80%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

CHEM 4162 Advanced Inorganic Chemistry: Embedded Exam Questions. PLO-1 Assessment focused on the 2nd quarter of the sequence, CHEM 4162, which builds on the foundation developed in CHEM 4161. Two specific course outcomes were tested with multi-part questions. Learning outcomes and corresponding distributions of scores are given for B.S. Chemistry majors (5) and M.S. Chemistry candidates (4).

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



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



Graduate Program

We specifically focused on PLO-3 which concerns understanding, organizing, and critically assessing information from the chemical literature. We also continued to assess PLO-1 (demonstrates specialized chemical knowledge beyond the undergraduate level) and PLO-2 (works effectively in a laboratory environment to test hypotheses or solve problems using instrumentation). At the Master's level, the ability to critically assess information from the chemical literature was measured through the Seminar course CHEM 6820. Knowledge of chemical information and the ability to generate and critically analyze experimental results was conducted through capstone laboratory exercises in CHEM 6430 (Protein Chemistry Techniques) and CHEM 4240 (Methods of Instrumental Analysis).

CHEM 6820 was used to assess PLO-3. This year's data demonstrates that, on average, students improved from their first seminar to their last seminar in their ability to understand, organize and present a journal article. By their third seminar, more than 75% of the students gave a presentation that exceeded expectations, whereas only 43% exceeded expectations for their first seminar. Assessment of PLO-3 in the Protein Chemistry Techniques course (CHEM 6430) did not provide such encouraging results. Performance on embedded exam questions requiring critical analysis of experimental data was assessed for course student learning outcomes 1, 2 and 6. The student sample was unusually small this year, only three M.S. Chemistry majors. None of the three mastered SLO-2 and two of the three mastered SLOs 1 and 6. Of eleven students who took the class, only 45% mastered SLO-2. A special exercise on analysis of protein purification data that includes calculation of specific activity will be assigned next year as a group activity. All of the M.S. Chemistry majors mastered the chemical knowledge SLOs (#s 3,4,5), which assessed PLO-1, and analysis of the student notebooks indicated that all three students were able to effectively use instrumentation and biochemical methods to solve experimental problems and test hypotheses (PLO #2) for at least two of the three SLOs monitored.

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

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

Seminar Presentation Ratings for 2015-2016

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

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

Seminar	# of Students	Met Expectations*		Exceeded Expectations	
		#	%	#	%
First	7	7	100	3	43
Second	11	11	100	11	100
Third	12	12	100	9	75

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

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

Assessment Tool 1: Embedded Exam Questions
Assessment Results for M.S. Chemistry Majors*: Winter 2016

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

*3 students **Credit was given if 75% of the possible points were earned.

Assessment Tool 2: Quality of laboratory notebooks.
Notebook Assessment Results for M.S. Chemistry Majors*: Winter 2016

Laboratory Notebook Learning Goal	% Students Meeting Expectations**
1 - Effective use of instrumentation (HPLC) to solve experimental problem	67
2 - Effective use of biochemical method (affinity chromatography) to solve experimental problem	100
3 - Effective use of biochemical method	

(IEF/SDS-PAGE) to test a hypothesis	100

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

CHEM 4240 Instrumental Methods of Analysis: Assessment of demonstrated specialized knowledge (PLO-1), effective use of modern instrumentation (PLO-2), and ability to critically analyze experimental results (PLO-3).
Assessment Tool: Embedded Questions in the lab reports and the final exam

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

*Where partial credit was given, the answer was counted as correct if at least 75% of the total possible points were awarded.
**Only two master's degree students took this course in 2016 winter quarter. More data points were needed for more meaningful assessment.

Assessment Data 2014-2015

Undergraduate Program

The detailed department assessment results for this reporting period are given below. We evaluated undergraduate student performance for PLO-2, this year's focus, in CHEM 3303, CHEM 4430, and CHEM 4240. Assessment results for PLO-1 are also reported in the areas of organic (CHEM 3301-02-03), physical (CHEM 3511-12-13), inorganic (CHEM 4162) and biochemistry (CHEM 4411, 4412 and CHEM 4430).

The assessment data for CHEM 3303 gives the student results for the last 5 years. Performance has been fairly consistent and 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 both in terms of using the methods and instruments, and also in 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 Lab) was taught both in Fall 2014 and Winter 2015. For both, 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.

SLO-1 assessment data collected in CHEM 3303 is summarized below. The chemistry and biochemistry majors 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. Despite the low average, 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 more work to be done.

CHEM 3303 Organic Chemistry: Capstone Lab Exercise SLO 2.
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

CHEM 3303 Organic Chemistry: Standardized National Exam. SLO-1
Results of Capstone Organic Lecture Assessment for 2010 – 2015

Year	**Percentile**
2010	34
2011	41
2012	28
2013	29

2014	33
2015	34

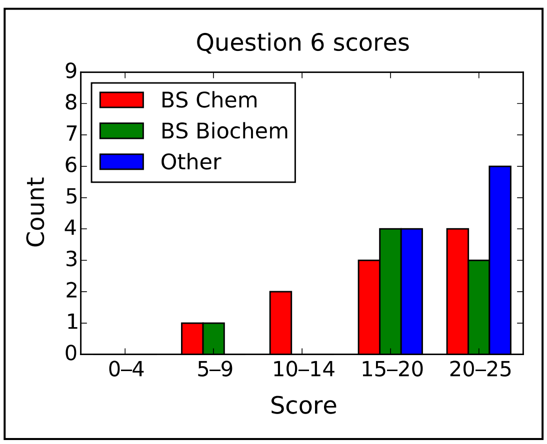
CHEM 3511 Physical Chemistry: Embedded Exam Questions. SLO-1

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

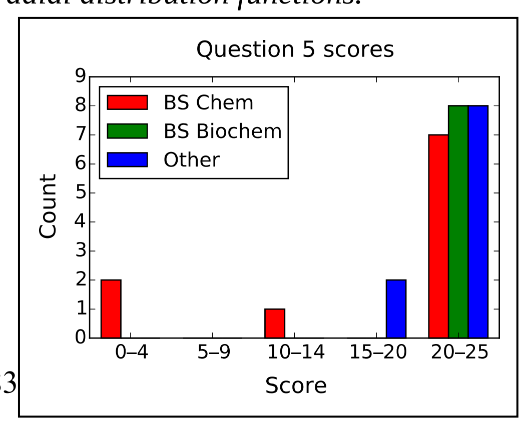
*P=problem (> 50% of points scored as correct); MC=multiple choice; TF=True/False.
**18 students ***14 students

CHEM 3512 Physical Chemistry: Embedded Exam Questions. SLO-1
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 (10).

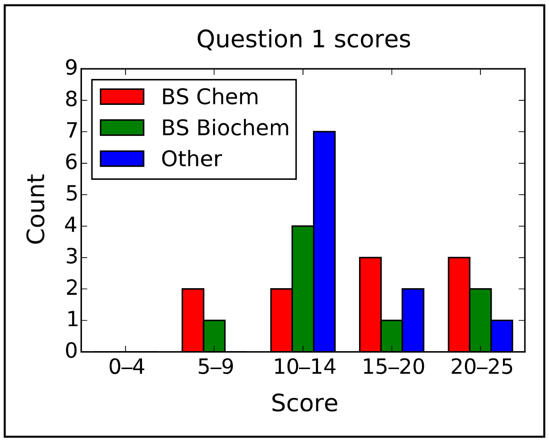
***Learning outcome**: Formulate the mathematical description for the quantum mechanical motion of a particle: translations, vibrations, and rotations.*



***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.*



CHEM 4411 General Biochemistry: Embedded Exam Questions (PLO-1)
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

CHEM 4411 General Biochemistry: Embedded Exam Questions (PLO-1) Table
Assessment Results for Biochemistry Majors: Winter 2014 and Winter 2015

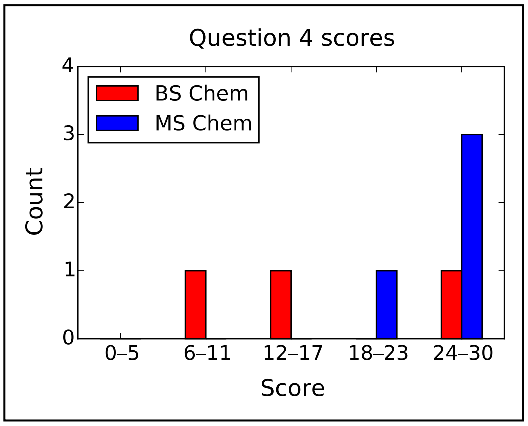
Biochemistry Learning Outcome*	Average % of students with correct answers-Winter 2014**	Average % of students with correct answers-Winter 2015***
6 - Bioenergetics	69	79
7 - ATP Chemistry	73	54
8 - Carbohydrates	69	64
9 - Metabolic Pathways	-	45

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

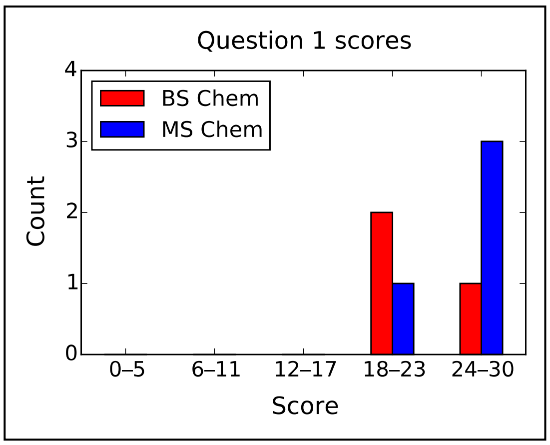
CHEM 4162 Advanced Inorganic Chemistry: Embedded Exam Questions. PLO-1

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.*



CHEM 4430 Biochemistry Lab: Laboratory notebook quality, experimental results and embedded exam questions used to assess performance (PLO-2)

Assessment Results for Biochemistry Majors - Fall 2014

Learning Goal	Assessment Tool	% of students with correct 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

Assessment Results for Biochemistry Majors - Winter 2015

Learning Goal	Assessment Tool	% of students with correct 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
4 - Enzyme kinetics data and graphs	Multiple Choice 5-10	22

*2 student responses were scored

CHEM 4240 Instrumental Methods of Analysis: Embedded Exam Questions (PLO-2)
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:

During 2014-2015 we assessed student performance in our M.S. Chemistry program for PLOs 2, 4 and 1. PLO-2 was assessed for graduate students in CHEM 4240 using embedded exam questions and in CHEM 6430 by analyzing experimental results presented in student notebooks. As can be seen below, the results for 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). 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.

Analysis of the laboratory notebooks to assess PLO-2 in CHEM 6430 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. PLO-1 was also assessed in CHEM 6430, using embedded exam questions. 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.

PLO-4, the ability to convey complex chemical information via an oral presentation, was also assessed for the graduate program. 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. 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.

CHEM 4240 Instrumental Methods of Analysis: Embedded Exam Questions PLO-2 Assessment Results for M.S. Chemistry Majors (8 students): Winter 2015

Learning Outcome	Assessment Tool	Average % of students with correct answers
1 - Light and Matter	Midterm Q4, FinalQ4	63
2 - Beer's Law	Final Q1- (a) to (e)	75
3 - Spectroscopy	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

CHEM 6430 Protein Chemistry Techniques: Embedded Exam Questions PLO-1 Assessment Results for M.S. Chemistry Majors 96 students): Winter 2015

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

CHEM 6430 Protein Chemistry Techniques: Laboratory Notebook Assessment PLO-2 Notebook Assessment Results for M.S. Chemistry Majors (6 students): 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

CHEM 6820 Graduate Seminar: Assessment of ability to convey complex chemical information via an oral presentation PLO-4

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%

Assessment Data 2013-2014

Undergraduate Program

Assessment of PLO-1 and PLO-2 focused on specific learning outcomes in the areas of organic chemistry (CHEM 3303), physical chemistry (CHEM 3511-12), and biochemistry (CHEM 4411-12, CHEM 4430). The methods included use of standardized national exams, capstone laboratory exercises, and embedded exam questions. Some of the results indicate that students are doing well and achieving the specific course outcomes whereas other results are difficult to interpret.

The results in CHEM 3303 for PLO-2 indicate that most students (84-92%) are able to perform a capstone laboratory exercise on their own and identify at least one unknown chemical using techniques and instruments covered during the year-long series. On the other hand the data for the standardized organic exam, which measures theoretical organic knowledge (PLO-1) was disappointing for the second year in a row. The percentiles achieved by the student majors have decreased from a high of 47 in 2007 to 33 in 2013. Our goal for the students is to reach or exceed the national average (50). Since organic chemistry has been taught by the same faculty members using similar methods for the last six years one is tempted to blame random variation for the changes in scores.

The physical chemistry lecture series assessment measured PLO-1 by monitoring specific course outcomes through embedded exam questions for CHEM 3511dand CHEM 3512. With the exception of a few questions where the results were very low, the data indicate that a majority of the students achieved the outcomes. However since our goal is for at least 75% of the students to master each outcome and this goal was reached for only a few questions, there is work to be done. The instructors plan to work collaboratively to develop strategies to improve the learning outcomes.

The biochemistry results for PLO-1 (CHEM 4411, 4412) were measured with embedded exam questions covering a series of course outcomes. The averages for the percentage of correct responses ranged from 40% to 82%, with most of the values above 55%. Again, however, we are aiming for 75% of the students achieving each outcome. Analysis via embedded questions is useful in providing information about specific areas of student weakness. Accordingly, during the upcoming year we will place special emphasis on the topics with the lower student scores. The biochemistry results (CHEM 4430) for PLO-2 indicate that by their senior year most students (73% to 100%) are able to correctly interpret experimental data and write a proper analysis in their lab notebook.

CHEM 3303 Organic Chemistry: Capstone Lab Exercise PLO 2.
Results of Capstone Organic Laboratory Assignment for 2010– 2013

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	24	11	46	22	92

CHEM 3303 Organic Chemistry: Standardized National Exam. PLO-1
Results of Capstone Organic Lecture Assessment for 2010 – 2013

Year	**Percentile**
2010	34
2011	41
2012	28
2013	33

CHEM 3511 Physical Chemistry: Embedded Exam Questions. PLO-1
Results of Physical Chemistry Lecture Assessment for 2013

Question#*	% Correct, Chemistry Majors*	% Correct, Biochemistry Majors**
2	45	71
6	45	65
8	36	65
9	18	12
10	9	47
16	82	53
19	55	47
20	55	53

*SLOs tested with eight questions. **11 students ***17 students

CHEM 3512 Physical Chemistry: Embedded Exam Questions. PLO-1
Results of Physical Chemistry Lecture Assessment for 2014

Question #*	% Correct, Chemistry Majors**	% Correct, Biochemistry Majors***
2	75	76
3	63	53
6ab	50	59
6cd	38	47

*SLOs tested with three multi-part questions. **8 students. ***17 students

CHEM 4411 Biochemistry: Embedded Exam Questions. PLO-1 for
Results of Biochemistry I Lecture Assessment for 2013

Learning Outcome	% Correct, Chem Majors**	% Correct, Biochem Majors***
2 Amino Acid Structure	55	61
4 Protein Structural Motifs	61	70
4 Protein Regulation	57	82
5 Properties Enzymes	42	56

5 Enzyme Kinetics	58	58

*Specific Course Outcomes tested with 13 questions. **13 students ***21 students

CHEM 4412 Biochemistry: Embedded Exam Questions. PLO-1
Results of Biochemistry II Lecture Assessment for 2014

Learning Outcome	% Correct, Chemistry Majors**	% Correct, Biochemistry Majors***
6	40	69
7	80	73
8	80	69

*Specific Course Outcomes tested with three questions. **5 students. ***26 students

CHEM 4430 Biochemistry Lab: Analysis of experimental results and laboratory notebooks. PLO-2.
Results of Biochemistry Lab Assessment for 2013

Tool	% Correct, Chem Majors*	# Correct, Biochem Majors**
Lab Notebook Analysis 1	83	91
Lab Notebook Analysis 2	83	82
Lab Notebook Analysis 3	83	82
Gel Photograph	100	100
Final Lab Notebook Score	100	73

*6 students; **11 students

Graduate Program

The results for PLO-4 for the graduate program clearly show an improvement in student ability to present complex chemical information in a seminar format as they proceed from their first presentation to the third seminar. Whereas the average student rating was 74.7% for students giving the first presentation, it rose to 80.3% for the second and to 85.9% for the third. We feel this shows student success in learning to analyze and present chemical information through our graduate seminar course (CHEM 6820), which the students are required to take three times.

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

Results of Seminar Presentation Ratings for 2013-2014

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%

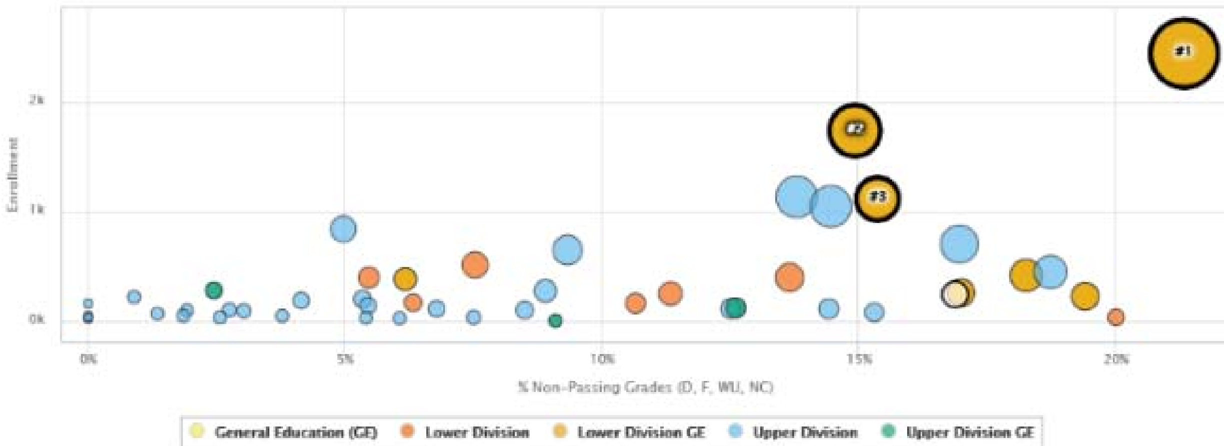
Appendix C

Student Success

Data in Appendix C was obtained from the Academic Performance Review Statistics available from Institutional Research and Assessment (http://www.csueastbay.edu/ira/).

Bottle Neck Courses

% of non-passing grades vs enrollment data for Chemistry and Biochemistry courses averaged over the last six years



#1 = CHEM 1101, #2 = CHEM 1102, #3 = CHEM 1103

Courses with Smallest Achievement Gap (averaged over last six years)
(GPA Gap = average nonURM course GPA - average URM course GPA)

Course	Title	GPA Gap	Typical Student Population
4430	Biochem Lab	-0.01	Biochem majors
4431	Adv. Biochem Lab	0.06	Biochem majors
4412	General Biochemistry	0.06	Biochem majors, some Biology majors
4413	General Biochemistry	0.06	Biochem majors
3511	Physical Chemistry	0.09	Chem and Biochem majors

Large Courses with Highest Achievement Gap (averaged over last six years)
(GPA Gap = average nonURM course GPA - average URM course GPA)

Course	Title	GPA Gap	Typical Student Population
1610/15	Basic Chemistry	0.45	Pre-nursing majors
1000	Popular Topics	0.45	General Elective
1101	General Chemistry	0.45	Chem/Biochem majors, other science majors
1100	Intro to College Chem	0.38	Liberal studies majors, general elective

Graduation Rates for First Time Freshman

	Cohort 2007		Cohort 2008		Cohort 2009		Cohort 2010	
	Biochem	Chem	Biochem	Chem	Biochem	Chem	Biochem	Chem
4 year graduation rate	27 %	17 %	42 %	12 %	27 %	6 %	14 %	14 %
6 year graduation rate	53 %	50 %	58 %	35 %	55 %	33 %	62 %	50 %
% of grads who stayed in the major	38 %	17 %	57 %	0 %	67 %	17 %	15 %	14 %

Graduation Rates for Transfer Students

	Cohort 2009		Cohort 2010		Cohort 2011		Cohort 2012	
	Biochem	Chem	Biochem	Chem	Biochem	Chem	Biochem	Chem
2 year graduation rate	50 %	0 %	43 %	14 %	30 %	33 %	17 %	25 %
4 year graduation rate	50 %	40 %	71 %	71 %	70 %	67 %	50 %	88 %
% of grads who stayed in the major	50 %	50 %	80 %	80 %	71 %	33 %	50 %	43 %

Graduation Rates for Graduate Students

	Cohort 2006	Cohort 2007	Cohort 2008	Cohort 2009	Cohort 2010
2 year graduation rate	20 %	0 %	0 %	0 %	0 %
4 year graduation rate	60 %	57.1 %	50 %	100 %	12.5 %

Appendix D

B.S. Program in Chemistry

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] MATH 2304 Calculus III (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] PHYS 1001 Gen Physics I (5) CHEM 2200 Quant Analysis (5)[2] GE	CHEM 3302 Org Chem II (5) PHYS 1002 Gen Physics II (5) CS 1020 Intro Computers (4), *or* CS 1080 Intro Media Comput (4), *or* CS 1160 Intro CS (4) GE	CHEM 3303 Org Chem III (5)[2] PHYS 1003 Gen Physics III (5) MATH 2101 Linear Algebra (4) GE
Third Year	CHEM 3511 Phys Chem I (3) ME GE	CHEM 3512 Phys Chem II (3) CHEM 3531 Phys Chem Lab I (2) CHEM 4240 Instrum Analysis (4) GE	CHEM 3513 Phys Chem III (3) CHEM 3532 Phys Chem Lab II (2) ME GE
Fourth Year	CHEM 4161 Inorg Chem I (3) CHEM 4411 Gen Biochem I (4) *or* CHEM 3400 Intro Biochem (4) ME GE	CHEM 4162 Inorg Chem II (3) ME GE	CHEM 4180 Inorg Chem Lab (2) ME GE

Lower Division: 55 units; Upper Division: 53-54 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
GE: General Elective
ME: Major Elective

Major Electives (9-10 units): a) One course from CHEM 4311 (4), CHEM 4430 (4), or CHEM 4521 (4). b) Additional courses from above list or from CHEM 4412 (4), CHEM 4413 (4), CHEM 4601 (4), CHEM 4602 (4), CHEM 4700 (2), CHEM 4810 (2), CHEM 4811 (2), CHEM 4900 (1-4). No more than four units total of CHEM 4810 + CHEM 4811 + CHEM 4900 may be applied towards the degree.

B.S. Program in Chemistry, Option Forensics

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] MATH 2304 Calculus III (4) GE
Second Year	BIOL 1401 Molec Cell Biol (5) PHYS 2701 Intro Physics I (4) CHEM 2200 Quant Analysis (5)[2] GE	BIOL 1402 Plant Biol (5) PHYS 2702 Intro Physics II (4) CRJA 2200 Basic Crim Invest (4) GE	BIOL 1403 Animal Biol (5) PHYS 2703 Intro Physics III (4) GE
Third Year	CHEM 3301 Org Chem I (5)[1] BIOL 3121 Princ Genetics (5) GE	CHEM 3302 Org Chem II (5) GE	CHEM 3303 Org Chem III (5)[2] CRJA 3800 Comp Evid Eval (4) GE
Fourth Year	CHEM 3511 Phys Chem I (3) BIOL 4485 PCR, DNA Sequencing & Fragment Analysis (4) BIOL 4830 Sem Forensic (1) GE	CHEM 3512 Phys Chem II (3) CRJA 4830 Sem Forensic (1) CHEM 4240 Instrum Analysis (4) GE	CHEM 3200 Bioanalyt Forensic Instrumentation (4) CHEM 3400 Intro Biochem (4) CHEM 4830 Sem Forensic (1) GE

Lower Division: 63 units; Upper Division: 49 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
GE: General Elective

B.S. Program in Biochemistry

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] MATH 2304 Calculus III (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] BIOL 1401 Molec Cell Biol (5) CHEM 2200 Quant Analysis (5)[2] GE	CHEM 3302 Org Chem II (5) BIOL 1402 Plant Biol (5) GE	CHEM 3303 Org Chem III (5)[2] BIOL 1403 Animal Biol (5) GE
Third Year	PHYS 1001 Gen Physics I (5), *or* PHYS 2701 Intro Physics I (4) CHEM 4411 Gen Biochem I (4) GE	PHYS 1002 Gen Physics II (5), *or* PHYS 2702 Intro Physics III (4) CHEM 4412 Gen Biochem II (4) CHEM 4430 Biochem Lab I (4) GE	PHYS 1003 Gen Physics II (5), *or* PHYS 2703 Intro Physics III (4) CHEM 4413 Gen Biochem III (4) CHEM 4431 Adv Biochem Lab (2) GE
Fourth Year	CHEM 3511 Phys Chem I (3) STAT 3031 Stat Method Biol (4) *or* STAT 3502 Stat Inference I (4) ME GE	CHEM 3512 Phys Chem II (3) ME GE	CHEM 3513 Phys Chem III (3) ME GE

Lower Division: 59-62 units; Upper Division: 52-55 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
GE: General Elective
ME: Major Elective

Major Electives (2 courses, 6-9 units): CHEM 4240 (4), CHEM 4440 (3), CHEM 4450 (3), CHEM 4460 (3), BIOL 3121 (5), BIOL 4455 (4).

B.A. Program in Chemistry

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] CS 1020 Intro Computers (4), *or* CS 1080 Intro Media Comput (4), *or* CS 1160 Intro CS (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] PHYS 2701 Intro Physics I (4) CHEM 2200 Quant Analysis (5)[2] GE	CHEM 3302 Org Chem II (5) PHYS 2702 Intro Physics II (4) GE	CHEM 3303 Org Chem III (5)[2] PHYS 2703 Intro Physics III (4) GE
Third Year	CHEM 3400 Intro Biochem (4) CHEM 3501 Biophys Chem (4), *or* CHEM 3511 Physical Chem (3) ME GE	ME GE	CHEM 3200 Bioanalyt Forensic Instrumentation (4) ME GE
Fourth Year	ME GE	ME GE	CHEM 4700 Survey Chem Lit (2) ME GE

Lower Division: 44 units; Upper Division: 39-40 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
GE: General Elective
ME: Major Elective

Major Electives (3-4 courses, 11 units): CHEM 4161 (3), CHEM 4162 (3), CHEM 4180 (2), CHEM 4240 (4), CHEM 4311 (4), CHEM 4601 (4), CHEM 4602 (4), CHEM 4810 (2), CHEM 4900 (1-4). No more than two units total of CHEM 4810 + CHEM 4900 may be applied towards the degree.

B.A. Program in Chemistry, Option Chem Ed

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] CS 1020 Intro Computers (4), *or* CS 1080 Intro Media Comput (4), *or* CS 1160 Intro CS (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] CHEM 2200 Quant Analysis (5)[2] GE	CHEM 3302 Org Chem II (5) BIOL 1000 Basic Concepts (5) GE	CHEM 3303 Org Chem III (5)[2] GE
Third Year	CHEM 3400 Intro Biochem (4) PHYS 2701 Intro Physics I (4) GEOL 1000 Earth Systems (5) GE	PHYS 2702 Intro Physics II (4) GE	PHYS 2703 Intro Physics III (4) CHEM 4700 Survey Chem Lit (2) GE
Fourth Year	CHEM 3501 Biophys Chem (4) PHIL 3335 Science Tech (4)[3] TED 3001 Exploring Educ (3) GE	CHEM 4601 Envir Chem I (4) CHEM 4400 Instruct Activities (2) GE	CHEM 4602 Envir Chem II (4) CHEM 3200 Bioanalyt Forensic Instrumentation (4) GE

Lower Division: 54 units; Upper Division: 46 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
[3]If PHIL 3335 is not offered, PHIL 3151, 3152, 3153, or 3332 can be substituted.

GE: General Elective

B.A. Program in Biochem

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] CS 1020 Intro Computers (4), *or* CS 1080 Intro Media Comput (4), *or* CS 1160 Intro CS (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] BIOL 1401 Molec Cell Biol (5) GE	CHEM 3302 Org Chem II (5) BIOL 1402 Plant Biol (5) GE	CHEM 3303 Org Chem III (5)[2] BIOL 1403 Animal Biol (5) GE
Third Year	PHYS 2701 Intro Physics I (4) CHEM 4411 Gen Biochem I (4) GE	PHYS 2702 Intro Physics III (4) CHEM 4412 Gen Biochem II (4) GE	PHYS 2703 Intro Physics III (4) CHEM 4413 Gen Biochem III (4) GE
Fourth Year	CHEM 3501 Biophys Chem I (4) *or* CHEM 3511 Physical Chem (3) ME GE	CHEM 4430 Biochem Lab I (4) ME GE	CHEM 4431 Adv Biochem Lab (2) ME GE

Lower Division: 54 units; Upper Division: 39-43 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
GE: General Elective
ME: Major Elective

Major Electives (1-2 courses, 3-6 units): CHEM 3200 (4), CHEM 4440 (3), CHEM 4450 (3), CHEM 4460 (3), CHEM 4700 (2), BIOL 3121 (5), BIOL 3151 (5), BIOL 3405 (6), CHEM 4810 (2), CHEM 4900 (1-4). No more than two units total of CHEM 4810 + CHEM 4900 may be applied towards the degree.

B.A. Program in Biochem, Option Chem Ed

	FALL	WINTER	SPRING
First Year	CHEM 1101 Gen Chem I (5)[1] MATH 1304 Calculus I (4) GE	CHEM 1102 Gen Chem II (5) MATH 1305 Calculus II (4) GE	CHEM 1103 Gen Chem III (5)[2] CS 1020 Intro Computers (4), *or* CS 1080 Intro Media Comput (4), *or* CS 1160 Intro CS (4) GE
Second Year	CHEM 3301 Org Chem I (5)[1] BIOL 1401 Molec Cell Biol (5) GE	CHEM 3302 Org Chem II (5) BIOL 1402 Plant Biol (5) GE	CHEM 3303 Org Chem III (5)[2] BIOL 1403 Animal Biol (5) GE
Third Year	PHYS 2701 Intro Physics I (4) CHEM 4411 Gen Biochem I (4) GEOL 1000 Earth Systems (5) GE	PHYS 2702 Intro Physics II (4) CHEM 4412 Gen Biochem II (4) CHEM 4601 Envir Chem I (4) GE	PHYS 2703 Intro Physics III (4) CHEM 4413 Gen Biochem III (4) GE
Fourth Year	CHEM 3501 Biophys Chem I (4) PHIL 3335 Science Tech (4)[3] TED 3001 Exploring Educ (3) GE	CHEM 4430 Biochem Lab I (4) CHEM 4400 Instruct Activities (2) GE	CHEM 4431 Adv Biochem Lab (2) CHEM 4700 Survey Chem Lit (2) GE

Lower Division: 59 units; Upper Division: 52 units.

[1]Sequence may be taken W, Sp, Su.
[2]Offered during summer quarter.
[3]If PHIL 3335 is not offered, PHIL 3151, 3152, 3153, or 3332 can be substituted.

GE: General Elective

Appendix E

B.S. Chemistry Degree Program Requirements

Courses	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Sacramento semester (quarter)	CSU Los Angeles semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
General Chem	15	10	10 (15)	10 (15)	10 (15)	15
Math	16	11	12 (18)	14 (21)	10 (15)	20
Physics	15	12	12 (18)	10 (15)	12 (18)	16
Organic Chem	15	10	12 (18)	10 (15)	11 (16.5)	21
Quantitative Analysis	5	4	4 (6)	4 (6)	4 (6)	3
Physical Chem	9	6	6 (9)	8 (12)	6 (9)	12
Physical Chem Lab	4	2	3 (4.5)	2 (3)	2 (3)	3
Inorganic Chem	6	4	3 (4.5)	4 (6)	3 (4.5)	6
Inorganic Chem Lab	2	2	2 (3)	2 (3)	2 (3)	3
Biochem	4	3	3 (4.5)	3 (4.5)	4 (6)	3
Instrumental Analysis	4	3	4 (6)	4 (6)	4 (6)	3
Computer	4	-	-	-	3 (4.5)	-
Writing for Chem	-	-	-	3 (4.5)	3 (4.5)	-
Science Ethics	-	-	-	-	3 (4.5)	-
Safety	-	-	-	-	1 (1.5)	-
Capstone Lab	-	-	-	3 (4.5)	3 (4.5)	-
Electives	9	3	6 (9)	4 (6)	6 (9)	12

Note: CSU Sacramento, CSU Los Angeles, and San Jose State are on the semester system. The equivalent quarter units are shown in parentheses.

B.A. Chemistry Degree Program Requirements

Courses	CSU East Bay quarter	CSU East Bay semester (Fall2018)	CSU Sacramento semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
General Chem	15	10	10 (15)	10 (15)	15
Math	8	7	12 (18)	3 (4.5)	16
Physics	12	8	8 (12)	8 (12)	12
Organic Chem	15	10	9 (13.5)	11 (16.5)	18
Quantitative Analysis	5	4	4 (6)	4 (6)	3
Physical Chem	4	3	3 (4.5)	4 (6)	12
Physical Chem Lab	-		3 (4.5)	-	3
Inorganic Chem	-	-	-	-	3
Biochem	4	3	-	-	-
Bioanalytical Lab	4	3	-	-	-
Instrumental Analysis	-	-	-	-	3
Computer	4	-	-	-	-
Writing for Chem	-	-	-	3 (4.5)	-
Science Ethics	-	-	-	3 (4.5)	-
Chem Literature	2	1	-	-	-
Safety	-	-	-	1 (1.5)	-
Electives	11	6	12 (18)	19 (28.5)	3

Note: CSU Sacramento and San Jose State are on the semester system. The equivalent quarter units are shown in parentheses.

B.S. Biochemistry Degree Program Requirements

Courses	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Sacramento semester (quarter)	CSU Los Angeles Semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
General Chem	15	10	10 (15)	10 (15)	10 (15)	15
Math	12	11	8 (12)	8 (12)	10 (15)	16
Physics	12	10	8 (12)	10 (15)	12 (18)	12
Organic Chem	15	10	12 (18)	10 (15)	11 (16.5)	18
Quantitative Analysis	5	4	4 (6)	4 (6)	4 (6)	-
Biology	15	10	12 (21)	10 (15)	8 (12)	11
Physical Chem	9	6	4 (6)	3 (4.5)	4 (6)	12
Physical Chem Lab	-	-	3 (4.5)	-	-	-
Inorganic Chem	-	-	-	4 (6)	-	3
Biochem	12	8	6 (9)	8 (12)	11 (16.5)	9
Biochem Lab	6	5	6 (9)	4 (6)	5 (7.5)	11
Statistics	4	-	-	-	-	-
Writing for Chem	-	-	-	3 (4.5)	3 (4.5)	-
Science Ethics	-	-	-	-	3 (4.5)	-
Safety	-	-	-	-	1 (1.5)	-
Capstone Lab	-	-	-	3 (4.5)	-	-
Electives	6	3	6 (9)	7 (10.5)	3 (4.5)	11

Notes: CSU Sacramento, CSU Los Angeles, and San Jose State are on the semester system. The equivalent quarter units are shown in parentheses.

B.A. Biochemistry Degree Program Requirements

Courses	CSU East Bay quarter	CSU East Bay semester	CSU Sacramento semester (quarter)
General Chem	15	15	10 (15)
Math	8	8	8 (12)
Physics	12	12	8 (12)
Organic	15	15	9 (13.5)
Quantitative Analysis	-	-	4 (6)
Biology	15	15	10 (15)
Physical Chem	4	4	4 (6)
Biochem	12	12	6 (9)
Biochem Lab	6	6	6 (9)
Computer	4	4	-
Electives	3	3	6 (9)

Notes: CSU Sacramento is on the semester system. The equivalent quarter units are shown in parentheses.

The degree at CSU Sacramento is a B.A. in chemistry with a concentration in Biochemistry. CSU Los Angeles, San Jose State, and University of California, Santa Barbara do not have a B.A. Biochemistry program or B.A. Chemistry with a biochemistry option or concentration.

B.S. Chemistry Degree with an Option in Forensic Science Program Requirements

Courses	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Sacramento semester (quarter)
General Chem	15	10	10 (15)
Math	12	11	8 (12)
Physics	12	10	8 (12)
Organic	15	10	12 (18)
Quantitative Analysis	5	4	4 (6)
Biology	15	10	-
Physical Chem	6	6	4 (6)
Biochem	4	3	3 (4.5)
Biochem Lab	-	-	3 (4.5)
Bioanalytical Lab	4	3	-
Instrumental Analysis	4	3	-
Genetics	5	4	-
Criminal Invest.	4	-	3 (4.5)
Comparative Evidence	4	-	3 (4.5)
DNA Sequencing Anal.	4	3	-
Forensic Seminar	3	-	-
Electives	3	-	6 (9)

Notes: CSU Sacramento is are on the semester system. The equivalent quarter units are shown in parentheses.

This degree at CSU Sacramento is a B.A. in chemistry with a concentration in Forensic Science.

This degree will become a B.S degree in Chemistry with a concentration in Bioanalytical and Forensic Chemistry starting in the Fall of 2018.

M.S. Chemistry Degree Program Requirements (thesis track)

	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Sacramento semester (quarter)	CSU Los Angeles semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
Core Course Units	7	15	11 (16.5)	14 (21)	15 (22.5)	-
Elective Course Units	26	9	9 (13.5)	6 (9)	9 (13.5)	24
Completion Units (Thesis, research, exam, etc.)	12	6	10 (15)	10 (15)	6 (9)	12
Total	45	30 (45)	30 (45)	30 (45)	30 (45)	36

M.S. Chemistry Degree Program Requirements (non-thesis track)

	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Los Angeles semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
Core Course Units	11	15	14 (21)	18 (27)	-
Elective Course Units	29	9	9 (13.5)	7 (10.5)	24
Completion Units (Thesis, research, exam, etc.)	5	6	7 (10.5)	5 (7.5)	12
Total	45	30	30 (45)	30 (45)	36

Note: CSU Sacramento, CSU Los Angeles, and San Jose State are on the semester system. The equivalent quarter units are shown in parentheses.

Minor in Chemistry Requirements

Course Units	CSU East Bay quarter	CSU East Bay semester (Fall 2018)	CSU Sacramento semester (quarter)	San Jose State semester (quarter)	UC Santa Barbara quarter
General Chem	15	10	10 (15)	10 (15)	15
Organic	15	10	-	-	-
Quantitative Analysis	5	4	4 (6)	-	-
Physical Chem	-	-	-	-	4
Instrumental Analysis	-	-	-	-	3
Safety	-	-	-	1 (1.5)	-
Upper Div. Electives	4	3	10 (15)	12 (15)	16

Note: CSU Sacramento and San Jose State are on the semester system. The equivalent quarter units are shown in parentheses.

Appendix F

List of Course Offerings at CSUEB (Quarter)

Courses for Majors

1101, 1102, 1103 General Chemistry
2200 Quantitative Analysis
3200 Bioanalytical and Forensic Instrumentation
3301, 3302, 3303 Organic Chemistry
3400 Introductory Biochemistry
3501 Biophysical Chemistry
3511, 3512, 3513 Physical Chemistry
3531, 3532 Physical Chemistry Laboratory
4161, 4162 Inorganic Chemistry
4180 Inorganic Chemistry Laboratory
4240 Instrumental Methods of Analysis
4311 Advanced Organic Chemistry
4400 Instructional Activities in Chemistry
4411, 4412, 4413 General Biochemistry
4430, 4431 Biochemistry Laboratory
4440 Protein Structure
4450 Nucleic Acid Chemistry
4460 Major Organ Biochemistry
4521 Elements of Chemical Thermodynamics
4601, 4602 Environmental Chemistry
4700 Survey of the Chemical Literature
4830 Seminar in Forensic Research
4810 Undergraduate Research
4811 Senior Thesis

Graduate Courses

6310 Advanced Topics in Organic Chemistry
6410 Advanced Topics in Biochemistry
6510 Advanced Topics in Physical Chemistry
6430 Protein Chemistry Techniques
6521 The Chemical Bond
6820 Seminar

Courses for Non-Majors

1000 Popular Topics in Chemistry
1100 Introduction to College Chemistry
1601, 1602 Basic Chemistry for the Health Sciences
2301, 2302 Survey of Organic Chemistry
3010 The Making of Wine
3011 Foundational Chemistry
3012 Foundational Chemistry Laboratory

List of Course Offerings at CSUEB (Semesters as of Fall 2018)

Courses for Majors

111, 112 General Chemistry
220 Quantitative Analysis
320 Bioanalytical and Forensic Instrumentation
331, 332 Organic Chemistry
340 Survey of Biochemistry
350 Biophysical Chemistry
351, 352 Physical Chemistry
355 Physical Chemistry Laboratory
410 Inorganic Chemistry
415 Inorganic Chemistry Laboratory
420 Instrumental Analysis
431 Advanced Organic Chemistry
441, 442 Biochemistry
443, 444 Biochemistry Laboratory
445 Protein Structure
446 Nucleic Acid Chemistry
447 Major Organ Biochemistry
451 Classical and Statistical Thermodynamics
460 Environmental Chemistry
470 Survey of the Chemical Literature
481 Undergraduate Research
481 Senior Thesis

Graduate Courses

631 Graduate Organic Chemistry
641 Graduate Biochemistry
651 Graduate Physical Chemistry
645 Protein Chemistry Techniques
621 Molecular Spectroscopy
652 Computational Chemistry
691 Issues in Chemistry
682 Seminar

Courses for Non-Majors

100 Introduction to College Chemistry
106 Chemistry and Society
110 General Chemistry for Engineers
160 Basic Chemistry for the Health Sciences
230 Survey of Organic Chemistry
233 Fundamentals of Organic Chemistry
301 Foundational Chemistry
302 Foundational Chemistry Laboratory
305 The Making of Wine
306 Green Chemistry and Sustainability

Appendix G

Student Level and Demographics

Data in Appendix F was obtained from the Academic Performance Review Statistics available from Institutional Research and Assessment (http://www.csueastbay.edu/ira/).

Number of Undergraduate and Graduate Majors Enrolled

Degree	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Biochemistry Bachelor	134	129	132	127	126
Chemistry Bachelor	100	94	90	96	92
Total Undergraduate	**234**	**223**	**222**	**223**	**218**
Chemistry Graduate	68	58	53	41	32
Total Enrolled	**302**	**281**	**275**	**264**	**250**

Number of degrees Awarded for the Past Five Years

Degree	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Biochemistry Undergraduate	30	29	19	16	33
Chemistry Undergraduate	11	17	14	15	12
Total Undergraduate	**41**	**46**	**33**	**31**	**45**
Chemistry Graduate	13	16	13	18	8
Total Degrees	**54**	**62**	**46**	**49**	**53**

Number of Chemistry Minors Enrolled for the Past Five Years

Degree	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Chemistry Minor	102	90	124	166	162

Number of Undergraduate Degrees by Degree Option

Degree	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Biochem BA	2	8	1	5	7
Biochem BS	28	21	18	11	26
Total Biochemistry	**30**	**29**	**19**	**16**	**33**
Chem BA	2	2	5	1	1
Chem BA Chem Ed	1	0	1	0	0
Chem BS	5	11	3	8	3
Chem BS Forensics	3	4	5	6	8
Total Chemistry	**11**	**17**	**14**	**15**	**12**

Number of Graduate Degrees by Degree Option

Degree	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
MS Chem	7	5	1	7	2
MS Chem Biochem Option	6	11	12	11	6
Total MS Chemistry	**13**	**16**	**13**	**18**	**8**

Percent of Full-Time vs Part-Time Undergraduate Biochemistry Majors

Status	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Full-time	89 %	90 %	91 %	89 %	90 %
Part-time	11 %	10 %	9 %	11 %	10 %

Percent of Full-Time vs Part-Time Undergraduate Chemistry Majors

Status	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Full-time	93 %	83 %	89 %	86%	92 %
Part-time	7 %	17 %	11 %	14 %	8 %

Chemistry and Biochemistry Graduates who started as Native (N) vs Transfer (T) students

	2012-2013		2013-2014		2014-2015		2015-2016		2016-2017	
Degree	**N**	**T**	**N**	**T**	**N**	**T**	**N**	**T**	**N**	**T**
Biochemistry	14	16	16	13	7	12	6	10	16	17
Chemistry	1	10	3	14	4	10	6	9	4	8
Total	**14** 34%	**26** 66%	**19** 41%	**27** 59%	**11** 33%	**22** 67%	**12** 39%	**19** 61%	**20** 44%	**25** 56%

Ethnicity of Chemistry Baccalaureate Majors Enrolled

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	0	-	0	-	1	1.1	1	1.0	1	1.1
Asian	30	30.0	24	25.5	16	17.8	22	22.9	24	26.1
Black	12	12.0	11	11.7	6	6.7	9	9.4	10	10.9
Hispanic	26	26.0	24	25.5	26	28.9	28	29.2	25	27.2
Pacific Islander	3	3.0	2	2.6	1	1.1	0	-	0	-
White	17	17.0	14	14.9	21	23.3	20	20.8	21	22.8
Multiple Ethnicity	7	7.0	13	13.8	13	14.4	13	13.5	6	6.5
Unknown	5	5.0	6	6.4	3	3.3	3	3.1	5	5.4
Total	100	-	94	-	90	-	96	-	92	-

Ethnicity of Chemistry B.S. and B.A. Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	-	0	-	0	-	0	-	0	-	0
Asian	1	14.3	3	33.3	2	20.0	7	43.8	3	23.1
Black	-	0	-	0	-	0	-	0	3	23.1
Hispanic	2	28.6	1	11.1	-	0	3	18.8	2	15.4
Pacific Islander	-	0	-	0	1	10.0	-	0	-	0
White	3	42.8	2	22.2	3	30.0	3	18.8	5	38.5
Multiple Ethnicity	-	0	1	11.1	3	30.0	-	0	-	0
Unknown	1	14.3	-	0	-	0	2	12.5	-	0
Nonresident alien	-	0	2	22.2	1	10.0	1	6.3	-	0
Total	7	-	9	-	10	-	16	-	13	-

Gender of Chemistry Baccalaureate Majors Enrolled

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	64	64.0	48	51.1	42	46.7	47	49.0	55	60.0
Male	36	36.0	46	48.9	48	53.3	49	51.0	37	40.0
Total	100	-	94	-	90	-	96	-	92	-

Gender of Chemistry B.S. and B.A. Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	5	71.4	5	55.6	7	70.0	7	43.8	7	53.8
Male	2	28.6	4	44.4	3	30.0	9	56.2	6	46.2
Total	7	-	9	-	10	-	16	-	13	-

Ethnicity of Biochemistry Baccalaureate Students Enrolled

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	0	-	-	-	-	-	-	-	2	1.6
Asian	67	50.0	61	47.3	59	44.7	43	33.9	45	25.7
Black	19	14.1	19	14.7	19	14.4	15	11.8	17	13.5
Hispanic	23	17.2	24	18.6	28	21.2	36	28.3	29	23.0
Pacific Islander	2	1.5	4	3.1	3	2.3	2	1.5	2	1.6
White	14	10.4	14	10.9	14	10.6	17	13.4	17	13.5
Multiple Ethnicity	4	3.0	2	1.6	7	5.3	7	5.5	7	5.6
Unknown	5	3.7	5	3.9	2	1.5	7	5.5	7	5.6
Total	134	-	129	-	132	-	127	-	126	-

Ethnicity of Biochemistry B.S and B.A Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	0	0	-	0	-	0	-	0	-	0
Asian	12	52.2	13	52.0	15	53.6	9	34.6	5	29.4
Black	2	8.7	3	12.0	1	3.6	3	11.5	4	23.5
Hispanic	4	17.4	2	8.0	2	7.1	4	15.4	4	23.5
Pacific Islander	-	0	-	0	-	0	1	3.8	-	0
White	2	8.7	1	4.0	4	14.3	3	11.5	4	23.4
Multiple Ethnicity	-	0	1	4.0	-	-	1	3.8	-	0
Unknown	1	4.3	4	16.0	2	7.1	3	11.5	-	0
Nonresident Alien	2	8.7	1	4.0	4	14.3	2	7.7	-	0
Total	23	-	25	-	28	-	26	-	17	-

Gender of Biochemistry Baccalaureate Majors Enrolled

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	73	54.5	71	55.0	76	57.6	73	57.5	68	54.0
Male	61	45.5	58	45.0	56	42.4	54	42.5	58	46.0
Total	134	-	129	-	132	-	127	-	126	-

Gender of Biochemistry B.S. and B.A. Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	15	65.2	14	56.0	16	57.1	12	46.2	9	52.9
Male	8	34.8	11	44.0	12	42.9	14	53.8	8	47.1
Total	23	-	25	-	28	-	26	-	17	-

Ethnicity of Chemistry M.S. Students Enrolled

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	1	1.5	1	1.7	1	1.9	1	2.4	0	-
Asian	35	51.5	29	50.0	26	49.1	21	51.2	14	43.8
Black	5	7.3	5	8.6	4	7.5	2	4.9	5	15.6
Hispanic	4	5.9	4	6.7	4	7.5	4	9.8	2	6.3
Pacific Islander	1	1.5	0	-	0	-	0	-	0	-
White	11	16.2	10	17.2	10	18.9	10	24.4	8	25.0
Multiple Ethnicity	3	4.4	1	1.7	2	3.8	1	2.4	0	-
Unknown	8	11.8	8	13.8	6	11.3	2	4.9	3	9.4
Total	68	-	58	-	53	-	41	-	32	-

Ethnicity of Chemistry M.S. Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	-	0	-	0	-	0	-	0	-	0
Asian	5	38.5	3	30.0	5	38.5	4	28.6	4	33.3
Black	1	7.7	-	0	1	7.7	-	0	2	16.7
Hispanic	1	7.7	1	10.0	-	0	4	28.6	1	8.3
Pacific Islander	-	0	1	10.0	-	0	-	0	-	0
White	2	15.4	2	20.0	1	7.7	4	28.6	-	0
Multiple Ethnicity	-	0	-	0	-	-	-	0	-	0
Unknown	2	15.4	-	0	1	7.7	-	0	1	8.3
Nonresident alien	3	23.1	3	30.0	5	38.5	2	14.3	4	33.3
Total	13	-	10	-	13	-	14	-	12	-

Gender of Chemistry M.S. Students Enrolled

	Fall 2012		Fall 2014		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	36	52.9	34	58.6	27	50.9	23	56.1	17	53.1
Male	32	47.1	24	41.4	26	49.1	18	43.9	15	46.9
Total	68	-	58	-	53	-	41	-	32	-

Gender of Chemistry M.S. Graduates

	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	9	69.2	5	50.0	4	30.8	8	57.1	5	41.7
Male	4	30.8	5	50.0	9	69.2	6	42.9	7	58.3
Total	13	-	10	-	13	-	14	-	12	-

Appendix H

Faculty and Academic Resource Allocation

Number of Tenured or Tenure-Track Faculty

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Full-Time Tenured/ Tenure-Track	7	100	9	100	9	100	8	100	9	100
Part-Time Tenured/ Tenure-Track	0	0	0	0	0	0	0	0	0	0
Total Tenured/ Tenure-Track	**7**	**-**	**9**	**-**	**9**	**-**	**8**	**-**	**9**	**-**

Number of Lecturers

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Full-Time Lecturer	0	0	0	0	0	0	0	0	0	0
Part-Time Lecturer	11	100	11	100	13	100	16	100	12	100
Total Lecturer	**11**	**-**	**11**	**-**	**13**	**-**	**16**	**-**	**12**	**-**

Tenured or Tenure-Track Faculty to Lecturer Ratio

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Total Tenured/ Tenure-Track	7	38.9	9	45.0	9	40.9	8	33.3	9	42.9
Total Lecturer	11	61.1	11	55.0	13	59.1	16	66.7	12	57.1
Total All Faculty	**18**	**-**	**20**	**-**	**22**	**-**	**24**	**-**	**21**	**-**

Ethnicity of Tenured/Tenure-Track Faculty

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	-	0	-	0	-	0	-	0	-	0
Asian	1	14.3	2	22.2	2	22.2	2	25.0	2	22.2
Black	-	0	-	0	-	0	-	0	-	0
Hispanic	-	0	-	0	-	0	-	0	-	0
Pacific Islander	-	0	-	0	-	0	-	0	-	0
White	6	85.7	6	66.7	6	66.7	5	62.5	6	66.7
Multiple Ethnicity	-	0	-	0	-	0	-	0	-	0
Unknown	-	0	1	11.1	1	11.1	1	12.5	1	11.1
Total	7	-	9	-	9	-	8	-	9	-

Gender of Tenured/Tenure-Track Faculty

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	4	57.1	5	55.6	5	55.6	4	50.0	5	55.6
Male	3	42.0	4	44.4	4	44.4	4	50.0	4	44.4
Total	7	-	9	-	9	-	8	-	9	-

Ethnicity of Lecturers

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
American Indian	-	0	-	0	-	0	-	0	-	0
Asian	1	9.0	1	9.0	2	15.4	4	25.0	4	33.3
Black	-	0	-	0	-	0	-	0	1	8.3
Hispanic	1	9.0	-	0	-	0	-	0	-	0
Pacific Islander	-	0	-	0	-	0	-	0	-	0
White	8	73.0	10	91.0	10	76.9	11	68.8	6	50.0
Multiple Ethnicity	-	0	-	0	-	0	-	0	-	0
Unknown	1	9.0	0	-	1	7.7	1	6.2	1	8.3
Total	11	-	11	-	13	-	16	-	12	-

Gender of Lecturers

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Female	1	9.0	3	27.3	5	38.5	4	25.0	4	33.3
Male	10	91.0	8	72.7	8	61.5	12	75.0	8	66.7
Total	11	-	11	-	13	-	16	-	12	-

Instructional FTE Faculty (FTEF)

Headcount and FTEF

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	FTEF	No.	FTEF	No.	FTEF	No.	FTEF	No.	FTEF
Professor	2	2.0	2	2.0	3	3.0	3	3.0	3	3.0
Associate Professor	4	4.0	4	4.0	2	2.0	2	2.0	2	2.0
Assistant Professor	1	1.0	3	3.0	4	4.0	3	3.0	4	4.0
Lecturer (Full-time)			1	1.0						
Lecturer (Part-time)	11	5.5	9	4.6	12	6.3	15	7.9	11	6.4
Teaching Associate	9	3.3	6	2.5	8	2.7	8	3.2	6	2.4
Total	**27**	**15.8**	**25**	**17.1**	**29**	**18.0**	**31**	**19.1**	**26**	**17.8**

% FTEF Breakdown by Type

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	%	% FTEF	%	% FTEF	%	% FTEF	%	% FTEF	%	% FTEF
Tenure-Track	25.9	44.3	36.0	52,5	31.0	50.0	25.8	42.0	34.6	50.6
Lecturer	40.7	34.6	40.0	32.7	41.4	35.2	48.4	41.3	42.3	36.0
Teaching Associate	33.3	21.1	24.0	14.8	27.6	14.8	25.8	16.8	23.1	13.5

Instructional FTE Students (FTES)

Total FTES Taught

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Tenure-Track	164.7 (47.8%)	162.5 (46.7%)	179.2 (50.3%)	141.6 (37.6%)	178.5 (48.7%)
Lecturer	141.6 (41.0%)	146.0 (41.9%)	145.4 (40.8%)	193.4 (51.3%)	160.7 (43.8%)
Teaching Associate	38.4 (11.1%)	29.5 (8.5%)	29.8 (8.4%)	38.2 (10.1%)	24.3 (6.6%)
Total	**344.7**	**348.1**	**356.1**	**376.9**	**366.9**

FTES by Type

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Major FTES	189	199	196	209	216
GE FTES	285	332	308	340	323
Waitlist	11	14	16	19	15

Student Faculty Ratios (SFR)

Overall SFR (All FTES/All Appointed FTEF)

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Tenure-Track	25.9	26.1	23.0	24.6	25.1
Lecturer	11.5	11.7	11.2	11.9	10.1
Teaching Associate	23.5	18.1	17.7	17.7	19.8
Total	**21.8**	**20.3**	**19.8**	**19.8**	**20.6**

Instructional SFR (All FTES/Course Assignments FTEF)

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Tenure-Track	27.2	32.6	28.6	27.9	28.7
Lecturer	11.2	12.3	11.7	11.5	10.1
Teaching Associate	32.4	25.2	23.9	23.8	21.9
Total	**25.1**	**25.3**	**23.1**	**23.0**	**22.3**

Total Instructional SFR by Course Level

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Lower Division	35.6	38.8	38.4	41.5	37.4
Upper Division	24.8	30.9	28.1	27.4	25.2
Graduate	16.5	12.3	9.0	13.8	13.0

Course Information

Section Size

	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Number of Course Sections Offered	104	110	111	101	110
Average Section Size for All Courses	26.6	27.5	27.6	30.6	28.8
Average Section Size for Lecture Classes	56.8	63.7	54.8	62.0	55.4
Average Section Size for Laboratory Classes	23.3	24.6	23.1	24.5	23.2
Graduate Average Section Size	14.5	13.0	26.0	18.0	17.5

Enrollment Count

	Fall 2012		Fall 2013		Fall 2014		Fall 2015		Fall 2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Majors	1056	38.1	1049	34.6	1095	35.8	1147	37.1	1235	39.0
General Education	1588	57.3	1814	59.9	1679	54.9	1821	58.9	1748	55.2
Repeat Enrollments	91	3.3	111	3.7	100	3.3	94	3.0	120	3.8
Waitlist	48	1.7	71	2.3	68	2.2	79	2.6	68	2.1

Appendix I

New Tenure Track Faculty Request Justification - Biochemist
Department of Chemistry and Biochemistry
November, 2010
Summary Justification for the Position

Overview:

This is a request for a tenure track faculty position in biochemistry or a closely related field. The Department of Chemistry and Biochemistry offers B.S. Biochemistry and B.A. Biochemistry degree programs. We also offer two Biochemistry Options under the M.S. Chemistry degree program. The Biochemistry programs provide excellent preparation for careers in the pharmaceutical and biotechnology industries, for teaching at the high school or community college level, for entry into Ph.D. programs and as preparation for health professional programs in medicine, pharmacy, dentistry, optometry and veterinary medicine.

Strategic goals:

Our program aims are well aligned with the university mission of providing an academically rich learning experience that prepares students to realize their goals, pursue meaningful work and contribute to their community. In terms of the undergraduate Biochemistry degrees and the Master's Options in Biochemistry, we strive to offer a broad range of chemistry and biochemistry courses that cover basic principles but also explore specialized areas and include recent advances. We want our graduates to be prepared to succeed in a variety of career choices. We recognize the fast pace of research in biochemistry, and try to prepare our students to embrace new concepts and to appreciate advances in experimental methods and instrumentation. In our courses we encourage students to think critically about the use of chemicals in society and about the responsibilities of scientists to contribute to societal issues relating to chemistry and biochemistry. Because of the increases in enrollment in our biochemistry courses in recent years and the death of one of our biochemists, our ability to fulfill this mission is in jeopardy.

Needs served by the position:

The most pressing needs to be served by the requested position are the acquisition of a qualified instructor to teach upper division and graduate courses in biochemistry, addition of supervisory capacity for research and literature projects for the growing number of Master's students opting to study biochemistry, and help in updating the biochemistry curriculum.

The Department of Chemistry and Biochemistry currently has two faculty members with a specialization in biochemistry. One is Chair and teaches a reduced load. The other was hired in 2006 to teach the extra class sections derived from earlier increases in the number of Biochemistry and Biological Science majors (who take biochemistry courses). That same year a third Biochemistry faculty member passed away suddenly. Because of a failed Search in 2008-09 and subsequent budget issues, he has never been replaced. In the meantime the department FTES has risen 28% and part-time lecturers are now teaching 50% (8/16) of the upper division and graduate biochemistry course sections. As a result, the quality of the instruction for many of the majors level biochemistry courses has been compromised and the turnover rate among the instructors is high. This is a real disservice to the students in the biochemistry degree programs and in related programs that require our courses. Currently about 60% of the undergraduate students matriculating in the department are biochemistry majors.

The number of students in the Chemistry Master's program has increased significantly over the last five years, increasing from 35 students in Fall 2005 to 55 in Fall 2009. More than half of the Master's students emphasize biochemistry in their curricula and many choose one of the Options in Biochemistry under the M.S. Chemistry program. There are currently not enough biochemistry faculty to handle supervision of these Master's students. The new biochemist would be expected to establish a research program in this area and supervise both thesis and non-thesis Master's candidates. Clearly, a new faculty member in the area of biochemistry is needed to maintain and improve the quality of our programs.

Student Demand:

The number of Biochemistry majors has increased only slightly over the last five years. The Master of Science in Chemistry program has increased 57% and the department FTES has increased 28%. The number of students taking biochemistry courses has increased about 40%. The popularity of the Cell and Molecular Biology Option under the B.S. Biological Science degree program is responsible for some of this increase. Students in that program are now required to take more biochemistry. At the same time the enrollments in biochemistry courses have increased, the number of biochemistry faculty has decreased to two because of the death of one of the biochemists.

Faculty Composition

a. Over the last five years one tenured faculty member retired (2009) and another passed away (2006). Two FERPers completed their service (both in 2007) and one tenured faculty member entered the FERP program (2006). During this same period, three new tenure track faculty were hired. The net loss was 0.39 position.

b. In 2009, the latest year for which the Fall numbers are available, the ratio of tenured/tenure track faculty to total FTEF for the Department of Chemistry and Biochemistry was 0.49. In comparing the numbers for the last five years, it is apparent that a significant drop in the ratio occurred between 2006 and 2007. In 2005 and 2006 the ratios were 0.69 and 0.70, whereas for 2007, 2008 and 2009 the ratios were 0.44, 0.35 and 0.49, respectively.

c. The Department has an acute need for a biochemist. Dr. Larry Scheve, the biochemist who passed away unexpectedly in 2006, has not been replaced. During the past four years it has been necessary to hire part-time lecturers to teach 50% (8/16) of our upper division and graduate biochemistry courses. As a result the quality of the instruction for many of the majors level biochemistry courses has been compromised and the turnover rate among the instructors is high. This is a real disservice to the students in the biochemistry degree programs and in related programs that require our courses.

d. The total number of Chemistry and Biochemistry majors in the Fall Quarter headcount for 2009 was 203; for Spring 2010 it was 193. This includes both undergraduate and graduate students. The latest available data on the Planning and Institutional Research website for the number of students working toward a minor in Chemistry is Winter 2006. At that time there were 43 Chemistry minors. Unofficial department records indicate there are currently a similar number of Chemistry minors. The ratio of majors to tenured/tenure track faculty is 193-203 / 7.50 or in the range of 25.7 to 27.1.

e. The Five Year Hiring Plan established at the time of our last Academic Program Review (2007-08) called for the addition of five new faculty members between 2007and 2012. At that time two faculty searches were in progress and it was anticipated that we would immediately hire a Biochemist and a Physical Chemist. We did hire the Physical Chemist, but the Search for a new Biochemist failed. Subsequent budget issues precluded completion of the Search for a Biochemist, leaving the department with a big deficiency in this area.

The other planned hires include an Analytical or Inorganic Chemist, another Biochemist and an Organic chemist. The Analytical/Inorganic Chemist is needed to teach the General Chemistry series, several analytical courses, and the Advanced Inorganic Chemistry series. Because the accrediting agency for our B.S. Chemistry degree requires that courses certified for the degree be taught by regular faculty, it has been necessary to ask faculty to teach outside of their specialties to cover these courses. As a result, part-time lecturers have taught some of the advanced classes that should be taught by regular faculty. This situation will be alleviated with a new Analytical /Inorganic Chemist hire.

Since enrollments in the Biochemistry area continue to increase and because we have added a non-thesis Biochemistry option to our Master's degree plan, the projected need for a second Biochemist appears to be materializing. However, at this time we are most anxious to obtain approval for the first Biochemistry hire. In our Five Year Plan we also projected the eventual need for another Organic Chemist to replace Richard Luibrand, who had started his FERP service in 2006. Now the need for a new Organic Chemist is looming since Dr. Luibrand will retire permanently in 2011.

To maintain ACS accreditation for the B.S. Chemistry degree, we are required to provide research opportunities for undergraduates. Also, with a growing graduate program, new faculty are needed to supervise Master's research projects. The shortage of tenure track faculty in our department has put an unusually heavy burden on the current faculty in this area. New faculty are needed to establish research programs and supervise Master's and undergraduate research.

Curriculum

a. Ten of 48 courses (21%) offered by the Chemistry and Biochemistry Department satisfy General Education requirements. The department hopes to add more GE courses in the near future.

b. Online teaching would not be a strict requirement of this position but the new faculty member would be encouraged to develop online courses where appropriate. Every faculty member in the department, including this new hire, is required to teach at other campus sites if our program makes that necessary. The laboratory facilities on the Concord campus have recently been outfitted for the teaching of Pre-Nursing chemistry courses and these courses were taught there in 2008-09 and 2009-10. It is anticipated that a new faculty hire would teach on the Concord campus.

c. The position would represent a central component of the education of a Biochemistry major. As mentioned above, part-time lecturers are currently teaching 50% (8/16) of our upper division and graduate biochemistry courses. As a result the quality of the instruction for many of the majors level biochemistry courses has been compromised.

Scholarship

a. The potential for scholarly success should be high as the individual chosen will be expected to have graduate training in biochemistry or a related field and be prepared to establish a research program appropriate for undergraduate and Master's level students. In the past most applicants for tenure track positions in our department have had postdoctoral experience as well. Our last three hires have established active research programs and published in peer-reviewed scientific journals. Students working with them have given numerous research presentations scientific meetings. It is anticipated that the new hire would attain a similar level of scholarly success.

b. All of our recent hires have applied for external and internal support soon after arriving at CSUEB. All have been awarded internal grants through the Faculty Research Support Program and two have obtained funding through the Sieber-Tombari Interdisciplinary Research Award. Each has been awarded a system wide CSUPERB grant in the range of $10,000-$15,000, one received a COAST grant and another a CSU-Agricultural Initiative Grant ($13, 400). All three have also been awarded large grants ranging from ~$75,000 to $450,000 through external funding from the National Science Foundation, the Research Corporation and the Bechtel and Broadcom Foundations. It is anticipated that a new hire would achieve similar success with external/internal funding.

c. Replacement is not critical to the scholarly activity of units outside the College of Science. Scholarly collaboration with faculty within the College is likely, depending on the professional interests of the new faculty member. Currently four of the seven Chemistry and Biochemistry faculty members collaborate with faculty in other departments within the College of Science.

d. The faculty in the Chemistry and Biochemistry Department have helped to increase FTES by teaching larger classes and have supported and maintained an active and growing Master's program by supervising an average of seven Master's students each at any given time (up from ~3 four years ago) with no compensation. They have helped our constantly turning over pool of lecturers "learn the ropes," especially with regard to laboratory procedures and safety. At the same time they have willingly taken on the increasing burden of committee work and special projects that keep the university functioning smoothly and enhance its reputation.

e. All seven Chemistry and Biochemistry faculty have been successful in obtaining external funding from government and private funding agencies, and from private industry over the last few years. The various awards have been used for individual and collaborative research projects involving students, to purchase large instruments, and for curriculum development and outreach activities.

Recruitment

a. In preparing our recruitment plan we will include the widest possible circulation of the position announcement. We will directly contact Chairpersons in departments at universities and colleges that are known to produce high-quality minority Ph.D. Chemists and Biochemists and we will post the position on the websites of established science organizations with minority membership such as SACNAS(Society for Advancement of Chicanos and Native Americans in Science) and The Black Collegian Online. We will also consult with the CSUEB Diversity and Equity Liaison Officer for additional suggestions.

b. We do not have a pressing need for a senior hire.

c. We would be happy to do a combined advertisement with another department that wishes to advertise in Science and on the websites mentioned in section a.

Request for New Tenure Track Faculty Search for 2012-2013 - Justification
Inorganic / Analytical Chemist
Department of Chemistry and Biochemistry
Justification for the Position

Overview:

This is a request for a tenure track faculty position in inorganic or analytical chemistry. Areas of specialization might include nanotechnology, materials science, bioinorganic chemistry or environmental chemistry. The Department of Chemistry and Biochemistry offers seven undergraduate degree options in Chemistry and Biochemistry and a Master of Science degree in Chemistry. The Chemistry programs provide excellent preparation for careers in the chemical and pharmaceutical industries, environmental chemistry, forensic science, teaching at the high school or community college level and entry into a Ph.D. program.

Strategic goals:

Our program aims are well aligned with the university mission of providing an academically rich learning experience that prepares students to realize their goals, pursue meaningful work and contribute to their community. In terms of the undergraduate and graduate Chemistry degrees, we strive to offer a broad range of chemistry courses that cover basic principles but also explore specialized areas and include recent advances. We want our graduates to be prepared to succeed in a variety of career choices. We recognize the fast pace of research in chemistry, and try to prepare our students to embrace new concepts and to appreciate advances in experimental methods and instrumentation. In our courses we encourage students to think critically about the use of chemicals in society and about the responsibilities of scientists to contribute to societal issues relating to chemistry. Because only 44% of our courses are currently taught by tenured or tenure-track faculty, our ability to fulfill this mission is in jeopardy.

Many chemistry courses are taken by students in other degree programs such as Biological Sciences, Engineering, Earth and Environmental Sciences, Pre-Nursing and Health Science. Growth in these programs has led to significant increases in enrollments in chemistry courses. The increased interest in chemistry has led to a shortage of tenure track faculty teaching courses in the department. A new chemistry position is needed to bring the percentage of department courses taught by tenured or tenure track faculty closer to the system-wide target of 75%. The addition of a new tenure track chemist will allow the department to maintain excellence in teaching and provide modern research opportunities for graduate students.

Needs served by the position:

The most pressing needs to be served by the requested position are the acquisition of a qualified instructor to teach majors-level inorganic and/or analytical chemistry courses, addition of supervisory capacity for research and literature projects for the growing number of Master's students, and help in updating the chemistry curriculum.

Over the last five years the number of Chemistry majors increased gradually (from 56 in 2007 to 76 in 2011). The Minor in Chemistry remains strong, with about 40 students declared. Many chemistry courses are taken by students in other degree programs such as Biological Sciences, Engineering, Earth and Environmental Sciences, Pre-Nursing and Health Science. Growth in these programs has led to significant increases in enrollments in chemistry courses.

The department FTES has increased 23% since 2006 and faculty have retired, so it is now necessary for 56 % of our course sections to be taught by part-time lecturers or teaching associates of variable quality and with a high turnover rate. As a result, the quality of the instruction for many of the chemistry courses has been compromised. This situation will be partly alleviated if we are able to hire a new tenure track biochemist in the 2011-2012 Search.

Many of the inorganic chemistry and analytical instrumentation courses are now taught by part-time lecturers. The inorganic curriculum has not been updated for many years and there is currently no faculty member in the department specifically trained in this area. A new inorganic chemist is needed to modernize the existing courses and provide direction for changes that will align the curriculum with developments in the field which are not currently represented (e.g. applications in nanotechnology). The department is also deficient in faculty in the analytical chemistry area. For several of the large instruments that students should learn to use, there is no faculty member to take responsibility for designing modern experiments or troubleshooting technical problems. There are also instruments the department should acquire to remain current, but no analytical chemist to apply for funding in those areas or to maintain the instruments if they were acquired. A new tenure track Chemistry position is needed to aid the current faculty in providing an appropriate curriculum for chemistry and biochemistry majors and for students in related majors taking service courses in chemistry. Either an inorganic chemist or an analytical chemist could improve the curriculum. An individual with skills in both areas would be especially attractive.

The number of students in the Chemistry Master’s program has increased over the last few years, from 36 students in Fall 2006 to 54 in Fall 2011. The current tenured/tenure track faculty are overburdened with the supervisory duties for overseeing the research or literature projects for the increased numbers of Master's students. The new Chemist would be expected to establish a research program in his or her area of expertise and supervise both thesis and non-thesis Master's candidates. Clearly, a new faculty member in the area of Inorganic or Analytical Chemistry is needed to maintain and improve the quality of our programs.

Student Demand:

The number of Chemistry majors has increased 36% over the last five years, from 56 in Fall 2007 to 76 in Fall 2011. The Master of Science in Chemistry program has increased 15% and the department FTES has increased 18%. The department hired only one tenure track faculty member over this period and lost 2.5 positions to retirements. A number of chemistry courses are required for other degree programs (Biological Sciences, Physics, Engineering, Environmental Science, Nursing, Health Science). Increases in these programs have led to increases in chemistry enrollments.

Faculty Composition

a. Over the last five years one tenured faculty member retired (2009) and three FERPers completed service (two in 2007 and one in 2011). During this same period, one new tenure track faculty member was hired. The net loss was 1.50 positions. The department is currently conducting a search for a tenure track faculty member with a specialization in biochemistry. This hire will help alleviate the net loss over the past five years.

b. In Fall 2010, the latest year for which the numbers are available, the ratio of tenured/tenure track faculty to total FTEF for the Department of Chemistry and Biochemistry was 0.47. In comparing the numbers for the last five years, it is apparent that a significant drop in the ratio occurred between 2006 and 2007. In 2006 the ratio was 0.70, whereas for 2007, 2008 and 2009 the ratios were 0.44, 0.35 and 0.49, respectively.

c. Increased enrollments in all the chemistry courses without a corresponding increase in tenure/tenure track faculty has led to a situation where 56 % of our courses are taught by part-time lecturers or teaching associates. There is a shortage of faculty to maintain and upgrade the chemistry programs. This is a real disservice to the students taking chemistry and biochemistry courses, and means they are not receiving the proper training for future jobs in industry or for advanced study.

Note: The latest available data from the Office of Planning and Institutional Research (Fall 2010) shows 63 course sections taught by the Department of Chemistry & Biochemistry, with 29 taught by part-time lecturers and 34 taught by tenured or tenure track faculty. These numbers are distorted, probably by our special registration classes CHEM 4810, 4811, 4900, 6900, 6830, 6850, 6910 (Undergraduate Research, Honors Thesis, Independent Study, Research, Methods in Graduate Research, Comprehensive Review). A quick look at the Fall 2010 class schedule will show that we offered 44 regular class sections of which 16 were taught by regular faculty and 28 by part-time lecturers or teaching associates. Regular faculty teach all of the special registration sections, of which we have many, but get NO WTU for doing so. The Graduate Coordinator has six units of release time per year and teaches some of the special registration classes but the other regular faculty teach the majority of them. Because the other faculty teach the special registration classes *gratis,* with NO COMPENSATION, including these sections in the calculation gives a distorted picture of the shortage of tenured and tenure track faculty. Therefore we have used an average of the regular course sections assigned to part-time lecturers and teaching associates for FWSp of 2010-2011 to calculate the percentage of sections they currently teach.

d. The total number of Chemistry and Biochemistry majors in the Fall Quarter headcount for 2010 was 202; for Spring 2011 it was 204. This includes both undergraduate and graduate students. The latest available data on the Planning and Institutional Research website for the number of students working toward a minor in Chemistry is Winter 2006. At that time there were 43 Chemistry minors. Unofficial department records indicate there are currently a similar number of Chemistry minors. The ratio of majors to tenured/tenure track faculty is ~203 / 7.00 or 29.0.

e. As of Fall 2009, the latest numbers available, the total student/faculty ratio for the Department of Chemistry & Biochemistry was 22.62 as compared with 23.56 for the College of Science as a whole.

f. The Five Year Hiring Plan established at the time of our last Academic Program Review (2007-08) called for the addition of five new faculty members between 2007 and 2012. At that time two faculty searches were in progress and it was anticipated that we would immediately hire a Biochemist and a Physical Chemist. We did hire the Physical Chemist, but the Search for a new Biochemist failed. Subsequent budget issues precluded completion of the Search for a Biochemist until this year. We are currently conducting a Search for a Biochemist (2011-2012 academic year).

The other planned hires included an Inorganic or Analytical Chemist or someone with expertise in both areas, another Biochemist and an Organic chemist. The Analytical / Inorganic Chemist is needed to teach the General Chemistry series, several analytical courses, and the Advanced Inorganic Chemistry series. Because the accrediting agency for our B.S. Chemistry degree requires that courses certified for the degree be taught by regular faculty, it has been necessary to ask faculty to teach outside of their specialties to cover some of these courses. As a result, part-time lecturers have taught some of the majors level classes that should be taught by regular faculty. This situation will be alleviated with a new Inorganic /Analytical Chemist hire.

Since enrollments in the Biochemistry area continue to increase and because we have added a non-thesis Biochemistry option to our Master's degree plan, the projected need for a second Biochemist appears to be materializing. In our Five Year Plan we also projected the eventual need for another Organic Chemist to replace Richard Luibrand, who had started his FERP service in 2006. Now the need for a new Organic Chemist is looming since Dr. Luibrand retired permanently in 2011.

To maintain ACS accreditation for the B.S. Chemistry degree, we are required to provide research opportunities for undergraduate research. Also, with a growing graduate program, new faculty are needed to supervise Master's research projects. The shortage of tenure track faculty in our department has put an unusually heavy burden on the current faculty in this area. New faculty are needed to establish research programs and supervise Master's and undergraduate research.

Curriculum

a. Ten of 48 courses (21%) offered by the Chemistry and Biochemistry Department satisfy General Education requirements. The department hopes to add more GE courses in the near future.

b. Online teaching would not be a strict requirement of this position but the new faculty member would be encouraged to develop online courses where appropriate. Every faculty member in the department, including this new hire, is required to teach at other campus sites if our program makes that necessary. The laboratory facilities on the Concord campus have recently been outfitted for the teaching of Pre-Nursing chemistry courses and these courses were taught there in 2008-09, 2009-10 and currently (2011-2012). It is anticipated that a new faculty hire would teach on the Concord campus.

c. The position would represent a central component of the educational experience for students majoring or minoring in Chemistry or related fields. As mentioned above, part-time lecturers or teaching associates are currently teaching 56% of the chemistry curriculum. As a result the quality of instruction in the department has been compromised.

Scholarship

a. The potential for scholarly success should be high as the individual chosen will be expected to have graduate training in inorganic and/or analytical chemistry and be prepared to establish a research program appropriate for undergraduate and Master's level students. In the past most applicants for tenure track positions in our department have had postdoctoral experience as well. Our last three hires have established active research programs and published in peer-reviewed scientific journals. Students working with them have given numerous research presentations scientific meetings. It is anticipated that the new hire would attain a similar level of scholarly success.

b. All three of our recent hires (since 2006) have applied for external and internal support soon after arriving at CSUEB. All have been awarded internal grants through the Faculty Research Support Program and two have obtained funding through the Sieber-Tombari Interdisciplinary Research Award. Each has been awarded a system wide CSUPERB grant in the range of \$10,000-\$15,000, one received a COAST grant and another a CSU-Agricultural Initiative Grant (\$13, 400). All three have also been awarded large grants ranging from ~\$75,000 to \$450,000 through external funding from the National Science Foundation, the Research Corporation and the Bechtel and Broadcom Foundations. It is anticipated that a new hire would achieve similar success with external/internal funding.

c. Replacement is not critical to the scholarly activity of units outside the College of Science. Scholarly collaboration with faculty within the College is likely, depending on the professional interests of the new faculty member. Currently four of the seven Chemistry and Biochemistry faculty members collaborate with faculty in other departments within the College of Science.

d. The faculty in the Chemistry and Biochemistry Department have helped to increase FTES by teaching larger classes and have supported and maintained an active and growing Master's program by supervising an average of seven Master's students each at any given time (up from ~3 four years ago) with no compensation. They have helped our constantly turning over pool of lecturers "learn the ropes," especially with regard to laboratory procedures and safety. At the same time they have willingly taken on the increasing burden of committee work and special projects that keep the university functioning smoothly and enhance its reputation.

e. All seven Chemistry and Biochemistry faculty have been successful in obtaining external funding from government and private funding agencies, and from private industry over the last few years. The various awards have been used for individual and collaborative research projects involving students, to purchase large instruments, and for curriculum development and outreach activities.

Recruitment

a. In preparing our recruitment plan we will include the widest possible circulation of the position announcement. We will directly contact Chairpersons in departments at universities and colleges that are known to produce high-quality minority Ph.D. Chemists and Biochemists and we will post the position on the websites of established science organizations with minority membership such as SACNAS (Society for Advancement of Chicanos and Native Americans in

Science) and The Black Collegian Online. We will also consult with the CSUEB Diversity and Equity Liaison Officer for additional suggestions.

b. We do not have a pressing need for a senior hire.

c. We would be happy to do a combined advertisement with another department that wishes to advertise in Chemical and Engineering News or Science and on the web sites mentioned in section a.

Request for New Tenure Track Faculty Search for 2013-2014
Organic Chemist
Department of Chemistry and Biochemistry
Justification for the Position

Overview:

This is a request for a tenure track faculty position in organic chemistry. In 2011 one of the organic chemistry faculty members in the Department of Chemistry and Biochemistry retired permanently. This is a request to replace him. The department offers seven undergraduate degree options in Chemistry and Biochemistry and a Master of Science degree in Chemistry. The Chemistry programs provide excellent preparation for careers in the chemical and pharmaceutical industries, environmental chemistry, green chemistry, forensic science, teaching at the high school or community college level and entry into a Ph.D. program. Courses in organic chemistry are required for all Chemistry and Biochemistry majors, for several of the Biological Sciences major options, for Pre-Nursing and Health Sciences majors, and for all Pre-Health Professional students (pre-Medical, Pre-Dental, Pre-Pharmacy, etc.).

Over 200 students take the year long majors-level organic chemistry course series each year. This translates to about 27 laboratory sections (nine per quarter). Due to the specialized nature of organic chemistry lab, these sections should be taught by tenured or tenure track (TT) faculty or by experienced lecturers. 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 courses, to help improve the department general education curriculum and to supervise projects for Master's candidates in chemistry.

Strategic goals:

Our program aims are well aligned with the university mission of providing an academically rich learning experience that prepares students to realize their goals, pursue meaningful work and contribute to their community. In terms of the undergraduate and graduate Chemistry degrees, we strive to offer a broad range of courses that cover basic chemical principles but also explore specialized areas and include recent advances. We want our graduates to be prepared to succeed in a variety of career choices. We recognize the fast pace of research in chemistry, and try to prepare our students to embrace new concepts and to appreciate advances in experimental methods and instrumentation. In our courses we encourage students to think critically about the use of chemicals in society and about the responsibilities of scientists to contribute to societal issues relating to chemistry.

Currently only 40% of our course sections are taught by tenured or tenure-track faculty. With two tenure track searches in progress we hope to increase this percentage to above 50% in 2013-14. However, even with two new faculty we will still not have recovered from the severe shortage we experienced over the last few years resulting from a combination of retirements, death, increasing enrollments and failure to hire. Thus our ability to properly fulfill our department mission will remain in jeopardy.

A number of chemistry courses are taken by students in other degree programs such as Biological Sciences, Engineering, Pre-Nursing and Health Science. Growth in these programs has led to significant increases in enrollments in chemistry courses. The increased interest in chemistry has led to a shortage of tenure track faculty teaching courses in the department. A new chemistry position is needed to bring the percentage of department courses taught by tenured or tenure track faculty closer to the system-wide target of 75% (or at least 65%). The addition of a new tenure track organic chemist will allow the department to maintain excellence in teaching and provide modern research opportunities for graduate students.

Needs served by the position:

The most pressing needs to be served by the requested position are the acquisition of a qualified instructor to teach majors-level organic chemistry courses and some of the introductory chemistry sections, addition of supervisory capacity for research and literature projects for the growing number of Master's students, and help in updating the chemistry curriculum.

Over the last five years the number of Chemistry majors increased gradually (from 56 in 2007 to 76 in 2011). The Minor in Chemistry remains strong, with about 40 students declared. Organic chemistry courses are taken by Chemistry and Biochemistry majors, students minoring in Chemistry, students in other degree programs such as Biological Sciences, Pre-Nursing and Health Science, and by all the Pre-Health Professional students. Growth in these programs has led to significant increases in enrollments in the organic chemistry courses. Enrollments in the introductory and general chemistry courses have also increased. Because the department FTES has risen 23% since 2006 while several faculty members have retired or passed away, it is now necessary for 60 % of our course sections to be taught by part-time lecturers or teaching associates of variable quality and with a high turnover rate. As a result, the quality of the instruction for many of the chemistry courses has been compromised, particularly for the lower division classes.

As an example, this Winter (2013) the lecture for one of the majors-level freshman chemistry courses will be taught by a tenure track faculty member and the lecture for the other course section will be taught by a part-time lecturer. However, all twelve laboratory sections will be taught by part-time lecturers or teaching associates. This means that none of our young chemistry, biochemistry or biological sciences majors will have an experienced regular faculty member as his or her laboratory instructor. This is a real failure to fulfill our mission to the students. Hopefully this situation will be partially alleviated if we are able to hire two new tenure track faculty in the 2012-2013 searches. However, we will still be woefully below the ideal of having 75% of our classes taught by regular faculty. Another concern is that the accrediting agency for our B.S. Chemistry degree (American Chemical Society) requires the "courses leading to student certification in an approved chemistry program" to be taught by full-time, permanent faculty. For the last two years we have had to use a part-time lecturer for one of the majors-level organic chemistry series, putting us out of compliance with the accrediting agency for the B.S. Chemistry degree.

The number of students in the Chemistry Master’s program has increased over the last few years, from 36 students in Fall 2006 to 54 in Fall 2011. The current tenured/tenure track faculty are overburdened with the supervisory duties for overseeing the research or literature projects for the increased numbers of Master's students. The new organic chemist would be expected to establish a research program in his or her area of expertise and supervise both thesis and non-thesis Master's candidates.

The undergraduate organic curriculum is in reasonably good shape as a result of the work of past and present organic chemistry faculty. It is however necessary to keep up with developments in the field, update our courses accordingly, and maintain and improve upon relevant instrumentation. The new faculty member would contribute to these goals. Whereas the undergraduate organic curriculum is well established, the graduate program needs improvement.

It is being strained by the increased number of students and the shortage of 6000 level courses in the organic chemistry area. It is anticipated that a new organic chemistry faculty member would develop one or more new courses for the graduate program.

We would also expect the new organic chemist to contribute to the General Education (GE) curriculum in chemistry by improving existing courses or developing new ones. Two of our current faculty have recently worked toward improving our GE curriculum but the program has been otherwise neglected for a number of years. We would like to serve the non-science majors appropriately and this requires some effort from the regular faculty. If we are successful in hiring two new faculty in 2012-2013 they will be very occupied with the biochemistry and analytical chemistry programs, respectively, which have been seriously neglected. In those areas part-time lecturers have taught major requirements for a number of years and there is serious need for curriculum development. On the other hand, a new organic chemist should be able to aid in improving both the graduate and the GE offerings.

Student Demand:

The latest numbers available on the Planning and Institutional Research website are for Fall 2011. Over the five year period from 2007 through 2011, the number of Chemistry majors increased 36%, from 56 in Fall 2007 to 76 in Fall 2011. The number of Biochemistry majors increased 24%, from 84 in Fall 2007 to104 in Fall 2011. The Master of Science in Chemistry program increased 15% and the department FTES increased 18%. A number of chemistry courses are required for other degree programs (Biological Sciences, Physics, Engineering, Environmental Science, Nursing, Health Science). Increases in these programs have contributed to increases in chemistry enrollments. The requested new organic chemist would teach courses taken by the increased numbers of Chemistry and Biochemistry majors, M.S. Chemistry students, Biological Sciences majors, Pre-Nursing and Health Science students and non-science majors.

Faculty Composition

a. Over the last five years one tenured faculty member retired (2009) and three FERPers completed service (two in 2007 and one in 2011). During this same period, one new tenure track faculty member was hired. The net loss was 1.50 positions. In 2006 a tenure track faculty member passed away and was not replaced. So between 2006 and 2011 the net loss was 2.5 positions. The department is currently (2012-2013) conducting two tenure track faculty searches for individuals with specializations in biochemistry and analytical or inorganic chemistry, respectively. These hires will help alleviate the net loss over the past six years.

b. In Fall 2011, the latest year for which the numbers are available, the ratio of tenured/tenure track faculty to total FTEF for the Department of Chemistry and Biochemistry was 0.46. In comparing the numbers for the last six years, it is apparent that a significant drop in the ratio occurred between 2006 and 2007. In 2006the ratio was 0.70, whereas for 2007, 2008, 2009 and 2010, the ratios were 0.44, 0.35, 0.49 and 0.48, respectively.

c. Increased enrollments in all the chemistry courses without a corresponding increase in tenure/tenure track faculty has led to a situation where 60% of our course sections are currently taught by part-time lecturers or teaching associates. This situation will improve if we are successful in the two tenure track searches being conducted during 2012-2013. However, we will still remain way below the system wide goal of 75% of the courses taught by tenured or tenure track faculty and we will even be below the more modest goal of 65%. This means there will continue to be a shortage of faculty to maintain and upgrade the chemistry programs and to supervise Master's projects. This is a real disservice to the students taking chemistry and biochemistry courses, and means they are not receiving the proper training for future jobs in industry or for advanced study.

Note: The latest available data from the Office of Planning and Institutional Research (Fall 2011) shows 71 course sections taught by the Department of Chemistry & Biochemistry, with 32 taught by part-time lecturers and 39 taught by tenured or tenure track faculty. These numbers are distorted, probably by our special registration classes CHEM 4810, 4811, 4900, 6900, 6830, 6850, 6910 (Undergraduate Research, Honors Thesis, Independent Study, Research, Methods in Graduate Research, Comprehensive Review). A quick look at the Fall 2011 class schedule will show that we offered 52 regular class sections of which 22 were taught by regular faculty and 30 by part-time lecturers or teaching associates. Regular faculty teach all of the special registration sections, of which we have many, but get NO WTU for doing so. The Graduate Coordinator has six units of release time per year and teaches some of the special registration classes but the other regular faculty teach the majority of them. Because the other faculty teach the special registration classes *gratis,* with NO COMPENSATION, including these sections in the calculation gives a distorted picture of the shortage of tenured and tenure track faculty. Therefore we have used an average of the regular course sections assigned to part-time lecturers and teaching associates for FWSp of 2010-2011 to calculate the percentage of sections they currently teach (60%).

d. The total number of Chemistry and Biochemistry majors in the Fall Quarter headcount for 2011 was 236; for Spring 2012 it was 227. This includes both undergraduate and graduate students. The latest available data on the Planning and Institutional Research website for the number of students working toward a minor in Chemistry is Winter 2006. At that time there were 43 Chemistry minors. Unofficial department records indicate there are currently a similar number of Chemistry minors. The ratio of majors to tenured/tenure track faculty is ~232 / 7.00 or ~33.1.

e. As of Fall 2011, the latest numbers available, the total student/faculty ratio for the Department of Chemistry & Biochemistry was 22.2 as compared with 26.6 for the College of Science as a whole.

f. The Five Year Hiring Plan established at the time of our last Academic Program Review (2007-08) called for the addition of five new faculty members between 2007 and 2012. At that time two faculty searches were in progress and it was anticipated that we would immediately hire a Biochemist and a Physical Chemist. We did hire the Physical Chemist, but the search for a new Biochemist failed. Subsequent budget issues precluded approval of the search for a Biochemist until 2011-2012. However, that search was unsuccessful and the position was rolled over. During 2012-2013 we are conducting two tenure track searches, one to fill the rolled over Biochemistry position and the other for a new Inorganic or Analytical Chemist.

The other planned hires included an Inorganic or Analytical Chemist or someone with expertise in both areas, another Biochemist and an Organic Chemist. The Analytical/ Inorganic Chemist position was approved last year and we are currently conducting that search. The retirement of one of our organic chemists has caused the need for a new position in Organic Chemistry to rise to the top of our list, thus this request.

Since enrollments in the Biochemistry area continue to increase and because we have added a non-thesis Biochemistry option to our Master's degree plan, the projected need for a second Biochemist also appears to be materializing. Because of the burgeoning General Chemistry enrollments and the need for faculty to cover physical chemistry courses in the graduate program, sentiment for another physical chemist is also developing. If the current request for an Organic Chemist is approved, our next tenure track request is anticipated in 2015-16 and this will likely be for a Biochemist according to our 2007 Five Year Plan. However, we will re-evaluate the situation before 2014 and also consider the need for a physical chemist.

To maintain ACS accreditation for the B.S. Chemistry degree, we are required to provide research opportunities for undergraduate research. Also, with a growing graduate program, new faculty are needed to supervise Master's research projects. The shortage of tenure track faculty in our department has put an unusually heavy burden on the current faculty in this area. New faculty are needed to establish research programs and supervise Master's and undergraduate research.

Curriculum

a. Eleven of the 50 regular courses (22 %) offered by the Chemistry and Biochemistry Department satisfy General Education requirements. The department hopes to add more GE courses in the near future. If this request is approved the new Organic Chemist will be expected to contribute to the GE curriculum.

b. Online teaching would not be a strict requirement of this position but the new faculty member would be encouraged to develop online courses where appropriate. Every faculty member in the department, including this new hire, is required to teach at other campus sites if our program makes that necessary. A few years ago the laboratory facilities on the Concord campus were outfitted for the teaching of Pre-Nursing chemistry courses and these courses were taught there in 2008-09, 2009-10, 2011-12 and currently (2012-2013). It is anticipated that a new faculty hire would teach on the Concord campus.

c. The position would represent a central component of the educational experience for students majoring or minoring in Chemistry or related fields. Some of the organic chemistry courses required for chemistry, biochemistry and biological sciences majors and all of the Pre-Nursing and Health Sciences organic chemistry courses are now taught by part-time lecturers. Additionally, many of the graduate courses and most of the GE courses are taught by part-time lecturers. As a result the quality of instruction in the department has been compromised and a new Organic Chemist is needed to restore the curriculum to a reasonable level.

Scholarship

a. The potential for scholarly success should be high as the individual chosen will be expected to have graduate training in organic chemistry and be prepared to establish a research program appropriate for undergraduate and Master's level students. In the past most applicants for tenure track positions in our department have had postdoctoral experience as well. Our last three hires have established active research programs and published in peer-reviewed scientific journals. Students working with them have given numerous research presentations scientific meetings. It is anticipated that the new hire would attain a similar level of scholarly success.

b. All three of our recent hires (since 2006) have applied for external and internal support soon after arriving at CSUEB. All have been awarded internal grants through the Faculty Research Support Program and two have obtained funding through the Sieber-Tombari Interdisciplinary Research Award. Each has been awarded a system wide CSUPERB grant in the range of $10,000-$15,000, one received a COAST grant and another a CSU Agricultural Initiative Grant ($13, 400). All three have also been awarded large grants ranging from ~$75,000 to $450,000 through external funding from the National Science Foundation, the Research Corporation and the Bechtel and Broadcom Foundations. It is anticipated that a new hire would achieve similar success with external/internal funding.

c. Replacement is not critical to the scholarly activity of units outside the College of Science. Scholarly collaboration with faculty within the College is likely, depending on the professional interests of the new faculty member. Currently four of the seven Chemistry and Biochemistry faculty members collaborate with faculty in other departments within the College of Science.

d. The faculty in the Chemistry and Biochemistry Department have helped to increase FTES by teaching larger classes and have supported and maintained an active and growing Master's program by supervising an average of seven Master's students each at any given time (up from ~3 four years ago) with no compensation. They have helped our constantly turning over pool of lecturers "learn the ropes," especially with regard to laboratory procedures and safety. At the same time they have willingly taken on the increasing burden of committee work and special projects that keep the university functioning smoothly and enhance its reputation.

e. All seven Chemistry and Biochemistry faculty have been successful in obtaining external funding from government and private funding agencies, and from private industry over the last few years. The various awards have been used for individual and collaborative research projects involving students, to purchase large instruments, and for curriculum development and outreach activities.

Recruitment

a. In preparing our recruitment plan we will include the widest possible circulation of the position announcement. We will directly contact Chairpersons in departments at universities and colleges that are known to produce high-quality minority Ph.D. Chemists and Biochemists and we will post the position on the websites of established science organizations with minority membership such as SACNAS (Society for Advancement of Chicanos and Native Americans in Science) and The Black Collegian Online. We will also consult with the CSUEB Diversity and Equity Liaison Officer for additional suggestions.

b. We do not have a pressing need for a senior hire.

c. We would be happy to do a combined advertisement with another department that wishes to advertise in Chemical and Engineering News or Science and on the web sites mentioned in section a.

New Tenure Track Faculty Request Justification for an Analytical, Physical or Biophysical Chemist to Start Fall 2016
Department of Chemistry and Biochemistry
January 2015

Overview:

This is a request for a tenure track faculty position in experimental chemistry for an Analytical, Physical or Biophysical Chemist. The request is being made under the disciplinary hires category (Faculty Hires ILO 6). Areas of research specialization for the new faculty member might include environmental science, spectroscopy, materials science, polymer chemistry or others.

The Department of Chemistry and Biochemistry offers seven undergraduate degree options in Chemistry and Biochemistry, a Minor in Chemistry and a Master of Science degree in Chemistry. A number of the undergraduate chemistry major courses are also requirements for students in other science majors. The department offers additional specialized service courses for Pre-Nursing, Health Science and Kinesiology majors, and for several of the Biological Science options. Eleven chemistry courses satisfy general education requirements.

Currently the department is underrepresented in the fields of analytical and physical chemistry, with just one physical chemist, one biophysical chemist and no one formally trained in analytical chemistry. A new experimental chemist in one of those areas would strengthen the department's ability to maintain currency in instrumentation, which is covered throughout the curriculum, and provide the critical mass of regular faculty needed to modernize the experiments in the inorganic and physical chemistry laboratory courses.

An important offering by the department is the year-long freshman General Chemistry series. The courses in this series have always had large enrollments since they are requirements for several science majors (Chemistry, Biochemistry, Biological Sciences, Physics, Engineering, Health Science, Earth and Environmental Science). In recent years enrollments have been steadily increasing (680 students in 2007-2008, 877 students in 2013-2014, 1042 projected for 2014-2015) to the point where there are not sufficient regular faculty to cover even very large sections. Currently about half the General Chemistry lecture classes are taught by part-time lecturers. In addition to compromising the quality of the education provided for the science majors, this puts the department out of compliance with the accrediting agency for our B.S. Chemistry degree (American Chemical Society). Individuals with expertise in analytical and physical chemistry have traditionally taught General Chemistry. A new tenure track faculty member in one of these areas would allow the department to better serve the students who take General Chemistry as a major requirement, both by providing quality instruction in the lecture sections and by providing the necessary expertise to upgrade the experiments for the laboratory components. A new tenure track faculty member is also needed to teach analytical chemistry courses, to better meet the demand for research supervision from students in the Chemistry Master's program and to help improve the chemistry general education curriculum.

Strategic goals:

Our program aims are well aligned with the university mission of providing an academically rich learning experience that prepares students to realize their goals, pursue meaningful work and contribute to their community. In terms of the undergraduate and graduate Chemistry degrees, we strive to offer a broad range of chemistry courses that cover basic principles but also explore specialized areas and include recent advances. We want our graduates to be prepared to succeed in a variety of career choices. We recognize the fast pace of research in chemistry, and try to prepare our students to embrace new concepts and to appreciate advances in experimental methods and instrumentation. In our courses we encourage students to think critically about the use of chemicals in society and about the responsibilities of scientists to contribute to societal issues relating to chemistry.

The data available from the Institutional Research, Analysis and Decision Support website for Fall 2013 indicate that only 51.3% of the department course sections were taught by tenured or tenure track faculty; 48.7% were taught by part-time lecturers or teaching associates. Similar percentages were taught by non-tenure track faculty throughout 2013-2014 and in Fall 2014. However, because we were able to hire two new tenure track faculty in Fall 2013, the alarming trend of having part-time lecturers teach upper division majors-level courses began to reverse. A comparison of the data for Fall 2013 with earlier years shows that the number of upper division and graduate sections taught by lecturers decreased from a range of 6 to 11 for 2009-2012 to five. This number should drop further as our newest faculty member (start date Fall 2014) becomes assimilated into the teaching program. However, the lower division numbers remain dismal, with 34 out of 40 sections taught by part-time lecturers or teaching associates in Fall 2013. Similar numbers apply throughout 2013-2014 and in Fall 2014.

A number of chemistry courses are taken by students in other degree programs such as Biological Sciences, Physics, Engineering, Earth and Environmental Sciences, Pre-Nursing, Health Science and Kinesiology. Growth in these programs has led to significant increases in enrollments in chemistry courses. The increased interest in chemistry has led to a shortage of tenure track faculty in the department available to teach the lecture sections. A new chemistry position is needed to bring the percentage of department courses taught by tenured or tenure track faculty closer to the system-wide target of 75% (or at least 65%). The addition of a new tenure track analytical or physical chemist will allow the department to restore excellence in teaching and provide modern research opportunities for graduate students.

Needs served by the position:

The most pressing needs to be served by the requested position are: i) the acquisition of a qualified instructor to teach majors-level General Chemistry and Analytical Chemistry courses; ii) addition of a faculty member qualified to upgrade the laboratory curriculum for General Chemistry and Analytical Chemistry, including department instrumentation; and iii) the addition of supervisory capacity for research and literature projects for Master's students.

As mentioned above the number of students now matriculating in the year-long General Chemistry series is very large (877 in 2013-14 and projected at 1041 for 2014-15 based on Fall and Winter enrollments of 324 and 348, respectively. General Chemistry supplies the chemical foundation not only for chemistry and biochemistry majors but also for students majoring in other sciences and pre-Health Professional students. As such, it is an important course and deserves appropriate attention from the department. As a result of earlier retirements, increasing enrollments and several years with no tenure track hires, about half the General Chemistry lecture courses and 90% of the laboratory sections are taught by part-time lecturers or TAs. This means many of the science majors will not have a regular faculty member for lecture and most will never have an regular faculty member as lab instructor anytime during the year-long series.

An even less desirable situation exists for the lower division analytical chemistry course (Quantitative Analysis), which is required for chemistry and biochemistry majors and for the

Minor in Chemistry. For the last five years this course has been taught by part-time lecturers. This is a real failure to fulfill our mission to the students. Also, the use of part-time lecturers for the General Chemistry and Analytical lectures puts us out of compliance with the accrediting agency for our B.S. Chemistry degree (American Chemical Society) which requires the "courses leading to student certification in an approved chemistry program to be taught by full-time, permanent faculty."

Since course development and improvement are not part of the mandate for part-time lecturers, the department has relied on one or two tenured or tenure track faculty members to keep the technology up-to-date for General Chemistry. These faculty have introduced some new equipment and experiments but the task is large. We hope a new faculty member with a major focus on General Chemistry will be able to work with the other tenure track instructors to continue to introduce innovative and modern ways of learning basic chemistry principles into the General Chemistry laboratories. No one has been working on the technology for the Quantitative Analysis course, except the department Instructional Support Technicians. Because this course introduces instrumentation to the students it is imperative to have a regular faculty member available to design new experiments. We cannot continue to use experiments developed 15 years ago and hope to be current. There are also instruments that the department should acquire to remain current, but no analytical chemist to apply for funding in those areas or to maintain the instruments if they were acquired. A new tenure track Chemistry position is needed to aid the current faculty in providing the instrumentation skills our students should acquire.

The Chemistry Master's program has averaged 50 students over the last five years, with an average of 13 graduating each year. A new tenure track faculty member is needed to help supervise research and literature projects for the graduate program. The new Chemist would be expected to establish a research program in analytical, physical or biophysical chemistry and provide new types of projects for our students. A new faculty member in the area of Analytical / Physical Chemistry is needed to maintain and improve the quality of our graduate program.

Student Demand:

Over the five year period from 2010 to 2014 the number of undergraduate chemistry majors increased 31%, from 62 in Fall 2010 to 81 in Fall 2014. The number of biochemistry majors increased 34%, from 88 in Fall 2010 to 118 in Fall 2014. The Master of Science program peaked in 2012 with 58 students and declined to 42 in 2014. (The decline is due to more rigorous enforcement of the admission requirements during the acceptance process to better ensure student success). The overall department Fall FTES rose 16% from 2009 to 2013 (293 to 340). A number of chemistry courses are required for other degree programs (Biological Sciences, Physics, Engineering, Environmental Science, Nursing, Health Science). Increases in these programs have contributed to increases in chemistry FTES. As mentioned above, General Chemistry has been particularly impacted by increased enrollments in the Sciences.

Faculty Composition

a. Over the last five years one tenured faculty member retired (2009); another completed service in the Faculty Early Retirement Program (2011). Three new tenure track faculty were hired, two in 2013 and one in 2014. The net was a gain of 1.5 positions. However, earlier losses from a death in 2006 and the completion of five years of FERP by two faculty in 2007 had never been recovered. The department now has one fewer tenure track faculty members than it had in 2006

(9 vs. 10). However, FTES has increased 25% and the number of majors increased from 181 to 241. Our request for 2015-2016 is based on need arising from increased enrollment.

b. In 2013, the latest year for which the Fall numbers are available, the ratio of tenured/tenure track faculty to total FTEF for the Department of Chemistry and Biochemistry was 0.46. This number is expected to be a little higher for 2014 because a new faculty member started in Fall 2014 and taught nearly a full load.

c. Increased enrollments in most of the chemistry courses have resulted in a large percentage of the course sections, particularly at the lower division level, being taught by part-time lecturers or teaching associates. There is a shortage of faculty to maintain and upgrade the chemistry programs, particularly in the areas of general chemistry and analytical chemistry. General Chemistry is a key course for the training of science majors and Analytical Chemistry is an important area of training for students planning to work in industry. It is a real disservice to our students to leave these courses in the hands of part-time instructors with no mandate to see that the laboratory and instrumentation curriculum is up-to-date.

d. The total number of Chemistry and Biochemistry majors in the Fall Quarter headcount for 2010 was 194; for Fall 2014 it was 241. This includes both undergraduate and graduate students. Unofficial department records indicate there are about 45 Chemistry minors. The ratio of majors to tenure/tenure track faculty is 241 / 9 or 26.8.

e. The department Student Faculty Ratio (SFR) for Fall 2013 (latest available) was 24.90. The College of Science SFR was 27.63.

f. The five year hiring plan included in our last Academic Program Review (2012-13) called for the addition of four new faculty members between 2013 and 2018. The fields of expertise needed at the time were Biochemistry, Inorganic, Organic and Analytical Chemistry. The shortage of Biochemistry faculty had led to the use of part-time lecturers for upper division majors level classes in that area and the department had no one specifically trained in either Inorganic or Analytical. Moreover, a senior Organic Chemist in the department had retired, forcing the use of part-time lecturers for some of the majors-level and graduate courses in organic chemistry. Searches for a Biochemist and either an Inorganic or Analytical Chemist were in progress during 2012-2013. Both were successful and two new faculty members with training in Biochemistry and Inorganic Chemistry respectively were hired for Fall 2013.

In Spring of 2013 a request for a new tenure track position in Organic Chemistry was approved. However, a key Physical Chemist on our faculty unexpectedly decided to take a Professional Leave for the 2013-2014 academic year. Since he had accepted a faculty position at Eastern Washington University it appeared unlikely he would return to CSU East Bay. His departure precipitated a crisis for our Physical Chemistry curriculum and exacerbated the shortage of regular faculty to teach General Chemistry. We obtained permission to switch the Organic Chemistry search to a Physical Chemistry search and anew Physical Chemist was hired for Fall 2014.

These events mean we are still lacking an Analytical Chemist and the retired Organic Chemist has not been replaced. The burgeoning General Chemistry enrollments and the need for faculty to cover physical chemistry courses in the graduate program have led to sentiment for another Physical Chemist as well. However, because we have a strong need for an individual who can work on our instrumentation curriculum, we are requesting to search for either an Analytical Chemist or an experimental Physical Chemist or Biophysical Chemist. Ideally we would hire an Analytical Chemist who could participate in the General Chemistry curriculum. However, by expanding the area to also include experimental Physical Chemistry or Biophysical Chemistry we hope to attract a wide pool of quality candidates.

The loss of one of our faculty to Eastern Washington University has caused us to amend our Five Year Plan to include the need for a fifth hire, an Organic Chemist to replace the retiredsenior faculty member. As mentioned above, because of his departure we are now using part-time lecturers to teach some of the majors-level and graduate organic chemistry courses. This puts us out of compliance with the accrediting agency for our B.S. Chemistry degree (American Chemical Society) and needs to be redressed.

Curriculum

a. Eleven of the 50 regular courses (22 %) offered by the Chemistry and Biochemistry Department satisfy General Education requirements. The department hopes to add more GE courses in the near future. If this request is approved the new faculty member will be expected to contribute to the GE curriculum.

b. Online teaching would not be a strict requirement of this position but the new faculty member would be encouraged to develop online courses where appropriate. Every faculty member in the department, including this new hire, is required to teach at other campus sites if our program makes that necessary. A few years ago the laboratory facilities on the Concord campus were outfitted for the teaching of Pre-Nursing chemistry courses, which have been taught there since 2008. In Fall 2014 the two Pre-Nursing courses were consolidated into one large unit course, which was taught on the Concord campus as well as on the Hayward campus. A new faculty hire would be required to teach on the Concord campus if the assignment of courses made it necessary.

c. The position would provide a central component of the educational experience for students majoring or minoring in Chemistry or related fields. As mentioned above, the new faculty hire would teach General Chemistry and Analytical Chemistry. General Chemistry is required for several science majors and is the major foundational course in Chemistry. Analytical chemistry is taken by chemistry and biochemistry majors and students minoring in chemistry. Because part-time lecturers are now teaching the majority of the lower division classes in chemistry, the quality of instruction for young students has been compromised and a new analytical or physical chemist is needed to restore the teaching balance. The new hire would also contribute to the M.S. Chemistry curriculum by teaching advanced courses and providing research supervision.

d. The department has a long-standing assessment plan. It lists general learning outcomes for each undergraduate program (Chemistry and Biochemistry) and for the M.S. Chemistry degree. Key required and capstone courses for each program were chosen for assessment and specific course outcomes have been established for those courses. The assessment methods vary depending on the type of course, but include standardized exams, embedded exam questions, and analysis of capstone exercises and communication proficiency. Assessment data has been collected for selected courses for the last ten years.

Last year five year assessment plans were developed for each of our programs in collaboration with the CSCI Educational Effectiveness Task Force (EETF). The plans outline the general program learning outcome(s) and the specific courses to be assessed each year, beginning in 2013-2014 and going through 2017-2018. The general program outcomes are matched with the university Institutional Learning Outcomes (ILOs) and the plans attempt to cover all of the department learning outcomes as well as the university ILOs. The results for 2013-2014 were presented to the CSCI EETF and to the Academic Senate through the Annual Program Report for 2014. The individual chosen for the requested faculty position would be involved in assessing courses, analyzing the results in collaboration with other faculty and making course and program adjustments if appropriate.

Scholarship

a. The potential for scholarly success should be high as the individual chosen will be expected to have graduate training in analytical, physical or biophysical chemistry and be prepared to establish a research program appropriate for undergraduate and Master's level students. In the past most applicants for tenure track positions in our department have had postdoctoral experience as well. Our recent hires have all established active research programs and published in peer-reviewed scientific journals, and students working with them have given research presentations scientific meetings. It is anticipated that the new hire would attain a similar level of scholarly success.

b. Our two recent hires (Fall 2013) applied for external and internal support soon after arriving at CSUEB. Both have been awarded internal grants through the Faculty Research Support Program. One was awarded an Undergraduate New Investigator Grant from the American Chemical Society (ACS) Petroleum Research Fund for $55,000 and a subcontract from Lawrence Livermore National Laboratory. Other faculty in the department have been successful in obtaining large external grants from agencies such as the National Science Foundation and the Bechtel and Broadcom Foundations. It is anticipated that a new hire would achieve similar success with external/internal funding.

c. Replacement is not critical to the scholarly activity of units outside the College of Science. Scholarly collaboration with faculty within the College is likely, depending on the professional interests of the new faculty member. Currently five of the nine Chemistry and Biochemistry faculty members collaborate with faculty in other departments within the College of Science.

d. Over the last five years the faculty of the Chemistry and Biochemistry Department have helped to increase FTES by teaching larger classes and have supported and maintained an active Master's program by supervising an average of six Master's students each at any given time with no compensation. They have helped our constantly turning over pool of lecturers "learn the ropes," especially with regard to laboratory procedures and safety. At the same time they have willingly taken on the increasing burden of committee work and special projects that keep the university functioning smoothly and enhance its reputation.

e. Seven of our nine Chemistry and Biochemistry faculty have been successful in obtaining external funding from government agencies and private industry over the last few years. (The other two faculty members were recently hired, in 2013 and 2014, and are expected to be similarly successful in obtaining external funding). The various awards have been used for individual and collaborative research projects involving students, to purchase large instruments, and for curriculum development and outreach activities.

Recruitment

a. In preparing our recruitment plan we will include the widest possible circulation of the position announcement. We will directly contact Chairpersons in departments at universities and colleges that are known to produce high-quality minority Ph.D. Chemists and Biochemists and we will post the position on the websites of established science organizations with minority membership such as SACNAS (Society for Advancement of Chicanos and Native Americans in Science) and The Black Collegian Online. We will also consult with the CSUEB Diversity and Equity Liaison Officer for additional suggestions.

b. We do not have a pressing need for a senior hire.

c. We would be happy to do a combined advertisement with another department that wishes to advertise in Chemical and Engineering News or Science and on the web sites mentioned in section a.

New Tenure Track Faculty Request: Justification for a Physical or Analytical Chemist to Start Fall 2017
Department of Chemistry and Biochemistry
December 2015

Overview:

This is a request for a tenure track faculty position for a Physical or Analytical Chemist. Areas of research specialization for the new faculty member might include environmental science, spectroscopy, forensic chemistry, materials science, polymer chemistry, nanotechnology or others.

The Department of Chemistry and Biochemistry offers seven undergraduate degree options in Chemistry and Biochemistry, a Minor in Chemistry and a Master of Science degree in Chemistry. A number of the undergraduate chemistry major courses are also requirements for students in other science majors. The department offers additional specialized service courses for Pre-Nursing, Health Science and Kinesiology majors, and for several of the Biological Science options. Eleven chemistry courses satisfy general education requirements.

Currently there is one Physical Chemist and one Biophysical Chemist among the department faculty; it is likely that an Analytical Chemist will be hired for Fall 2016. Nevertheless, based on our inability to cover the all the courses traditionally taught by faculty trained in physical or analytical chemistry (such as General Chemistry, Analytical Chemistry, Physical Chemistry and graduate courses), the department is in need of another Physical or

Analytical chemist. There is also need for an Organic Chemist since some majors-level and graduate courses in organic are taught by part-time lecturers. However, the department has decided that the greater need is for another Physical or Analytical Chemist and we are therefore requesting a position in one of these areas.

The new faculty member would be expected to strengthen the department's ability to maintain currency in instrumentation, which is covered throughout the curriculum, and provide the critical mass of regular faculty needed to modernize the experiments in the general, analytical, inorganic and physical chemistry laboratory courses. The new person would also contribute to the teaching of Introductory Chemistry, Pre-Nursing Chemistry and/or General Education courses, currently all taught by part-time lecturers.

An important offering by the department is the year-long freshman General Chemistry series. The courses in this series have always had large enrollments since they are requirements for several science majors (Chemistry, Biochemistry, Biological Sciences, Physics, Engineering, Health Science, Earth and Environmental Science). In recent years enrollments have been steadily increasing (680 students in 2007-2008, 877 students in 2013-2014, 1037 students in 2014-2015, and 1114 projected for 2015-2016) to the point where there are not sufficient regular faculty to cover even very large sections. Currently about half the General Chemistry lecture classes are taught by part-time lecturers and more than 90% of the laboratory sections are taught by lecturers or teaching associates. In addition to compromising the quality of the education provided for the science majors, this puts the department out of compliance with the accrediting agency for our B.S. Chemistry degree (American Chemical Society). Individuals with expertise in physical or analytical chemistry have traditionally taught General Chemistry. A new tenure track faculty member in one of those areas would allow the department to better serve the students who take General Chemistry as a major requirement, both by providing quality instruction in the lecture sections (and more of the lab sections) and by providing the necessary expertise to upgrade the experiments for the laboratory components. A new tenure track faculty member is also needed to better meet the demand for research supervision from students in the Chemistry Master's program and to help improve the chemistry general education curriculum.

Strategic goals:

Our program aims are well aligned with the university mission of providing an academically rich learning experience that prepares students to realize their goals, pursue meaningful work and contribute to their community. In terms of the undergraduate and graduate Chemistry degrees, we strive to offer a broad range of chemistry courses that cover basic principles but also explore specialized areas and include recent advances. We want our graduates to be prepared to succeed in a variety of career choices. We recognize the fast pace of research in chemistry, and try to prepare our students to embrace new concepts and to appreciate advances in experimental methods and instrumentation. In our courses we encourage students to think critically about the use of chemicals in society and about the responsibilities of scientists to contribute to societal issues relating to chemistry.

The data available from the Institutional Research, Analysis and Decision Support website for Fall 2014 indicate that only 55.4% of the department course sections were taught by tenured or tenure track faculty; 44.6% were taught by part-time lecturers or teaching associates. Similar percentages were taught by non-tenure track faculty throughout 2014-2015. However, because of the recent hiring of new tenure track faculty members, the alarming trend of having part-time lecturers teach upper division majors-level courses has begun to reverse. A comparison of the data for Fall 2014 with earlier years shows that the number of upper division and graduate sections taught by lecturers decreased from a range of 6 to 11 for 2009-2012 to a range of 4 to 7 for 2013 and 2014. This number should drop further when the current tenure track hire (start date Fall 2016) becomes assimilated into the teaching program. However, the lower division numbers remain dismal, with 34 out of 43 sections taught by part-time lecturers or teaching associates in Fall 2014. Similar numbers apply throughout 2014-2015 and in Fall 2015.

A number of chemistry courses are taken by students in other degree programs such as Biological Sciences, Physics, Engineering, Earth and Environmental Sciences, Pre-Nursing, Health Science and Kinesiology. Growth in these programs has led to significant increases in enrollments in chemistry courses. The increased interest in chemistry has led to a shortage of tenure track faculty in the department available to teach the lecture sections. A new chemistry position is needed to bring the percentage of department courses taught by tenured or tenure track faculty to the system-wide target of 75%. The addition of a new tenure track physical or analytical chemist will allow the department to restore excellence in teaching and provide modern research opportunities for graduate students.

Needs served by the position:

The most pressing needs to be served by the requested position are: i) the acquisition of another qualified instructor to teach majors-level General Chemistry and Physical Chemistry courses; ii) addition of a faculty member qualified to upgrade the laboratory curriculum for General Chemistry and Analytical Chemistry, including department instrumentation; and iii) the addition of supervisory capacity for research and literature projects for Master's students.

As mentioned above the number of students now matriculating in the year-long General Chemistry series is very large (1037 in 2014-15). General Chemistry supplies the chemical foundation not only for chemistry and biochemistry majors but also for students majoring in other sciences and pre-Health Professional students. As such, it is an important course and deserves appropriate attention from the department. As a result of earlier retirements, increasing enrollments and several years with no tenure track hires, about half the General Chemistry lecture courses and 90% of the laboratory sections are taught by part-time lecturers or teaching associates. This means many of the science majors will not have a regular faculty member for lecture and most will never have a regular faculty member as lab instructor anytime during the year-long series.

At present we do not have enough physical chemists to teach our majors-level and graduate physical chemistry courses. One of the biochemists has been teaching part of the physical chemistry series as a stop gap measure. We will be hiring an analytical chemist for Fall 2016 and that person will teach our lower division Quantitative Analysis course, which is taken by the chemistry and biochemistry majors and approximately 45 students minoring in chemistry each year. Quantitative Analysis is the course where students are first introduced to chemical instrumentation. Since we have been without an analytical chemist for many years it may be unrealistic to put the full burden of improving the teaching of instrumentation on this individual. Given these needs, we hope to hire either a physical or analytical chemist, or preferably an individual with expertise in both areas.

Since course development and improvement are not part of the mandate for part-time lecturers, the department has relied on one or two tenured or tenure track faculty members to keep the technology up-to-date for General Chemistry. These faculty have introduced some new equipment and experiments but the task is large. We hope a new faculty member with a major focus on General Chemistry will be able to work with the other tenure track instructors to continue to introduce innovative and modern ways of learning basic chemistry principles into the General Chemistry laboratories.

The Chemistry Master's program has averaged 50 students over the last five years, with an average of 13 graduating each year. A new tenure track faculty member is needed to help supervise research and literature projects for the graduate program. The new Chemist would be expected to establish a research program in physical or analytical chemistry and provide new types of projects for our students. A new faculty member is needed to maintain and improve the quality of our graduate program.

Student Demand:

Over the five year period from 2010 to 2014 the number of undergraduate chemistry and biochemistry majors increased 33%, from 150 in Fall 2010 to 199 in Fall 2014. The Master of Science program peaked in 2012 with 58 students and declined to 42 in 2014. (The decline is due to more rigorous enforcement of the admission requirements during the acceptance process to better ensure student success). The annualized department FTES rose 21% from 2010-11 to 2014-15 (281 to 341). A number of chemistry courses are required for other degree programs (Biological Sciences, Physics, Engineering, Environmental Science, Nursing, Health Science). Increases in these programs have contributed to increases in chemistry FTES. As mentioned above, General Chemistry has been particularly impacted by increased enrollments in the Sciences.

Faculty Composition

a. Over the last five years one tenured faculty member left the university (2015) and one other completed service in the Faculty Early Retirement Program (2011). Three new tenure track faculty were hired, two in 2013 and one in 2014, and another will be hired for Fall 2016. These hires have finally allowed us to recover from earlier losses that were not addressed during the recession, i.e. a death in 2006 and the completion of five years of FERP by three faculty members (in 2007 and 2009). If the current search is successful the department will have the same number of tenure/tenure track faculty members in 2016 as it had in Fall 2006. However, FTES has increased 25% and the total number of majors increased from 181 to 241. Our request for 2016-2017 is based on need arising from increased enrollment.

b. In 2014, the latest year for which the Fall numbers are available, the ratio of tenured/tenure track faculty to total FTEF for the Department of Chemistry and Biochemistry was 0.49. This number is expected to improve for 2016-2017 if the current search is successful.

c. Increased enrollments in most of the chemistry courses have resulted in a large percentage of the course sections being taught by part-time lecturers or teaching associates. This is occurring throughout the curriculum in both lower and upper division majors-level courses, as well as in graduate courses and general education courses. There is a shortage of faculty to maintain and upgrade the chemistry programs, especially in the areas of general chemistry, physical chemistry and analytical chemistry. General Chemistry is a key course series for the training of science majors. It is a real disservice to our students to leave this course in the hands of part-time instructors with no mandate to see that the laboratory curriculum is up-to-date.

d. The total number of Chemistry and Biochemistry majors in the Fall Quarter headcount for 2010 was 194; for Fall 2014 it was 241. This includes both undergraduate and graduate students. Unofficial department records indicate there are about 45 Chemistry minors. The ratio of majors to tenure/tenure track faculty is 241 / 9 or 26.8. If the current search is successful we will have 10 faculty members as of Fall 2016 and the ratio of majors to tenure track faculty will likely decrease slightly.

e. The department Student Faculty Ratio (SFR) for Fall 2014 (latest available) was 22.8. The College of Science SFR was 27.2.

f. The five year hiring plan included in our last Academic Program Review (2012-13) called for the addition of four new faculty members between 2013 and 2018. The fields of expertise needed at the time were Biochemistry, Inorganic, Organic and Analytical Chemistry. The shortage of Biochemistry faculty had led to the use of part-time lecturers for upper division majors level classes in that area and the department had no one specifically trained in either Inorganic or Analytical. Moreover, a senior Organic Chemist in the department had retired, forcing the use of part-time lecturers for some of the majors-level and graduate courses in organic chemistry. Searches for a Biochemist and either an Inorganic or Analytical Chemist were in progress during 2012-2013. Both were successful and two new faculty members with training in Biochemistry and Inorganic Chemistry respectively were hired for Fall 2013. A Physical Chemist was hired in 2014 but a faculty member in that area left the university in 2015. So the net gain since 2012 has been two new tenure track faculty members. Currently we have a search underway and hope to hire an Analytical Chemist for Fall 2016. If this happens we will have gained a net of three tenure track faculty members over the last several years. We would like to hire one more in order to meet the goals in our five year plan.

As explained above, we need both another Physical or Analytical Chemist and an Organic Chemist. The burgeoning General Chemistry enrollments, the need for faculty to cover physical chemistry courses in the graduate program and the importance of instrumentation in the overall curriculum have led to sentiment for another Physical or Analytical Chemist. In choosing Physical or Analytical we are shortchanging the Organic program a bit but it turns out that one of our Biochemists has training in organic chemistry and has been able to teach majors-level organic. We are still relying on part-time lecturers for some of the Organic Chemistry courses and the choice of a Physical/Analytical position was a difficult one but the somewhat desperate situation with General Chemistry and the need for tenure rack faculty to teach both undergraduate and graduate physical chemistry courses led to this decision by our faculty.

Curriculum

a. Eleven of the 50 regular courses (22 %) offered by the Chemistry and Biochemistry Department satisfy General Education requirements. The department hopes to add more GE courses in the near future. If this request is approved the new faculty member will be expected to contribute to the GE curriculum.

b. Online teaching would not be a strict requirement of this position but the new faculty member would be encouraged to develop online courses where appropriate. Every faculty member in the department, including this new hire, is required to teach at other campus sites if our program makes that necessary. A few years ago the laboratory facilities on the Concord campus were outfitted for the teaching of Pre-Nursing chemistry courses, which have been taught there since 2008. In Fall 2014 the two Pre-Nursing courses were consolidated into one large unit course, which was taught on the Concord campus as well as on the Hayward campus. A new faculty hire would be required to teach on the Concord campus if the assignment of courses made it necessary.

c. The position would provide a central component of the educational experience for students majoring or minoring in Chemistry or related fields. As mentioned above, the new faculty hire would teach General Chemistry and Physical and/or Analytical Chemistry. General Chemistry is required for several science majors and is the major foundational course in Chemistry. Physical chemistry is taken by chemistry and biochemistry undergraduate and graduate students. Analytical chemistry is taken by chemistry and biochemistry majors and students minoring in chemistry. Because part-time lecturers are now teaching the majority of the lower division classes in chemistry, the quality of instruction for young students has been compromised and a new physical or analytical chemist is needed to restore the teaching balance. In addition to teaching graduate courses, the new hire would also contribute to the M. S. Chemistry curriculum by providing research supervision.

d. The department has a long-standing assessment plan. It lists general learning outcomes for each undergraduate program (Chemistry and Biochemistry) and for the M.S. Chemistry degree. Key required and capstone courses for each program were chosen for assessment and specific course outcomes have been established for those courses. The assessment methods vary depending on the type of course, but include standardized exams, embedded exam questions, and analysis of capstone exercises and communication proficiency. Assessment data has been collected for selected courses for the last ten years.

In 2013 five year assessment plans were developed for each of our programs in collaboration with the CSCI Educational Effectiveness Task Force (EETF). The plans outline the general program learning outcome(s) and the specific courses to be assessed each year, beginning in 2013-2014 and going through 2017-2018. The general program outcomes are matched with the university Institutional Learning Outcomes (ILOs) and the plans attempt to cover all of the department learning outcomes as well as the university ILOs. The results for 2014-2015 were presented to the CSCI EETF and to the Academic Senate through the Annual Program Report for 2015. The individual chosen for the requested faculty position would be involved in assessing courses, analyzing the results in collaboration with other faculty and making course and program adjustments if appropriate.

Scholarship

a. The potential for scholarly success should be high as the individual chosen will be expected to have graduate training in physical, biophysical or analytical chemistry and be prepared to establish a research program appropriate for undergraduate and Master's level students. In the past most applicants for tenure track positions in our department have had postdoctoral experience as well. Our recent hires have all established active research programs and published in peer-reviewed scientific journals, and students working with them have given research presentations scientific meetings. It is anticipated that the new hire would attain a similar level of scholarly success.

b. Our recent hires (Fall 2013 and Fall 2014)) applied for external and internal support soon after arriving at CSUEB. Two have been awarded internal grants through the Faculty Research Support Program. One was awarded an Undergraduate New Investigator Grant from the American Chemical Society (ACS) Petroleum Research Fund for $55,000, a subcontract from Lawrence Livermore National Laboratory and a Course Redesign and Technology Initiative grant from the Chancellor's Office. Other faculty in the department have been successful in obtaining large external grants from agencies such as the National Science Foundation and the Bechtel and Broadcom Foundations. It is anticipated that a new hire would achieve similar success with external/internal funding.

c. Replacement is not critical to the scholarly activity of units outside the College of Science. Scholarly collaboration with faculty within the College is likely, depending on the professional interests of the new faculty member. Currently five of the nine Chemistry and Biochemistry faculty members collaborate with faculty in other departments within the College of Science.

d. Over the last five years the faculty of the Chemistry and Biochemistry Department have helped to increase FTES by teaching larger classes and have supported and maintained an active Master's program by supervising an average of six Master's students each at any given time with no compensation. They have helped our constantly turning over pool of lecturers "learn the ropes," especially with regard to laboratory procedures and safety. At the same time they have willingly taken on the increasing burden of committee work and special projects that keep the university functioning smoothly and enhance its reputation.

e. Seven of our nine Chemistry and Biochemistry faculty have been successful in obtaining external funding from government agencies and private industry over the last few years. (The other two faculty members were recently hired, in 2013 and 2014, and are expected to be similarly successful in obtaining external funding). The various awards have been used for individual and collaborative research projects involving students, to purchase large instruments, and for curriculum development and outreach activities.

Recruitment

a. In preparing our recruitment plan we will include the widest possible circulation of the position announcement. We will directly contact Chairpersons in departments at universities and colleges that are known to produce high-quality minority Ph.D. Chemists and Biochemists and we will post the position on the websites of established science organizations with minority membership such as SACNAS (Society for Advancement of Chicanos and Native Americans in Science) and The Black Collegian Online. We will also consult with the Chair of the Faculty Diversity and Equity Committee and the University Diversity Officer for additional suggestions.

b. We do not have a pressing need for a senior hire.
c. We would be happy to do a combined advertisement with another department that wishes to advertise in Chemical and Engineering News or Science and on the web sites mentioned above.

REQUEST TO HIRE NEW TENURE TRACK FACULTY FOR FALL 2018

Background and Timeline:
During 2017-18 we will be recruiting for our first class of faculty who will only teach under Semesters at CSU East Bay. We hope that departments and deans will hire with their transformed curricula in mind, and will be thinking ahead of new programs or concentrations that need to be offered in a changing economy. In addition, Chairs and Deans should be mindful of the 2025 mandate, which calls on all of us to improve the graduation rates for 2-year transfer and 4-year native matriculants, and to eliminate the gap that exists for underrepresented minority students.

Affinity hires will be suspended during the hiring year of 2017-18 as we work to refine the RTP document and other policies in light of interdisciplinary faculty work.

Requests for hires, 2017-18 must go through the normal channels from Chair, to Dean, to Provost, the timelines will be:

February 10, 2017	Departments/Library submit tenure-track hire requests to Dean.
February 20, 2017	Deans submit ranked requests to Provost
March 1, 2017	Provost releases list of authorized recruitments to the Colleges/Library

Overview of Hire:

Department: ____**Chemistry and Biochemistry**

Area of specialization: ____**Physical Chemistry**

Rank at hire: X Assistant professor ☐ Associate professor ☐ Full professor

Tenure status at hire: ☐ Probationary (untenured) ☐ Tenured

Department Chair: ____
Signature Date

Narrative Justification

Please answer the following 6 questions in 6 short paragraphs:

1. How will this position affect graduation rates and achievement gaps in the department?
The Chemistry and Biochemistry Department offers seven undergraduate degrees in either chemistry or biochemistry and a Master's degree in Chemistry. Because chemistry is also required for a number of other science degrees (Biological Sciences, Engineering, Nursing, Physics, Health Science, Kinesiology, Earth and Environmental Science) as well as for degree options in Geography and Liberal Studies, the department has a significant service course component. Additionally, the department offers several courses that satisfy General Education requirements or are discipline courses for a freshman learning community. A new faculty member with expertise in physical chemistry can fill several gaps in our major curricula by

teaching both undergraduate and graduate courses in this area and by participating in the year long General Chemistry curriculum. While General Chemistry is required for Chemistry and Biochemistry majors, it is also the most important chemistry course required by other science major programs. The ability to provide competent teaching in General Chemistry affects the graduation rates of not only Chemistry and Biochemistry majors but those of other science majors. Currently about 500 students per year take General Chemistry and we have been forced to use lecturers to teach the majority of the lecture sections and virtually all of the laboratory sections. A new physical chemist who could teach General Chemistry and help motivate students by working to modernize the laboratory curriculum should have a very positive effect on graduation rates.

2. **What implications does this position have for your baseline budget? How much one-time funds will be needed.**

Based on a scenario where an Assistant Professor with a starting salary of $70,000 partially displaces a lecturer with a marginal instructional cost of $1,226/WTU, this position will increase the college's baseline budget by $40,576 per year for the first two years. In subsequent years when the new TT faculty teaches a full load, the extra cost will decrease to $25,864. In cases where the new faculty member replaces a retiring Full Professor, the impact on the college budget is likely to be net positive, with the magnitude dependent on the retiring faculty's salary. One time start funding will depend on the specific research needs of the successful candidate.

3. **What immediate needs must (and will) be met by this position? In answering, please address factors such as accreditation requirements, and/or curricular needs.**

At present an alarmingly high number of our course sections are taught by part-time lecturers. For example, during Winter 2017 part-time lecturers are teaching 39% of our lecture sections and lecturers or teaching associates (TAs) are teaching 71% of our laboratory sections. The data provided below for Fall 2016 indicate that 43% of the total instructional FTEF was accounted for by lecturers, although the data do not include TAs. While we do have a number of excellent TAs and lecturers, we think students should experience a tenured or TT faculty lab instructor sometime in matriculating through our program. However, this doesn't happen until they reach upper division lab courses, which means students from other majors usually never have a tenured or TT lab instructor. In addition to many of the General Chemistry lecture sections, part-timers also teach Basic Chemistry, Introduction to College Chemistry (to Pre-Nursing, Geography and Liberal Studies majors), Organic Chemistry and several Biochemistry courses. The department needs a new faculty member. In our judgment a physical chemist would best meet our needs by covering the gaps in our physical chemistry program that will appear as we move into semesters, teaching General Chemistry and helping to modernize the General Chemistry lab program, teaching some of the Introduction to College Chemistry or Basic Chemistry sections, and allowing other faculty to be moved into Organic and Biochemistry courses.

4. **How will the proposed area of specialization factor into the Department's curriculum and overall agenda of scholarly/creative work?**

As we move into the semester system, the department will need instructors for several new courses, including a graduate Physical Chemistry course, a graduate Computational Chemistry course, an expanded Inorganic Chemistry Laboratory course, and an undergraduate Equilibrium Statistical Mechanics course, as well as for the converted existing physical chemistry curriculum.

As stated above we are short of tenured or TT faculty to teach and modernize General Chemistry, and we are also unable to cover Basic Chemistry and Introduction to College Chemistry with tenured or TT faculty. The proposed new faculty member would physical chemistry/inorganic area as well as General Chemistry and possibly Basic Chemistry or Introduction to College Chemistry. Many newly trained physical chemists are theoretical (hopefully teach some of the new courses in the computational) chemists and we are open to hiring in this area. Computational analysis is becoming an important tool in chemistry and a number of students in our graduate program have expressed an interest in this type of training. We currently have a computational inorganic chemist on our faculty and a new computational physical chemist would allow us to develop additional strength in this area.

5. Are there any anticipated retirements, departures, or other factors you feel to be relevant and necessary to include in this justification?

There are no retirements or departures pending at the moment.

6. Please indicate if you have or will need office space, lab space, and/or equipment for the new hire.

We do have office space for a new hire, recently acquired when several departments moved to the SF Building. We do not have a ready lab space for a new faculty member but do have some space currently housing instruments that could be turned into a computational lab with several student workstations. Also there is new space planned for our department after the first floor renovation; this will include a chemistry instrument room and half of a lab bench in a shared lab area. This space could possibly be used as a research area by a new faculty member. Physical chemists doing wet chemistry often utilize instrumentation and could likely use part of the new instrument room and the bench in the shared area as research space.

<u>Data</u>

The following data points are important in making a clear decision. James Hershey, Director of Institutional Research and Effectiveness at 5-4120, can help provide the data requested below.

1. Majors
    a. Total number of majors (Source: item A.4)

	Fall 2013	Fall 2014	Fall 2015
a. Total majors	255	241	225

Additional comments (if any):

2. Enrollment and Demand: Total enrolled across regular academic year (Source: sum of total enrollment)

	AY 13-14	AY 14-15	AY 15-16
Total enrolled	4,818	4,816	5,037

Additional comments (trends involving enrollment, wait lists, etc.):

3. Faculty
    a. Total headcount regular faculty
    b. Total headcount FERP or PRTB faculty

c. Total instructional FTEF, regular faculty
d. Total instructional FTEF, lecturer

	Fall 2014	Fall 2015	Fall 2016
a. Total regular faculty	9	8	9
b. Total FERP or PRTB faculty	-	-	-
c. Total instructional FTEF, regular faculty	9	8	9
d. Total instructional FTEF, lecturer	6.6	8.1	6.7

Additional comments (if any):

4. Student-faculty ratio
   a. Total FTES
   b. Total FTEF
   c. SFR

	Fall 2013	Fall 2014	Fall 2015
a. Total FTES	347.13	356.1	376.93
b. Total FTEF	13.67	15.39	16.42
c. SFR	25.39	23.15	22.96

Additional comments (if any): Although the department runs many lecture courses with large enrollments (e.g. 66 students up to 240 students), Chemistry and Biochemistry are laboratory sciences. The majority of our courses have an associated laboratory component with a maximum enrollment of 18, 22 or 24. These smaller laboratory section enrollments are dictated by the complexity of the experiments, the capacities of the laboratory classrooms, the need to maintain safe learning conditions for students working with chemicals, and the need to provide student training on expensive instruments where only one or two such instruments are available in the department. The laboratory sections are the primary reason our SFR is not higher. In 2013 the SFR for Chemistry and Biochemistry for the CSU system as a whole was 21.1. By comparison, the CSU East Bay SFR for Chemistry and Biochemistry was 25.39 in Fall 2013 and 22.96 in Fall 2015.

ea students for California jobs. It is clearly an enriching and inclusive place to learn, practice and collaborate in chemistry and biochemistry for students, faculty, and staff.