

Chemistry Department Self-Study

I. General Information.

A. Programs and Degree Options.

The chemistry department currently offers a BS degree in Chemistry and three BA degrees in chemistry with different concentrations including General, Biochemistry, and Forensic Chemistry. A four year flowchart of courses required by these degrees is included in the appendix as pages in the student advising handbook. The BS in Chemistry is an American Chemical Society (ACS) Certified Degree and is subject to very specific course and lab experiences. Since the last program review, the ACS revised its guidelines for certification of the BS chemistry degree. Our chemistry department meets the current expectation, although we constantly struggle to maintain our faculty teaching contact hours below the ACS acceptable level. In fact, the department in the past has found itself on probation due to a violation in this area. Both faculty and students value this certification enormously and have stated that they would not desire to teach in or attend a program ineligible for ACS certification (from last program review). The current ACS guidelines are provided in the appendix to this report.

The chemistry department currently offers two Master's of Science degrees in chemistry, including the new Master's with a concentration in Biochemistry. The MS in Biochemistry is a new program implemented since the last program review. This new degree option has proven to be popular with approximately one half of the incoming MS students selecting this program of study. The program utilizes two core courses from the traditional MS Chemistry program with Protein Biochemistry and Nucleic Acids added as the remaining two core requirements. Students select two electives from Chemistry or Biology graduate courses. All Chemistry MS degree options are thesis based and require extensive independent research under a chemistry faculty member's direction. During this review, the chemistry graduate committee performed a major revision to the graduate program policies. The policy changes were deemed necessary to improve implementation of the program and to increase student progress to the MS degree. Program summaries and course flow charts are provided in the appendix as pages in the Undergraduate Advising Handbook and Master's Student Handbook.

B. Pending Program.

The chemistry department is awaiting university approval of the new BS Biochemistry degree option submitted last year. We have been informed that our program has been approved by our President and is now at the Chancellor's office. The new program was developed through a creative utilization of some existing upper division courses required in the traditional BS Chemistry program and upper division Biology course work. The upper division chemistry courses will undergo some content modification to accommodate the BS biochemistry student population. For example, the Physical Chemistry Laboratory (CHEM 141) course will be modified to include biophysical experiment options, specialized data analysis techniques, and molecular modeling components in order to meet the needs of the BS Biochemistry students. In this course,

although a majority of assignments will be the same independent of degree option, some assignments will be specifically linked to the student's degree. We are hopeful to be able to formally begin to offer this degree option beginning Fall 2009. The chemistry department currently has several students pursuing this degree under the "Special Major" degree designation until the program is formally approved. A summary of the course requirements for this degree option is included in the appendix.

C. Future Programs.

The chemistry department has begun preliminary discussions regarding an MS degree in Science Education. The chemistry department's hire of a Chemistry Education faculty member, Dr. Jeffrey Paradis, with ongoing educationally based research combined with similar faculty hires in Biology, Physics, and Geology represents a potential nucleus for a multidisciplinary program. There are also preliminary discussions regarding a BA degree with a concentration in Environmental Chemistry.

D. New Courses.

Since the last program review, the chemistry department has added two new graduate courses in order to accommodate the new MS degree option in biochemistry which includes Protein Biochemistry (CHEM 260) and Nucleic Acids (CHEM 261). These are the two biochemistry specific courses required for all MS Biochemistry students. The other two core courses are selected from the MS Chemistry core options. Both of these courses were taught as "Selected Topics in Chemistry" (CHEM 250). In terms of "Special Topics in Chemistry" (CHEM 250), the addition of many new faculty with a variety of specialization has permitted the department to offer a wide range of courses under this title. For example, over the past six years we have offered topics such as Organometallic Chemistry, Environmental Chemistry, Advanced Organic Synthesis, Magnetic Resonance in Chemistry, and Advanced Topics in Chemical Education. In fact, we find that many senior level undergraduate students are increasingly interested in taking these courses to serve as one of their major electives. The department recently began surveying student interest in specific topics for the course in an attempt to offer the course topics in greatest demand. As a result, we have observed the enrollment in these courses increase. The other new course is (CHEM 5) which will be taught for the first time this spring. The syllabus for CHEM 5 is included in the appendix. The two faculty members, Dr. Linda Roberts and Dr. Katherine McReynolds, have designed an innovative course that is intended to teach the specific chemistry nursing students need through case studies and application based examples. We believe that this course is novel in its approach to teaching the nursing population.

E. Major Course Modifications.

The chemistry department hired a full-time faculty member with a research focus in chemical education. Dr. Jeffrey Paradis joined the department in 2002 and quickly began an almost complete revision of CHEM 106, "Chemical Concepts", the course taken by liberal studies students working to obtain the multiple-subject teaching credential. This course is formatted to contain a fifty minute lecture that meets once per week combined with two activity sessions. Dr. Paradis modified this course so that the students now

actually perform and learn chemistry content by performing the activities and experiments that they can take back into the classroom.

F. Faculty

The chemistry department has experienced an enormous change in faculty over the past ten years, much of this change taking place since the last program review. Most of this has occurred due to faculty retirement. The demographically young department currently has 16 full-time faculty and one full-time lecturer. The current faculty profile includes: 1 Full Professor (FERP ends Spring 2010); 2 Full Professors (one recently promoted Fall 2009); 6 Associate Professors; and 7 Assistant Professors (one resignation effective 1/09). The department employs several part-time faculty and up to approximately 10 graduate teaching assistants to cover the teaching schedule needed by chemistry. The full-time lecturer, Dr. Jeff Mack, taught with the department for five years prior to being converted to full-time lecturer. He has a Ph.D in physical chemistry from UC Santa Barbara, post doctoral experience, and considerable teaching experience. The Chemistry department strives to have the majority of the lecture courses, particularly upper division courses, taught by full-time faculty. All graduate courses are taught by full-time faculty. The chemistry department has a minimum of two faculty members per area of subspecialty which permits some variety in teaching assignments from one semester to the next and offers a broader perspective when modifying curriculum. The department anticipates only a couple of new hires over the next several years, one to replace the resignation of the inorganic assistant professor and one to replace the faculty member ending a FERP assignment. Table 1 lists the current full-time faculty and lecturer in the chemistry department and summarizes their faculty career at CSUS. All faculty had a Ph.D when hired and almost all had significant postdoctoral and or teaching experience prior to joining the department.

Table 1. Current faculty and full-time lecturer in the chemistry department.

Name	Lect.	Inst.	Asst.	Assoc.	Full	Empl.	Retire	Status		
Baker, Brad			2004			2004			PhD	Analytical
Crawford, Susan			1998	2004		1998			PhD	Physical
Dixon, Roy			2000	2004					PhD	Analytical
Feazell, Rodney			2007					Resigned	PhD	Inorganic
Gherman, Ben			2006			2006			PhD	Physical
Hill, James			1968	1973	1978	1968	2005	FERP	PhD	Inorganic
Kellen-Yuen, Cynthia			1999	2007		1999			PhD	Organic
Lucero, Claudia			2008			2008			PhD	Organic
Mack, Jeff	2005					2005			PhD	Physical
McCarthy, Mary		1997	1998	2005		1997			PhD	Biochemistry
McReynolds, Kathie			1999	2007		1999			PhD	Biochemistry
Miranda, James			2006			2006			PhD	Organic
Paradis, Jeff			2002	2007	1988	2002			PhD	Science Ed.
Ritchey, James			1977	1983		1977			PhD	Biochemistry
Roberts, Linda			1995	2001		1995			PhD	Biochemistry
Savage, Tom			2004			2004			PhD	Biochemistry
Spence, John			2004			2004			PhD	Organic

G. Faculty Research and Scholarly Activities.

The chemistry department is committed to providing high quality research experience to its undergraduate and graduate students. This commitment is reflected in the department's tenure and promotion policies that require faculty to maintain an independent research program that includes opportunities for student involvement in their ongoing research. It also requires faculty to make vigorous attempts to financially support their research through a minimum of one annual grant submission unless they are funded on a multiple year grant. Faculty must publish the results of their scholarly activities in a peer-reviewed journal in order to secure tenure. The department has shown great success in this area over the period being analyzed securing multiple external grants from NIH, NSF, Research Corporation, Petroleum Research Fund, and CSUPERB. The department has also been quite successful in securing internal release time, summer salary, and supply monies from the University Research and Creative Activity Program where we typically are awarded 2-4 awards per academic year. Unfortunately, this program has been cut in size which will result in greater competition for the remaining resources and a lower success rate. This program has helped the chemistry department enormously in the past by offering a mechanism to obtain some release time to obtain the preliminary data needed for external grant submission. We have also been successful in obtaining support from the Pedagogy Enhancement Program.

In 2005, the chemistry chair met with a representative from Research Corporation which has funded several faculty research projects in our department. Although the representative commented on the high quality research proposed by our faculty and the desire to see continued proposals from our department, he made a direct statement regarding the lack of college and university support for research on our campus and how this negatively impacted our potential for securing research funding. The representative clearly stated that the lack of institutional grant matching in the form of faculty release time, summer salary, and supply funding sent a strong message that faculty and undergraduate research was not highly valued on this campus. Although we have submitted numerous Research Corporation funding requests over the past 10 years, only three have been funded. Additionally, although we have been successful in securing initial grants from NIH in the form of Area Grants, we have yet to be successful in securing a renewal grant with the greatest criticism being the lack of publications resulting from the initial funding allocation. The involved faculty agonize over the lack of time to actually perform the research, write papers, and prepare proposals while teaching a full load of courses. Thankfully, the STEM initiative with the Office of Sponsored Projects have very recently helped by supplying a small amount of release time for faculty to submit research grants. We currently have a \$500K grant going to NSF and two more in the cue for subsequent submissions based upon these small awards. A similar matching program providing faculty release time with awarded grants would do a great deal to improve our continued success. A survey of faculty grant submission covering the past six years provided the following results for the eight faculty members who responded:

External grants submitted = 29 funded = 15 (approximately 50%)
Internal grants submitted = 48 funded = 33 (approximately 70%)

Corresponding to the increased vigor of research activity within the department, we have also shown an increase in the number of research presentations and publications associated with this work. Although the department has not been keeping annual count of the number of publications and presentations, we are currently beginning to do this through a "Chemistry Annual Report". Dr. John Spence compiled the first of these for the 2005-2006 time frame. We are currently working to update this for the 2006-2008 time period. The 2005-2006 report is provided in the appendix.

Faculty publications 1995- 2004 (9+ years) = 10 (7 with student authors)
Faculty publications 2004 – current (5 years) = 23 (12 with student authors)
Undergraduate student presentations 2005-2006 (1 year) = 27+
Graduate student presentations 2005-2006 (1 year) = 3+
Faculty presentations = 2005-2006 (1 year) = 28+ (not all accounted)

Although the statistics show that the chemistry department is showing a greatly improved success in the areas of research and external funding, there are a number of challenges associated with increasing or even maintaining this level of success. The largest area of concern is the fact that there are an increasing number of students who desire to work with faculty in research. In fact, examination of almost any current application to graduate school in chemistry will explicitly ask for the applicant to describe their activity and success in this area. This clearly illustrates that these experiences are becoming the norm rather than the exception in an undergraduate chemistry program. As a department, we agree that these are enormously beneficial for the student. However, as discussed under the **Student** section below, providing these experiences takes a great deal of faculty time for which no teaching credit is provided. With greater numbers of students demanding an opportunity to participate and a 12 unit teaching load, faculty can quickly find themselves overwhelmed by the time required. The department is concerned that overloaded faculty will have less time to write grants and publications as a result.

H. Faculty Workload.

The chemistry department bases its teaching schedule on 12 units of assigned teaching load. However, the fact that laboratory sessions are only allocated 2/3 of the WTU of a lecture course, faculty teaching a significant lab load can end up spending significantly more than 12 hours in the classroom. For example, 12 units of lab teaching assignment corresponds to approximately 18 hours of classroom contact time. Although the department must do everything possible not to assign this level of lab teaching in order to avoid violating the ACS certification guidelines, it is often unavoidable to keep a faculty member's classroom contact time below 12 hours if they are on a full 12 unit teaching load. Fortunately, the chemistry department faculty are diligent in applying for and securing internal and external funding to provide some release time for research activities. The chemistry department recently surveyed faculty workload. Most faculty (75%) responded. The questions and results are provided below.

Survey of Chemistry Faculty Workload:

1. How many hours **per week** do you spend:

a) teaching in lecture and lab classes?

Average: **12 Hours** (However 2/3 of the respondents were on 6-9 unit loads at the time).

b) preparing for lecture or lab teaching?

Average: **8 Hours**

c) grading?

Average: **5 Hours**

d) holding official and unofficial office hours?

Average: **5 Hours**

e) working with research students?

Average: **7 Hours** (range 1-10 hours depending on number of students)

f) working on research / scholarship yourself?

Average: **3 Hours**

g) working on tasks associated with lab management/ equipment maint. / safety?

Average: **2 Hours**

h) working on publications/ presentations / grants?

Average: **3 Hours**

i) advising (academic) undergraduate students?

Average: **2 Hours**

j) attending to department committee work / meetings / tasks?

Average: **2 Hours**

k) attending to college and university level committee work/ meetings/ tasks?

Average: **1.5 Hours**

l) working on other professional activities (outreach/ letters rec/ prof. orgs/...)?

Average: **2 Hours**

m) working at home in the evening and on weekends?

Average: **10 Hours**

Average number of hours/ week faculty reported working: **65 Hours** (range 50-86)

Faculty were given the opportunity to add comments at the end of the survey. All respondents stated that they do not feel like they have enough time to adequately engage in their professional lives to the extent that they desire. Most stated that the time to write publications, write grants, perform research, and work on major curricular changes were the items that suffered most.

I. Faculty and Department Outreach Activities.

The chemistry department faculty and students participate in a number of community outreach activities. Several faculty have participated in the "Expanding Your Horizons" event geared at increasing the science interest of middle-school aged girls. Several chemistry faculty have designed and lead activity sessions for this event over the past two years. The department also remains a very active player in the Regional Science Olympiad which has been held annually on our campus for many years. Our faculty routinely serve as event coordinators for this large scale event that brings hundreds of students to campus to compete in science events. Our students, particularly those in the Chemistry Club also volunteer for these events as well as doing their own outreach activities described below. Our department does its best to accommodate campus summer programs such as the Academic Talent Search that uses our lab rooms throughout the summer months. We have also given tours to school groups and assisted in judging at numerous local science fairs. Dr. Mary McCarthy, a biochemistry faculty member in our department plays a large role in outreach endeavors through her appointment as the Research Coordinator for the Science Educational Equity Program (SEE) and CSUS-Los Rio Community College District Science Transfer Project (STP). In this position, she helps to recruit and retain Sacramento State and community college students who face social, economic, and educational barriers to careers in the health professions, science research, and science teaching. She participates in numerous activities associated with this appointment including the development and implementation of a two- to three-week "Introduction to Science Research" Program for Sacramento State and Los Rios Community College students, every summer from 2003 to 2008 and several other events. The SEE office funds these activities and release time for Dr. McCarthy to have time to commit to these endeavors. Additionally, we have faculty members who periodically take high school students into their research labs. For example, Dr. Linda Roberts is currently working with two very motivated high school students.

J. Students.

The chemistry department currently has 352 students who are pursuing either an undergraduate or graduate degree in the chemistry department. Of this number, 298 students are pursuing an undergraduate BA or BS in chemistry, 28 are second Bachelor's students and 26 are Master's level students. The department has experienced a steady upward increase in enrollment over the past several years. Table 2 shows the span of chemistry major increase over the past four years. Figure 1 illustrates the trend including data from each year in the four year span. It is worthwhile to mention that while the greatest impact in terms of numbers of students is represented by the increase in those pursuing the BA/BS in chemistry, the largest increase in percentage is represented by the number of students returning to the university system in pursuit of a 2nd BA/BS in