

PROGRAM REVIEW 2008-2011

Division: Physical Sciences, Math, and Engineering
Department or Program: Chemistry
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I. Description and Mission of the Program

Which area(s) does this program considerably address (check all that apply):

Basic Skills Transfer Career/Technical Other (describe)

A. Provide a brief description of the program including any services provided and the program's mission.

The chemistry department currently offers courses in preparatory chemistry (Chem 50), general education chemistry (Chem 10), allied health chemistry (Chem 30A/B), general chemistry (1A/B/C), and organic chemistry (Chem 12A/B/C). All of the courses are both UC and CSU transferable, with the exception of Chem 50 which is only CSU transferable. All of the courses are composed of both a lecture and a laboratory component. We are projected to offer 96 sections of courses during the 2008-2009 academic year (27 sections in Fall, 28 in Winter, 26 in Spring, and 15 in Summer). Due to health and safety considerations, class section sizes are fixed by MOU at 28 students for all sections except for Chem 12A, 12B, or 12C, which are fixed at 26 students. Additionally, we employ roughly 7 students per quarter for roughly 50 hours per week as stockroom assistants.

Our mission is:

- To broaden students' knowledge of science in general and of chemistry specifically;
- To demonstrate the importance of chemistry in the global community and to the environment;
- To prepare university transfer students for a future careers in science;
- To help allied health students obtain technical degrees; and,
- To prepare medical students for entry into professional school.

B. Provide a summary of the program's main strengths.

Our program serves approximately 2,500 students each year in both daytime and nighttime, with a retention rate that has been above 85% since 2002; additionally, our success rate has been above 75% since 2002, which is markedly higher than the national norm in chemistry, as reported by the National Science Foundation. We have a diverse staff of dedicated full- and part-time instructors and an extremely competent stockroom manager and support staff. The Science Center offers modern laboratory facilities, accented by an organic chemistry lab room featuring fume hood space for each student to work in; combined with state-of-the-art laboratory equipment, our organic chemistry lab matches the environment often found in research facilities. Thanks to the extensive range of equipment acquired or upgraded in connection with the construction of the Science Center in 2004, we have a robust instrumental lab program that is superior to many other community colleges in the State and that is usually available only to upper-division students at four-year institutions.

C. Provide a summary of the program's main areas for improvement.

One of the most common complaints about our program is the inability of many students to secure spaces in our classes. For example, although we have nearly 700 students currently enrolled for the Spring 2009 quarter, there are roughly 300 students currently on waitlists for those same courses – 42% beyond the number of students actually enrolled – with an unknown but vocal number of additionally students unable to add onto the wait lists. Assuming that all students have an equal likelihood of remaining in the courses, this means at least a third of students who wish to enter are program are unable to do so. As discussed below, budgetary and staff limitations currently prevent the program from expanding to accommodate those students, which has a domino effect on other courses, particularly the biological sciences and allied health courses for which chemistry is a prerequisite. We are cognizant that expansion of our program must be in step with campus goals for growth and enrollment and that the cost of chemicals and waste disposal must also be taken into account; that being said, it is often extremely difficult for students to enter and complete our program within any predictable timeframe, especially for those students that do not qualify for any of the various forms of early registration.

Our other primary area of improvement relates to the reassessment of our curriculum, particularly in regards to our laboratory program. Although our courses fully articulate with the majority of in-state institutions and we do update our curriculum in a timely fashion, it has been some time since the department has entered into a serious and detailed discussion of all of the topics and outcomes contained in individual courses in comparison to similar courses at other institutions. Similarly, it has been some time since the laboratory programs for our introductory and general education courses (Chem 50 and Chem 10) have been overhauled. Our intention is to review those experiments in Spring 2009 to create a lab program that is more engaging to these entry-level students with implementation hopefully beginning in Fall 2009.

D. What are your expected outcomes (such as learning outcomes, transfer, career goals, certificate and degrees) for students in your program?

Although the courses we offer are somewhat diverse in terms of the content presented and the skill developed, the thrust of our program can be reduced to the following four outcomes:

- To predict the reactivity of an element or molecule based fundamental principles of atomic and molecular structure;
- Apply principles of stoichiometry and chemical combination to calculate the yield of a chemical reaction or the molecular structure of an unknown compound;
- To evaluate the likelihood that a chemical reaction will occur and predict the resulting products that will form using key principles of kinetics, thermodynamics, and equilibrium; and,
- To appreciate the role of chemistry in understanding biological processes, industry, and maintenance or reclamation of the environment.

Although our program does offer several sections of a general education course (Chem 10), the majority of our students are taking our courses to either satisfy transfer requirements or to complete requirements for some form of medical certification. In relation to transfer, our goal is then to ensure that we thoroughly prepare our students for the subsequent lower- or upper-division courses they will be taking. Since a B.A. or B.S. is normally required for even entry-level jobs in chemistry and since the majority of our students are solely focused on transfer, we do not currently offer any form of certificate or degree, although we are currently discussing the option of implementing a chemistry degree.

II. Retention and Growth

A. How has the program responded to the institutional goal of increased access, growth and retention?

Our department has demonstrated increased growth and retention above the national norms for science students. Our 2008 overall enrollment has increased by 10.4% since 2002. We serve a large number of students: for the 2005-2006 academic year, our enrollment was 2,375 students; for the 2006-2007 academic year it was 2,420 students, and for the 2007-2008 academic year it was 2,444.

Our retention rates have remained consistently high, above 85% for the last six academic years. This is very close to the targeted goal of 90 % (The 2007-2008 retention rate was 88%). Our success rates have also been especially high, near 75% or above for the last six academic years. The student success rates are especially notable considering the national average for students obtaining a bachelor of science in the Science, Technology, Engineering and Mathematics (STEM) related fields is only about 60% (source: National Science Foundation).

In terms of growth, the department has expanded the number of sections it offers since the last program review. We now currently offer 98 sections in comparison to 2002-2003 when we only offered 82. Additionally, the full-time FTEF for our department has increased 20% from 3.66 in 2002-2003 to 4.40 in 2007-2008. Our section offerings are dictated by availability of lab space and lab support. Even though we have already grown by 10% in the last six years, we still have the potential and student demand (waiting lists for all chemistry classes are consistently in the double digits) to expand our program to offer more lab sections. However, we are unable to do so due to limitations of available resources, i.e., budget and personnel shortage. In terms of access, we already offer courses throughout the day (from 7:30 AM to 10:20 PM), however we will be unable to offer courses in the evening during the summer due to the lack of a stockroom technician and, for similar reasons, we are unable to offer weekend lab courses.

B. How has the program responded to the institutional goal of increased access, growth and retention specifically for the identified targeted populations of African Ancestry, Latino/a, and Filipino/a students?

Comparing two academic years, 2004-2005 and 2007-2008, for which we have been provided statistics, we have increased the number of African American students from 1.4% to 2.3% in comparison to the total number of students for each year. For Hispanic students the numbers increased from 4.7% to 6.5% and for Filipino students the total student population increased from 5% to 6%. While these numbers are rather modest, the percent success for these students has significantly improved. The success among African American students has increased by 16% and among Hispanic students it has increased by 5% and among Filipino students it has increased by 8%.

In our last strategic plan we proposed to increase the number of minority students within our program through various initiatives; however, it should be noted that our department received none of the funding allotted for strategic planning. Despite the lack of any structured funding, our department, through creative, endeavors has accomplished some outreach activities:

- 1) National Chemistry Week: A panel discussion was hosted in which professionals in various science related disciplines talked about their careers and educational backgrounds. This event was attended by 60 people and targeted toward high school and college students. Participants included students from several bay area locations as far south as Gilroy.

- 2) Student Science Demonstrations: As part of the Santa Clara Valley American Chemical Society, our students participated in chemistry demonstrations at the San José Martin Luther King Junior Public Library during the last couple of years. The audience for this activity included young children and young adults in our community.
- 3) Our department participates in on-campus outreach activities. Details are described below by Ms. Carmen Pereida from the Co-op program:

“The Co-op program has participated in most outreach event scheduled by the outreach office including Student/Parent nights. In collaboration with PUENTE, LEAD, and Outreach, the Co-op program was part of the planning process for bringing Latinos and African American students to campus. In collaboration with groups mentioned above and with the Chemistry Department Chair and the Biology Department Chair, Co-op provided science information and a tour of the science areas to underrepresented high school students.”

C. In what ways does your program address the basic skills needs of students? For programs that do not directly address basic skills, how does the lack of basic skills impact student success rates for your program?

The international language of science, currently, is English. Most professional scientific journals are published in English and the largest professional organization in the world is the American Chemical Society. Students require high-level math and English skills in order to manipulate experimental data and in order to model chemical concepts. Students also require basic skills in English reading and writing in order to read textbooks, lab manuals, and write comprehensive laboratory reports.

Similarly, students from disadvantaged socioeconomic backgrounds frequently possess weakly developed mathematical skills. Since the framework of chemistry is mathematics, weakness in the development of math skills translates into enormous difficulty in functioning in chemistry. However, despite this disadvantage the faculty and department have worked hard to help students develop their English and math skills by assigning mathematically intensive homework problems and requiring detailed written lab reports. As is evinced by our student success (refer to section IIb) our strategies appear to be effective.

III. Student Equity

A. What progress or achievement has the program made towards decreasing the student equity gap?

The overall success percentage among all students has remained more or less the same when comparing 2004-05 (74%) with the average success percentage among all students during the last three years (76%). Even so, significant increases in success percentages were found in comparing the average success percentage among targeted groups (Hispanics, African American, and Filipino) during the last three years with that from 2004-05. Among Hispanic students the success percentage increased from 55% in 2004-05 to 64%; among African American students the success percentage increased from 51% in 2004-05 to 62%; and among Filipino students the success percentage increased from 58% in 2004-05 to 66%. While these numbers indicate a general trend of increasing success among the targeted populations during the last three years relative to the overall success percentage and are definitely encouraging, we feel that further efforts (as indicated in section III B) can reinforce these trends and improve these numbers to bridge the equity gap even more.

B. In what ways will the program continue working toward achieving these goals?

One of the most effective ways that we as a department can help to bridge the equity gap is for each one of us to be attentive, nurturing role models to each of our students, regardless of their backgrounds. The members of our department – the full-time faculty, part-time faculty, staff, and student helpers – come from a variety of socioeconomic and ethnic backgrounds, speak a variety of languages, and reflect a diversity of academic and industrial experience. We are passionate about our chosen profession, and we convey that passion to any student willing to listen. By our collective experience, we can do our best to be sensitive to the particular needs of different populations, and by our enthusiasm we can do our best to encourage our students to believe in themselves and to inform them of the discipline and study skills necessary to succeed in science.

Many of the department's efforts in the area of equity coincide with our efforts in the area of growth of target populations, as motivation and inspiration are often as important in retaining students in our program as addressing real or perceived deficiencies in student preparedness. Other efforts that the department intends to pursue are as follows:

- Encourage our students to become active in tutoring programs. Just as the members of the department can act as role models to our students, students from target populations who excel in our program can themselves be exemplary models to their peers. Additionally, by being students, they may be able to connect with their peers in a way that we as faculty and staff may be unable to since we are on the other side of the podium. These efforts may be significantly enhanced by the newly-hired Science and Math Tutorial Center supervisor, with whom the department will work closely.
- Assist in the creation of a chemistry club. A campus club that could periodically perform safe but engaging demonstrations and become involved in the surrounding community may help further spark an interest in students across all backgrounds.
- Reach out to area high schools to engage in a conversation about our curriculum. As mentioned above, weakness in math and English skills translates into enormous difficulty in functioning in chemistry. By emphasizing the critical need for well-developed basic skills, we might hopefully be able to communicate to our incoming population the importance of diligently pursuing courses they may not otherwise understand the need for.

C. What challenges exist in the program in reaching such goals?

Although the department would like to more vigorously pursue outreach activities, both time and monetary limitations present a daunting challenge. In addition to the standard load, most of our full-time teach an overload – admittedly partly for financial considerations, but also out of a sincere desire to maintain and develop our program. Without overloads, full-time faculty would only teach 42% of the weekly program hours – 75 hours out of 177 total, based on the upcoming Spring 2009 schedule – which speaks to the need of another full-time chemistry instructor. In addition, we also invest countless hours outside of class maintaining our equipment and lab spaces, handling hazardous waste, and grading lab reports; this situation is exacerbated by the lack of adequate technician support, as discussed in section IV below. We are enthusiastic in our efforts to attract and retain students of all populations, but it is difficult – although by no means impossible – for the six full-time faculty members currently in the department to maintain our program and also plan outreach activities and attend extracurricular events. It should be noted, however, that perennial underfunding of department, also described in detail below, almost entirely precludes us from spending any funds on any activities outside of the classroom.

IV. Budget Limitations

A. Identify any limitations placed on the program based on limited funding. What increases in resources are critical to the program and what are the consequences of continued limited funding on the program?

Our department is currently facing a wide range of budgetary challenges, many of which have plagued the program for quite some time prior to the current worldwide economic meltdown. Some of our most pressing problems are listed below:

- As the Administration is well aware, the District is currently under a 10-year probationary watch due violations in hazardous waste management. As a consequence of waste disposal protocols developed by the department in conjunction with Mona Voss in response to this situation, we have incurred a significant increase in the costs (on the order of \$8,000 per year) for purchasing waste bottles and labels for waste management. The department has never received any increase in our operating budget in compensation for this increased disposal cost.
- We have been forced to close our evening chemistry program during the summer due to the lack of funding for a technician to manage the stockroom in the evening. We will be unable to address the needs of students who only can take courses in the evening until the position is reinstated. Furthermore, the 2009 American Chemical Society Guidelines in Two-Year College Programs recommend that chemistry programs should retain one full-time laboratory technician for each four full-time faculty members or full-time equivalent. Since we have an average total FTEF of between 10 and 11, this means that we are deficient the equivalent of 1.5 technicians even at the current size of our program. This deficiency will prevent us from expanding the program into Fridays and Saturdays as has been requested of the department.
- Although one of our stated strengths of the department is the robustness of our laboratory program, the bulk of the funding for our current instrumentation came from funds made available in association with the construction of the Science Center. Unfortunately, no funds are available from that source for the maintenance and repair of this equipment, some of which is already beginning to age and require repair. Without adequate funding to properly service this equipment, it is destined to become unusable, which will directly translate into a significant deterioration of our laboratory program.
- Over the past several years, the department has made a conscientious effort to reduce the quantity of chemicals used in our laboratory program. However, the cost of chemicals and, in particular, the cost of shipping those chemicals has increased dramatically over the past few years – a fact that is entirely outside of the department's control. At the same time, as previously mentioned our department has increased the number of sections that we offer – without any concomitant increase in the budget for chemicals. While we should be offering more sections to accommodate the demand for our courses as demonstrated by the perennially full waitlists for most of our courses, we may instead be forced to close sections due to the lack of funds for purchasing chemicals.

Taken individually, each of these budgeting challenges might seem to be surmountable. However, all of these costs are increasing in unison while our budget has remained nearly constant. Frankly, for a considerable time the program has been underfunded in comparison to other California community colleges – including Foothill College – and it was only through the considerable efforts and advocacy of our previous and current deans, Anne Leskinen and Jerry Rosenberg, that the department has not already faced even more dire consequences.

We simply cannot change the fact that we as a discipline are a laboratory-based, instrumentally-intensive science with unavoidable corresponding expenditures.

It should be noted that we recognize one natural response to the current campus budgetary situation might be to suggest an increase in class size. We are also aware that although our productivity is respectable given the size of our laboratory section, our program does not generate the same level of productivity as classes that are able to offer much larger lecture sections. However, increasing class size would not have any effect on the corresponding expense of chemicals, maintenance of instrumentation, or remediation of waste that would accompany any increase in the number of students in our program. Moreover, from the aspect of safety, we already have a higher number of students per laboratory in comparison to the recommendations of the American Chemistry Society (ACS) – 28 students per section versus the 25 recommended for the majority of our classes, and 26 students per section of organic chemistry versus the 20 recommended (as stated in section 3.2 of the ACS Two-Year College guidelines referenced above). Finally, due to the way that the Science Center was constructed, we are physically unable to accommodate any additional students in a section without significant remodeling or repurposing of our laboratory spaces.

Given all of these considerations, it should be emphasized that, with modest increases in program funding, we would be able to accommodate many of the students languishing on wait lists for our courses. Again, these waitlisted students represent a potential 42% increase over the number of students officially enrolled. Accommodating those students would relieve a bottleneck that would allow students to then proceed to other courses in the biological sciences and allied health, thus contributing heavily towards campus efforts to meet capacity in the next few years. Some examples of how we could expand – and the approximate corresponding costs – are given below:

- Our evening summer program could be reinstated for approximately \$2,500, corresponding to roughly 100 hours employment of a part-time stockroom technician; there would be no additional cost for the laboratory sections themselves as they were simply moved into the daytime program for the Summer 2009 quarter.
- Aside from costs for support staff, additional laboratory sections could be opened for, on average, \$1000 per section, corresponding to the costs of chemicals, waste disposal (including the cost of bottles, waste labels, and the disposal itself), and laboratory supplies (such as pipettes, filter paper, etc.).
- During the regular academic year, we sometimes have time slots in our traditional Monday through Thursday laboratory schedule during which the lab spaces are not being utilized. Laboratory sections could be opened during these time slots for approximately \$700 per student stockroom assistant per time slot, plus the costs associated with the laboratory sections mentioned above.
- We would be able to utilize our lab spaces on Fridays and Saturdays for approximately \$1,800 per time slot, corresponding to roughly 70 hours employment of a part-time stockroom technician, plus the costs of student assistants and the costs for laboratory sections.

B. Describe the consequence to students and the college in general if the program were eliminated or significantly reduced. Please be specific.

Chemistry is a cornerstone course of science, and our courses are required as prerequisites by other programs on campus, particularly the biological sciences and allied health. In addition, our courses are normally required for students transferring into science-related programs at four-year institutions and, as stated previously, the bulk of our students are transfer students. Given that our program already turns away a large number of students every quarter, the elimination or significant reduction of the chemistry program would have a direct and tangible impact on programs for which chemistry is a prerequisite. Additionally, given that students are unlikely to travel to multiple institutions to complete breadth or transfer requirements if it is avoidable, the cancellation or reduction of the chemistry program would also have a ripple effect that would extend to non-science courses, such as English and mathematics. It must be said that the cancellation of the program would also seem an enormous waste of the bond money, the time, and the resources invested in the construction and maintenance of the Science Center.