

# **ACADEMIC PROGRAM REVIEW REPORT**

## **Department of Chemistry and Biochemistry California State University, Fullerton**

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### **Information Sources**

The committee used information and data from the 2017 Chemistry Department Self-Study, the 2011 American Chemical Society Committee on Professional Training Periodic Report and individual on-site meetings with the following groups from the Chemistry Department:

- Staff
- Lecturers
- Undergraduate and graduate students
- Pre-tenure faculty (Assistant professors)
- Mid-career faculty (Associate professors)
- Full professors

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## **1. Overview of the Department of Chemistry and Biochemistry**

The Department of Chemistry and Biochemistry is housed within the College of Natural Sciences and Mathematics at California State University, Fullerton. The department consists of 20 full time faculty (one full-time lecturer; eight assistant professors; five associate professors; six full professors) and 17 part-time faculty members. Additionally, the department is supported by eight staff members. The department office is located in McCarthy Hall with classrooms, teaching labs, faculty offices, research, and support space distributed between McCarthy and Dan Black Halls. Department personnel and facilities are discussed in detail in Sections 5 and 6.

Degree programs supported by the department include an ACS accredited B.S. in Chemistry, a B.A. in Chemistry, a B.S. in Biochemistry, a chemistry minor, and both course-based (M.A.) and thesis-based (M.S) graduate degrees. One of the distinguishing characteristics of the bachelor degree programs is the requirement for undergraduate research for all majors. The Department serves over 600 majors per year. In addition to its own majors, the department supports students in biological science, engineering, health science/kinesiology, nursing, physics, and psychology. The department also offers courses for non-majors that satisfy the B.1 physical science and B.3 laboratory experience general education requirements. Academic programs are further discussed in Section 2.

Although the number of first-time freshmen and upper division transfer student applicants and admissions has increased during the past five years, it has been noted that only about ten percent of first-time freshmen and thirty percent of transfer students enroll. The department recognizes the need to more clearly identify and address the causes of the loss of majors. Student success is further discussed in Section 3.

The department has a very strong research culture that engages virtually all of its undergraduate and graduate students in research experiences. This is a highly laudable enterprise but presents some challenges, discussed further in Section 4.

The department has identified a set of goals that address a commitment to the development of teacher-scholars who contribute not only to their diverse fields of research, but also promote the growth and development of chemistry/biochemistry professionals, teachers and scientifically literate citizens. Faculty engage students in research that has well defined connections to current areas of concern such as climate change, pharmaceuticals, and environmental remediation. The department is also committed to ongoing assessment of student performance within the program and subsequent success in the workplace.

## **2. Academic Programs and Teaching**

### *Degree programs*

The Chemistry Department offers three undergraduate degrees, a BA and BS in Chemistry and a BS in Biochemistry. The BA degree can be completed with Emphasis in Environmental Chemistry. There is also an option to complete the BA degree in conjunction with a minor in Business Administration. Students who complete this are then eligible to complete an MBA at CSUF in one year (if they have completed MBA entrance requirements). The BS Biochemistry degree can be completed with Emphasis in

Biotechnology. None of these paths are popular and very few students have enrolled in them. One explanation may be that students are unaware of these tracks. No information on either of the Emphasis programs or the MBA track could be found on the department website or in the CSUF catalog. The department should either remove these tracks or increase awareness about them. Since both tracks seem to offer students attractive career options, the committee recommends increasing awareness (assuming that this does not pose a need for additional resources). The department offers a Chemistry minor degree which is overseen by the Chair and Vice Chair who handle advising for Chemistry minors. Two graduate degrees are offered, an M.A. and M.S. in Chemistry. The MA degree is a non-thesis option involving a library-based research project. The enrollment in these programs has been low and will be addressed further in Section 3.

### *Curriculum*

Since the previous self-study in 2009, the department has made several changes to their curriculum. These changes were made to 1. improve progress towards degree, 2. address the workload associated with the senior research requirement, 3. update the curriculum to reflect existing faculty strengths and current career interests.

### *Undergraduate curriculum*

In an attempt to remove bottlenecks towards graduation, the department has plans to decouple lecture and lab in first-year gateway courses, 120A (General Chemistry I) and 120B (General Chemistry II). This will greatly increase the flexibility of offerings, allowing students to choose a lecture and lab combination that fits their schedules. They are also planning to take the current Organic Chemistry lab course, CHEM 302, which is now taken concurrently with Organic Chemistry II lecture and split it into two semesters so that lab runs concurrently with both semesters of lecture. The motivation for this is to provide additional support to lecture material in both semesters, which is expected to improve student performance. This should help with time towards graduation since Organic Chemistry currently has the highest DFW rates of courses offered in the department.

Currently, all students must take CHEM 495 to complete the senior research requirement. With the growth in majors, supervision of individual research projects for every student has become problematic and may be adding to delay in graduation. To address this, the department is developing a series of integrated laboratory capstone courses, beginning with CHEM 427 Medicinal Chemistry, which will embed a research experience in a course taught by a single instructor. Addition of CHEM 427 is also a step towards creating a department focus in medicinal chemistry. The department added another new course, CHEM 492 (also offered as ENST 492) which covers the topic of sustainability. The course is popular and also fulfills the capstone research requirement. Additional laboratory capstone courses in analytical/physical chemistry and biochemistry/biotechnology are also planned. For those students with a more research focused career path, the department has added CHEM 195, which will engage students earlier in research. The department has also added CHEM 430 Bioorganic Chemistry, a lecture course, to draw upon expertise in current faculty and increase elective choices. CHEM 427 and 430 can also be included in the 9 units allowed toward the graduate degree. Overall, these courses address the workload issue in the senior research requirement, provide an update to the curriculum, complement faculty strength and provide an opportunity to streamline the pathway to the graduate program. Finally, the department retired several courses that were no longer offered.

### *Graduate Programs Curriculum and Course Offerings*

The department offers two graduate degrees, an M.A. and M.S. in Chemistry both of which require 30 units, 21 of which must be graduate level. One of the main goals for the department is to revamp the graduate program to provide a faster pathway to the MA and MS chemistry degrees. During our interviews the graduate students shared that they have had difficulty enrolling in the organic chemistry courses due to lack of offerings. They have shared that they have completed those requirements using 400 level courses which are more available. However, they did feel that they didn't provide as much rigor. They also stated that class size is very small. This can be attributed to the low numbers enrolled in the graduate program. The Self-Study does not address graduate program curricular changes. The committee recommends that the Department review its graduate program curriculum to ensure that it addresses graduate student learning objectives and is offered in a timely fashion to ensure efficient progress towards degree. This should be part of a larger effort to address graduate program enrollment and graduation which is discussed further in the next section.

It is clear that overall, the department has been reflective and proactive about its curriculum with a clear plan towards student success. However, during our interviews, faculty (Assistant Professors and Lecturers) shared that Student Learning Outcomes (SLOs) vary greatly in course syllabi for the same course. In particular, they felt CHEM 315 needed to have consistent SLOs. The students echoed this concern sharing that they felt there wasn't consistency in the curriculum across the same course. Faculty pointed out that this inconsistency not only confuses students but could be detrimental to faculty in performance reviews due to different levels of rigor and student expectation. Faculty also pointed out a lack of consistency among Chemistry caucuses in assignment of new course preps which is a workload issue that effects retention and promotion. To address these concerns and to manage the future curriculum changes planned by the department, the department needs to have an active Curriculum Committee which meets regularly, with equitable representation from the different caucuses, including tenured and pre-tenured faculty.

### **3. Student Success**

#### *Overview*

The department takes student success very seriously and this was confirmed by the students we interviewed. Since the previous PPR, the department has revised their goals to put student success in the forefront. Goal 1 of the department's strategic plan is "Improve Student Success" which includes 11 sub-goals. Some highlights from this list are to shorten time to degree by pinpointing bottlenecks in degree programs (#5), create ways to better screen, inform and prepare incoming FTF (#6), improve the time to degree for MA and MS students (#8), give release time to faculty with significant advising workloads and develop a College-based Advising Center where specific advisors from each department have office hours (#9).

#### *Enrollment*

Applications and admittance of first-time freshmen (FTF) and upper-division transfer (UDT) students has grown steadily in the past 5 years and are very strong (Appendix I - Tables 1A and 1B). Enrollment grew steadily to a high of 688 undergraduate majors in 2014-2015 and has leveled off to about 640. Due to this growth, the department has not made much effort to recruit majors. However, enrollment of first-time freshman in

undergraduate programs offered by the Department of Chemistry and Biochemistry has decreased from 17.6% of admitted students in 2012-13 to 10.1% in 2016-17. Given this decline as well as growth in employment opportunities for chemistry and biochemistry graduates, the department could consider a recruitment strategy for the future focused on FTF.

At the graduate level, enrollment has fluctuated from a high of 61.1% in 2012-13 to a low of 27.3% in 2015-16 to the current rate of 45.5% in 2016-17, the most recent year available.

#### *Graduation Rates*

First time freshman four-year graduation rates have increased from 2% in 2007 to 4% in 2013 for students in the major and six-year graduation rates have fluctuated from a low of 6.9% in 2008 to a high of 24.2% in 2009 to the current rate of 4.1% in 2013. Transfer student two-year graduation rates have also fluctuated from a low of 0% in 2011 (headcount 50) to a high of 16.3% in 2010 to the current rate of 1.6% in 2013 and four-year graduation rates have fluctuated from the most recent low of 34.9% (2013) to a high of 53.5% in 2010. The department has increased their issuance of undergraduate degrees conferred from a low of 62 students to a high of 91 in 2016-17, the most recent year available.

Graduate student three-year graduation rates have risen from a low of 11.1% in 2009 to a high of 25% in 2011 to the current rate of 18.2% (2016-17). Graduate student four and five-year graduation rates are identical and have fluctuated from a low of 0% (headcount 8) to a high of 75% in 2011 to the current rate of 27.3% (2016-17). The department has had a fluctuation in Master degrees awarded from a low of 2 students (2015-16) to a high of 10 (2014-15) to the current number of 6 (2016-17).

Improving graduation rates is a clear priority for the CSU system and the department has a stated goal of improving time to degree (Goal 1 #5). Graduation rates are influenced by many factors which include bottlenecks in the curriculum, access to courses, and preparation for major courses, all of which are addressed by the Department at some level. The department has identified first year Math and Chemistry courses as bottlenecks for those students who need remediation. The department shares that the number of students requiring remediation has decreased from 44% to 27% (73% exempted, 2016). The department is encouraged that the number of students who can enroll in Math 150A (Calculus I) without remediation has increased. Further, students who have been identified as needing remediation have been completing the math remediation course at a higher rate. All of these point to a potentially increased graduation rate for the incoming cohorts.

The first-year chemistry course which the department feels is creating a bottleneck is CHEM 120A both due to students taking a remediation course, CHEM 115, and due to high repeat rate in CHEM 120A. Students can bypass CHEM 115 by taking a chemistry placement exam (CPE) which has about a 50% success rate in predicting student pass rates in 120A. The department Chair shared that data has been collected on the impact of CHEM 115 on student success in CHEM 120A. The data are not fully analyzed but there is not an obvious significant trend regarding CHEM 115 and success in CHEM 120A. The department has considered possible options to requiring CHEM 115 before enrolling in CHEM 120A. One option is to remove an entry requirement for CHEM 120A

for a couple of semesters and evaluate the result. This option would require supplemental instruction to avoid an increase in DFW rate. A second option is to offer CHEM 115 exclusively online during summer and winter intersession so that students may complete it before registering for CHEM 120A. Chair De Lisjer expressed a preference for the second option but a final decision will be made after the data on CHEM 115 and CHEM 120A success are more fully evaluated.

The department recognizes that the organic chemistry sequence (301A/B) is contributing to slower time to graduation due to its high DFW rate. A remedy to this involving restructuring the lab is discussed above in Section 2. They are also planning a conversion to teaching space to create an active learning classroom for organic chemistry. This is discussed further in Section 5. The department also has recently restructured the upper division curriculum in ways that may increase time to graduation, discussed in Section 2 above.

Overall, the department has been proactive about addressing curricular bottlenecks in the undergraduate curriculum to improve progress towards degree.

In interviews, faculty noted difficulties in the graduate program with students taking a long time to graduate. Part of this is attributed to slow progress in research but a graduate student during the student interview indicated how he had been delayed due to lack of course offerings in his area. The department should undertake analysis of its graduate curriculum with regard to timeliness of course offerings so students can graduate. Although the graduate coordinator meets with graduate students every semester to discuss their progress, it doesn't appear that the research mentor is involved. Creating a system for regular progress checks that includes the research mentor and the student together could help improve student progress in the program.

### *Assessment*

The department has a strong and thorough assessment process that "closes the loop" by connecting student learning outcomes to curricular revisions. The department is to be commended for its strong assessment practice. The only concern noted during the committee interview is that the faculty member currently overseeing assessment is retiring soon. She is concerned about how assessment will be carried forward after she is gone. The department should plan for the departure of this faculty member to prevent interruption of its assessment process.

### *Advising*

One issue which plays a crucial role in graduation rates is advising. The department has a strong advising program for its undergraduates which includes mandatory advising for all students every semester, detailed advising checklists for faculty advisors, and intervention for students whose GPA falls below 2.0. In our interviews with faculty, it was shared that the Vice Chair has assumed the role of primary undergraduate advisor and meets with all incoming first-year students enrolling in Chemistry in groups at the beginning of the semester. The department Chair meets with incoming transfers and also meets with all students who have reached 120 units to counsel them about graduation. The remaining tenure line faculty advise 15-30 students a semester. In interviews, essentially all the faculty shared that they are happy with this scenario as they enjoy meeting with their students and feel it is the responsibility of the faculty to guide students in their education. They stated that, "our students are first". Some faculty did stress that

sometimes the advising needs of the students go beyond the curriculum and they don't feel prepared to handle counseling and psychological issues.

The department should consider an early tracking system to intervene with students before they fall below 2.0 GPA. Students can be passing non-science classes and failing sciences classes for many semesters before coming to the attention of the department Chair. Ideally, students failing exams early in the semester in lower division courses should be contacted for advising intervention. This would require assistance from Department Faculty to identify at-risk students.

New graduate students are given a graduate student handbook and all graduate students are advised every semester by the graduate coordinator. A recommendation for more involvement of research mentors is given above as a means to improve student progress in the program.

#### **4. Scholarship**

The Department of Chemistry and Biochemistry continues to fulfil one of its core goals and thus its mission to "be a leader in undergraduate and master's level research".

*This goal is successfully achieved by:*

- Promoting involvement of students in research

The department has long had a senior research requirement which has become unsustainable due to the large growth in majors. This is being replaced by a series of laboratory capstone courses in which a research experience is embedded. The department has created a course that will engage students in research earlier to allow sufficient time for successful training and research contributions. Overall, a substantial number of students establish their mentor-mentee relationship early and set off their research efforts well in advance in order to be successful in this aspect of the curriculum.

- Supporting students and faculty mentors performing research

The department provides continuing support for students and their faculty mentors who are performing active research. This includes summer research and student research programs, which financially support students who are performing research and at the same time provide faculty with equitable support for consumables.

- Encouraging faculty to write and apply for intramural and extramural grants

Junior faculty are highly encouraged and supported to attend grant-writing workshops in their first two years of appointment. Additionally, faculty are aware of the language pertinent to external grants that is included in the department's RTP documents.

- Promoting scientific collaborations

The department has successfully initiated and maintained research internship programs in collaboration with local industry and university partners. This allows students to familiarize themselves with diverse research settings and obtain unique training and experience. This program also provides opportunity for scientific collaborations for faculty and occasionally results in equipment donations from those partners. Such collaborations have contributed to the high post-graduate success of Chemistry and Biochemistry majors.

*The opportunities for improvement include:*

- limitations in research space

The department has some serious limitations in research space, which has direct impact on the hiring process of new faculty. The challenges pertinent to research space have been outlined in the PPR Self-Study Report and also indicated during the on-site interview sessions. The Program Review Committee strongly encourages the department Chair to discuss this matter with College Administration in order to find creative ways of addressing this challenge within a reasonable period of time. Space limitations are further discussed in Section 6.

- external grant requirement in the RTP Document

The language regarding external grant in the RTP document is unquestionably a strong motivating factor for the department's faculty to achieve high research output. While the faculty are aware of and support this requirement, there has been a lack of specificity in this requirement. In interviews with faculty, it is apparent that faculty support external grant requirements. A reasonable requirement for tenure in the view of some faculty interviewed is one funded external grant with on-going vigorous activity in grant submissions throughout the tenure process.

Overall, the department strongly promotes and supports research efforts of the faculty and students. This is reflected in the outstanding research productivity accomplished within less than 10 years' time and includes: over 100 journal publications with students as co-authors; countless number of students and faculty presentations at conferences and meetings held at local, regional, and national level; grants awarded from external sources and agencies, and a number of prestigious recognitions and awards won by the department's faculty. Accordingly, the department is commended for its research productivity and is respectfully encouraged to maintain this highly-stimulating and vibrant research environment.

## **5. Personnel**

Faculty in the Department of Chemistry and Biochemistry represent a range of disciplinary expertise that support coursework in the foundational areas of chemistry including analytical, organic, inorganic, physical, and biochemistry. The department recognizes the importance of and promotes the development of interdisciplinary collaboration. Examples include faculty with expertise in atmospheric chemistry, chemistry education, electrochemistry, organic and bioorganic chemistry, photochemistry and theoretical chemistry. A recent hire in the area of medicinal chemistry promises to build on existing strengths within the department. Full-time and part-time faculty teach courses and laboratories at all levels in the program.

The department has had a fair amount of turnover in its faculty in recent years, due to replacements of retiring faculty and personal choices of faculty who have left the department. During interviews, faculty indicated that hiring has been difficult at times due to a delay in approval of new tenure lines and insufficient startup funding. Despite this, a number of recent hires, including a medicinal chemist noted above have been made, resulting in a total of eight assistant professors. With five associate and six full professors, the department currently has a well-balanced age structure in its faculty. The department has one full-time lecturer and 17 part-time faculty, slightly less than the same number of tenure line faculty. The ratio of part-time/lecturer to tenure line faculty has grown substantially in the past ten years. The majority of growth in majors has been accommodated by hiring part-time vs tenure line faculty.



The consensus of the faculty is that the morale of the department has improved over time with many expressing appreciation for the leadership and support of their current Chair and the sense that the department “works as a team.” Despite the generally positive attitudes towards the environment of the department, concerns exist related to the overall workload and distribution of workload amongst the faculty. It is felt that inequities exist in the number and diversity of new courses (“new preps”) expected from faculty. Faculty at all levels expressed concern that their colleagues are being overworked which could lead to the loss of personnel. Workload concerns are compounded by the perceived lack of coordination in the instructional design of multi-section courses and absence of graduate assistants who could lessen the burden of grading, especially in large classes. Part-time faculty in particular feel the impact of this workload and mentioned the benefit of graders.

The support staff in the department include a department coordinator, administrative assistant, and a budget coordinator as well as an instrumentation technician, equipment technician, chemical technician and a computer technician. The department hires three to four student assistants who help with lab prep and the chemical stockroom. At the time of this visit, the department was in the process of searching for a replacement for the IT staff position and had recently replaced the departmental coordinator. The position of coordinator for the teaching labs and webmaster is held by a full-time lecturer. Additionally, the department employs multiple graduate teaching assistants. The staff also feel they have a high workload. The number of majors in the department has grown substantially over the last ten years but staff hiring has not kept up with this. The need for staff hires is further discussed in Section 6.

Some concerns were expressed from both faculty and staff about professional development. Lecturers value the ability to work with faculty, but would appreciate more guidance towards conferences and workshops that would contribute to their professional development. Lecturers also expressed a lack of support as new faculty in the department with little guidance or materials for the course they were teaching. The department could consider its support of its lecturers, particularly those who are new to teaching or to the department. The need for the mentoring and cultivation of mid-career leaders was identified as another area that could be improved. Mid-career faculty indicated a strong interest in learning about leadership opportunities but a lack of avenues for information or training. Finally, staff members are looking for opportunities for professional development that could lead to advancement or reclassification.

## **6. Facilities and Infrastructure**

### *Overview of the Physical Space*

The Chemistry department is housed in McCarthy (MH) and Dan Black Halls (DBH). Administrative offices, faculty offices, Supplemental Instruction classroom, chemical education and computational chemistry teaching and research are housed in MH. Teaching and research laboratories are located in DBH. The department has a chemical stockroom in DBH and an equipment stockroom in MH.

Both buildings are aging, especially MH. The department strives to maximize the space it has and there is an on-going effort to repurpose spaces. For example, computational teaching spaces (MH 536/587) in which desktop computers are no longer needed are being renovated to create an active learning classroom for organic chemistry lecture (301A), which has the highest DFW rate in the department. Chair de Lisjer, who obtained

35K from the Provost for the renovation of one of these classrooms this coming summer, believes converting this course to an active learning environment is likely to improve student performance. There is a long-term vision to repurpose and renovate space for general chemistry. This would involve converting existing small lecture spaces (512, 514, 563, 565) in MH into active learning spaces containing laboratories. This is an ambitious plan which requires significant renovation and resources but would modernize the pedagogical approaches being used in this gateway course and likely improve pass rates. Another long-term vision, less costly in terms of renovation, is to create more open, integrated spaces for chemical education and computational chemistry.

A long-standing practice to maximize facilities by the department (and by other CSU Chemistry departments) is the sharing of laboratory space and equipment between teaching and research activities. For example, much of the equipment research students need to access is located in teaching laboratories. Although this results in efficient use of facilities, it presents some safety issues, which are addressed in the section on Safety below.

#### *Current laboratory spaces*

All chemistry “wet” labs are housed on the first and second floors of DBH. The department is currently able to meet the enrollment for general chemistry (CHEM 120A,B). Enrollment in organic chemistry laboratory (CHEM 306A,B) is more of a problem and there are limitations on accommodating demand due to a finite number of lockers in DBH 213. Given this, the only option to meet demand would be to have students share lockers. This solution would require the ability to house glassware for two students in one drawer and/or provide inexpensive common glassware housed in the laboratory.

Upper division (UD) teaching labs seem adequate except for CHEM 495, the course students take to satisfy the research requirement for graduation. Here, the difficulty is not in laboratory space but in the ability of faculty to individually mentor all senior students in research. As discussed above, this course is being replaced with a series of laboratory capstone courses each taught by a single instructor and each providing a research project for enrolled students (e.g. CHEM 467 Medicinal Chemistry Laboratory) - it is not clear from the Self-Study in which space integrated laboratory capstones will be taught.

Research laboratories seem adequate for smaller groups of research students but are inadequate for the large numbers of students many faculty are mentoring (upwards of 20 or more). Replacement of the senior research requirement with laboratory capstone courses could help this situation. A bigger problem regarding research laboratories is the lack of space for new hires. Interviews with faculty and the Self-Study document indicate the need for inorganic and organic chemists in the next hires. The Self-Study document includes a short-term plan for two additional hires but this plan would provide space only for dry laboratory caucuses (chemical education and computational chemistry). There is no clear way to hire additional wet chemists in the department, except through replacement.

#### *Office spaces*

Tenure-track (TT) faculty offices seem adequate, mainly because they did not arise as an issue during interviews with faculty. It is important for faculty advising students to have private office space and the department is able to provide single offices to TT faculty. A

difficulty in tenure-track offices is the lack of office space needed for new hires but the Self-Study identifies some changes in MH that could create limited additional office space.

Office space for part-time (PT) faculty is located in MH 577. This is a large room containing a large number of semi-private desk spaces. The initial impression upon entering this room is the potential for a lot of noise with multiple students trying to visit multiple faculty. This impression was confirmed during the committee interview with PT faculty. The committee recognizes the on-going challenges regarding space on most CSU campuses but we encourage CSUF administration to consider whether MH 577 could undergo a low-cost renovation to provide sound and privacy barriers.

TAs have office space for holding office hours. There is a plan to move and redesign TA office space in line with those of other departments. There doesn't seem to be space for graduate students in general. A graduate student study room would be a nice addition to facilitate interactions between labs, however it is recognized that space limitations probably prevent this.

### *Equipment*

Instrumentation is the mainstay of chemistry departments. The strong research culture and hands-on approach in the CSUF chemistry department makes equipment an even more critical resource. The department has a lot of equipment and most of it is used directly by both graduate and undergraduate students. A tour of the chemistry department left the committee with the impression that while the department seems to have adequate equipment for teaching, much of it is very old. For example, biochemistry laboratory (CHEM 422) taught in DBH 121 is a spacious room with an associated equipment room and sufficient benchtop equipment. However, with few exceptions (e.g. a new LC-UV system purchased with funds from the Provost), the equipment is more than 20 years old. Not only does this present a problem in terms of the expense of maintenance and replacement, it fails to provide students with modern versions of equipment they will use in laboratory-based employment and graduate research.

In terms of major instrumentation, a 400 MHz NMR was acquired with an NSF-MRI grant in 2005 and is undergoing a computer and software upgrade. The department would greatly benefit from a 500 or 600 MHz NMR which would add substantially more capability in multi-dimensional work, especially for macromolecules, so this should be a plan for long-term acquisition of major instrumentation. There is a research-grade EPR but it is not being used and perhaps could be traded with another campus for other needed equipment. Two new LC-MS instruments purchased with DOD funding were recently purchased and form the core of a new focus in medicinal chemistry.

The department has one equipment technician to maintain their inventory who works with 1-2 student assistants/semester. With the exception of a few service contracts on some chromatography and spectroscopy equipment, the technician is responsible for all instrumentation used in teaching, an enormous workload due to size of the inventory and its age. He also assists faculty in maintaining some research equipment, although this is done as a second priority. Due to the workload and lack of an assigned annual budget, the equipment technician is mainly operating in a reactive mode to situations as they arise. The ACS 2011 report indicates that the department allocates ~\$50K for equipment repair and replacement. A portion of this could be assigned directly to the equipment technician to facilitate a regular plan of action for maintenance (e.g. replacement of

spectrometer light sources, annual purchase of consumables, etc.). A known budget (excluding unanticipated major repairs) would also guide in decision making about strategies for minor repairs, e.g. purchasing a refurbished item (faster solution) vs a repair with components (less costly solution), over the course of the academic year.

The department used to receive ~30K/year from NSM for equipment, part of an annual equipment call which was discontinued during the recession. Such calls have been restored on other CSU campuses but apparently not at CSUF. Instrumentation-heavy disciplines such as chemistry cannot operate without an on-going strategy for regular replacement and modernization. CSUF administration should prioritize resources for instrumentation and help departments plan by disbursing funds each year to the College and departments.

#### *Department budget*

The overall department budget shows an increase over the last six years or so but this is due to salaries so funds for operating expenses have actually decreased. Interviews with faculty indicate a lack of competitive start-up for new hires (e.g. 90K CSUF vs 200K CSULB). The faculty have done a good job in obtaining external grants (despite some lack in administrative support, addressed below) and also internal grants. The department has 15-35K in donations in each year, much of which is in the form of student scholarships. As noted above, there are insufficient funds for upgrading and replacing equipment. The department must also grapple with rising costs in chemicals and consumables, especially for cryogenics. It is recognized that most of the budgets of the Provost and Dean is taken up by salaries which presents limitations in increasing a department's OE. However, if there is any opportunity to redirect funds, the committee hopes that administration will understand and prioritize the complex operating needs of the chemistry department. Other approaches to improving resources include increasing donations (there is a plan to work with alumni through university advancement), increasing external grants, and utilizing CCE/summer operations monies; the latter of these is not provided in the Self-Study so it is not clear what the department currently gains from this avenue.

#### *Administrative and staff support*

The committee recognizes the difficulty of adding staff positions due to the associated cost. However, we would like to draw attention to two areas needing additional support. The first of these is the need for more technical staff. Currently, the one equipment technician is experiencing a very heavy workload and the department is without an IT person. Perhaps one hire could fulfill both needs, with an IT hire having some time allocated to equipment support. Second, faculty indicated an insufficiency in administrative support and assigned time for writing and submitting external grants. For example, boilerplate demographic data were difficult to obtain. It was noted by faculty that the College lacks a research grant specialist but that there were additional difficulties working with the Office of Grants and Contracts. Since external grants provide critical resources to the department in both teaching and research, the committee recommends attention be paid to this issue as both the department and College will benefit from external awards.

#### *Safety*

Safety is always the top priority in any chemistry program. The CSUF chemistry department is doing an outstanding job of training personnel, including students, in safe

handling of chemicals, which is evidenced by training documents and videos provided to the committee. Training of TAs is particularly robust. Furthermore, the department has a close and collegial working relationship with EHS. However, the committee would like to point out a few areas of possible concern. First, although the department has a “buddy” system to ensure that no one works alone in a laboratory, undergraduates are allowed to work unsupervised and have access to laboratories on evenings and weekends. Even if students are trained, the department should consider whether during non-business hours undergraduates should be accompanied by graduate students or faculty. Second, the department intermingles teaching and research in space, chemicals and equipment. This makes operations highly efficient and also greatly supports the strong research culture of the department. However, it also puts untrained students (those who haven’t received training for a particular research laboratory) in proximity to potentially dangerous substances and scenarios. This is a systemic problem within the CSU. To address this, the department could conduct an analysis of potential proximity issues that are created by intermingling teaching and research, reduce research materials in teaching labs as much as possible, and verify that all students at all times are wearing the appropriate PPE for activities taking place in the lab. This is related to the third concern which is storage of chemicals in teaching labs. Ideally, only chemicals pertaining to the activity on a given day should be present in the lab. This reduces the exposure of students in classes to chemicals with which they have no familiarity and perhaps not the appropriate PPE. Fourth, visibility in the organic chemistry teaching lab (DBH 213) is problematic due to a central instrumentation room that blocks the view of students working in hoods on the far side of the room. This problem is exacerbated by the high enrollment of students in CHEM 301A (24 students, higher than the number in comparable courses around the CSU which more commonly have 16-20 students). The easiest solution is to provide TAs or ISAs in this course to assist the instructor in maintaining visibility of all students at all times and/or reduce enrollment in the course. Fifth, there is no stockroom coverage for evening labs which leaves instructors teaching evening labs alone to deal with accidents or emergencies. Finally, although it has a faculty representative to an EHS safety committee, the department does not have its own safety committee. The department should consider creating this committee and populate it with faculty representatives from the different caucuses, the chemical stockroom technician, and the equipment technician. This committee should meet monthly and create a forum for discussions involving safety. One activity this committee could do is to institute a reporting system for tracking accidents and incidents in labs. Such a system enables adjustments to teaching and research that reduce accidents and can be implemented in such a way as to remove blame or fear of reprisal from the process.

In summary, the chemistry department has some challenges in its normal operations including aging equipment, understaffing, and insufficient support for grant activities. The department is to be strongly commended for its ability to maintain a high quality of teaching, research productivity, and placement of graduates in spite of these challenges. In particular, Chair de Lisjer is to be commended for his thoughtful analysis of the department’s environment and operations and his innovative ideas for improving teaching and research.

## **7. Summary of Commendations and Recommendations**

*Commendations:*

1. The Department of Chemistry has dedicated, hard-working, student-centered faculty and staff.
2. Diversity of the faculty is a strength of the department. The department has an excellent record in recruiting and hiring.
3. The Department of Chemistry has a strong research culture in which dedicated faculty engage every undergraduate and graduate student in research experiences.
4. With a focus on biotechnology and medicinal chemistry, the Department of Chemistry is building changes into its curriculum that will both better manage the student research requirement and increase preparation of students for careers in industry and research.
5. The Department of Chemistry has an excellent advising program for both undergraduate and graduate students.
6. The Department of Chemistry has robust, closed-loop program assessment.
7. The Department of Chemistry has both flexibility and innovation in utilizing its limited space for teaching and research.
8. The Department of Chemistry has strong, inclusive, and supportive leadership from its Chair, which has led to improved morale among faculty and staff.
9. Undergraduate and graduate students expressed a strongly positive attitude towards the education they are receiving in the degree programs. They also were highly positive about the department culture and the department Chair.
10. Chemistry faculty vigorously pursue external funding and have a high rate of award success.
11. The Department of Chemistry has demonstrated an interest in and is showing a move towards student-centered active learning pedagogy.
12. The Department of Chemistry has a strong internship program and a high rate of post-graduate placement of its graduates in industry and research.

*Recommendations:*

Recommendations to the Department

1. Continue to explore ways to increase the number of faculty/full-time lecturers to keep pace with the growth of the major.
  - As noted in the self-study, hiring in the area of inorganic/materials chemistry and organic chemistry should be priorities.
2. Maintain a robust and active departmental curriculum committee to manage and plan for curricular changes and to oversee consistency and continuity in course learning objectives.

- The department has many curriculum changes planned and underway and these will best be managed by regular meetings of faculty from each caucus to review and discuss changes. Furthermore, the department should use this committee to engage in deep discussions concerning how courses are taught when multiple lead faculty are involved and how learning objectives in courses sequence and connect with one another.
3. Offer graduate courses such that students can graduate in a timely fashion.
    - Currently, graduate students are delayed in graduating due to lack of course offerings. The department is already considering how to address this by revising the curriculum, a task that can be taken on by the departmental curriculum committee in conjunction with the graduate program advisor.
  4. Provide mentorship to junior faculty and leadership opportunities to mid-career faculty.
    - The department has a large number of new hires that would greatly benefit from mentoring by more experienced faculty. The balance of teaching and research in chemistry is particularly challenging and new faculty should be assisted in learning how to manage their workload. Mid-career faculty are the incoming leaders for the department and should be provided with opportunities to assume positions of leadership and responsibility. The department, Dean, and Provost all have a role in this.
  5. Support staff advancement and provide professional development opportunities for staff.
    - Staff currently have classifications that are well below their actual training and job duties and they have few professional development opportunities. Staff should be fully supported in advancing themselves professionally.
  6. Address issues of inequity and workload throughout the department including issues of pay inequity for graduate teaching assistants.
  7. Review safety practices in the department and consider the following changes:
    - 1) create a department safety committee, 2) restrict undergraduate access to laboratories, 3) analyze potential dangers that arise from teaching and research proximities, 4) support organic chemistry laboratory instructors with TAs during lab, 5) expand stockroom hours to cover evening lab courses, 6) reduce storage of chemicals in teaching labs.
  8. To remove remedial courses from the curriculum without increasing DFW rate in CHEM 120A, offer CHEM 115 as an online course during summer and winter intersession.
  9. Require one external grant awarded with on-going vigorous attempts to obtain funding in the absence of awards in RTP guidelines for tenure.
    - Discussions with junior, mid-career and late-career faculty indicated this level of grant writing is the most appropriate in the current environment.

#### Recommendations to the Dean

1. Provide administrative support and assigned time to assist faculty in external grant activities.
  - The department requires at least one external award prior to tenure. Faculty need to be supported to successfully compete for funding. In particular, the College needs its own grant writing specialist.
2. Add a staff position to cover IT/Equipment needs.
  - The department is under-staffed, particularly in the IT/Equipment area.
3. Provide leadership opportunities to mid-career faculty.
  - Mid-career faculty will carry the department into the future and need to be educated and provided with opportunities to become department, College and campus leaders.
4. Support the department in its innovative plans for maximizing research and teaching space.
5. Support the department in maintaining a safe environment for students, faculty and staff.
  - Provide professional development for faculty on resources on campus for students who are in crisis.
6. Address issues of inequity and workload throughout the department including issues of pay inequity for graduate teaching assistants.

#### Recommendations to the Provost

1. Support the Dean and department in providing adequate space for new faculty hires.
2. Support the Dean in providing full support for faculty grant-writing activities.
3. Assist the College and department in addressing its staffing needs.

#### Recommendations to the Faculty Senate

1. The Chemistry Program Review Committee recommends that the Chemistry Program be approved for six years or until the next program review.