

December 22, 2017

PROFESSOR EDWARD DENNIS, Chair
Department of Chemistry and Biochemistry

SUBJECT: Undergraduate Program Review for the Department of Chemistry and Biochemistry

Dear Professor Dennis,

The Undergraduate Council discussed the Department of Chemistry and Biochemistry's 2017 Undergraduate Program Review. The Council supports the findings and recommendations of the review subcommittee and appreciates the thoughtful and proactive response from the Department.

The Council will conduct its follow-up review of the Department in Spring Quarter 2018. At that time, our goal is to learn about the Department's progress in implementing the recommendations of the program review subcommittee and the Undergraduate Council with the help of the Department's new education committee. The Council extends its thanks to the Department for their engagement in this process and we look forward to the continued discussion.

Sincerely,

Sam Rickless, Chair
Undergraduate Council

Attachment

(1) Undergraduate Program Review Report and Responses for Chemistry and Biochemistry

cc: F. Ackerman
S. Boggs
J. Eggers
R. Horwitz
J. Kim
J. Moore
R. Rodriguez
M. Sidney

**Undergraduate Program Review
Department of Chemistry and Biochemistry
University of California, San Diego
February 8-9, 2017**

I. Introduction

The Undergraduate Program Review Committee for the Department of Chemistry and Biochemistry met on February 8 and 9, 2017. The committee had previously received material from the Chair of Undergraduate Council and the Associate Vice Chancellor for Undergraduate Education (AVCUE). This material included:

1. A letter dated June 22, 2016 from Geoffrey Cook, Chair of Undergraduate Council, to Professor Partho Ghosh, then Chair of the Department of Chemistry and Biochemistry;
2. A letter dated September 22, 2016 from Barbara Sawrey, the AVCUE, to Professor Ghosh;
3. The Department's self-study report;
4. Supporting material, including course scheduling and enrollment data, courses taught, grade distribution by courses, funding and support summary, instructor ratings from CAPE, faculty workload policies, teaching statistics for chemistry and biochemistry, physical sciences and the general campus, ladder-rank faculty demographics, degree requirements, degrees awarded, distribution of majors by college, retention and time to degree, UCUES results, post-baccalaureate survey, UCSD Career services survey,
5. The report of the last review of the department in April 2009 and subsequent letters dated 2011, from Professor Marc Appelbaum, Chair, Committee on Educational Policy and Courses, and 2015, from Professor Leslie Carver, Chair, Undergraduate Council.
6. Organizational chart of the department and the department's resource profile provided by UCSD Academic Affairs.

The committee met on February 8th with the Associate Vice Chancellor for Undergraduate Education, the interim department chair and the vice-chair of education, with senate faculty, with Student Affairs Advisors, the departmental manager and business officer, and with graduate teaching assistants. On February 9th, the committee met with representatives from the colleges' Deans of Advising, non-senate teaching faculty, undergraduates, and finally during an exit interview with the AVCUE, the Dean of Physical Sciences and the interim department chair and the vice-chair of education.

II. Description of the current operation of the department

The Department of Chemistry and Biochemistry (C&B) currently has 62 faculty members, including partial appointments and three in administrative positions. The Department Chair is Steve Briggs. There is a single Vice-Chair for Education, Judy Kim, in place of the two Vice Chair system in use at the last review.

The COO, Steve Ford, oversees nine individuals who in turn are responsible for a staff of 42, a significant increase from the prior review. On the undergraduate education side, this includes a Student Affairs Office, managed by Erica Lennard and with 7 staff, and Undergraduate Laboratories run by Suzanne Anderson with a staff of 7.5. Every meeting of the committee with a constituent group identified the departmental administration overseeing

teaching, including the MSO, office managers and councilors, as a major strength for the department.

C&B is a large department, with approximately 1100 majors. This makes it one of the largest such departments in the country by number of graduating majors. At the same time, the number of majors fluctuates considerably due primarily to changes in the number of students accepted into other STEM majors on campus. This point is considered further below.

C&B teaches a very large number of service courses: undergraduate enrollments in C&B course in the 2014-2015 academic year exceeded 21,000. Although the self-review surprisingly did not break down enrollments by majors, back-of-the-envelope calculations indicate that chemistry students represent roughly one tenth of the total enrollment in the large lower level courses and in organic chemistry.

The standard faculty course load is essentially 2 per year, one large and one small class. The departmental Bylaws contain a remarkable formula to determine each faculty member's teaching load, but in practice class allocation is carried out in concert among the Chair, the Vice Chair for Education, the COO, and the Divisions within the department (these essentially reflect research areas: Biochemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry). A faculty Committee on Undergraduate Affairs appears to provide only minimal input into the department's undergraduate teaching.

III. Analysis of the strengths and weaknesses of the department's program

There is a clear, deep commitment to education on the part of all faculty—research professors, teaching professors and instructors. Furthermore, in a department rich with top-ranked researchers there is an admirably high level of participation among such faculty in teaching introductory courses. The review committee was also impressed by the fact that teaching professors have full voting rights, a policy not in place in many STEM departments at UCSD. We found this status of teaching professors to be emblematic of the importance placed by the department on undergraduate education and a clear statement of the status of the teaching professors among the faculty.

Conversations with Senate and non-Senate faculty, as well as staff, provided strong evidence that teaching is taken very seriously. This impression was strengthened by the committee's interactions with undergraduate majors, who discussed individual faculty in glowing terms and, remarkably in our experience, by name. The committee was also impressed by the implementation of innovative educational approaches, including Process Oriented Guided Inquiry Learning (POGIL) and other forms of active or inquiry-based science education. Participation in the Center for Advancing Multidisciplinary Scholarship for Excellence in Education (CAMSEE) by a number of the Department's teaching faculty confirms their interest in developing and promulgating best practices and ideas.

Across all the interviews and meetings, the existence of an open and supportive atmosphere for students was readily apparent. Female students, roughly half of the departmental majors, described a welcoming atmosphere. Furthermore, in the meeting with TAs the committee learned that LGBT students found the environment sufficiently comfortable to initiate conversations about preferred gender pronouns.

IV. Recommendations

1. Developing and implanting a coherent, overarching educational vision across STEM disciplines

We recommend establishment of a working group, and ultimately a new Education Committee, that can discuss the goals of the educational experience and their implementation, as

well as begin reaching out to other departments impacted by the Department's curricula. We were struck by how many departmental constituents assumed that such conversations must already occur, and further assumed they were left out the conversation. Instead, individual faculty teach within their disciplines in consultation with others in the discipline, and little broad engagement and dialog actually occurs. Within C&B there is an education operations committee focused on the mechanics of delivering courses and implementing the curriculum. However, a new education committee could address the overarching educational and curriculum goals of the department's teaching mission. It is hoped that this committee will institute a spirit of innovation that is the norm for the Department's research.

As initiated by a revamped Education Committee, the conversation about teaching by the department needs to focus on the fact that the vast majority of students enrolled in lower division courses and in organic chemistry are not Chemistry majors. Organic chemistry provides an excellent starting place for revising the curriculum to achieve greater relevance to the broad cross-section of students, many of whom are life science majors, taking the course. Carbonyls, for example, need to be discussed early in the organic series and with biological examples. Departments with successful experience developing such curricula include UC Berkeley and U. Michigan. There is both a need and an opportunity for C&B to contribute and innovate with regard to the tectonic shifts in curricula modernization taking place in the field.

Such conversations should cross STEM fields, include faculty from departments served, and involve both teaching and research faculty from the Department. Since physics and math similarly have broad groups of students and a majority of non-majors in their courses, the discussion should logically be at the level of the Division rather than just C&B. However, given chemistry's centrality to other sciences, engineering, and the pre-health professional curricula, C&B appears well-placed to initiate this discussion.

New and revised curricula for the service courses, and indeed all courses, should include implementation of *clear learning objectives and learning outcomes*. This is essential for developing and evaluating effective courses and curricula. It will also benefit program reviews, accreditation, and student success in demonstrating required proficiencies.

In addition to better serving the needs of majors from other STEM departments, the curriculum needs updating to reflect the courses and content required for 21st century chemistry. For example, statistics has gained prominence due to the emergence of "big data" and the need to query and manipulate that data rigorously and readily. A course in statistics would be a good addition to the major, and the material could benefit from emphasis in multiple courses. More challenging, however, is the elimination of less relevant topics, an essential aspect of this effort. Again, an Education Committee would have the scope and overview necessary to identify such changes and their impacts across multiple courses and departments.

Additionally, conversations across STEM departments need to address not only optimization of course content in service courses, but also a strategy for avoiding seesawing numbers of majors in C&B and elsewhere. Furthermore, it is essential that these discussions eventually include the relevant chairs and deans to ensure that efforts at optimizing education are not met with financial disincentives, which might occur from large enrollment shifts in service courses from one department to another.

2. Key data for departmental planning is not collected or not readily available.

The committee was interested in data items that should be easily accessible and highlighted in such a review, but were not readily available. These included statistics on non-majors enrollments in service courses, the number of students working in undergraduate labs

receiving and not receiving course credit, and the fates of students graduating from the department. Thus, for example, there needs to be an analysis of student preparation, performance, and learning within and across the core courses. One particular area in need of study is the Chem4 placement exam, currently administered by the colleges. C&B could look to Math for an example a powerfully useful placement exam that has been properly developed and vetted. Furthermore, undergraduates should be systematically tracked after graduation to learn about their careers and whether the department's educational objectives align with their employment and expectations.

The university is undergoing rapid and substantial growth. Given that most of the influx of students will be in STEM fields, the expected growth in enrollment and number of majors should be anticipated and a plan devised for its successful accommodation. In this regard, the committee notes that the student body now has a broader range of preparation and training than in the past. It is therefore imperative that those students in good standing, but struggling academically, be proactively identified and advised. This will require coordination with the registrar and the colleges. However, this effort is essential to avoid having UC San Diego becoming a school that is in effect providing the opportunity for large numbers of students to fail. As the number of international students increases, this group will also need focused additional support (e.g., language proficiency testing and assistance for both MS and PhD students).

3. Classroom assignments and innovative instructional space utilization need to be addressed.

The committee heard from both TAs and students that seating in discussion sections was sometimes inadequate for attendance, such that students taking quizzes had to sit on the floor. It was not clear whether this reflected in part or in whole students choosing to attend sections other than those to which they are assigned. Regardless of the cause, steps need to be taken to ensure a match between classroom seating and the number of participating students.

The committee also learned that, despite two additional flexible classrooms currently being planned, the existing flexible or studio classroom space is often used in a conventional format as surge space to assist with course scheduling. This situation appears to reflect an insufficient number of course instructors trained and interested in making use of more interactive classroom space. The Department's educational mission would benefit from a commitment to training and encouragement of instructors to leverage the studio classroom for its intended purpose.

4. Teaching loads need to be addressed.

As an amalgam of physical and natural science faculty, C&B is faced with a split in expectations as to normal teaching loads. Nationally, those in the physical sciences tend to be higher than those in the natural sciences, particularly at institutions such as UC San Diego, where counterparts in a medical school have markedly lower involvement in classroom teaching. The committee has no easy solution to offer, but heard clear evidence that resentment exists about unequal teaching loads. The department needs to address this matter directly and transparently and, in particular, to determine whether these inequities affect the quality of teaching. For example, concerns were raised about the difficulty in offering the biochemistry courses with a decreasing number of faculty in the area.

One form of teaching inequity in particular need of attention is the practice of receiving more than one course credit for teaching a single course listed concurrently with two course numbers – one for graduates and one for undergraduates. Such a practice represents a

bureaucratic sleight of hand unfairly benefiting a small group of faculty, and should be abolished.

V. Previous Review

Two points from the previous review came up during our discussions:

1. Relationships with Client Departments. There do not appear to be mechanisms for interaction with client departments. Some mechanisms in between informal conversation and formal requests to CEP would probably be helpful. To quote a review committee report from last year:

“The committee realizes that obtaining feedback from client departments can be difficult. The current review structure does not explicitly contain a mechanism for doing so. However, it would be useful to have some mechanism in place for subsequent CEP reviews of departments with large service teaching loads to aid in understanding how successful the service teaching is, or at least appears to be. This is really a recommendation to CEP as well as to the department.”

2. A More Active Undergraduate Affairs Committee. Such a committee could well be chaired by the VCUA and might take some of the burden off the VCUA in the area of curriculum. Committees are not always enthusiastic about undertaking tasks like curriculum revision and prerequisite hunting, but appropriate incentives might make an active role more palatable.

Professor and Program Review Chair Guershon Harel, UC San Diego

Professor Steven Wasserman, UC San Diego

Professor Gregory Weiss, UC Irvine