



University of Colorado **Boulder**

2017 Program Review

Division of Chemistry

Academic Review and Planning
Advisory Committee Report

Approved

A handwritten signature in black ink, appearing to read "Paul M. ...".

03/20/2018

Provost and Executive Vice Chancellor for Academic Affairs: Date

Contents

Process Overview – 3

2017-18 ARPAC Members – 4

Unit Overview – 5

Past Reviews – 13

Campus Context – 16

Disciplinary Context – 17

Analysis – 18

Recommendations – 23

Required Follow-Up – 28

Process Overview

The review of the Division of Chemistry within the Department of Chemistry and Biochemistry was conducted in accordance with the 2017 review guidelines. Since the separation of Chemistry from the larger department is now in process, this review has sought to document and assess its distinctive features and record. The Academic Review and Planning Advisory Committee (ARPAC) completes the final reviews of all Boulder campus academic units. The division prepared a self-study report during 2016, which was checked in early 2017 by a two-person internal review committee staffed by faculty members from outside of the department, who also met with division personnel and surveyed undergraduate and graduate students. An external review committee, consisting of two members from within the discipline outside of CU Boulder, visited the division on February 28 – March 2, 2017. The external reviewers read the relevant documents and met with faculty, students, staff, university administrators, and ARPAC members. Following the visit, in May 2017, ARPAC issued a preliminary statement encouraging continued discussion at all administrative levels of the department's separation. Additionally, on September 1, 2017, the ARPAC chair and the committee's liaisons to biochemistry and chemistry divisions met with the leaders of those divisions to discuss ongoing developments. The internal and external reviewers' comments and recommendations, as well as the preliminary ARPAC statement, are cited at appropriate points throughout this report. This public document reflects the assessment of, and recommendations for, the Division of Chemistry as approved by ARPAC.

Academic Review
and Planning
Advisory
Committee
(ARPAC)

Sanjai Bhagat, Professor, Leeds School of Business
Robert Erickson, Professor, Electrical, Energy, and Computer Engineering
Erin Furtak, Associate Professor, School of Education
David Korevaar, Professor, College of Music
Clayton Lewis, Professor, Computer Science
Daryl Maeda, Associate Professor, Ethnic Studies
David Mapel, Associate Professor, Department of Political Science
Susan Nevelow Mart, Associate Professor, School of Law
Carole McGranahan, Associate Professor, Anthropology
Paul Moeller, Associate Professor, University Libraries
Bryan Taylor, Professor, Department of Communication

Academic Year
2017-18
Voting Members

Non-Voting Members

Jeff Cox, Chair, Vice Provost and Associate Vice Chancellor for Faculty Affairs and Professor of English and Humanities
Bob Boswell, Vice Chancellor for Diversity, Equity, and Community Engagement and Professor of Molecular, Cellular, and Developmental Biology
Katherine Eggert, Quality Initiative Leader and Professor of English
Bill Kaempfer, Senior Vice Provost and Associate Vice Chancellor for Budget and Planning and Professor of Economics
Mary Kraus, Vice Provost and Associate Vice Chancellor for Undergraduate Education and Professor of Geological Sciences
Ann Schmiesing, Vice Provost and Dean of the Graduate School and Professor of Germanic & Slavic Languages & Literatures

Staff

Andre Grothe, Office of Faculty Affairs
Emmanuel Melgoza Alfaro, Office of Faculty Affairs

Unit Overview

The campus's standardized description of the Department of Chemistry and Biochemistry may be found on the website of the Office of Data Analytics (ODA) at <https://www.colorado.edu/oda/institutional-research/institutional-level-data/information-department/academic-review-and-planning>. ODA updates the profile annually in the fall semester. This report cites the ODA data for the department posted in October 2016, reflecting the state of the department as of academic year (AY) 2015-16. It is important to note, however, that this profile—including data from the spring 2013 National Survey of Student Engagement (NSSE)—aggregates data for both Chemistry and Biochemistry. In its self-study, Chemistry selectively disaggregated portions of this data. As a result, and unless otherwise specified, references to data in this report are distinguished as follows: references to “the department” indicate aggregated (i.e., nonspecific) data; references to “the division” indicate disaggregated (i.e., division-specific) data.

The department offers chemistry undergraduate and graduate degrees. The Division of Chemistry's faculty members conduct research in physical chemistry, materials chemistry, and atmospheric chemistry. The Chemistry faculty also make extensive service contributions, both professionally and in service to the campus.

Personnel and Governance

The self-study lists 29 Chemistry division tenured and tenure-track faculty (TTT). Combining information in the self-study with additional data from the division's website this count breaks down as one fully rostered distinguished professor line, and one shared line with that title, 14.5 full professors, six associate professors, and seven assistant professors. Additional division faculty FTE include one research professor, 4.5 instructors, and five adjunct faculty. Of the TTT faculty, 20.5 FTE are rostered in

the College of Arts and Sciences, and 8.5 in related institutes and programs. The Office of Data Analytics unit profile shows salaries for assistant and associate professors in the larger department are close to or above peer-institutional averages (98% and 107%, respectively), while those for full professors lag (90%).

The self-study attributes the ongoing decline in Chemistry teaching power and support of core curricular areas (e.g., inorganic chemistry) to recent and imminent retirements and to a relative increase in faculty affiliation with institutes and other programs. As a result, the division proposes a multi-year hiring plan, resulting in 24 tenured and tenure-track faculty rostered in the College of Arts and Sciences. The self-study also requests permission to hire instructors and lecturers to teach additional sections of Chemistry undergraduate courses. The external reviewers recommend that “hiring continue unabated for the foreseeable future.”

The Division of Chemistry operates with relative autonomy within the department, and is currently led by the department chair, who also serves as the lead representative of the division’s faculty. Envisioning a future governance structure, the external reviewers recommend changes to the legacy department approach, such as better representing junior faculty voices in decision-making by expanding the operation of its executive committee (i.e., rather than frequently convening full faculty meetings).

Research
and
Scholarship

Chemistry faculty are widely acclaimed as productive researchers. For the current review period, the self-study documents considerable achievement in areas such as external research funding (\$100 million), article publication and citation counts (1345 and 34,200, respectively), and awards (e.g., four

faculty belong to the National Academy of Sciences, five to the American Academy of Arts and Sciences, and one to the United States National Science Board). *U.S. News and World Report* has ranked the physical chemistry program ninth in the nation. Though Chemistry does not have exhaustive data on its graduate student placement statistics, data presented in the self-study suggest an impressive record of placement in academe, industry, and federal laboratories. The external reviewer committee's overall assessment is that Chemistry's research productivity is "ranked highly and compares extremely favorably with Chemistry departments within peer public institutions."

Undergraduate Education

The Department of Chemistry and Biochemistry offers the Bachelor of Arts (B.A.) degree and a minor in Chemistry. These will require disaggregation from their Biochemistry complements prior to regent approval of a department split. The self-study reports 236 declared chemistry majors in fall 2015, a five-year increase of 28%. The number of declared minors is 67 (-27% over five years). In the 2015-16 academic year (AY), the larger department recorded over 33,000 student credit hours (SCH). Tenured and tenure-track (TTT) faculty offered 38% of these hours, and instructors 47%; the remaining 15% were offered by other instructional faculty, including adjuncts, visitors, lecturers, and graduate part time instructors. Of these SCH, 82% stem from non-major enrollments in service offerings in the areas of general and organic chemistry. These courses are offered both to the general campus and in Residential Academic Programs (RAPS). Various tracks in these offerings serve distinct groups of majors and non-majors from other units (e.g., environmental sciences and engineering).

Recently, Chemistry faculty have reformed the division's curriculum and assessment programs to increase student

retention and to aid student success. The internal review committee report emphasizes Chemistry's "long history of supporting undergraduate research" in programs such as University Research Opportunities (UROP) and honors. The student / TTT faculty ratio for the larger department is 5.1, lowest among comparable units in this review cycle. The external reviewers praise the quality of the division's offerings, its recent curricular reform, and its modernizing renovation of organic chemistry labs. The self-study presents plans for refining student assessment to facilitate placement in introductory courses, decreasing the size of course sections offered to non-majors, improving first-year experience and declaration rates among majors, and increasing participation among TTT faculty as instructors of general chemistry classes.

The 2013 National Survey of Student Engagement indicates low to moderate levels of satisfaction among majors on such topics as course availability (68%; 4/5 of review units), advising (48%; 3/5), and academic quality (75%; 4/5). However, results of the spring 2017 internal review survey of indicate more satisfaction in two of these areas: 75.48% of Chemistry majors report being either "satisfied" or "very satisfied" with course availability, and 72.64% with faculty and staff advising. Overall satisfaction with the division in the internal review survey is 73.6%.

A substantial share of students who declare Chemistry as their first major are not retained within the major. The Office of Data Analytics shows that, of students declaring Chemistry as their first major within the undergraduate cohorts entering CU Boulder between 2007 and 2010 (i.e., graduating between 2010 and 2016), only 19% graduated with a Chemistry major within six years. By comparison, other natural sciences majors during the same period saw 48% of students graduating within six years in the major that they originally declared. Of those

declaring Chemistry as their first major, 64% graduated with a College of Arts and Sciences degree (any major) within six years, and 67% graduated from CU Boulder overall (any college). Campus-wide, the six-year graduation rate for these cohorts was 70%.

Graduate Education

The department offers the M.S. and Ph.D. in Chemistry. The Office of Data Analytics (ODA) reports that there are 169 graduate students in total, four of whom are M.S. students. Separate figures for Chemistry graduate students are not available; the self-study count of 169 Ph.D. students simply repeats the ODA total in all department graduate programs. The self-study reports that the Division of Chemistry sees, on average, seven Chemistry M.S. and 28 Chemistry Ph.D. degrees awarded annually. ODA's comparators for the department as a whole for AY 2015-2016 are eight MS degrees (4/7 rank of units under review, unchanged over five years) and 22 PhD degrees (2/7, an 83% five-year increase). Concerning departmental median time to degree completion, ODA reports no data for the M.S. program; the figure for the Ph.D. program is 5.72 years (rank 2/7).

Chemistry has developed and participates in numerous programs fostering interdisciplinary graduate student research and providing extensive instructional training. On campus, related certificate programs and partnerships include those with the Cooperative Institute for Research in Environmental Sciences (CIRES), JILA, the Renewable and Sustainable Energy Institute (RASEI), and the Materials Research Science and Engineering Center (MRSEC). Partnerships with federal laboratories include those with the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the National Center for Atmospheric Research (NCAR). The self-study reports

“excellent placement of our graduates in academia, industry, government, and post-doctoral positions.”

The most recent data for department graduate student surveys supplied by the Office of Data Analytics date to 2009. These aggregated results display relatively unsatisfactory ratings by graduate students of several program elements, ranging from a low of 47% for “space and facilities” to a high of 67% for overall quality (mean of 57.17% across six items). As with the undergraduate data, however, results from the Spring 2017 internal review survey display better results: 73.81% are “satisfied” or “very satisfied” with the availability of required courses, and 80.95% with the quality of advising. Still, other results indicate areas of graduate student concern: only 51.77% endorse the “clarity” of program requirements and 59.52% their level of financial support (mean of 60.3% across 10 items). In interpreting these findings, the self-study and internal review balance the graduate students’ high ratings of research opportunities and advising with concern that Chemistry needs to foster stronger community and revise its current use of cumulative exams. The external review report echoes these findings and recommends continuing efforts to ensure successful communication with graduate students about program policies and expectations for successful progress. It also recommends supporting and standardizing a program for increasing and improving graduate student faculty mentorship beyond the primary advisor-advisee relationship. ARPAC notes the additional challenge faced by Chemistry in addressing the unique needs of its postdoctoral researchers and fellows.

Facilities Chemistry’s research spaces and instructional spaces (totaling 67,000 square feet and unknown square feet, respectively) are primarily located in the Cristol Chemistry and Ekeley Science buildings. There are longstanding and increasingly urgent

concerns with these spaces' safety, functionality, and currency. Organic chemistry labs located in Ekeley and some faculty research labs located in Cristol have recently undergone extensive renovation. Both the self-study and the external review report conclude that the need for additional improvements is critical, e.g., in fume-hood intensive research labs, undergraduate organic chemistry labs, etc. Both the self-study and the external reviewers recommend a major Cristol remodel, as well as the construction of additional research space in a bridge/annex connecting Cristol and Ekeley.

Staffing
and
Budget

The Office of Data Analytics profile numerates 17 exempt and classified staff positions for the department. The Chemistry and Biochemistry divisions are redesigning their staff roles to ensure successful stand-alone functioning. Chemistry staff roles are generally categorized as administrative (e.g., finance), teaching (e.g., advising), and research (instrumentation support). Here, the self-study and external review report record negative effects created by general understaffing (e.g., in light of increased enrollments and complexity of federal grant administration), and by turnover related to staff departures and retirements. While dedicated, the remaining staff are relatively few and inexperienced. The self-study requests—and the external reviewers endorse—increased Chemistry staff hiring. The external reviewers also endorse a separate Chemistry request concerning enhanced staffing in the Office of Contracts and Grants (OCG). These staffing increases will hopefully ensure the department's successful division and aid future teaching and research work.

The self-study presents plans to fund Chemistry's improvements through increased revenues from external research funding, industry research partnerships, and fundraising (e.g., for endowed chairs and student scholarships).

Both the self-study and external reviewers cite the urgent need for the college and the campus to revisit funding models for new and replacement faculty startup packages. Specifically, Chemistry reports an imminent financial crisis in its ability to meet standing startup commitments, let alone to recruit and retain desired faculty.

Inclusive Excellence

The self-study does not provide Chemistry/Biochemistry - specific data concerning faculty and student diversity. However, the Office of Data Analytics unit profile yields the following data for the entire department:

Category	Female (%) Rank of Units in Review Cycle; 5- year % change)	Minority Race/Ethnic Status	Underrepresented Minority
TTT Faculty	24% (1/8); N/A	18% (3/8); N/A	4% (2/8); N/A
Undergraduate	35% (2/6); - 7%	30% (2/6); + 31%	16% (2/6); +31%
Graduate	34% (3/7); - 9%	19% (2/7); +84%	11% (2/7); +115%

Compared to other units in this review cycle, this data suggests a relatively high degree of diversity among faculty and students for the larger department. Five-year gains in the inclusion of minority students are particularly impressive. Related declines in the percentage of female students, however, are a potential area of concern. The self-study presents extensive strategic planning that identifies challenges to achieving inclusive excellence among members of underrepresented groups, including among non-major undergraduates, Chemistry majors, and Chemistry graduate students. Additional plans include cultivating existing programs to facilitate increased student success and retention and developing new programs in the event of receiving new resources.

Past Reviews

As previously noted, this review marks the first analysis of the department as separate units. While recommendations from the last department review still pertain to Chemistry, the lack of a division-specific baseline or trend data complicates ARPAC's assessment.

At the time of the previous review, in 2010, Biochemistry's move to East Campus was pending. At that point, the department intended to continue integrated operations, and ARPAC recommended various efforts to increase cohesion across divisions. These matters are now moot. Specifically, Chemistry strongly desires to remain located on the main campus.

A 2010 recommendation to strengthen new faculty mentorship resulted in the development of a formal mentoring policy. The self-study reports that this policy produced mixed results, saying that advancing Chemistry assistant professors rely increasingly on informal mentoring. In turn, Chemistry depends on the chair to assess annually what combination of mentoring resources are appropriate for each faculty case. Here, the external reviewers recommend that Chemistry better match the research interests of tenure candidates and their mentoring and evaluation committees. They also recommend that the division proactively nominate junior faculty for available awards. ARPAC also suggests connecting Chemistry's junior faculty with senior faculty in other units sharing similar interests.

The 2010 review also cited poor graduate student completion rates as an area of concern. However, according to the Office of Data Analytics unit profile, the overall department's PhD conferral rate has increased 83% in five years, and the department ranks second on this measure among seven comparable units for this review cycle. The department has

made similar progress improving median time to completion of the Ph.D.. That figure is now 5.72 years; although no corresponding five-year % change is provided, the percentage of Ph.D.'s completing the degree by the six-year milestone has grown to 57% overall. The 2010 review also cited relatively high female graduate student attrition rates as a problem; though the current Chemistry self-study does not discuss this. However, it does report that its "various divisions have implemented or are in the process of implementing mechanisms to provide feedback and guidance to [Ph.D.] students in their fifth semester through graduation" which could be an important aid to all students. As discussed above, current student survey results are relatively positive, while still indicating some areas for improvement.

It is difficult to assess Chemistry's progress on a prior ARPAC recommendation to implement a plan to implement faculty and student diversity improvements because of scant specific data. This lack of information creates problems for assessing trends in the Chemistry faculty composition. However, Office of Data Analytics statistics indicate that overall minority student enrollments have increased, but there is a decline among enrollment of women students. At least in part, any success in this area may be attributed to extensive activities and programs developed by Chemistry (summarized in the self-study) to promote inclusive excellence. However, diversity is not a prominent concern in self-study discussions of faculty hiring or mentoring (although it is mentioned incidentally concerning recent hiring in the Materials and Nanoscience Program). ARPAC urges all departments to consider inclusive excellence in recruiting faculty, as well as staff and students.

Finally, laboratory safety was cited as an issue in the department's last review. As discussed above, significant

progress has been made in this area, but “serious safety concerns” persist. For example, the external reviewers cite continuing hazards in Cristol’s undergraduate general chemistry lab space.

Several issues raised in the 2010 ARPAC recommendations directed to the college and the campus remain unresolved. Funding gaps arising from the mandated allocation of Indirect Cost Recovery (ICR) persist, the provision of adequate lab space for faculty research has not been addressed, and the restructuring of campus support units such as the Office of Contracts and Grants (OCG) remains concerning.

Campus Context

The most important campus contextual circumstance for Chemistry is its relationship to the current parent department. Planning for the proposed split of Chemistry and Biochemistry appears to be proceeding in a collegial manner, with the participants sharing the end goal of successful independence. Both the Chemistry internal and external reviewers support this plan.

Chemistry maintains extensive relationships with other campus entities. Perhaps most important is the division's substantial provision of instruction that serves other units, and more generally, college core curriculum requirements. Additionally, Chemistry faculty engage in broad research collaborations with units such as the Cooperative Institute for Research in Environmental Sciences (CIRES), JILA, the Renewable & Sustainable Energy Institute (RASEI), and MRSEC. Internally, Chemistry has displayed its commitment to interdisciplinarity by creating a division for materials and nanoscience. The fruits of these efforts are demonstrated in the self-study report that "54% of papers published by Chemistry faculty since 2010 had interdisciplinary co-authors."

Disciplinary Context

Internationally, the Chemistry division enjoys preeminent status and visibility; the external reviewers, for example, praise the atmospheric chemistry program as “one of the strongest in the world.” Nationally, the external reviewers qualify Chemistry’s physical chemistry program “within the top ten in the country”; that same program is ranked ninth in the nation by *U.S. News and World Report*. The external reviewers project that a successful split of the divisions will help Chemistry better to achieve its potential.

Analysis

The Chemistry external review committee expresses enthusiasm for the division, with respect to both to its current practices and its future as an independent department. Noting this and similar support expressed for the separation of Chemistry and Biochemistry by the latter's external reviewers, ARPAC issued a statement on May 10, 2017, recommending that planning for the separation go forward.

The Chemistry external reviewers praise the division's research accomplishments, its successful relationships with cognate institutes and programs, its "dedication to offering high quality educational experiences," and the "superb" renovation of some of the undergraduate organic chemistry labs. The reviewers also compliment the current department chair and the self-study authors for their leadership through this period of change. The external reviewers also join the internal reviewers in encouraging further planning that will help Chemistry to build on its strengths. ARPAC in large part concurs with these evaluations, as discussed below.

Faculty Hiring

The external reviewers endorse the division's proposal to conduct at least four faculty hires over a multi-year period to maintain its research productivity and to support its educational programs; hires should be made strategically to further scholarly strengths and to put scholar/teachers into the classroom. The external reviewers also endorse moves to further specify and prioritize proposed hires, and ARPAC highlights the opportunity here for Chemistry to link strategic hiring goals to areas of existing strength, including to the research interests of recent hires. Chemistry should also explicitly integrate its hiring plans with its broader plan for achieving inclusive excellence.

Chemistry must take care when considering institute hires, which can create financial challenges, as mentioned earlier. A related concern, noted in the self-study, and elaborated in a meeting between ARPAC and Chemistry/Biochemistry leadership, is that institute-directed hiring (versus college-directed hiring) complicates the department's ability to address education and research disciplinary priorities. Over the long term, institute hiring, if done at the expense of college hiring, exacts intellectual and financial costs on departments. ARPAC agrees that there are important and complex issues here that should be addressed in a campus-level conversation involving departments, institutes, deans, and the Office of the Vice Chancellor for Research and Innovation.

Undergraduate Program

ARPAC applauds efforts in the Chemistry self-study to assess the division's undergraduate program and to plan. Specifically, Chemistry anticipates growing enrollments and an ongoing need to revise its curriculum and assessment programs. The self-study envisions a future for Chemistry that includes reduced class sizes in first-year general chemistry courses, classroom (re)designs to better facilitate teaching and learning and increased upper-division course offerings. ARPAC notes that Chemistry needs to secure additional instructor lines to follow through with its planned class size reduction. Additionally, the self-study requests permanent status for the Organic Chemistry program coordinator position. It further projects that hiring additional tenured and tenure-track faculty will increase the division's teaching power and that facility renovation will improve the student experience. The external reviewers concur with these plans and offers additional recommendations, including that the division should enhance fundraising for the purchase of instrumentation, should seek increased college support for the Assessment and Learning in Knowledge Spaces (ALEKS) program, should continue

instructional staff management of undergraduate advising, should hire additional instructional staff, and should reform the current procedures for Chemistry's administration of special needs accommodations (e.g., outsourcing related exam administration to campus-level units such as the Center for Academic Success and Engagement). ARPAC finds these recommendations reasonable and urges the unit to consider them as it moves forward.

Chemistry loses far more of the students who initially choose it as a major than do its sibling natural sciences departments (81% vs 52%). If unchecked, the factors producing these losses may weaken the major from an imbalance of lower and upper division instruction. The unit should monitor the data carefully, and prepare to act if improvements already underway prove ineffective.

Graduate Program

In addition to maintaining its graduate program's current strengths, the division commits in its self-study to better communication with its graduate students about policies and procedures and to fostering a greater sense of community among the students and with post-doctoral researchers. The division projects that future faculty hiring will maintain "the strength of [its] interdisciplinary and cutting-edge research" to the clear benefit of graduate students. The unit also plans to enhance student and post-doctoral preparation for "entrepreneurial and industrial careers." The external reviewers concur and further recommend abolishing the use of cumulative exams, supporting student cultivation of committee member relationships, and establishing a Chemistry graduate student organization. ARPAC concurs with these recommendations, particularly that concerning exams. ARPAC also urges Chemistry to place more emphasis on strategizing and

documenting its recruitment and retention of female graduate students.

- Financial Issues The self-study summarizes Chemistry's financial situation as "extremely challenging," noting unsustainable expenses associated with aging infrastructure and the funding of new faculty startup packages. On a more positive note, the self-study and the external reviewers agree that Chemistry has unrealized fundraising potential. The reviewers specifically recommend fundraising for endowed chairs. ARPAC concurs with these findings.
- Space ARPAC endorses current plans to keep Chemistry located on the main campus. The self-study and external reviewers recommend a staged (2-4 year) renovation of Cristol Chemistry, coupled with a modest expansion of the Cristol/Ekeley complex to create a second and third-floor bridge between the buildings. ARPAC praises Chemistry's sustained efforts to ensure instructional space safety and effectiveness and recommends that the division, dean, and provost work together to devise and review plans for the Cristol building renovation/expansion.
- Staff The self-study reports that staff positions associated with Chemistry's administrative, teaching, and research programs are in flux, pending the completion of a division-specific needs assessment. Pressing staffing needs include: (1) hiring an additional staff member in Biochemistry, which will allow Chemistry staff to reduce and eliminate tasks they currently perform for both units; (2) "converting a [Professional Research Assistant] position associated with the undergraduate teaching program to a permanent position"; and (3) "hiring additional instructors and lecturers to teach additional sections of undergraduate chemistry courses."

The division remains committed (as reported in the self-study) to improving staff climate and community even as it faces strains from hiring and training new staff during the upcoming transitional phase and that also coincides with increasing enrollments. Further, as mentioned above, the division strongly prefers that its instructional staff conduct in-house student advising. The external reviewers concur, as does ARPAC, that this is often a useful approach. The external reviewers also recommend that the division reconsider the staff graduate advisor's duties to create a reasonable workload. Finally, the reviewers recommend that the Office of Contracts and Grants (OCG) dedicate a full-time staff member to securing chemistry grants. ARPAC finds these conclusions reasonable.

Inclusive Excellence

As discussed above, the self-study reports specific plans by Chemistry to assess and address current barriers to achieving inclusive excellence and to develop additional programs as needed. However, ARPAC is concerned by the absence in the self-study of both data and discussion about gender equity in Chemistry's programs and plans. Chemistry's future requests for hiring will be strengthened by explicitly addressing the need for gender equity. ARPAC also recommends that the division familiarize itself with and respond to research¹ showing the impact of including more than one female/underrepresented minority candidate in each finalist pool.

Because of how data are currently aggregated between Chemistry and Biochemistry, we lack division-specific graduate and undergraduate diversity information. As division-specific data become available, Chemistry should attend closely to them.

¹ Johnson, S.K., Hekman, D.R., & Chan, E.T. 2016. If There's Only One Woman in Your Candidate Pool, There's Statistically No Chance She'll Be Hired. Harvard Business Review. April 26, 2016. <https://hbr.org/2016/04/if-theres-only-one-woman-in-your-candidate-pool-theres-statistically-no-chance-shell-be-hired>

Recommendations

The members of the Academic Review and Planning Advisory Committee (ARPAC) address the following recommendations to the Division of Chemistry, and to the offices of responsible administrators:

To the Division:

1. Proceed with planning and gaining approvals for the separation of Chemistry from the Department of Chemistry and Biochemistry and its establishment as an independent department. As part of the planning process:
 - a) Consider how the new department will rate in the Academic Prioritization process that weighs the number of degrees per year, cost per student credit hour, faculty scholarly achievement, student satisfaction, and service teaching.
 - b) Develop strategies for minimizing and deferring costs (e.g., through facility sharing with Biochemistry) to maximize available funds for future faculty startup costs.
 - c) Review and revise (as needed) existing policies on self-governance and faculty mentoring.
 - d) Determine how Chemistry and Biochemistry will equitably share responsibilities for introductory course instruction. Explore the possibility of a joint hire in discipline-based education research connected with these courses.
 - e) Maintain opportunities for undergraduate students to double major in Chemistry and Biochemistry.

- f) Work with the college and with the Office of Academic Advising to address issues concerning the assignment and training of the unit's undergraduate advisors.
 - g) Eliminate or revise the under-enrolled International Baccalaureate of Science degree offering.
2. Clarify professional staffing needs as part of the planning process. Make sure that staffing is adequate for the unit's emerging status as a department and that arguments for proposed positions are justified.
3. Continue the strategic planning discussion to develop a specific multi-year hiring plan, including articulating ranked requests for hiring new and replacement tenured and tenure-track faculty and instructors. Prioritize the following two concerns:
- a) Consider cluster hiring to fortify existing program strengths and to build new strengths. When possible, project a replacement-hiring schedule against expected faculty retirements.
 - b) Work with the Office of Diversity, Equity, and Community Engagement (ODECE) and the Office of Faculty Affairs (OFA) to develop a concrete faculty recruitment plan for women and members of underrepresented minorities, using tools such as the Strategic, Targeted, and Accelerated Recruitment (STAR) program and the Chancellor's Postdoctoral Fellowship program. In reporting progress on this recommendation, include the makeup of the finalist pools for each faculty recruitment. Aim for pools that include multiple diverse candidates.

4. Initiate conversations with the college and campus administration about new faculty start-up costs. Work to identify additional resources for start-up cost funding, including external fundraising and the possibility of banking salary savings associated with vacant faculty lines.
5. Investigate the optimal course size and structure for General Chemistry and Organic Chemistry and associated labs, particularly as they relate to learning outcomes and cost efficiency. Work to reduce General Chemistry class size and offer additional upper-division course sections.
6. Gather and respond to data about the proportion of Chemistry majors who leave the program before graduating. Reduce this proportion, aiming to reach the level of other CU Boulder natural science majors.
7. Implement planned enhancements to Chemistry's doctoral and postdoctoral programs, including:
 - a) Address the advising needs of students intending careers outside academe;
 - b) Abolish cumulative exams;
 - c) Facilitate wider post-doctoral researcher engagement with faculty both inside and outside the current division; and
 - d) Consider gender-focused inclusive excellence goals.
8. Work with the Office of the Senior Vice Provost for Planning and Budget and the quality initiative leader to develop

formal mechanisms for measuring learning outcomes and student success.

9. Develop proposals for renovating and expanding the Cristol and Ekeley facilities. Consider the optimal size and number of courses and sections, as well as the need to redesign classrooms to facilitate best teaching and learning practices.
10. Work with the Office of Advancement and the Office of the Vice Chancellor for Research and Innovation to explore opportunities for diversifying unit research funding, including undertaking external and industry fundraising efforts.
11. Facilitate and support the separation of the biochemistry and chemistry divisions into separate departments. Provide Chemistry's faculty and staff with the resources required to establish independence without losing quality in educational and research programs.
12. Support Chemistry in developing sustainable start-up package funding plans for new and replacement faculty hire lines.
13. Work with Chemistry faculty to develop proposals for renovating its Cristol and Ekeley facilities.
14. Assist Chemistry in coordinating its hiring plans with those of relevant institutes. Seek ways to address the financial and programmatic problems associated with the allocation of faculty positions to institutes rather than the College of Arts and Sciences.

To the Dean of the
College of Arts and
Sciences:

15. Ensure that Chemistry recruitment plans move towards increasing faculty diversity, including gender diversity.
16. Provide the staff resources needed to establish Chemistry as an independent department. Work with the unit to address issues concerning the assignment and training of its undergraduate advisors.

To the Vice
Chancellor for
Research and
Innovation:

17. Investigate the financial and programmatic issues associated with the allocation of faculty positions to institutes rather than via the college. Assist Chemistry in working with institutes to minimize problems and maximize benefits.
18. Assist Biochemistry with exploring opportunities for diversifying unit research funding, including external fundraising and industry funding.
19. Consider the Chemistry request for appropriate staffing of the Office of Contracts and Grants (OCG) to ensure effective processing of Chemistry proposals and the administration of secured grants.

To the Provost:

20. Support efforts to achieve the successful establishment of biochemistry and chemistry departments.
21. Support Chemistry and college efforts to develop a sustainable faculty startup package funding model.
22. Support Chemistry and college efforts to fund Cristol and Ekeley facilities renovations.

Required Follow-Up

The lead of the Division of Chemistry, or the chair of its successor department, shall report annually to the provost and the dean of the College of Arts and Sciences on the implementation of these recommendations. Reports should be filed on the first of April for a period of three years following the year of the receipt of this report (i.e., April 1st of 2019, 2020, and 2021). Likewise, the dean and the vice chancellor for research shall report annually on the first of May to the provost on the implementation of recommendations addressed to their units. The provost, as part of the review reforms, has agreed to respond annually to all outstanding matters under their purview arising from this review year. All official responses will be posted online.