

**Seven Year Program Review Report
Department of Chemistry and Biochemistry
University of Maryland Baltimore County
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Executive Summary

The Department of Chemistry and Biochemistry has many strengths. This department is one of the most diverse Chemistry and Biochemistry Departments in the nation with a strong commitment to diversity at the undergraduate and graduate levels. A strong cohort of research active senior faculty and an upward trajectory of the junior faculty make a convincing argument for a positive future direction. The location of the Department in the Baltimore/Washington area with multiple universities and national laboratories is a strength that should be better utilized for research collaborations and personnel hires. The Department is at a crossroads where modest investments in the growth of faculty (at least 2 additional tenure/tenure track appointments which can be used to increase faculty diversity) and graduate students along with a carefully executed strategic plan will lead to enhanced national recognition. These investments, along with some entrepreneurial activities, will help make the department financially sustainable and help retain the outstanding junior faculty. Strong basic science departments, like Chemistry and Biochemistry, are essential for national recognition of STEM-oriented universities.

Departmental Direction (c and i)

The Chemistry and Biochemistry Department has fewer tenure/tenure-track faculty than many peers and aspirational peers. For this size department, it is very difficult to have outstanding programs in every area of chemistry and biochemistry. Therefore, it is important for the department to develop a strategic plan that identifies areas of excellence currently in the department as well as areas to grow and develop. The goal is for the department to achieve national recognition in several areas. Some of the faculty identified structural biochemistry and imaging as two possible areas of excellence to build on. Areas like these should be sufficiently broad to bring together faculty who can cover all aspects of a top-notch teaching and training program (analytical, biochemistry, inorganic, organic, physical, theoretical). The strategic plan should identify priorities areas for hiring. Growth in the tenure/tenure-track (T/TT) faculty is essential for the department to achieve its goals of national recognition and we recommend

adding two additional T/TT faculty. Furthermore, the number of lecturers relative to the size of the T/TT faculty should be included in the plan. The strategic plan should identify peer and aspirational peer departments and do a detailed comparison of all areas to develop a plan to move the department forward. We suggest that the plan identify and take advantage of local opportunities, such as collaborations with other departments, the diversity of the campus, the location of the department in the Baltimore/Washington area, and the new interdisciplinary life sciences building. Development of the strategic plan should include all stakeholders (faculty, staff and students) and focus on strengths, opportunities and aspirations. A well-developed and executed strategic plan is essential for continuing the upward trajectory of the department and for hiring and retention of outstanding faculty.

The strategic plan should also be consistent with plans and priorities of the College and the University and take into account opportunities to collaborate with other units on campus and other research institutions in the area. The research interests of faculty in the Chemistry and Biochemistry Departments lead to productive collaborations with faculty in Biology, Physics and Engineering, among others. Further, collaboration in educational programs with these departments can also be very productive and allow the department to provide broader coverage of the field than is possible with the departmental faculty. Campus leadership should work with the Department to take advantage of unique opportunities to recruit outstanding faculty when they occur.

The Department Chair has helped the department work together better and provided some strategic direction for the department. He has done an excellent job in helping faculty identify ways to regain funding for their research programs. The Departmental faculty are worried about succession planning for the future leadership of the department and would benefit from a discussion of this topic with University leadership.

A common concern from the faculty about the future of the department was that the size of the graduate program was too small. We agree with this assessment. However, an increase in the size of the incoming graduate class must be accompanied by increases in both the departmental grant funding to enhance the RA opportunities for the students and the applicant pool to the department. Increased grant funding and increased national recognition for specific areas of excellence should lead to increases in both the applicant pool and in the yield of students matriculating into the graduate program. Developing mechanisms to increase retention of graduate students in years 1 and 2 would also be helpful in increasing the number of students available to contribute to the success of the departmental research mission. An action plan to address each of these issues should be developed in the strategic planning discussions.

Resources (h, j)

The department is doing remarkably well despite severely constrained resources. Many aspects of the department functions are under financial stress and many recent investments and accomplishments are vulnerable. The department needs to be more entrepreneurial and with the support of the Dean and the Provost strengthen its extramural funding, summer

income and philanthropy. Regarding extramural funding, the current trajectory is positive and will help the department move up the ranks. The improvement over the last few years is evident both in the number of faculty who have been able to secure extramural funding, and by the types and size of grants obtained. The goal should be for all faculty members to have extramural funding and for a large number of them to secure NIH and NSF support. However, funding from other federal agencies (DOE, DOD, etc.) and private foundations should also be recognized and encouraged. Further improvements in external funding will occur if additional institutional investment is in place, which first and foremost includes strengthening of the graduate program. A number of the recently funded projects are vulnerable, as faculty do not have access to the quantity and quality of graduate students that they need to accomplish their work. To address this issue, we suggest a reasonable institutional investment in the form of graduate scholarships and/or teaching assistantships. This investment in the department is essential to allow the faculty to successfully carry out their proposed research and to remain competitive for future funding. Departmental initiatives to help the development of students, faculty, and staff, outreach, seminars, maintain the website, etc., will also need resources that could be generated from summer session teaching and philanthropy as discussed below. The department should be commended for having balanced its finances and we recommend that their fiscal responsibility be rewarded by allowing the department to own and reinvest their savings.

Scholarly work (f)

The Department has a number of senior faculty with well-funded, creative, nationally and internationally recognized research programs. The majority of assistant professors are making good progress at developing excellent research programs as well. The Department Chair has done a remarkable job in developing mechanisms to increase the number of funded faculty in the department, particularly at the Associate Professor level. However, additional resources, such as the availability of seed grants and support of interdisciplinary research, would enhance the ability of faculty regain and retain research funding. Finally, the department should develop a mechanism, such as an awards committee, to be aggressive in nominating their faculty for external awards. These nominations provide recognition for both the faculty member and the department.

Currently the size of the program is not adequate to provide research opportunities for undergraduate students, particularly in the area of biochemistry. Growth in the tenure/tenure-track faculty would help alleviate this bottleneck. The department might also consider altering the upper level laboratories to develop the student skill in asking and answering research questions.

Perceptions of students and teaching (b, d, e, g)

The Undergraduate program is in excellent shape. The goals of the program are being met by providing a high quality education based on the use of the most current educational tools, largely thanks to the efforts of the teaching faculty. The students interviewed, which included Chemistry, Biochemistry and Chemical Education majors, most of them doing research, conveyed a great deal of satisfaction in terms of the quality of instruction, faculty availability

and research opportunities. While the infrastructure of the teaching labs seems appropriate, it appears that safety is almost entirely dependent on the staff person in charge of the laboratory preparations. Opportunities for improvement conveyed by students include establishing a “research day” dedicated to help student find a good research match with a faculty member. Students also suggested the introduction of writing skills earlier in the program and in a more gradual and general manner so that the writing required in the Physical Chemistry Lab is not overwhelming and the skills acquired can be used in other labs. Students noted the challenges that arise by leaving the second Biochemistry course to their senior year, which prevents some students from on-time graduation and suggested a revision of the schedule. Having ACS accreditation is of value to the program but the use of multiple-choice ACS examinations may not be conducive to the development of analytical and writing skills. Perhaps a mix of ACS and non ACS exams could be considered. The department is doing a good job at developing tools for assessment of teaching excellence.

The graduate students in the department that we met with felt that the department provided a supportive community that actively worked to help the students achieve their career goals. They reported that the faculty were friendly, open to collaboration and were excellent mentors. The students identified the rotation program and the summer bridge program as aspects that attracted them to the department. They made two specific suggestions:

- (1) Move the independent proposal to the first or second year so that it could be used as part of fellowship applications (such as NSF and NIH proposals). This should increase the number of students who apply for these fellowships which would be good for both the students and the department.
- (2) Ask for input from the students about their TA assignments, develop standardize training for TAs and standardize the TA workload across the different courses.

The graduate students did not complain about the size of their stipends. However, in comparison to peer departments, the stipends appear to be low which may contribute to the difficulty in recruiting students to the department.

The Department should re-examine the graduate curriculum to determine whether courses could be shared between different areas of the department or could be done in collaboration with other departments to decrease the graduate teaching load. The students suggested that there was a lack of a graduate-level Biochemistry course in the department and this is a drawback. This course could be jointly taught with faculty from other departments.

The use of undergraduate students as learning assistants was viewed positively by undergraduate students and seems to be a reasonable way to deal with the need for more TAs in classes than the current number of graduate students in the department.

Staff

While the staff indicate that the department is a friendly, great place to work, they also feel overworked and undersupported. Regular staff meetings with departmental leadership (chair or associate chair) would be useful for understanding the pressure points and priorities of the

department. There is little cross-training or back-up to cover for staff when they are absent due to illness or vacations. The lack of career ladders in the Department and at UMBC in general is seen as a negative. Furthermore, the staff need support from the departmental leadership in communicating and implementing any changes in service that affect the faculty.

Identification of ways to increase the efficiency of the staff should be explored and the staff members have suggestions. A number of proposals were suggested: (1) outsource or use student workers to photocopy materials for courses, such as exams, and require advance notice; (2) review the systems used for shipping and receiving, potentially engaging student workers to enhance this service; (3) use technology, such as Concur, to upload and track travel reimbursements; (4) close the stockroom to outside users; (5) get help from the college for tasks such as filling out visa applications; and (6) reorganize the pre-award support based on agency of the proposal (i.e. NSF, NIH, DoD) to create staff experts in a given type of application.

Answers to Questions from the Department

- 1. Assuming that the state budget does not increase significantly in the next five years, what suggestions do you have on how to increase support for the department from industry or donations?*

It appears that the most accessible source of additional income in the short term could be from teaching in summer sessions. A strong marketing strategy based on enrollment trends and course needs combined with a top-notch educational experience should lead to an increase in enrollments. In addition, it is possible that the department may be able to develop summer courses that are attractive to high school students in the area. Additional resource-generating educational options may be based on the development of professional Masters, particularly suited to the needs of local industries, and Post-Baccalaureate programs to prepare students for professional health programs. Development of a BA in Biochemistry major that serves the needs of pre-health students would likely increase the number of majors in the department. However, it is not clear whether this increase in teaching responsibilities would lead to additional departmental resources. Long term sources of income that should be part of the Department and the University culture include philanthropy and intellectual property. From these, philanthropy may have the potential of some (relatively) short-term impact. The Department and the University should connect with as many alumni as possible and engage them in the development of a vision that can be accomplished in part by creating endowments for faculty chairs, graduate student fellowships, student and faculty awards, departmental activities, etc. The development of a visiting committee is one mechanism to engage the most active alumni and to solicit the views of industrial leaders. If the university does not have a strong donor prospecting system, a place to start would be to generate lists of alumni from established (and retired) faculty members and engage them in key departmental activities. While it is likely that only a few of them will have a significant giving potential it will be beneficial for the department to have as many small and medium level donors as possible. In addition, non-alumni and foundations might be interested in helping to support departmental

programs designed to enhance diversity in the fields of Chemistry, Biochemistry and Engineering.

2. Support for Assistant Professors to be more competitive in getting extramural funding, what else can be done?

Assistant professors confirmed a strong level of support from the department and from several of their senior colleagues. While successful initial funding is extremely important to earn tenure and set new faculty off to a good start, sustained funding is essential for a long term successful career. In order to accomplish sustained funding success beyond tenure and to retain successful faculty it will be critical to strengthen the graduate program, which at this moment is clearly subcritical. The number of graduate students in the department needs to increase to make sure that the faculty research projects can be executed in a timely manner. After having invested over \$500,000 in setup costs for new assistant professors, and after these faculty have proven that they can compete for large extramural funds, the University should make additional investments in mechanisms that will help the department increase the size of their graduate program. The recent increase in success in obtaining extramural funding provides strong justification to increase funding for Chemistry and Biochemistry graduate students, either as RA or TA lines, even if only temporarily, with the expectations that the number of graduate research fellowships will increase accordingly.

The Department has a formal mentoring policy. However, the assistant professors indicate that there is no oversight of the mentoring program and that two of the assistant professors are unclear about who is their formal mentor. Nonetheless, the assistant professors indicate that there is strong informal mentoring available and the Department Chair provides significant mentorship. The Department might consider increasing mentoring of assistant professors in their first year to make sure that they get off to a strong start. The Launch program at the University of Michigan ADVANCE program is one such model. Support of a peer mentoring program among the assistant (and possibly associate) professors might also have beneficial results.

The reviewers note the need to develop a strong mentorship program for the Associate Professors in the department to advance their research programs and to help them prepare for promotion. The Associate Professors carry a significant portion of the important administrative duties of the Department (committee chairs and Associate Chair). This procedure should be examined to determine whether these high levels of service are not reviewed positively as part of the promotion packages and are delaying promotion to full professor.

3. Re-establish support of research funding for mid-career and senior faculty

The department has developed methods that appear to be having success in this area. Mechanisms to get faculty involved in the research of other funded faculty include a sabbatical in another lab or awarding small seed grants to facilitate collaborative research. The

Department should also be willing to explore differential teaching loads for faculty with low research productivity such that they contribute to the success of the department in this way.

4. BS degree

The suggestion of adding a data analysis perspective to the Chemistry and Biochemistry curriculum is an excellent one and the department is encouraged to explore opportunities. The department can explore educational innovations in quantitative biology and biostatistics as well as applications in theoretical and computational chemistry that are going on at several institutions. The data analysis perspective could be included in the current coursework rather than developing new courses.

5. On-line teaching resources

Many departments are struggling with the question of how to determine which courses and which content to deliver on-line. A report from Georgia Tech, "Deliberate Innovation, Lifetime Education" (http://www.provost.gatech.edu/sites/default/files/documents/deliberate_innovation_lifetime_education.pdf) might be helpful.

6. Diversify the Department

The University of Michigan has successfully used a postdoc to faculty program (similar to your prefaculty position) to recruit 2 diverse faculty to the Chemistry department. Challenges with this program that need to be overcome to make it successful include: (1) identification of the reason why you are hiring the person as a prefaculty member rather than as a tenure track faculty member and clarification of the credentials that will be required to make a tenure track faculty offer at the end of the postdoc period. Alternatively, the 2 yr postdoc can be used as a recruitment tactic where the faculty member is hired into a TT position but is given 2 years as a research associate before the tenure clock begins to jump start their research; and (2) development of mechanisms to support the research of the prefaculty member either by providing sufficient start-up funds or mentorship in the laboratory of a current faculty. If the latter, the research program of the prefaculty member must be developed in a way to differentiate it from the mentor.

Other ways to incentivize faculty diversity would be to reserve some partial faculty lines (or start-up funds) at the college or university level that could be used to hire faculty with a commitment to diversity. The request for a diversity statement as part of the hiring documents also can be used to signal that this a priority for the Department. Requiring training for all of the members of the search committee (not just the chair of the committee) in unconscious bias and strategies to run an unbiased search is also recommended. A hiring rubric that includes a commitment to diversity as one criteria is also helpful.

To increase the pool of faculty candidates, advertising in or getting lists of names from Chemistry-specific organizations such as COACH and OXIDE might be helpful. Another

mechanism to increase the pool would be to host future faculty mentoring workshops where diverse candidates (senior grad students and postdoctoral fellows) are invited to visit campus and are provided programmatic mentorship as well as information about the department and the university, including information about the importance of diversity. The NextProf Science and NextProf Engineering programs at the University of Michigan provide one template for this type of activity.

Detailed, effective written mentoring programs can be helpful in recruiting diverse faculty candidates. The LAUNCH program at the University of Michigan was particularly attractive to incoming assistant professors.

7. Engaging newer generations of students, particularly individuals from URM groups

An effective mechanism to empower URM students in an academic department is by supporting student organizations and affinity clubs that help them share their experiences and support each other while having opportunities to develop their leadership skills. This is a model that has worked well since ca. 2005 for graduate students at UCLA where they combine hosting scientific/diversity seminars with professional preparation and outreach. A key part of their mission is reaching out to the community, by visiting high schools and community colleges and hosting groups of visitors to campus. Faculty mentors can play a relatively simple support role.

8. Public Awareness

Mechanisms to increase public awareness will depend on the intended audience. In general, most activities with that goal in mind can be grouped within the broad banner of Public Relations. While a printed or an electronic newsletter should be considered for an audience that includes alumni and peers, an annual science fair or an open house may be considered for the general public and all members of the community. If prospective students are the intended audience, maintaining the website current will be critical. The department and college might consider supporting their faculty in developing materials for the Conversation (<https://theconversation.com/us>) whose goal is to develop articles that make research more accessible to the public.