

UGC Report on Chemistry and Biochemistry Annual Program Review

Prepared by Terrance Worchesky

A. Introduction

The Department of Chemistry and Biochemistry offer the following undergraduate degrees: B.A. in Chemistry, B.A. in Chemistry Education, B.S. in Chemistry, and B.S. in Biochemistry and molecular Biology; and graduate degrees: M.S. and Ph.D. in Chemistry, and Ph.D. in Chemistry and Biochemistry. In addition, the Department offers a minor in Chemistry.

The Department reports having 19 tenured/tenure-track faculty (including the Dean of CNMS) and 7 lecturers. The faculty have been very successful in their research, scholarship, and teaching, with many of the faculty receiving prestigious awards for their work, publishing hundreds of peer reviewed journal articles and book chapters to describe their research advancements and serving the research community as journal and book editors, and reviewers and panelists of research proposals for research funding agencies.

Since the prior review, the Department reports having significant turnover within its faculty with 4 tenured faculty members leaving the Department, replaced by 4 new assistant professors. Also, it was during this period that the number of chemistry lectures grew from 5 to 7 to meet the increased demand for the large service courses in chemistry and biochemistry. The increase in lecturers has allowed the Department to meet its core and service teaching with Departmental faculty, reserving the use of adjuncts to specialty elective courses.

The external reviewers suggested that the faculty be increased by two tenure-track members. They note that the Department has fewer faculty than their peers and this would strengthen the Department's national stature. Also, they suggest this would be an opportunity to continue to increase the faculty diversity. To address this recommendation, the Department has received approval to advertise a Professoriate-Track Faculty Research Fellowship that can lead to a new faculty position.

Undergraduate enrollment in the chemistry and biochemistry majors has remained steady since 2013 with the number of undergraduate chemistry majors at 142 and biochemistry majors at 356. However, the service-course load has increased over the years to the present 2500 students per year.

B. Student Learning Outcomes

Teaching in the Department is innovative and places a high emphasis on student responsibility as part of the learning process. The faculty have implemented compared various pedagogical methods to increase student involvement in large lecture courses. Advanced lab courses serve as capstone experiences for chemistry and biochemistry majors and are writing intensive courses that demand in-depth reports that have significant instructor feedback.

The Department makes extensive use of ACS standardized exams to assess student performance and teaching effectiveness, particularly in foundational courses. During the 2014-2015 academic year, the Department collaborated with the other College of Natural and

Mathematical Sciences (CNMS) departments (Biology, Physics, Mathematics & Statistics) to review existing assessment procedures and share best practices across departments. Course-level assessment in the department initially targeted large-enrollment lower-level courses that are foundational for both chemistry and biochemistry majors; some of those are also General Education Program (GEP) courses. Courses continue to be added each year, including GEP courses that are not part of the sequence for majors. An important aspect of the program-level assessment involves understanding the relationship between undergraduates participate in research experiences and how those experiences correlate or influence their future career plans.

C. State of the Discipline; Program Modifications; Program Changes

The Department's B.S. degree in Chemistry is approved by the American Chemical Society (ACS), the premier professional organization for chemists in the United States. The ACS has standards for chemistry that must be satisfied; thus, their graduating seniors in chemistry have completed a course of study that is approved by the ACS and includes a breadth of content that include various sub disciplines. As an ACS approved program, the Department seeks to provide intense laboratory and problem-solving based instruction to prepare the next generation chemists and biochemists with technical and soft skills required for successful scientific careers in industry, government laboratories (there are many in our area) and other organizations. Also, they seek to provide the students with the knowledge and skills necessary to pursue graduate level careers through admission to graduate school, medical school or other professional schools.

The Department continues to examine its programs and update the programs and courses to meet the ACS requirements and the needs of the students. This includes recognition of market needs, and equipping the students with relevant technical and "soft skills" including verbal and written communication skills. The Department is examining the various options for online teaching; however, it is cautious since these majors require intensive lab-based and problem-solving-based instruction with close and personal interactions between faculty and students.

D. Undergraduate Curriculum

The Department offers three major programs: the B.S. in Chemistry, a rigorous program certified by the American Chemical Society; a B.A. in Chemistry, which provides the option of an increased number of electives so the student may combine a solid background in chemistry with other areas of interest, such as law, education, business management; and a B.S. in Biochemistry and Molecular Biology (jointly with the Department of Biological Sciences). In conjunction with the education department, a program leading to a B.A. in Chemistry Education allows students to receive a degree in chemistry and a high-school teaching certification in a single four-year program. Core courses are required across the undergraduate degrees and programs offered in the Department, providing shared training across the programs and allowing students to make career choice throughout the first two years of their college education.

The B.S. in Chemistry requires a minimum of 76 credits, which include 15 core chemistry courses. The B.A. in Chemistry requires a minimum of 62 credits, which include 12 core

chemistry courses. The B.S. in Biochemistry requires a minimum of 76 credits, which include 17 core chemistry and biochemistry courses. The B.A. in Chemistry Education requires a minimum of 107 credits, which include 11 core chemistry courses and 9 education courses. Many of the Chemistry Education courses count toward the University's general-education requirements.

E. Research Opportunities for Undergraduates

The Department views exposure to hands-on laboratory work an important component of the chemistry and biochemistry curriculum, to prepare students for careers and/or graduate education in chemistry or biochemistry. Thus, students complete multiple laboratory-based courses, starting in the first year. Course credit can be earned for research and CHEM 399 and CHEM 499 are granted to students doing research with the Department's faculty members, regardless of the student's major. Likewise, BIOL 499 can be taken for research with biology faculty regardless of the student's major (biochemistry students may find appropriate research mentors in either department).

About a third of the recent graduates earned course credit for independent research during their undergraduate years at UMBC. The actual number of students involved in undergraduate research is probably higher, since students sometimes work with a researcher without applying for academic credit. Also not included are the students who participate in summer research at other universities, typically as part of formal NSF-REU programs.

The external reviewers point to this area as one that would be strengthened by an increase in the tenure-track research faculty.

F. Undergraduate Advisement

Undergraduate student in the Chemistry and Biochemistry programs with less than 30 credits and first semester transfer students are advised by a professional advising staff in the Dean's office. In general, students with more than 30 credits who are in good standing in the programs are advised by a faculty member. Depending on various factors, faculty members can be assigned up to 17 students to academically advise each semester. The faculty members receive training on the various rules, policies, and procedures from the professional advising staff in the Dean's Office.

G. Council of Majors; Undergraduate Honors; Awards; Recognition

The Chemistry Department supports the undergraduate Chemistry Club, which is a chapter of the ACS. The advancement of students in the club comes through leadership opportunities, social events, seminars, and workshops. The chapter sponsors the presentation of several undergraduate research projects at the student session of the ACS National meeting each year. As part of their education mission, the Chemistry Club host an annual display on campus to incorporate the theme of National Chemistry Week into the everyday lives of college students. The chapter supports an

active lecture and tour program each year to acquaint UMBC students with various career options. To create community connections, the chapter hosts hands-on science workshops at local elementary schools and businesses. An outreach program into local elementary schools includes a program of science demonstrations to assist instructors in teaching chemical principles. Over the last seven years, the chapter has been recognized by the ACS multiple times for their activities.

H. Faculty Development; Teaching Quality

The Department evaluates its teaching effectiveness through SSEQs, student participation in promotion and tenure reviews, and informal feedback from students. The department has established qualitative assessment methods to complement the quantitative SEEQ. A review of course materials to ensure proper course design, content, and creativity in instructional approaches is conducted as part of every faculty review including promotion and tenure, contract renewal of lecturers and senior lecturers, and the five-year review of tenured faculty. An enhanced self-assessment of teaching effectiveness to determine whether the faculty are continuously striving to improve and maintain high teaching effectiveness is required by faculty at all levels.

Faculty in the Department make use of the Faculty Development Center to develop and improve their teaching strategies. The FDC has been used to assist in gathering and analyzing feedback from students in the faculties' courses. Faculty use the ongoing discussion groups and one-time workshops to explore various topics related to teaching and learning; and several faculty members in the Department have completed or are in the process of completing the Active Learning, Inquiry Teaching (AILT) certificate offered through the FDC.

I. Additional Comments; Summary Evaluation

The external reviewers commended the Chemistry and Biochemistry undergraduate program, stating that it is excellent shape. In particular, they noted the high quality education based on the use of current educational tools. An issue that was noted by the reviewers was the continued use of ACS multiple-choice examinations that may be a hindrance to the development of analytic and writing skills. They recommended considering a mix of ACS and non-ACS exams. Also, the reviewers recommended altering the upper-level labs to develop student skills in asking and answering research questions. The Department is examining altering a required analytic chemistry lab to address this concern.

The reviewers saw the Department poised to build on its strong research-active senior faculty and promising junior faculty. The reviewers recommended that the Department develop a strategic plan to build on these strengths, and the Dean in his comments fully supports this suggestion.