# UMBC'S DEPARTMENT OF BIOLOGICAL SCIENCES
# ACADEMIC PROGRAM REVIEW 2017
# UNDERGRADUATE COUNCIL REPORT

The following is based on the review of the portions of the Self Study, the Reviewers' Report, the Dean's Response, and the Post-APR Action Plan that relate to undergraduate education. At the time of the review in the Spring 2017, there were 22.5 core tenured/tenure track faculty and 9 lecturers. The department serves approximately 2000 undergraduate majors annually, which the reviewers note is nearly three times the number of majors that there were 15 years ago.

## A. STUDENT LEARNING OUTCOMES

In their Self Study, the Biological Sciences Department lists nine Learning Outcomes for their undergraduate programs:

1. Apply to the analysis and solution of novel problems the core content of the Biology major, including, but not limited to: evolutionary processes, cell structure and function, plant and animal physiology, ecology, genetics and molecular biology, and biochemistry
2. Incorporate chemical and physical principles into explanations of biological processes and systems whenever and wherever it is appropriate to do so
3. Locate and summarize the key scientific literature on a particular topic in biology
4. Design experiments to test a given hypothesis, perform careful measurements, and analyze experimental results using standard techniques
5. Make, manipulate, and interpret graphs and tables, and use spreadsheets and simple statistical measures to organize, present and characterize data and to assess experimental uncertainty
6. Access major biological databases, perform basic analyses on data accessed, and apply the data and analysis to a biological problem
7. Coherently and concisely present orally and/or in writing the results of experiments, whether one’s own or those of others in the scientific literature
8. Apply understanding of biological systems to larger societal issues, such as the use of embryonic stem cells in research or the development of conservation policies
9. Use mathematical models to analyze, describe and predict changes in biological processes and relationships

The department assesses the achievement of these outcomes with a pre- and post-test each year. In addition, individual courses are assessed by their instructors. The results of these assessments are used to ensure that students are achieving the learning goals, making adjustments where indicated. At the time of the Self Study, the department was developing assessments for Biological Sciences GEP courses not already included in course assessments.

## B. STATE OF THE DISCIPLINE; PROGRAM MODIFICATIONS; PROGRAM CHANGES

The reviewers praised the high quality of the undergraduate programs. They commended the innovative, team-based, and active learning techniques employed by the faculty. They saw the department's practice of having faculty from all ranks, including those with active research agendas, teaching large-enrollment classes as a strength of the program. They commended the department's use of assessments in making changes and improvements to the curriculum. They also noted that the diversity of the students and faculty and the positive atmosphere of the department is a strength and a draw to the program.

The reviewers' principal concerns centered on the low numbers of faculty (especially research faculty) compared to the number of students, the high advising loads carried by the faculty, and the quality of the facilities. They see these resources as insufficient to serve the increasing numbers of students interested in the Biological Science, saying "The resulting faculty to student ratio [1:86] is both dramatically out of line with other departments and insufficient to provide a high-quality educational and research environment."

The reviewers concerns echoes the challenges regarding undergraduate education enumerated in the Self Study by the department, which saw "enrollment growth in the undergraduate majors" as its number one challenge. The Self Study identified more specific concerns that grow out of this imbalance in the faculty to student ratio coupled with declining external funding and accompanying reductions in graduate students. These concerns include the limited research opportunities for undergraduates under either faculty or graduate students and an increased need for undergraduate Teaching Assistants. The department plans to address these needs by expanding their "Discovery-Based Laboratory Courses" and expanding their training for undergraduate TAs.

The reviewers' recommendations to remedy the problems caused by the large numbers of undergraduates relative to the faculty were to increase the number of faculty and hire professional advisors, as well as to update labs, increase lab fees, and increase training for undergraduate TAs. These recommendations were taken up in the responses from the Dean and the Action Plan. Going forward, the plan is to increase the number of tenure track faculty over the next 7-10 years, increase student lab fees and update the facilities, and take new approaches to advising undergraduates.

The reviewers also raised a question about whether the BA degree that was added in 2010 was adequately preparing those students for their intended careers. They recommended examining the outcomes for students in the BA and BS program to assess whether this program was having the learning outcomes the department and the students desired. This issue was recognized by the Dean, and the recommendation was incorporated into the Action Plan.

## C. UNDERGRADUATE CURRICULUM

The Department of Biological Sciences offers BA and BS degrees in Biological Sciences, a BS in Bioinformatics and Computational Biology, a BA in Biology Education, and a BS degree in Biochemistry and Molecular Biology jointly offered with the Department of Chemistry and

Biochemistry, as well as a minor in Biological Sciences. In response to rapid increase in undergraduate Biological Sciences BS majors, the BA degree was established, requiring fewer Biological Science courses. In 2010, the curriculum for the department majors was redesigned to reduce the number of required courses and increased the number of students in their courses, with courses in the first two years carrying enrollments of 300 students. Since that revision, all departmental majors take a core curriculum of required courses in Biological Sciences, Chemistry, Physics, and Math during their first two years. Students then take a set of required and elective courses specific to their major degree. In this redesigned curriculum, students are required to take fewer laboratory courses, something compensated for by the addition of more "discovery-based" laboratories and active-learning approaches in lecture classes.

## D. RESEARCH OPPORTUNITIES FOR UNDERGRADUATES

The reviewers saw undergraduate research as an important part of the mission of the department and one that was suffering as a result of the low numbers of research faculty compared to the number of majors. As faculty have less time for research and the pursuit of grants to fund that research, along with reductions in funding for graduate students, there are fewer opportunities for undergraduates to be involved in research. They say, "The combination of the increase in student enrollment, the decrease of T/TT faculty, and the decrease in numbers of graduate students to serve as mentors has led to a paucity in the availability of positions for undergraduate researchers, which is a hallmark of Carnegie R1 and R2 universities." In addition to the calls for more faculty and improved laboratories, the reviewers note the department's plans to revive and increase course-based research experiences as a way to address this.

## E. UNDERGRADUATE ADVISEMENT

Each regular faculty member advises 50-60 students, according to the reviewers report. The reviewers saw this as a significant problem for both students and faculty, and recommended the hiring of professional advisors. The Dean's response and the Action Plan specified addressing this need by building on the Science and Math Advising Resource Team (SMART) resources.

## F. COUNCIL OF MAJORS; UNDERGRADUATE HONORS; AWARDS; RECOGNITION

The department offers an honors program for students wishing to conduct an extensive independent research project under the supervision of a faculty member. Upon the successful completion of a thesis and conference presentation, the student receives an "honors" transcript notation.

The department also offers students the opportunity to participate in the Biology Council of Majors (BioCOM), as well as the UMBC Pre-Medical Society and the Minority Association of Pre-Medical Students (MAPS).

## G. FACULTY DEVELOPMENT; TEACHING QUALITY

The reviewers were impressed with the faculty, particularly in light of the challenges of the large numbers of students and relatively few faculty to serve them. They noted the ways that faculty were responding to these challenges by adopting innovative, team-based, and active learning techniques. They praised the positive environment maintained by the faculty. They saw the department's practice of having faculty from all ranks, including those with active research agendas, teaching large-enrollment classes as a benefit for undergraduates.

## H. ADDITIONAL COMMENTS; SUMMARY EVALUATION

The external reviewers' and the Dean's reports agree that the Biological Sciences Department's undergraduate programs are doing excellent work with limited faculty, given the huge increase in undergraduate majors. The principal recommendation throughout these reports is to increase tenured/tenure track faculty. This would address challenges throughout the department, as the reviewers conclude, leading to "enhanced course offerings in the undergraduate and graduate curricula" and "increased capacity for undergraduate independent research opportunities." In addition, the reviewers recommend the hiring of a professional adviser to take some of the pressure off of the faculty. With increased time to pursue their own research and external funding, the faculty would be able to include undergraduates in their own research and to support graduate students, who in turn will be able to incorporate undergraduates into their research. The Undergraduate Council supports these requests.