

IBHE Program Review Report

1. **Reporting Institution** Eastern Illinois University
2. **Program Reviewed** B.A. in Chemistry (40.0501)
3. **Date** January 11, 2019
4. **Contact Person** Dr. Rebecca Peebles
 - 4.1. **Telephone** (217)581-3322
 - 4.2. **E-mail** rpeebles@eiu.edu
 - 4.3. **Fax** N/A

5. Overview

The mission of the Chemistry program is to provide a broad background of factual knowledge about chemistry while providing students with tools to effectively solve problems relating to chemistry. The Chemistry Department faculty specialize in all five traditional sub-disciplines of Chemistry (Organic, Inorganic, Physical, Analytical, Biochemistry), and several faculty have interdisciplinary interests that bridge more traditional areas. The department has 8 tenured/tenure-track faculty. This is a reduction from 14 faculty as recently as 2016 and is a direct result of faculty attrition as a consequence of the Illinois budget crisis and resulting damage to higher education. This drop is far in excess of the drop in enrollment seen by EIU, and particularly by the Chemistry and Biochemistry department, over the same time period. The department is unique in the importance of undergraduate research participation to the development of chemistry majors; currently, about 1/3 of faculty have external grants to support their undergraduate research programs, which is an unusual level of support for a school this small. Research results are published in peer reviewed journals and presented by faculty and students at national and international conferences.

Learning objectives are that students will be able to: (1) learn fundamental principles and applications in each of the major sub-disciplines in chemistry, (2) critically analyze a breadth of chemical problems and experimental results, (3) execute chemical experiments utilizing modern methods & equipment, (4) be familiar with computer applications in chemistry, (5) be able to properly utilize chemical information sources, (6) apply the scientific method of investigation, and (7) communicate technical material effectively in speaking & writing.

6. Major Findings and Recommendations

- a. **Description and assessment of any major changes in the program/disciplinary context, e.g., (1) changes in the overall discipline or field; (2) student demand; (3) societal needs; (4) institutional context for offering the degree; (5) other elements appropriate to the discipline in question; and (6) other.**

(1) Changes in the discipline: The Bureau of Labor Statistics projects ~7% growth in chemistry and materials science over the 2016-2026 period (commensurate with average growth in all occupations), with the Chicago area being the 6th highest employer of chemists in the country (Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, Chemists and Materials Scientists, on the Internet at <https://www.bls.gov/ooh/life-physical-and-social-science/chemists-and-materials-scientists.htm>, accessed January 14, 2019). On the other hand, the current presidential administration's seeming inclination to shun foreign manufacturing and workers could lead to an increase in demand for American-educated chemists. As EIU's overall enrollment has dropped, the number of Chemistry majors has remained relatively constant, showing steady demand for the major. Demand for high school teachers in Illinois has decreased as schools have been laying off teachers due to budgetary constraints, and this is visible in smaller numbers of students pursuing Science Teacher Certification options. At the same time, interest in biochemistry as a pre-health or stand-alone major has increased greatly. This is partly a result of the recent addition of biochemistry content to the MCAT exam, making premed students more aware of biochemistry as a separate subject and leading them to take more courses that are not housed in Biological Sciences departments. While some of these students are interested in rigorous Biochemistry B.S. degrees, many opt for the B.A. in Chemistry degree, with broad coverage and flexibility to take a wide range of courses in both Chemistry and Biochemistry and Biological Sciences departments.

(2) Student demand: Overall enrollment at EIU has declined steadily since 2011, with a drop of 47% from 2011 – 2016, but over this time Chemistry undergraduate enrollment has remained relatively constant. The total number of Chemistry and Biochemistry majors was equal in Fall 2010 and Fall 2016 (43), with a high of 51 in 2013. Interest in biochemistry, materials and alternative energy remains high. One retirement has allowed us to hire a new faculty member with materials science expertise, so we are well staffed in materials science. Demands for biochemistry teaching and research opportunities consistently exceed our capabilities, and we are presently working to hire an additional biochemist, along with a second hire to replace faculty who left EIU during Illinois's budget crisis. The recent addition of biochemistry as a subject on the MCAT medical school entrance exam has led to further increased demand in this area.

(3) Societal needs: With the present presidential administration, it is expected that the number of highly qualified foreign scientists in the US will drop; thus, there

will be a need for American scientists to fill vacant research, development, manufacturing and other technical jobs. In addition, the National Student Clearinghouse found that the number of science and engineering bachelor's degrees completed increased by 5% for men and 2% for women from 2006-2016, with 3% of all degrees being in physical science disciplines in 2016 and 20.5% of all degrees being in science, technology, engineering or math (STEM) fields (<https://nscresearchcenter.org/wp-content/uploads/SnapshotReport27r.pdf>). There is a clear demand for strong scientific training amongst today's college students.

- (4) Institutional context for offering the degree:** Chemistry is a discipline that is central to many other subjects, ranging from biology, dietetics and health-professions to physics and engineering. This leads to a significant service component to teaching within the department, with some students from other majors requiring as many as 5-6 semesters of chemistry courses. The central and interdisciplinary nature of the subject also leads many students from other majors to seek out research experiences within the Chemistry Department. This often happens late enough in a student's career that it is too late for them to complete a Chemistry or Biochemistry B.S. degree; however, the Chemistry B.A. offers a degree that is attainable for these students who discover their interest in the field after their first few semesters of college. Significant general education contributions are also made by the department, with an average of 479 students enrolling in general education courses in the Chemistry department each year from 2011 – 2018. The presence of vibrant undergraduate chemistry degrees is central to delivery of EIU undergraduate curriculum and to maintaining a strong group of faculty with expertise to deliver this curriculum. The B.A. degree contributes to this by serving a variety of students who have career goals outside of being Chemists and who have multiple academic interests, leading to double majors. Although the overall enrollment in the Chemistry B.A. program is low, required courses are all also required for the higher enrollment B.S. programs in Chemistry and Biochemistry; thus, the B.A. helps maintain healthy and diverse enrollments in courses that already exist in the department of Chemistry and Biochemistry, while also bringing students to the Chemistry major who would not otherwise have considered it.
- (5) Other elements appropriate to the discipline:** The department was re-approved to offer degrees certified by the American Chemical Society (ACS) in Fall 2016, and this approval is valid through 2021. Although the Chemistry B.A. degree is not an ACS-approved program, it benefits from the approved B.S. degrees within the Chemistry and Biochemistry department, since it draws on the same courses, instrumentation, undergraduate research opportunities, and other resources.

b. Description of major findings and recommendations, including evidence of learning outcomes and identification of opportunities for program improvement.

A variety of measures are used to assess achievement of student learning objectives. These include percentages of students achieving certain score levels on specific assignments in a variety of courses, student performance on the Major Field Test that is administered to graduating seniors each year, and responses on exit surveys given to graduating students and alumni surveys that are sent 3 and 8 years after graduation. For data collected from course assignments, stated goals are generally met. The best performance is on the goal of being able to execute chemical experiments utilizing modern methods and equipment. This is arguably one of the most important aspects of the Chemistry degree since graduates in the job market will almost certainly be performing hands-on tasks. In all years evaluated the goal of 100% of students completing a series of laboratory experiments that demonstrate breadth of ability was met. Performance in critical analysis and problem solving is consistently below expectations when measured based on course grades. Additional measures of this goal include the percentage of students performing individual research projects and responses from alumni and exit surveys. Those responses overwhelmingly exceed expectations, with 60-70% of graduating seniors participating in research (criterion is 50%) and survey responses averaging 4-4.5 on a 5 point scale (criterion is ≥ 3). We continue to do reasonably well in meeting expectations that students will learn fundamental principles and applications in major sub-disciplines of chemistry. This is measured using the Major Field Test, with the expectation that a majority of students will score at or above the 50th percentile. Over the time period evaluated typically 40-55% of students met this expectation; however, the validity of the Major Field Test as a comparison for EIU students is questionable, since some other universities require a certain score for graduation and/or have classes aimed specifically at preparation for the test. One excellent source of feedback from graduating students has been oral exit interviews and "anecdotal" results from this have led to modifications to our degree requirements in the past. Presently, the department is working to find a way to quantify this direct student feedback and share it with faculty more effectively.

c. Description of actions taken since the last review, including instructional resources and practices, and curricular changes.

(1) Recent faculty hires: The hiring of a faculty member with expertise in materials, and particularly with interests in solar cell development has allowed the department to build strong ties to the CENCERE renewable energy center on campus. This faculty member was hired in 2012 and has been successful in obtaining significant external funding for his research program, and he has an active research program involving both undergraduate and masters students. Following the Illinois budget crisis, the Chemistry and Biochemistry department lost nearly 50% of tenured faculty due to retirements and resignations. This limited our ability to provide the needed staff to teach required course work. The department is now performing two tenure track searches, with the expectation of at least one more search next year. These new hires will bring a

fresh outlook to the department, will launch new, cutting edge undergraduate research projects, and will give us the resources to teach needed courses without difficulty.

(2) Instructional resources: The department was the victim of a major vandalism attack in November 2011. This resulted in destruction of all of the major instrumentation in the department, many computers, and significant numbers of samples and equipment in faculty research labs. The department was able to rebound from this setback relatively quickly, thanks to the support of the EIU administration for facilitating many large equipment orders very quickly. Ultimately, a few classes had to be taught differently than usual during the Spring 2012 semester, but operations were back to normal by Fall 2012. In addition to replacement equipment obtained as a result of the vandalism losses, we have continued to modernize equipment used in general chemistry and higher level lab classes, to the extent that very limited budgets will allow. In General Chemistry labs some experiments now utilize handheld digital data collection units which have replaced old mercury-containing manual instrumentation. The department upgraded its computational resources to a 12 CPU Linux workstation running state of the art computational chemistry software in Spring 2013, and this and PC versions of the software are used at multiple curricular levels.

d. Description of actions to be taken as a result of this review, including instructional resources and practices, and curricular changes.

The department is in flux as revisions are made to the Chemistry M.S. program as a result of the institutional Vitalization project that occurred during Fall 2016. As a result, we are developing graduate programs that are more attractive to students with a wide range of interests related to Chemistry and Biochemistry. Along with this, we are focusing also on recruiting Chemistry and Biochemistry majors with a wider range of interests. This, in particular, will relate to attracting students to our recently approved Accelerated M.S. program in Chemistry. There are already three students completing B.A. degrees (two as post-baccalaureate students), who plan then to enter the M.S. in Chemistry program. All three students were originally attracted by the accelerated M.S. program, although they may ultimately enroll in either the 1- or 2-year M.S.

7. Responses to Institution-Assigned Issues

No institutional questions were assigned.

8. Outcome

8.1 Decision:

Program in Good Standing

____ Program flagged for Priority Review

____ Program Enrollment Suspended

8.2 Explanation

On behalf of the office of Academic Affairs, I appreciate the faculty and program's continued commitment to innovation and resiliency, particularly in light of recent staffing and budgetary constraints. Likewise, the efforts to enhance assessment and the programming that results from such evaluation are to be commended. Finally, the report demonstrates a commitment to academic excellence and student success.

Dean's Comments

The B.A. in Chemistry program was developed as an option for students with an interest in chemistry who seek greater flexibility and options with their coursework. The B.A. option involves very little additional "cost" as students take courses that also serve students in the B.S. in Chemistry and Biochemistry programs. The planned replacement of three faculty positions in the next two years will position the department well for the future. An accelerated M.S. in Chemistry option has already attracted several students from the B.A. in Chemistry program.