EASTERN ILLINOIS UNIVERSITY *report summary form updated: 1/26/2022*

Eight-Year Program Review IBHE Report Summary: see attached Resources page

PROGRAM REVIEW REPORT SUMMARY

1. Eastern Illinois University

2. B.S. Chemistry

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5. OVERVIEW

The mission of EIU's chemistry BS program is to prepare graduates with a broad background in chemistry, sufficient to prepare them for pursuit of higher degrees and/or professional employment in chemical industry/government/health care field. In IL, EIU is 1 of 40 institutions with BS Chemistry programs, and 1 of 12 public institutions (1 of 7 without a PhD program). EIU is amongst the 3 public institutions that has not seen an appreciable drop in the number of BS degrees awarded from 2017 to 2024, according to the IBHE Database. EIU's program is unique due to the communication component (including a seminar series), as well as the equal emphasis on both teaching and research at a very high and successful level. Five faculty have been recognized with teaching awards. Currently 57% of tenure/tenure track faculty have major external grants, with a total of 15 grants awarded for over $1.6 million during this review period, and with 94% of the BS majors doing at least 1 semester of research. Of the 13 tenure/tenure-track faculty active in Fall 2016, 5 retired and 3 left; these were replaced by 3 hires (one of which left after 2 years). Currently 2 subdisciplines (analytical and physical) have only 1 faculty member. Student learning objectives include students (1) understanding the fundamental principles and applications in all subdisciplines of chemistry, (2) executing experiments in chemistry, (3) critically analyzing data, (4,5) utilizing computer applications and chemical database, (6) generating new knowledge and data in the field, (7) communicating effectively in speaking and writing, and (8) awareness / practice in working safely in labs. The career objective of students is to have a significant and impactful career in the chemistry or biomedical realm, either directly or after pursuing a MS/ PhD degree in the field or a professional health degree (MD, PharmD, etc). Significant changes include, in 2019, splitting off a separate BS Biochemistry degree (instead of being a concentration in the BS Chemistry) and creation of an accelerated BS/MS track. Significant changes in students include an increased percentage of transfer students (70% of total), as well as a decline in math / critical thinking abilities and increased rates of noncompletion of assignments. Future plans include some curricular revision (such as content of year-long physical chemistry course, relaxation of the math and physics co-requirements) resulting from changes in the ACS CPT program certification requirements, participation of CHM 1310 in EIU's DFW initiative to promote increased student success, and eventual movement into a state-of-the-art new building (to be shared with Biological Sciences).

6. MAJOR FINDINGS AND RECOMMENDATIONS

a. Description and assessment of any major changes in the program:

(1) changes in the overall discipline or field

Externally, in 2023, the American Chemical Society's Committee on Professional Training (CPT) revised their guidelines for ACS-accredited programs, which EIU's BS Chemistry seeks to adhere to. Major changes included more freedom in course work (by designation of foundation and in-depth courses in the 5 classical subdisciplines of chemistry); emphasis on polymers, macromolecules, and nanoscience (MSN); and 3 levels of compliance. The latter makes it possible to reduce some of the required co-courses, namely that algebra-based physics is acceptable and that the second math course does not need to be Calculus II. These changes are only beginning to be implemented in this program, though given the reduced offerings of the calculus-based physics, we have been already allowing the algebra-based version. The field continues to become more interdisciplinary and merging into other disciplines, with increases in chemical physicals, chemical biology, as well as deeper specializations, as evidenced by over 13 new ACS journals on applied/technical subjects. Additional changes include the increased number of open-access journals, use of AI and technology in all aspects, increased regulations and consolidation within the chemistry industry.

(2) student demand

While EIU's undergraduate enrollment has grown modestly (by ~13%) over the 8 year period (with a dip in the middle), the overall percentage of all EIU students taking chemistry classes remains around 13%. The introduction of a full Nursing program has led to increase demand for CHM 1040G, to be nearly double the demand. The number of majors has decreased from a peak in Fall 2019, to currently be on par with the Fall 2016 levels (around 40 majors). Though faculty numbers have decreased over the period, student participation in chemistry research has actually increased.

(3) societal needs

Using IPEDS data, the number of BS degrees conferred in chemistry between 2016-2021 has been relatively steady (a 6% drop), though the Bureau of Labor Statistics predicts there will be an 8% growth in jobs as chemists and material scientists, which is above the average for all occupations. Thus the demand for BS chemists remains strong, as does the efforts to increase student numbers in STEM fields.

(4) institutional context for offering the degree

Chemistry remains a central and integral part of EIU's teaching mission, as the year-long sequence is required for 7 BS degree programs outside of the major, and the general education requirements specify 1 lecture course in a physical science and 1 lab course in a science (Chemistry contributes 4 gen ed courses, 2 that contain a lab component). Additionally many pre-health profession tracks require at least 3 semesters of chemistry, including PreMed, PreVet, PrePharm, PreDent, PreChiro, PrePA, PreOpt, and PrePod with the remaining 4 pre-health profession as well as nursing students requiring at least 1 semester of chemistry. Courses in chemistry continue to contribute to all the University learning goals, in the areas of critical thinking (gathering, presenting, and interpreting data; proposing, testing, and defending hypotheses); writing and critical reading; speaking and listening; quantitative reasoning; and responsible citizenship. Chemistry still continues to be one of the most active and productive (in terms of external grants, scholarship, and student presentation of research) units in both the College and University.

(5) other elements appropriate to the discipline in question

In 2022, the ACS CPT re-accreditated the BS degree in the department, citing as strengths increased skills development in CHM 3500 Intro to Chemistry Research (a required course for the major), tracking of graduates, and appropriate MSN coverage, while noting as items needing attention including faculty numbers, resources, and aging instrumentation. A significant internal change was the merging of the College of Sciences (11 departments) with the College of Arts and Humanities (9 departments) to give a new College of Liberal Arts and Sciences. While the new structure meant there was only 1 dean for the College, 2 associate deans were kept, one for each of

the previous colleges. Overall this change has not significantly impacted the operation of or delivery of the curriculum of the Dept, though with revenue situations the University administration is more strongly adhering to courses meeting established enrollment minima to run, which is likely to result in some upper level courses being offered on a more limited basis (once every other year, instead of once every year). A worry has been, due to rising subscription costs, the cancellation of nearly all chemistry journal subscriptions except for the ACS package. However there has been markable improvement in interlibrary loan efficiency. Also offsetting the decrease in journal subscription is the continued subscription to SciFinder, as well the ability to provide ChemDraw access to active EIU students.

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

Over the 8 year review period, a total of 36 students matriculated with a BS in Chemistry degree - 27 with chemistry concentration, 7 with biochemistry concentration (before establishment of the separate BS Biochemistry degree), and 2 with management concentration - with an average of 4.2 students graduating per academic year. While the number of management concentration majors were never very high, there have not been any students seeking this track for the past 4 academic years. It should be noted that the Department also offers a BS Science Teacher Licensure degree as well as a BA Chemistry degree, and an accelerated BA/MS and BS/MS degree.

Of the BS matriculates, about 39% transferred into EIU with over 1 year of community college credits, with another 17% transferring in from another 4-year institution. For the most part, these transfer students were able to graduate in 4-5 semesters. Matriculates who start at EIU typically graduate within 8 semesters.

There is still significant attrition of majors, especially within the first two years (freshman and sophomore). So two years ago, the Dept began to administer a version of the MUST (Math-Up Skills Test) on the first day of CHM1310 General Chemistry I. While the test results were not used to administratively remove students from the course, students did receive their score as well as data on the success rates based on scorings, with the advice to take either CHM 1040G World of Chemistry or MAT 1271 College, or both, if their scores were low. A university-wide DFW initiative, targeting gen ed courses with significant DFW ratios, is to implemented for AY24-25, which hopes to identify challenges encountered by students in these courses as well as strategies to improve completion rates. CHM1310G will be part of this inititative.

With respect to learning outcomes for the degree, data suggests the students did well at learning the fundamental principles and applications, as evidenced by between 40-60% of the students taking the MFT scoring at or above the 50th percentile in the 4 subdisciplines, and 70% scoring at or above the 50th percentile overall. (The lowest areas were inorganic, which the biochemistry concentration only took one course in, and organic, which was typically the most distant course taken (in sophomore year) with respect to when they took the test). Additionally the average response, on a 5pt scale where 5= strongly agree and 1=strongly disagree, for this item on the exit survey was 4.40 and on the alumni surveys (sent out at 3 and 8year periods) was 4.0. Similarly scores of 4.0 or higher were achieved for the remaining 6 learning objectives, with utilization of information sources the highest (4.50) and communication the lowest (4.10). The individual course-related benchmarks had at least 60% of the students achieving the desired outcome, with it going to over 90% in some cases.

33 of the students (over 90%) participated in at least one semester of research, with the average student doing 2.75 semesters of research. In particular, there has been a large uptick of students staying with research, with 50% of BS majors doing 4 or more semesters. This is directly attributable to the two newer faculty members who has established active research groups of large size for EIU (>5 students), as well as their ability to strongly recruit students they interact with. This resulted in 50% of BS matriculates presenting at least once at a regional/national chemistry meeting, but only 10% being listed as an author on a peer-reviewed journal article. Clearly would like to improve the latter, but the low number here may be in part due to phasing out of older faculty while the new faculty not quite having enough results yet for publication.

Of the matriculates, 32% went on directly into a Chemistry PhD program (at places including

U Chicago, Indiana, Iowa, Michigan State, U Washington) while 29% went directly into the chemistry industry. At this point, only 1 student did not successfully complete the PhD program. Only 2 students went on to a health-professional program (one PharmD and one MD) – this is historically low but is also is a reflection that the BS Biochemistry degree aligns better with their pre-health course requirements. Both of these were successfully earned their doctoral degree. 12% of our matriculates came back to EIU for a MS degree, while 14% took up jobs not in the chemistry field. One student was a student athlete, and went oversees to continue their athletic career.

c. Description of actions since last review:

As mentioned previously, the BS Biochemistry was successfully launched as a separate degree in 2019. While this did not lead to the hoped for increase in the overall number of majors in the Dept, there has been, for the most part, an even split between the number of BS Chem (average 3.8/yr) and BS Biochem majors (average 2.6/yr), suggesting that the new degree was not drawing students away from the BS Chemistry degree. (The split between biochemistry and chemistry was similar to that seen before the two separate degrees were established). On the whole, less than 20% of the matriculates in the Dept received a BA degree (introduced in 2010) as opposed to a BS, with the exception of AY18-19 (50%) and AY23-24 (31%). Thus there has been a significant number and demand of majors pursuing the BS Chem degree over other degree options in the Dept.

An accelerated (5yr) BS/MS, and accompanying BA/MS, program was also established, both due a trend of having EIU matriculates enter our MS program, as well as an effort to increase recruitment and enrollment of chemistry majors at EIU. The program started off well, with 2 students immediately switching to the program, but unfortunately neither completed their MS degree. (One became pregnant and withdrew from the university, while the second had completed the coursework and research but had difficulties writing the thesis). Since then, no other students have pursued this option, though 7 majors did subsequently immediately come back to enter the traditional MS program. Reasons for the low participation include that some of these students were transfer students, who would have had to declare their intentions after only their first semester at EIU and were just more focused on degree-completion, while other students did not have clear career plans in their junior year but then in their last semester decided upon further education / continuation of research in their undergraduate research group.

The BS Chemistry assessment plan was reviewed in 2020, with 2 new items added to specifically address students participating in research and presenting/publishing their work, and with regard to students being practiced in chemical safety (as applies to working in lab). In addition, 9 courses in the major had one or more benchmarks specifically tied into the plan (so for instance, each student in CHM3915 Physical Chem lab was evaluated on their ability to critically analyze data; utilize computer applications in a spreadsheet / plotting program, in a word processing software, and in a computational chemistry package; and their ability to communicate effectively in writing).

Currently for FA24 the department is at 8 tenure/tenure-track faculty (including the chair), with at least 1 faculty member in each of the classical 5 chemistry subdisciplines. This is supported by 3 instructional faculty, and one tenure-track faculty member with a 50% assignment. This compares to 12 tenure/tenure-track faculty in 2016, and identical numbers of instructional and part-time assigned faculty. Up to 2019, the retirements were in part due to the state adjustment of the retirement benefits, restrictions due to the state budget crisis, and faculty wishing to be at different types of institutions. There are still enough faculty to deliver the curriculum, but further reductions would make it very difficult to continue doing so. It should be pointed out that the two faculty hired in 2019 have both been able to establish productive research groups that are externally supported and now number 6 or more undergraduate students.

Since 2021, the design and planning for a New Science Building, which will house the Dept of Biological Sciences in addition to the Dept of Chemistry and Biochemistry, has been underway.

This is reaching final stages, with anticipated construction beginning in 2026 and completed June 2028. The building will be 3 stories, with chemistry occupying the complete 3rd floor as well as shared labs/classrooms on the other 2 floors. This building will provide modern lab spaces for both teaching and research labs, with individual research labs being maintained.

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

The majority of the curricular changes will be made to take advantage of the flexibility of the ACS CPT guidelines, as well as to make a pathway for students without a full BS chemistry degree to enter into our MS program. These changes include (1) removing the CHM 4900 Inorganic II pre-requisite for CHM 4915 Advanced Lab; (2) giving the option of taking that MAT 2250 Elementary Statistics or CSM 2170 Computer Science I in place of MAT 2442 Calculus II, 1; (3) revision of the 2-semester physical chemistry sequence to have the first semester be a survey of the two current courses (so covering thermodynamics, kinetics, and quantum mechanics) and the second semester a more in-depth course (which will be at the 4000-level). Additionally increased coverage of polymers will be introduced into courses throughout the discipline. A second change will be reducing the frequency of certain upper-level course offerings (eg, CHM 4900, 3920, etc) to once every other year (instead of once a year), due to low enrollment issues.

Comments from the College Dean:

The B.S. in Chemistry remains a successful program at EIU. The program continues to have a strong teaching and research focus and since the last review five faculty members have been recognized with teaching awards. In the area of research, department faculty were awarded a total of 15 external grants for over $1.6 million during the review period and over 90% of BS majors completed at least one semester of research during their time in the program. One significant program change since the last review includes the creation of a separate BS in Biochemistry degree: previously, Biochemistry was a concentration in the BS in Chemistry program. The department also established an accelerated track for BS students interested in pursuing an MS in Chemistry at EIU. The program presently includes around 40 majors which is a decrease from a peak in Fall 2019 though the current number is similar to Fall 2016 levels. According to the Bureau of Labor Statistics, employment in chemistry-related occupations is projected to grow at 8% over the next ten years which is faster than the average. Chemistry's foundational sequence remains a requirement for seven BS degree programs outside of the major and the expansion of EIU's Nursing program has increased demand for CHM 1040G. The department has been active in preparing for an eventual move into a new science building alongside the Department of Biological Sciences. The anticipated move will occur in 2028.

We recommend a decision of **Program in Good Standing**

VPAA Decision:

- (●) Program in good standing
- ( ) Program flagged for priority review
- ( ) Program enrollment suspended

VPAA Explanation:

40.0501 B.S. in Chemistry

The summary above describes multiple adaptations and changes implemented by the B.S. in Chemistry program. With the 2002 re-accreditation by the ACS (American Chemical Society), the program was commended for strengthening skills acquisition in the Introduction to Chemistry Research core course, tracking graduates of the program, and offering solid coverage for Master of Science in Nursing students. The main improvements to the program include curricular streamlining and adoption of new ACS professional training guidelines, a new B.S. in Biochemistry degree, new accelerated 5-year B.A./M.S. and B.S./M.S. degrees, and serving nursing students. The research profile of the department's faculty is impressive, particularly for its grant-sponsored mentoring of undergraduates who are able to perform research, professional presentation, and publishing over multi-year intervals. The program will continue to refine its curriculum to best serve its students, and to attract more majors; the program continues to serve as a staple requirement for a wide variety of pre-health and other STEM majors.