

REVIEW OF THE B.S. IN CHEMISTRY

Classification of Instructional Programs (CIP) Code: 40.0501
Chemistry, General

OVERVIEW

The B.S. in Chemistry program at Illinois State University is housed in the Department of Chemistry within the College of Arts and Sciences. The Department offers a Minor in Chemistry, a B.S. in Chemistry with three distinct sequences—Traditional Chemistry, Chemistry Teacher Education (CTE), and Pedagogy Emphasis—as well as a B.S. in Biochemistry. At the graduate level, the Department offers an M.S. in Chemistry and two fully online graduate degrees focused on teacher education: the M.S. in Chemistry Education and the Master of Chemistry Education. The Traditional Chemistry sequence provides rigorous training in all five core areas of chemistry and meets the requirements for American Chemical Society (ACS) certification. The CTE sequence prepares students for licensure as secondary chemistry teachers in Illinois and integrates content knowledge with professional education coursework and field experiences. Both sequences offer extensive hands-on laboratory experiences and opportunities for undergraduate research.

Enrollment, Fall Census Day, 2017-2024 B.S., in Chemistry, Illinois State University First Majors Only

	2017	2018	2019	2020	2021	2022	2023	2024
Chemistry (default) sequence	71	73	60	62	53	76	77	73
Chemistry Teacher Education sequence	24	27	20	19	21	18	11	11
Pedagogy Emphasis	0	0	0	0	0	0	0	0
Total	95	100	80	81	74	94	88	84

Degrees Conferred, Graduating Fiscal Year, 2017-2024 B.S., in Chemistry, Illinois State University First Majors Only

	2017	2018	2019	2020	2021	2022	2023	2024
Chemistry (default) sequence	19	15	16	12	14	7	12	15
Chemistry Teacher Education sequence	4	1	5	4	1	7	4	4
Pedagogy Emphasis	0	0	0	0	0	0	0	0
Total	23	16	21	16	15	14	16	19

*Graduating Fiscal Year consists of summer, fall, and spring terms, in that order. For example, Graduating Fiscal Year 2019 consists of the following terms: summer 2020, fall 2020, and spring 2021. Degrees by sequence for 2015 were not available.

EXECUTIVE SUMMARY PROGRAM REVIEW SELF-STUDY REPORT

Self-study process

The Department Chairperson coordinated with various stakeholders to formulate this self-study. Faculty and staff were engaged in numerous ways, including organizational meetings, charges given to individuals or departmental committees, and large group discussions involving the entire community. In addition, resources provided by the American Chemical Society (ACS) were consulted to ensure that our program provides students with the skills they need to succeed in a career in the chemical sciences.

Program Curriculum

At the undergraduate level, the Department offers a minor in chemistry and two majors (a B.S. in Chemistry and a B.S. in Biochemistry). The Chemistry degree also has a track in chemical education (CTE). At the Master's level, the Department offers an M.S. in Chemistry and two online master programs in teacher education – the Master of Science in Chemistry Education and Master of Chemistry Education. We are an ACS-approved department.

Academic unit faculty

The number of faculty within the Department has varied throughout the review period. Our faculty are involved in the direct instruction of all of our courses and provide individualized attention whenever possible. The Department strongly supports undergraduate involvement in research. All of our tenure/tenure track faculty have vibrant undergraduate research programs that regularly result in peer-reviewed publications and presentations at regional/national venues that involve student co-authors. Opportunities to participate in undergraduate research are offered via the CHE 290/299 courses, which can fulfill a graduation requirement for the B.S. of Chemistry degree. The Department currently supports multiple undergraduate research fellowships during the summer. These experiences involve ~28 hours/week of independent research experience in a Faculty member's research laboratory and are transformative experiences. Undergraduate research is known to have significant and positive impacts on student retention and can close the equity gaps in STEM graduation rates. Our faculty are dedicated Teacher-Scholars who are active within the classroom and research laboratory.

Program goals and quality indices

Since 2022, the Department has been revising its strategic plan in response to the Biochemistry program review.

Mission & Goals

As a collaborative group of teacher-scholars, the Department of Chemistry at Illinois State University promotes a culture of intellectual engagement while inspiring our community to expand chemical and biochemical knowledge in ways that positively impact society. We engage all students through welcoming classrooms and individualized, collaborative research. Students, Staff, and Faculty are passionate about research and education.

Goals:

- 1) Provide a student-centered Chemistry and Biochemistry curriculum that is both robust and engaging.
- 2) Develop and refine departmental support mechanisms for students and faculty.
- 3) Define an Equity, Diversity, and Inclusion plan tailored to chemistry and biochemistry.
- 4) Foster an environment conducive to student and faculty scholarship.

Specific objectives are contained within the report. We are proud of our engagement with students within undergraduate research. Each academic year, 60-100 students engage in independent research projects mentored by our tenure-track faculty. These works are frequently presented at regional and national meetings. In addition, students are often co-authors of peer reviewed publications in top-ranking chemistry and biochemistry journals.

Student learning outcomes assessment plan and process

Our assessment plan at the program level includes five goals. These goals were chosen such that we are ensuring that our courses provide students with the necessary background and experience to be successful chemical professionals. Our goals are assessed primarily with data collected from our courses, with some additional information regarding our engagement with students in undergraduate research. This data is collected by faculty and the Department Chairperson. A few example data types include course GPA, standardized ACS chemistry subject exams, exam tracking, writing assessment, and participation in undergraduate research experiences, to name a few.

The Department council and the curriculum committee discuss data. However, with the frequent changes in chairship and the pandemic during this review period, making adjustments based on assessment data and overall evaluation of the assessment instruments was a low priority.

Specialized accreditation

The ACS Committee on Professional Training establishes guidelines and standards for approving bachelor's degree programs in Chemistry. Our undergraduate degree programs undergo an annual review to ensure that courses are offered sufficiently frequently, that Faculty have adequate formal training, and that the Institution offers sufficient resources (e.g., library subscriptions and physical facilities). In addition to the annual review, every five years, the Department undergoes a periodic review that includes providing samples of instructional materials for external review. We are pleased to report that the department underwent the in-depth periodic review in 2022 and that we have maintained good standing as an ACS-approved department.

Responses to recommendations resulting from the previous program review

The Academic Planning Committee (APC) made several recommendations during the last review. Since that time, the department had two permanent and one interim Chairperson. In addition, a pandemic took place that had a significant impact on laboratory-based disciplines, such as chemistry. These events made continuity challenging, and hence, long-term progress was slow.

The department has worked to revise its strategic plan and continue collaborating with the library to maintain sufficient resources to secure continued ACS approval. We have accomplished both of these goals. In addition, the APC made several recommendations related to student recruitment and retention. Retention in STEM fields is challenging nationwide. This study revealed that the Fall 1 to Fall 2 retention metric is convoluted with issues involving preparation – roughly 50% of declared FTIC Chemistry Majors enrolled in no CHE courses during Fall 2023. As such, while retention in STEM is an important goal for the department, it is a challenging topic requiring broader institutional support. It primarily speaks to student preparation issues before arriving at Illinois State University.

Changes in the academic discipline, field, societal need, and program demand

Within the academic discipline, chemistry programs have increasingly integrated interdisciplinary courses and collaborations with a stronger emphasis on the intersections of chemistry with biology, materials science, environmental science, and data science. In many programs, the curriculum has evolved to include more contemporary topics such as nanotechnology, sustainable chemistry, and data science, with courses on computational chemistry and machine learning applications in chemistry becoming more common. The modern chemical professional is already more likely to identify as an environmental chemist focusing on ecological degradation, climate science, pollution control, renewable energy, and sustainability (green chemistry) or as a biochemist/chemical biologist driven by the boom in biotechnology, pharmaceuticals, and personalized medicine, or as a materials scientist developing new materials for electronics, energy storage, and nanotechnology applications.

A concern for the department is that far too many prospective chemical professionals arrive at university insufficiently prepared to succeed in chemistry. The threat of failed student success simultaneously provides substantial opportunities for programs that can adapt to accommodate these students and advance them from “where they are” when they arrive to where they “need to be” as a B.S. chemical professional while at the same time helping them achieve this within the constraints of four-year 120 credit hour programs. See section VI for more details.

Major findings of this program review self-study

- 1) The department has excellent time to degree, with the vast majority completing their degree within four years.
- 2) Enrollment decreased from 2015 to 2023 but remained relatively stable between 2017 and 2023. This trend is not isolated to Illinois State but rather true across the state of Illinois.
 - a. Enrollment in the CTE program is down significantly, which is likely due to the pandemic. This is especially apparent in FTIC enrollment.
 - b. Transfer student enrollment is rare.
 - c. While this report is primarily about the chemistry program, it must be made clear that biochemistry is roughly half of our student population. We need to make it a priority to provide them with a curriculum that is unique from chemistry.
- 3) Within the state, the institutions that enroll the most CHE students are stable. The same institutions consistently received nearly the same percentage of the total CHE enrollment throughout the review period.
 - a. Illinois State University is within the top 6 for CHE enrollment/degree production.
 - b. The analysis is complicated because biochemistry is a degree at some institutions but a track of a chemistry program at others.
 - c. Illinois State University is the only top producer besides UIUC, more than 30 minutes from a large metropolitan center.
- 4) The department plays a significant role in service and general education courses.

Initiatives and plans for the next program review cycle

Action Plan 1: Development of new program requirements and advising tracks: While the current program produces very well-prepared chemistry graduates, it is also rigid and primarily focused on meeting and exceeding the requirements set forth by ACS. While we wish to continue offering this level of degree program, many of our peers and aspirant institutions take a different approach. Namely, the minimum degree requirements are lower and do not meet ACS requirements. By reducing requirements, more flexibility is immediately introduced into the major. These peer and aspirant institutions provide students with advising tracks that allow them to focus on a particular area of study.

Action Plan 2: Enhanced marketing and recruitment efforts: Earning a degree in chemistry results in a highly employable graduate. According to recent Bureau of Labor Statistics reports, the median wage for a chemist is \$84,680 per year, and from 2022 – 2032, chemists will have faster-than-average projected job growth (5-8%). Moreover, graduates from a STEM program succeed in many non-STEM fields and have great flexibility in their career paths. The department must do a better job of presenting this information to current and future students.

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome. The Academic Planning Committee, as a result of this review process, finds the B.S. in Chemistry to be in Good Standing.

The Academic Planning Committee thanks the program for its efforts in completing a comprehensive self-study report and acknowledges the substantial work that went into maintaining accreditation with the American Chemical Society (ACS). The committee commends the program's highly experienced faculty whose deep disciplinary expertise provides substantial mentorship opportunities. This expertise is exemplified by the program's strong emphasis on undergraduate research, resulting in meaningful laboratory experiences, student co-authorships on scholarly publications, and regular presentations at professional conferences. The committee also recognizes that the program's collaboration with Milner Library has ensured robust access to scholarly resources, supporting both teaching and research missions. Advising practices, regularly evaluated for effectiveness, further guide students through a challenging and well-structured curriculum, while the Chemistry Club's community outreach and high school partnerships enhance the program's visibility and serve as a significant co-curricular strength.

In recent years, enrollment in the B.S. in Chemistry has declined, reflecting statewide and national trends in undergraduate chemistry enrollment. Despite these challenges, the program has maintained a cohort of well-qualified majors, many of whom are engaged in undergraduate research and successfully complete their degrees

within four years. The program has taken steps to support student success: its strong advising system ensures students understand course sequencing and graduation requirements, the regular availability of faculty office hours and review sessions helps students overcome academic hurdles, and structured mentoring through undergraduate research experiences fosters deeper engagement with the discipline. Additionally, co-curricular organizations, such as the Chemistry Club, and outreach activities provide supportive learning communities that can improve retention and graduation rates. Going forward, more formalized and proactive recruitment and retention strategies can help stabilize enrollments and ensure that a diverse range of students benefit from the program's high-quality educational experiences.

While these strengths are commendable, the committee notes that declining enrollment, mirroring statewide and national trends, poses a significant challenge. Current efforts have not yet yielded a comprehensive, strategic recruitment and retention plan. The program has acknowledged difficulties in recruiting a diverse student body, including underrepresented groups and transfer students, and must enhance its outreach and marketing efforts. Additionally, while the curriculum is rigorous and ACS-accredited, it has not evolved substantially in response to emerging disciplinary areas and the changing career interests of students. The curriculum could benefit from increased flexibility through optional tracks, greater incorporation of interdisciplinary topics (e.g., green chemistry, computational methods), and direct integration of equity, diversity, and inclusion (EDI) principles into course content and pedagogy.

Assessment, though present, is another area needing refinement. While data are collected, they are not systematically integrated into decision-making. Clear feedback loops that use assessment results to inform curricular changes and pedagogy would strengthen continuous improvement efforts. Enhanced use of assessment data, in consultation with University Assessment Services, would ensure that faculty regularly reflect on and adjust teaching strategies, course content, and resource allocations in response to documented student outcomes.

Furthermore, the committee encourages a stronger strategic focus. While the program aligns its actions with university and college-level priorities, it currently lacks its own comprehensive strategic plan. Developing a program-level strategic plan will enable more effective responses to enrollment challenges, clearer integration of EDI goals into the curriculum, data-driven assessment practices, and responsiveness to rapidly evolving trends in the field of chemistry. Leveraging information from comparator and aspirational programs could guide these strategic revisions, as could more formalized alumni and stakeholder engagement to ensure the curriculum remains current and career-relevant.

The Academic Planning Committee acknowledges these challenges and encourages deliberate and sustained action. Detailed descriptions of implemented changes, their outcomes, and ongoing strategies should be included in the next program review self-study report, tentatively due October 1, 2032.

Follow-Up Reports

Formalize enrollment management, recruitment, and retention efforts. Develop a comprehensive plan focused on recruiting a diverse student body, stabilizing enrollments, and supporting underrepresented and transfer students. Targeted outreach to community colleges, improved marketing, scholarship initiatives, and leveraging faculty and alumni networks can improve overall enrollment profiles and ensure student success. This plan should be submitted to the Office of the Provost by August 15, 2026.

Aspirational programs. The committee commends the program for acknowledging external benchmarks and encourages deeper engagement with comparator and aspirational models. This includes translating external insights into strategic curricular enhancements, improved outreach techniques, and updated instructional methods. The committee requests a revised aspirational plan that shows evidence of data-informed action. This plan should be submitted to the Office of the Provost by August 15, 2026.

Recommendations

In addition to the program's noteworthy efforts and accomplishments, the Academic Planning Committee provided recommendations for consideration. The committee's recommendations outlined below are to be addressed within the next regularly scheduled review cycle. Details describing the actions and outcomes associated with each of the

committee's recommendations should be included in the next program review self-study report that is tentatively due October 1, 2032.

Develop a strategic plan for the program. While the self-study report references alignments between the program and college and university goals, the Committee recommends that the program faculty work to develop strategic plan for the program. Such a plan should address enrollment management, recruitment and retention strategies, strengthening diversity, improving curricular flexibility, and implementing systematic assessment. By establishing clear, measurable objectives with timelines, the program will better respond to challenges identified in this review.

Strengthen curriculum review and EDI integration. Conduct a comprehensive curricular review considering changing disciplinary trends, student career pathways, and stakeholder feedback. Introduce optional tracks or modernize course content, ensuring the curriculum aligns with contemporary chemistry fields. Incorporate EDI principles directly into coursework by integrating examples of diverse chemists, global chemical challenges, and inclusive teaching practices. Such efforts will create a more inclusive and globally relevant learning environment.

Remain current with changes in the discipline. Stay abreast of evolving trends—such as sustainable chemistry, computational tools, and interdisciplinary areas like chemical biology—by consulting current literature, participating in professional development opportunities, and engaging with professional organizations. This proactive stance will keep the curriculum cutting-edge, appealing to prospective students, and aligned with industry and research standards.

Enhance and utilize assessment for continuous improvement. The committee encourages faculty to continue their implementation of the student learning outcomes assessment plan for the program during the next program review cycle, to continue to utilize information gathered through plan implementation to make program revisions as necessary, and to document how that has been done. Move beyond data collection toward structured reflection and action. Document how assessment data inform curricular changes, collaborate with University Assessment Services to refine outcomes, and routinely review results to guide improvements. This feedback loop will ensure continuous refinement of the program based on concrete evidence of student learning.

Continue collaborations with Milner Library. Build upon a strong existing relationship to evaluate and maintain resource availability. Consider expanding digital resources, integrating information fluency outcomes and assessment into the curriculum, and integrating library tools into assessment plans. Such efforts ensure that both faculty and students have ongoing access to the information and skills needed for effective scholarship.

Further alumni and stakeholder engagement. Strengthen ties with alumni and external stakeholders to remain current with industry trends and job market needs. Regular alumni surveys, advisory boards, and panels can inform curriculum updates and highlight career pathways for prospective and current students, enhancing the program's relevance and attractiveness.