

REVIEW OF THE B.S. IN BIOLOGICAL SCIENCES

Classification of Instructional Program (CIP) Code: 26.0101
Biology/Biological Sciences, General

OVERVIEW

The B.S. in Biological Sciences program at Illinois State University is housed in the School of Biological Sciences within the College of Arts and Sciences. The school also offers a minor in biological sciences, a B.S. in Biological Sciences Teacher Education, a B.S. in Molecular and Cellular Biology, a M.S. in Biological Sciences, and a Ph.D. in Biological Sciences. The B.S., M.S., and Ph.D. programs have been reviewed in the current program review cycle, whereas the biological sciences teacher education program and the molecular and cellular biology program are scheduled for review in 2023-2024 and 2021-2022, respectively.

The B.S. in Biological Sciences program is designed to prepare students for employment in research and development and for advanced training in healthcare professions. Most graduates of the program follow one of four career paths: work with businesses with links to biology or biomedicine, such as pharmaceutical, biotech, or agricultural companies; work with governmental agencies such as the U.S. Department of Agriculture or the Illinois Department of Natural Resources; positions with academic institutions as laboratory technicians or instructors; or completion of graduate or professional programs in medicine, dentistry, or veterinary science.

Since the 2009 program review, the School of Biological Sciences has substantially restructured the curriculum of its B.S. in Biological Sciences program. Students may now choose a general biological sciences plan of study or one of four specialized plans of study: conservation biology; physiology, neuroscience, and behavior; plant biology; and zoology. One sequence of the program has been disestablished (organismal biology and public outreach), whereas another (biological sciences teacher education) has been elevated to its own major. Although the majority of students in the B.S. in Biological Sciences program enroll in the general plan of study, the four specialized sequences have been gaining in popularity. A hallmark of all plans of study in the program and of all programs offered by the school is the opportunity students have to conduct research, either in collaboration with their faculty mentors or independently.

Enrollment by Sequence, Fall Census Day, 2010-2017

B.S. in Biological Sciences, Illinois State University

First Majors Only

	2010	2011	2012	2013	2014	2015	2016	2017
General Biology				83	202	284	364	361
Conservation Biology				1	13	19	27	25
Physiology, Neuroscience, and Behavior				12	53	62	84	81
Plant Biology					8	6	5	5
Zoology				8	41	75	87	81
Biology Teacher Education*	129	93	96	77	67	66	19	4
Organismal Biology and Public Outreach**	23	31	31	14	2	1		
NA or None	409	412	445	344	148	38	3	5
Total	561	536	572	539	534	551	589	562

* Disestablished effective 5-16-16

** Disestablished effective 12-10-12

Degrees Conferred by Sequence, Graduating Fiscal Year 2010-2017***

B.S. in Biological Sciences, Illinois State University

First Majors Only

	2010	2011	2012	2013	2014	2015	2016	2017
General Biology						NA	65	68
Conservation Biology						NA	4	5
Physiology, Neuroscience, and Behavior						NA	8	10
Plant Biology						NA	3	2
Zoology						NA	5	14
Biology Teacher Education*	21	25	25	20	17	NA	12	14
Organismal Biology and Public Outreach**	6	2	3	8	3	NA		
NA or None	121	106	117	103	104	NA	14	1
Total	148	133	145	131	124	141	111	114

* Disestablished effective 5-16-16

** Disestablished effective 12-10-12

*** Summer, fall, and spring terms (e.g., graduating fiscal year 2017 consists of the following terms: summer 2016, fall 2016, and spring 2017)

**EXECUTIVE SUMMARY
PROGRAM REVIEW SELF-STUDY REPORT**

Program goals

- To recruit students with strong academic records
- To promote and support diversity among students
- To promote a strong conceptual understanding of biology as well as the scientific method
- To promote scholarship through research under the supervision of a faculty mentor

Student learning outcomes

- Understanding of fundamental concepts in biology
- Insight into disciplines that extend from central concepts
- Fundamental understanding of scientific method and research
- Development of related skills

Curriculum (2017-2018)

Graduation requirements: 120 credit hours consisting of 37-40 credit hours of biological sciences courses (depending on the sequence selected), 21-26 credit hours of chemistry, mathematics, and physics courses; 39 credit hours of General Education courses; and the balance of credit hours in elective courses.

All students complete three core courses (Biological Diversity, Molecular and Cellular Basis of Life, Biological Investigations) and requirements of one of five sequences: general biology; conservation biology; physiology, neuroscience, and behavior; plant biology; or zoology.

Faculty members mentor students in developing research skills through laboratory sections of courses and through co-curricular research opportunities. By the end of their program of study, approximately half of the students have completed at least one semester of independent study/research in the School of Biological Sciences, while approximately one-third have completed two or more semesters.

Two registered student organizations related to the discipline and supported by the School of Biological Sciences are the Biological Sciences Student Association and the Phi Sigma Biology Honors Society.

Program delivery

The program is offered on the Normal campus.

The program is delivered primarily through face-to-face or blended face-to-face/online instruction because laboratory components of biological sciences courses do not lend themselves to an online learning platform. Some courses in the major and some courses that meet General Education requirements are offered online during the summer session.

The School of Biological Sciences offers a study abroad opportunity through its Rainforest Ecology course. The course includes field work at La Selva Biological Station in Costa Rica.

School faculty (Fall 2017)

26 tenure track faculty members (8 Professors, 10 Associate Professors, and 8 Assistant Professors)

4 part-time non-tenure track faculty members (1.08 FTE)

Student to faculty ratio: 26.3 to 1

Student to tenure-line faculty ratio: 27.6 to 1

All fall 2017 tenure track faculty members in the School of Biological Sciences had a doctorate and post-doctorate experience. One non-tenure track faculty member held a doctorate in biology. Four faculty members held the title of Distinguished Professor, and one held the title of University Professor. Among retirees and emeritus professors, seven held the title of Distinguished Professor. From 2012 through 2016, faculty members collectively averaged 58 publications (journal articles and book chapters) per year; seven faculty members collectively served on 13 different review panels for grants submitted nationwide to the National Institutes of Health, National Science Foundation, U.S. Department of Energy, and the Beckman Foundation; and 10 faculty members collectively served on 12 editorial boards of national or international scientific journals. In 2016 the 26 tenure track faculty members in the school published 48 research articles in refereed journals and three book chapters. Approximately 25 percent of those publications were co-authored by at least one undergraduate student. Also in 2016 the 26 tenure track faculty members attracted extramural funding in excess of \$1.5 million from federal, state, or local government agencies or from private foundations. Eleven current faculty members have been recognized with a cumulative total of 33 college or university-level teaching or research awards.

Specialized accreditation

The B.S. in Biological Sciences program is not accredited or certified by a national association. In the biological sciences, accreditation or certification is available only to biological sciences teacher education programs.

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

Exponential growth of scientific and technical knowledge, particularly in biology, and its ever increasing impact on all aspects of human life means that there is a growing need for trained biologists. These scientists are not needed solely in academia but are also needed across all sectors of human endeavor. There is a growing need for well-trained biologists capable of collaborating broadly and eager to take on many different roles. Both the Illinois Department of Employment Security and the U.S. Department of Labor predict that biology-related and health-related job markets will be among the strongest in the future economy. Although the strongest demand is currently for job candidates with master's-level training, some directors of biotechnology-based companies believe that future employment opportunities will be strongest for candidates with specialized training at the baccalaureate level.

Response to previous program review recommendations

Develop long-term program goals and objectives that clarify future curricular changes as they relate to the School of Biological Sciences' strategic vision. This recommendation led to a complete overhaul of the curriculum by its faculty. Two degree programs autonomous from the B.S. in Biological Sciences were established: the B.S. in Molecular and Cellular Biology and the B.S. in Biological Sciences Teacher Education. The curriculum of the B.S. in Biological Sciences program was revised to offer a general biology sequence and four sub-disciplinary sequences: conservation biology; physiology, neuroscience, and behavior; plant biology; and zoology.

Work with the Office of Enrollment Management and Services to determine an optimum enrollment for each degree program. Faculty of the School of Biological Sciences has met with staff from the Office of Enrollment Management and Academic Services to plan for enrollments in the B.S. in Biological Sciences program. One target monitored by faculty is the percentage of students at the University who major in biological sciences compared to the percentage nationally. Historically, approximately 8 percent of students enrolled in U.S. universities major in biological sciences. In 2010 the percentage at Illinois State was approximately 3.5 percent. Since implementing the 2011 curricular changes, the percentage has increased to just over 5 percent. Any further growth in that percentage will be limited by the number of faculty members in the School of Biological Sciences, which is lower than national averages.

Work with the University Assessment Office to develop an assessment plan of student learning outcomes that leads to program improvement. Faculty members have worked since the last program review to refine the student learning outcomes assessment plan for the program and continue to do so. Although faculty implemented some new assessment strategies four years ago, a team to evaluate assessment findings had not yet been formed. A school assessment committee has since been established and has been charged with interpreting assessment data to identify opportunities for program improvement.

Develop a plan for faculty recruitment especially for new program development. At the time of the last program review, the school typically replaced a departing faculty member with a scientist in the same sub-discipline without considering how the discipline might have changed since the departing faculty member was hired. That practice changed with the hiring of a new school director in 2010. Faculty has since established sub-disciplinary foci for faculty hires based on the sub-disciplines biology faculty members have identified for longer-term curricular development. Priorities are revisited by faculty annually to accommodate unforeseen circumstances, such as unexpected faculty retirements or resignations.

Identify benchmark programs to which the Illinois State program in biological sciences can aspire. Since the last program review, faculty members have identified biological sciences programs at Miami University (Ohio) and Clemson University as programs to which the B.S. in Biological Sciences program at Illinois State University aspires. The program at Illinois State is quite similar to the two aspirational programs qualitatively but is substantially smaller with respect to enrollment and the number of faculty numbers. Over the past five years the discrepancy between the program at Illinois State and its aspirational programs has narrowed with respect to the number of majors; however, the number of faculty and staff members associated with the B.S. in Biological Sciences program at Illinois State is still substantially smaller. The School of Biological Sciences hopes to lessen the discrepancy in the coming program review cycle.

Major findings

Significant changes to the undergraduate curriculum in the School of Biological Sciences since the last program review, including the curriculum of the B.S. in Biological Sciences program, have resulted in substantial enrollment increases. Faculty members are now teaching more majors while continuing to contribute to General Education instruction. Faculty has made significant strides in developing, implementing, and refining a functional assessment plan for the program. Assessment results document that students are learning and applying general concepts of biology, are gaining proficiency in technical writing, and are able to critically evaluate and assimilate information contained in the primary literature of the field. The B.S. in Biological Sciences program remains a leader nationally in promoting and supporting undergraduate research in the biological sciences through individualized attention provided by faculty members. Challenges for maintaining and growing enrollment during the next program review cycle include the need to increase the number of tenure track faculty members, non-tenure track faculty members, or a combination of the two. Another significant challenge is the need to replace much of the Science Laboratory Building infrastructure (completed in 1997), especially equipment used in teaching laboratories. In the years ahead, the program could benefit from increased involvement of its alumni in providing input regarding the program and in mentoring students.

Initiatives and plans

- Maintain an attractive and competitive school that can recruit the top high school and community college students to the program. Establishment of specialized sequences and stand-alone majors seems to have succeeded in attracting prospective students. Faculty will continue to monitor the sequences to identify opportunities to elevate one or more to stand-alone majors, establish sequences in additional sub-disciplines, or disestablish sequences in low demand.
- Increase the number of academic advisors in the school. The single advisor of undergraduate students in the School of Biological serves more than 600 students, which is one of the highest ratios at the University. Particularly needed is additional attention to students hoping to pursue careers in medicine, dentistry, or pharmacy.
- Enhance efforts to recruit students from underrepresented groups. Strategies include increasing contacts with high school counselors in the Chicago metropolitan area, increasing the number of open house invitations explicitly targeted to high schools and community colleges with substantial populations of students from traditionally underrepresented racial or ethnic groups, and sending advisors on visits to those community colleges.
- Continue efforts to maintain start-up funding of new faculty at nationally competitive levels. It is imperative that the school hire qualified scientists and provide them ample opportunity to establish a research program, so they can attract extramural funding and high-quality graduate students and thus help maintain a vibrant research environment for undergraduate students.
- Further strengthen alumni relations through more frequent surveys, newsletters and other web-based information, and special events such as alumni seminars and research symposia. These activities will help the school track its alumni and gather feedback from them regarding its programs.

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 Biological Sciences program to be in Good Standing.

The committee commends contributions by Biological Sciences faculty members to the University and to the discipline through their extensive scholarship as well as their teaching and service. Biological Sciences faculty members have collectively published more than 900 peer-reviewed publications during their careers, an average of approximately 40 per faculty member. Faculty members have been awarded more than \$35 million in externally-funded research grants during their tenure at Illinois State, and many serve as grant reviewers for entities such as the National Science Foundation, the United States Department of Agriculture, the United States Department of Energy, and the European Research Council. Faculty contributions have been recognized through numerous college and university awards. Four Biological Sciences faculty members hold the rank of Distinguished Professor, the highest faculty rank conferred by the University.

The committee recognizes the work faculty has done since the last program review to restructure the curriculum to allow students greater flexibility in their plans of study. Students may now choose a general biology sequence or one of four specialized sequences: conservation biology; physiology, neuroscience, and behavior; plant biology; and zoology. Underlying the curriculum restructuring effort is a longer-term plan to elevate sequences in the program to independent degree programs. Since the last program review, faculty has elevated the long-standing biology teacher education sequence of the Biological Sciences program to the B.S. in Biological Sciences Teacher Education program. Faculty has also established the B.S. in Molecular and Cellular Biology program from a sequence in the since-disestablished B.S. in Biochemistry and Molecular Biology program, which had been offered collaboratively with the Department of Chemistry. Even with the loss of teacher education students to a new major and the ability of students to choose the Molecular and Cellular Biology program instead of the B.S. in Biological Sciences program, enrollment in the B.S. in Biological Sciences program increased from 534 in fall 2014 to 589 in fall 2016. To recruit students, faculty and staff members have attended academic fairs and open houses as well as science fairs and college days sponsored by secondary schools, following up multiple times with prospective students having particularly strong academic potential. Participation in these events has also helped the school develop and nurture mutually-beneficial relationships with more Illinois communities. The committee commends faculty and staff for these successes.

Throughout the curriculum restructuring effort, faculty has worked to retain emphasis in the program on individualized attention to students, particularly through research mentoring. The numerous external research grants obtained by faculty members have greatly aided those research mentoring efforts. For example, between 2004 and 2014, Illinois State ranked second among research-intensive universities in the United States with respect to grant awards from the National Institutes of Health that support undergraduate research. In the past five years, 56 percent of students graduating from the B.S. in Biological Sciences program had spent at least one semester working with faculty on research while 36 percent had spent two or more semesters doing so. During the same period, 23 percent of scientific manuscripts or research presentations authored by faculty members in the school listed undergraduate students as contributors. The committee commends faculty for these research mentoring efforts and their impact on student success, including admission to graduate schools and obtaining jobs requiring biological sciences expertise. For example, 75 percent of program graduates responding to a survey conducted for this self-study report indicated that they had been accepted by one of their three top-choice graduate schools. The committee also commends faculty members for their impact on student success in other undergraduate programs at the University. Biological Sciences faculty members teach seven general education courses that annually enroll more than 3,500 students.

The ability of the program to sustain and build on these successes should be greatly enhanced through implementation of a student learning outcomes assessment plan developed by faculty since the last program review. Assessment methods set forth in the plan have been expanded from course evaluations and a quinquennial alumni survey to include administration of a biology concepts assessment tool at three points across the curriculum, assessment of technical writing at two course levels, and review of research summaries compiled by students. Establishment of a standing assessment committee in the school to facilitate and coordinate student learning outcomes assessment should help systematize assessment and use of assessment findings to guide program changes.

Recommendations. The Academic Planning Committee makes the following recommendations to be addressed within the next regularly scheduled review cycle. In the next program review self-study report, tentatively due October 1, 2025, the committee asks the program to describe actions taken and results achieved for each recommendation.

Increase the percentage of program graduates admitted to professional schools. The committee concurs with the concern articulated in the self-study report regarding the recent decline in the percentage of program graduates admitted to professional schools. Over the last four years the percentage of students successful in their application for admission to such schools has decreased from approximately 80 percent to approximately 40 percent. Causes may be multiple and compounding. The committee encourages faculty to further analyze the decline to identify its causes and develop strategies for reversing it. Among the issues to explore is how best to provide advisement services to students who enter the program intending to seek admission to professional school. The committee encourages the program to explore this issue collaboratively with the College of Arts and Sciences and University College (which provides advisement services to undergraduate students until they have earned 24 credit hours). Another potential factor to consider is the modest reduction since fall 2013 of average ACT scores for first-time-in-college students entering the program. If this decrease is deemed related to the decline in professional school admission rates, the committee encourages the program to explore the efficacy of additional academic supports for students. Student learning outcomes assessment findings may help faculty identify points within the curriculum at which academic supports may be most effective.

Develop a plan for maintaining and replacing high-cost equipment. The committee concurs with faculty in its plan to work with the College of Arts and Sciences to address school equipment needs, including equipment for biology laboratories. A long-term plan for maintaining and replacing essential but high-cost equipment will likely benefit the school particularly during times of fiscal austerity. Working through the college may lead to collaborative approaches with other programs and academic units, such as equipment sharing, cost sharing, or savings resulting from coordinated purchasing.

Continue and enhance efforts to increase student diversity. The committee recognizes successful efforts by the program to increase the percentage of students who self-identify with groups traditionally underrepresented in the discipline, including women and persons of color. Those efforts have included targeted recruitment in majority minority schools in the Chicago metropolitan area. The committee commends the program for those efforts and supports faculty efforts to enhance them. In addition to the strategies identified by faculty in the self-study report,

the committee suggests that faculty consider efforts to increase the number of scholarships available for targeted recruitment.

Develop and implement a plan for furthering faculty diversity. The committee acknowledges the obstacles faced by the school in achieving greater gender and racial/ethnic diversity among its faculty, such as the low percentage of doctoral candidates who are women or persons of color. It is evident from the self-study report that the school is committed to working toward greater faculty diversity despite those obstacles. The committee commends the school for its efforts and encourages the school to continue them. However, it may be difficult for the school to increase faculty diversity without having goals and strategies for achieving them. Accordingly, the committee encourages the school to develop and implement a plan for furthering gender and racial/ethnic diversity among its faculty, articulating in the plan specific goals for diversity even if modest. The committee recommends that the plan also address retention efforts, setting forth strategies for nurturing an environment of inclusiveness.

Identify and address unmet needs for timely access to research resources. According to the self-study report, the combination of academic journal costs in the discipline rising at rates higher than inflation and Milner Library serials budgets remaining stable at best has made it increasingly difficult for biological sciences faculty and students to access the literature they need to conduct their research. This includes inquiries faculty members need to conduct to develop their own research questions and apply for external grants funds to explore them. The library has sought to maintain faculty and student access to the journals most needed by biological sciences faculty and students through cancellations of less-used serials. In an effort to continue providing some level of access to cancelled periodicals, the library has provided article-level access in many cancelled periodicals through adoption of the *Get It Now* service, through which Milner pays for individual article access rather than expensive yearly subscriptions. It has also subscribed to *BrowZine*, which provides table of content access to periodicals, including many that were cancelled. Despite these efforts, access to research literature remains problematic for some biological sciences faculty members. The committee is concerned about the impact this situation may have on research and teaching in the school and on the ability of the school to retain and attract highly credentialed faculty. Accordingly, the committee recommends a collaborative effort involving the School of Biological Sciences, the College of Arts and Sciences, and Milner Library to document unmet needs for timely access to research literature by biological sciences faculty and students and to identify strategies for addressing those needs. Success in doing so may require additional efforts by the library but also contributions from sources external to the library. Options that might be explored may include modifications to the student fee structure to include supplemental funding for research literature or incorporating funding for research literature in external grant requests.

Continue refining the student learning outcomes assessment plan. The committee supports faculty in its ongoing refinement of the new student learning outcomes assessment plan for the program. The committee encourages faculty to continue its work to supplement administration of the biological concepts assessment tool with direct assessment in one or more core courses. Doing so should help faculty identify points within the curriculum at which modifications would be most effective for improving student achievement of learning objectives. The committee also suggests that faculty consider refining learning objectives so they are more specific and measurable and mapping each objective to one or more core courses. However, the committee also cautions faculty to consider sustainability of its assessment efforts when making any changes to its assessment plan. It is not necessary to assess every learning outcome in every course nor is it necessary to review the work of every student when administering an assessment method. Limiting assessment of each learning goal to a single assignment in just a few courses and sampling student work are methodologically-sound yet sustainable approaches that can yield information useful program planning.