REVIEW OF THE PH.D. IN BIOLOGICAL SCIENCES

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

OVERVIEW

The Ph.D. 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, a B.S. in Biological Sciences Teacher Education, a B.S. in Molecular and Cellular Biology, and a M.S. in Biological Sciences. The B.S. in Biological Sciences, the M.S. in Biological Sciences, and the Ph.D. in Biological Sciences programs have been reviewed in the current program review cycle, whereas the B.S. in Biological Sciences Teacher Education program and the B.S. in Molecular and Cellular Biology program are scheduled for review in 2023-2024 and 2021-2022, respectively. The doctoral program in biological sciences is one of 10 doctoral programs offered by Illinois State University.

The Ph.D. in Biological Sciences program prepares students for careers in the biological sciences involving both research and teaching. The curriculum is designed to provide students a well-rounded awareness of the various subdisciplines of the field while permitting students to specialize in any one of them or to create a unique plan of study that meets the student's learning and career goals. Regardless of the plan of study, the focus of the program is on research, with completion and successful defense of a dissertation being the major requirement for the degree. Doctoral students serve as teaching assistants for undergraduate biological sciences courses, through which experiences the doctoral students prepare for their own careers in teaching and research.

Enrollment by Sequence, Fall Census Day, 2010-2017
Ph.D. in Biological Sciences, Illinois State University

	2010	2011	2012	2013	2014	2015	2016	2017
Behavior, Ecology, Evolution, and Systematics	5	6	7	9	8	6	8	8
Molecular and Cellular Biology	4	8	9	12	10	9	7	6
Neuroscience and Physiology*							1	5
No sequence/specialized plan of study	13	9	6	6	4	4	3	2
Total	22	23	22	27	22	19	19	21

* Established effective 5-18-15

Degrees Conferred by Sequence, Graduating Fiscal Year 2010-2017**
Ph.D. in Biological Sciences, Illinois State University

	2010	2011	2012	2013	2014	2015	2016	2017
Behavior, Ecology, Evolution, and Systematics			1		1	3		
Molecular and Cellular Biology				1	1	1	1	2
Neuroscience and Physiology*								
No sequence/specialized plan of study	4	5	3	2	3	1	2	
Total	4	5	4	3	5	5	3	2

* Established effective 5-18-15
** 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

Prepare students for careers in the biological sciences involving both research and teaching.

Student learning outcomes

- In-depth understanding of advanced concepts in biology
- Developing advanced scientific literacy
- Developing understanding of biological research
- Make and report a significant contribution to body of knowledge within discipline

Curriculum (2017-2018)

Graduation requirements: 4 credit hours of Graduate Seminar in Biology, coursework (typically 30-40 credit hours) in an individual plan of study designed by the student in consultation with advisors or coursework in one of three sequences, taking and passing the Ph.D. qualifying examination, 15 or more credit hours of doctoral research, and a dissertation and its successful defense. Sequences include behavior, ecology, evolution, and systematics; molecular and cellular biology; and neuroscience and physiology (established since the prior program review). Regardless of plan of study, the focus of the program is on research. Admission to candidacy is to be completed before the fifth semester.

Program delivery

The program is offered on the Normal campus.
The program is delivered through face-to-face instruction.
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)

Courses in the Ph.D. in Biological Sciences program are taught by full-time tenured or tenure track faculty members who actively contribute to scholarship in the discipline.

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. Nine of the 48 articles were lead-authored by graduate students, and three articles named one or more graduate students as co-authors. 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 Ph.D. in Biological Sciences program is not accredited or certified by a national association. In the biological sciences, accreditation or certification is available only to undergraduate 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 there is a growing need for trained biologists capable of collaborating broadly and eager to take on many different roles. These scientists are not needed just as faculty members in academia but are also needed across all sectors of human endeavor. Thus, there is a growing need for well-trained biologists with advanced degrees who are capable of collaborating broadly and who are eager to take on various roles such as university faculty, government researcher, corporate scientist, secondary school teacher, medical professional, and lawyer.

Response to previous program review recommendations

In response to the 2009-2010 review of the Ph.D. in Biological Sciences program, faculty of the School of Biological Sciences has pursued the following initiatives.

Maintain competitive financial support for Ph.D. students. Doctoral students serving as teaching assistants in the School of Biological Sciences receive a monthly stipend and a tuition waiver. Due to the lack of budget increases, the school has been able to increase the monthly stipend only modestly over the last eight years, from $1,755 to $1,870 (a 6.6 percent increase). The current stipend has remained unchanged for about five years and is near the median for doctoral-level biology students at benchmark institutions.

Maintain and increase research start-up funds for newly-hired faculty members. Many faculty members hired by the School of Biological Sciences in the late 1990s or early 2000s were granted research start-up packages ranging from $50,000 to $100,000 each when they joined the school. From 2000 to 2009, start-up package amounts granted by the school were substantially higher, ranging from $250,000 to $400,000. The additional funds were contributed by the school and the College of Arts and Sciences. Since 2009, however, the school has been unable to maintain those higher amounts because it has lacked a fund dedicated to start-up packages.

Implement new dissertation guideline. The School of Biological Sciences has fully implemented a requirement that its doctoral students submit at least two manuscripts from their dissertation prior to its defense. Students in the program continue to meet this requirement. Its implementation has resulted in more doctoral students graduating with research papers in press, which helps graduates when seeking employment and helps newly-employed program alumni advance their research agenda more quickly than they might otherwise.

Strengthen relations with graduates of the program. The School of Biological Sciences has increased its communication with school graduates, including graduates of the Ph.D. in Biological Sciences program, through newsletters and other web-based information, interactions on social media platforms, special events, and more frequent surveys. As a result, more graduates are accessing information offered by the school and more graduates have been invited to return to campus for seminars or Homecoming events.

Major findings

In its nearly 60 year history, the Ph.D. in Biological Sciences program at Illinois State has graduated approximately 175 students, many of whom have had illustrious careers in academia or industry or with government scientific agencies or non-governmental organizations. The program has built on this record since the last program review despite financial limitations and institutional restrictions. The Ph.D. program remains closely integrated with the bachelor's and master's programs in biological sciences at the University. Students in all three programs collaborate with faculty to produce original scholarship. Involvement of doctoral students as teaching assistants for undergraduate biological sciences courses makes it possible for the school to offer numerous, high quality laboratory experiences for biological sciences majors and for students enrolled in other academic programs at the University.

As Illinois State University strives to maintain its position in the state as a choice public university through national and international recognition of its academic programs and faculty, strengthening and further developing the Ph.D. in Biological Sciences program takes on greater urgency. Through this program review process, School of Biological Sciences faculty members have identified several goals for the next program review cycle collectively intended to help strengthen and further develop the doctoral program.

Initiatives and plans

- Maintain a competitive graduate assistant stipend for doctoral students in the School of Biological Sciences. Maintaining the stipend at or above the median across benchmark institutions is necessary to remain competitive in student recruitment.
- Enhance efforts to recruit students for the doctoral program by going beyond using offers of teaching assistantships as a recruitment tool. Other recruitment strategies to explore include providing additional fellowship support for first-year doctoral students and increasing the number of research assistantships supported by externally-funded research projects.
- Continue efforts to provide nationally-competitive faculty start-up packages. Competitive start-up packages are needed to attract highly qualified applicants for faculty positions in the school and to help new faculty members establish research programs as quickly as possible. External funding of those research programs can, in turn, help attract and support highly-qualified doctoral students.
- Further strengthen doctoral 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 Ph.D. in Biological Sciences program to be in Good Standing.

The committee commends faculty of the Ph.D. in Biological Sciences program for offering a program unique among its comparators in its opportunities for students to specialize in a sub-discipline while developing a higher-level understanding of the discipline than they might otherwise. Students may enroll in one of three sequences, each covering one or more sub-disciplines of the field: behavior, ecology, evolution, and systematics; molecular and cellular biology; or neuroscience and physiology. Yet faculty advisors encourage their students to take courses in specializations other than their chosen specialization so they will develop an understanding of multiple sub-disciplines and how they interrelate and so they will have more flexibility in their career choices.

The committee commends faculty members for the rigor of the curriculum and for the individualized attention they provide students to successfully navigate it. Since the last program review the decision whether to admit a student to candidacy has been moved earlier in the curriculum, so students will know sooner if doctoral work is an appropriate choice for them. To emphasize the importance of developing a research agenda and publishing research findings, candidates are required to submit two publication-ready manuscripts in lieu of a traditional dissertation. Students are supported in their studies and research by their faculty advisor and colleagues in their laboratory learning community. Numerous venues are available for students to vet their research while it is still in progress, including informal faculty-student gatherings, the school seminar series, and research symposia. Also supporting students is the Beta Lambda chapter of Phi Sigma, the national biology honors society. Beta Lambda is the largest such chapter in the country and is one of the most active with regard to its sponsorship of training seminars and research symposia and its granting of funds to students to support their research. Success of the program in preparing students for their careers is evidenced by employment of program alumni by universities, medical centers, and private research corporations. A review of scholarship by 11 students who completed the program in 2009-2010 identified approximately 90 peer-reviewed publications by those graduates and more than 1,300 citations of those publications by other research manuscripts as of September 2017

Critical to the reputation of the program regionally and nationally is the quality of its faculty and students. The committee commends both. Faculty members are highly credentialed and well respected in their fields. Their contributions have been recognized through numerous college and University awards for research, teaching, or

service. Four Biological Sciences faculty members hold the rank of Distinguished Professor, the highest faculty rank conferred by the University. From 2012 through 2016, 10 faculty members served on 12 journal editorial boards and seven faculty members served on 12 research grant panels, among them panels of the National Science Foundation, United States Department of Agriculture, United States Department of Energy, and European Research Council. During the same period, faculty members collectively averaged 58 peer-reviewed publications annually. Biological Sciences faculty members are prolific at obtaining external grant funds to support their research and, in turn, research involving their students. Faculty members have been awarded more than $35 million in research grants during their tenure at Illinois State. Demand for the program among prospective students permits faculty to select the most highly credentialed applicants. For the fall 2016 term, for example, only 4 of 35 applicants were admitted. Faculty members carefully vet program applicants through campus interviews. In the case of applicants for whom travel to campus is difficult, including applicants residing in other states or countries, interviews are held via telecommunications application software with real-time audiovisual capabilities. The quality of students admitted to the program is evidenced in part by Graduate Record Examination scores substantially higher than averages across all graduate programs at the University and by grants and fellowships obtained by students from external entities after they are enrolled.

The committee recognizes the students in the Ph.D. in Biological Sciences program who serve as teaching assistants for their contributions to undergraduate education at the University. The assistants teach undergraduate students in biology laboratory sections and work with students individually to help them develop their research skills. The teaching assistants also help with general education courses taken by students enrolled in other academic programs at the University. The School of Biological Sciences offers seven general education courses that annually enroll more than 3,500 students. The committee commends biological sciences faculty members for their expansion of teaching assistant orientation and training since the last program review. New teaching assistants now attend a three-day orientation held prior to the fall semester.

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.

Continue the dialogue about increasing graduate assistantship stipends. Almost every student in the Ph.D. in Biological Sciences program serves as a graduate assistant. The graduate assistants make valuable contributions to research in the discipline and to undergraduate education at the University. The self-study report articulates concerns regarding competitiveness of the stipend paid to graduate assistants in the program relative to stipends offered by biological sciences programs at other universities. The self-study report also notes that the stipend amount paid to biological sciences students at Illinois State has remained unchanged for five years. The committee recommends that the school continue dialoguing with the college, Graduate School, and university administration regarding the need to increase assistantship stipends. The committee also suggests exploring ways to engage individual donors and external entities in contributing financially to stipends and fellowships.

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.

Develop and implement a plan for furthering student diversity. While the ratio of female students to male students in the program is approximately 1:1, less than 15 percent of students self-identify with racial or ethnic groups traditionally underrepresented in the discipline (excluding international students). The self-study report indicates that the program has not needed to recruit students given that the program receives many times the number of applicants it can admit. Given that strong demand, the lack of recruitment efforts may be a missed opportunity to increase student diversity. The committee encourages the program to develop and implement a student recruitment plan that articulates goals for diversity. The committee suggests that the program work with the Office of

Enrollment Management and Academic Services and with University Advancement to identify strategies. The committee further suggests that the recruitment plan include strategies for nurturing a climate of inclusiveness.

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 further 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 where 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.

Develop and implement a plan for tracking alumni. Primarily via communication between faculty members and their former students, the program has compiled contact information for about 68 percent of students graduating from the program between 2009 and 2017. The school has expanded its efforts to maintain communication with its alumni through numerous venues including newsletters and social media. The committee recommends that the school build on those accomplishments by developing and implementing a plan for systematically tracking and networking with alumni. Many elements of such a plan are already in place, including the alumni database that is being populated and the communication strategies already being deployed. A plan can guide those efforts going forward by identifying what information will be collected and what contacts will be made when and by whom. Some information collected through implementation of the plan, such as alumni perceptions of the program and alumni career outcomes, could be used in the student learning outcomes assessment process (see below). In addition, alumni could be recruited to guest lecture or otherwise contribute to student learning, provide career advice to students, assist them with job placement, or contribute financially to the school.

Evaluate the appropriateness and effectiveness of course scheduling and curriculum review processes. The self-study report notes that faculty members had regularly been contributing to course scheduling and curriculum review processes in their sections until the sections were eliminated and a less organized approach to the processes evolved. The self-study report alludes to concerns regarding that change. The committee encourages discussion of course scheduling and curriculum processes currently being deployed by the school to identify any concerns faculty may have regarding their appropriateness or effectiveness.

Continue refining and implementing the student learning outcomes assessment plan. The committee recognizes the program for its use of comprehensive examinations and dissertation proposals to identify trends in student learning that can inform decisions regarding the curriculum. The committee encourages faculty to continue that practice. When faculty next considers refinements to the assessment plan, the committee suggests that faculty consider incorporating strategies for systematically obtaining feedback from students and alumni. Perceptions gathered from those stakeholders may provide valuable inputs for program planning. Indirect assessment strategies to consider may include student exit surveys or interviews, alumni surveys, or systematic documentation of feedback already being gathered by faculty through informal contacts with students and alumni.