Integrative Life Sciences
Doctoral Program

Program Guidelines
2019-2020
Administrative Structure

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Program Mission

The Ph.D. in Integrative Life Sciences is housed within the Center for Life Sciences Education. It is a flexible program designed for students who want to conduct research that is integrative across multiple disciplines and that takes a systems approach to emerging research questions across the many fields that comprise the life sciences. Students may opt to work with faculty members from departments on the Monroe or Medical campuses of VCU. The program provides the opportunity to conduct interdisciplinary research at multiple scales of study from the molecular to ecosystem levels.

Program Goals

Interdisciplinary knowledge and skills: The core curriculum of the ILS program will effectively assist students in gaining understanding of life sciences research integrated across disciplines along with training in the interdisciplinary skills and knowledge increasingly required for conducting effective research. It will also foster progressive development of a mastery of the current state of the research in students’ areas of interest as they seek to identify key focus areas for their integrative research.

Research skills: The mentored research component of the program, building on the core curriculum and interdisciplinary elective course work, will foster development of an ability to synthesize this learning and identify key focus areas for integrative research. It will support students as they learn how to design, implement and interpret interdisciplinary approaches that will best address their research questions.

Communication skills: Students in the program will develop skills in both written and oral communication of life science knowledge, experimental design, results and interpretation to a variety of potential audiences.
Student Learning Outcomes

1. **Oral communication skills:** The candidate will demonstrate the achievement of an appropriate level of oral communication skills with respect to the content, organization, logical flow, presentation and appropriate use of language incorporating the use of visual aids, as measured by rubric.

2. **Written communication skills:** The candidate will demonstrate the achievement of an appropriate level of written communication skill with respect to grammar, syntax, spelling and use of vocabulary to effectively present information including the use of figures, tables and citations, as measured by rubric.

3. **Experimental design:** The candidate will demonstrate the achievement of an appropriate level of competence in the ability to appraise, modify, and/or create and implement experimental protocols and to design and develop experiments, as measured by rubric.

4. **Problem-solving skills:** The candidate will demonstrate an appropriate level of skill in the identification and selection of meaningful problems to be addressed in life science research, including the ability to defend said identifications and to design and develop appropriate methods to solve said problems, as measured by rubric.

5. **Integrated knowledge:** The candidate will demonstrate an appropriate level of knowledge of the life sciences and a more detailed understanding of the disciplines most pertinent to their own interdisciplinary research areas, including an appropriate familiarity with the research literature and the ability to evaluate and critique publications, as measured by rubric.

Admissions Requirements and Procedures

Admission requirements for the Ph.D. Program in Integrative Life Sciences ensure selection of outstanding students whose motivation, ability and education prepare them for interdisciplinary graduate study in the life sciences. The following requirements and procedures incorporate those of the VCU Graduate School.

1. **Admission requirements**
   a. Graduation from an accredited college or university or its equivalent, with a degree in a discipline, a spectrum of course work, and/or professional experience that provides an appropriate background for graduate-level study in the life sciences. Students who anticipate graduating by the time of matriculation in graduate school may apply.
   b. An undergraduate or graduate record indicating superior performance. Applicants must have a minimum GPA of 3.0 on a 4.0 scale. In very unusual cases this requirement may be waived by approval of the Dean of the Graduate School.
   c. As of Fall 2019, the Graduate Record Examination (GRE) is not required.
   d. For applicants whose native language is not English, satisfactory scores from a standardized test commonly used and deemed appropriate for evaluation of English
Language Proficiency, such as the TOEFL (a minimum score of 100) or IELTS (minimum band scores of 7.0).

e. Transcripts from non-US undergraduate and graduate institutions must be evaluated by off-campus evaluation services. See Office of Admissions website for details and recommendations.

f. Letters of recommendation from three individuals qualified to evaluate the applicant’s ability to engage in graduate research study in the life sciences.

g. A written “personal” statement describing the applicant’s interests, motivation, education and goals for pursuing graduate study in the integrative life sciences program. Applicant should indicate why this program is the most appropriate and evidence as to why specific mentor(s) would be the best fit for planned research.

2. Admission procedure

The above material must be sent along with a completed application form and the required application fee to the VCU Office of Admissions (see on-line application). Applications are accepted for only Fall semester admissions. Admission to graduate study in the Integrative Life Sciences program requires recommendation by the Graduate Program Committee, which is constituted by graduate faculty and is appointed by and includes the Program Director as chair. These recommendations are then approved by the Vice Provost for Life Sciences and the Dean of the Graduate School.

Applicants are strongly encouraged to contact potential research advisers prior to submitting application materials and to identify potential research advisers in their personal statements. Individuals who have identified a research adviser will be given preference for admittance and funding.

3. Application deadline

The Deadline for completed applications is January 10th to ensure consideration for financial assistance. All materials – including recommendation letters – must be received by the Office of Admissions or the Program Director by Jan. 10th.

Student Support and Financial Aid

In addition to need-based financial aid awarded through the Office of Financial Aid, students may be eligible to be considered for a variety of scholarships, fellowships, and teaching and research assistantships. Information regarding available financial support will accompany an offer of acceptance. Support may be in the form of tuition, fees and/or stipend support.

Admitted students with greater than a 3.4 out of 4.0 undergraduate GPA are eligible for 12-month Graduate Assistantships covering stipend, tuition and fees provided through the VCU Graduate School and supplemented by VCU Life Sciences, contingent on acceptable progress and the availability of funds. These funds can then be made available in continued years; otherwise, students may be expected to be supported by grants, teaching assistantships, and other funding sources obtained themselves, by their mentor, or from their advisor's department/school. Students are strongly encouraged to work with their research advisor to apply for internal and external funding early in their matriculation in the ILS Program.
Program Requirements

Upon matriculation, students are required to initiate a research project and coursework in core and elective courses. Research lab rotations are allowed, but not required. Comprehensive exams (written and oral) should be scheduled at the end of the student's second year, with a written and oral proposal defense that follows. The doctoral degree is finally conferred after the written and oral defense of the dissertation. All work towards the degree must be completed within 8 years of the first enrollment.

Teaching is an integral component of the training of this program. Students receiving funds through ILS in the 3rd year and beyond may fulfill additional TA responsibilities, one to two courses per year, depending on the source and amount of funding.

There is no set vacation time for graduate students; students are required to schedule time off with their research advisor. Payment of tuition and fees for topical research courses beyond the second semester of the 2nd year is not guaranteed.

Course requirements. Students in the program are required to earn a minimum of 64 hours of graduate-level credits. At least one-half of the credit hours presented for graduation must be at the 600-level or higher. Degree applicants must achieve an overall grade-point average of 3.0 ("B") with a grade of C in no more than one course. The grade-point average for graduation shall be based on all graduate courses attempted after acceptance into the program, unless otherwise approved by the Program Director. Graduate-level VCU course work taken as a nondegree-seeking student or in a previous graduate matriculation for which a degree was never awarded may be evaluated to determine whether it can be used to fulfill degree requirements of this program in accordance with the VCU Graduate School transfer policy. Course work completed toward a previous degree can also be considered as a waiver of program core or elective course work requirements. In these cases, the requirement(s) are waived, and other course work or research credits can be used to make up the 64 credits needed toward the degree. There is no maximum number of courses/credits that can be considered for waiver. A minimum grade of B is required for credit hours transferred or waived.

The student's coursework Plan of Study form must be approved by the student's Research Advisory Committee and the Program Director (see Blackboard program site for approval form). This document is a plan and should be completed by end of the first year of study, but can be updated at any time before graduation.

Students receiving Assistantships (any funds administered by VCU for stipend and tuition), are required to enroll full time, which is 9-15 credits during each of the Fall and Spring semesters and 3 credits during Summer semesters. Enrollment in more than 15 credits during each of the Fall and Spring and more than 3 credits during the Summer is considered an overload and will result in additional tuitions costs not included in Assistantships. Students who are self-supporting may enroll for 1 credit per semester as long as it works with visa requirements. Students planning to complete their dissertation and paperwork within 30 days of the start of a semester may enroll in 1 credit that semester when on an Assistantship.
Concentrations

The ILS program also includes two concentrations, one in “Bioinformatics and Genome Sciences” and "Behavioral and Statistical Genetics", which follow the same program guidelines and requirements as the overall ILS program, but may have additional coursework/requirements. Students may apply directly into concentrations or they may transfer into concentrations from the ILS general program as desired and with approval by Program Director. Additional information is included in the Curriculum Requirements section below.

Dissertation Research

The dissertation research project should represent a significant contribution to the body of knowledge in its field and should be deemed suitable for publication in refereed journals. The emphasis of the research conducted by students in this program shall be on interdisciplinary research. Research projects may take advantage of the many research opportunities across the life sciences on VCU’s Monroe Park and Medical College of Virginia (MCV) campuses. Projects should encompass multiple scales of study from molecular to ecosystem levels.

Research Advisor and Research Advisory Committee

Students should select a research adviser prior to matriculation, but no later than the end of the first semester. The research adviser may be chosen from among the many graduate faculty members from any VCU research unit. This individual is the primary mentor of the student and primarily responsible for the coursework, research direction and mentoring, and funding of the student. The student may also choose to have co-advisors responsible for their training. Co-advisors can be chosen at any time during the student's time in the program. The research adviser(s) is approved by the Program Director in accordance with the Graduate School bylaws.

Students are required to form a Research Advisory Committee that is headed by the research adviser (as chair) and that consists of a minimum of four other members of the VCU graduate faculty. Individuals who are not graduate faculty members (i.e., individuals from another institution or industry) must apply to the Dean of the Graduate School for temporary affiliate graduate faculty appointment. This process includes the student or research advisor contacting the Program Director with a CV of the outside member and a justification for why this individual should be on the VCU Graduate Faculty. The Program Director then makes the recommendation to the Dean of the Graduate School.

The significant areas of the student’s research focus should be represented by the members of the research advisory committee. At least two members of the committee should have primary appointments in departments other than that of the research adviser, with one of those members being integrally associated with the student’s research to foster the interdisciplinary intent of this degree program. Students should form their committees no later than the end of the second semester of study.
The student's Research Advisory Committee must be approved by the Program Director (see Blackboard program site for approval form).

**Student Evaluations and Satisfactory Progress**

Reviews by the research advisor will be an important aspect of the evaluation process. A student's progress is evaluated each semester based on their performance in coursework and enrollment in research credit. A student whose overall performance has been judged "satisfactory", following the below, may proceed into the next academic year.

As per the graduate bulletin, students receiving one F, one D, or two C or U grades in courses will be reviewed for possible dismissal from the ILS Program. Additionally, students who receive two "unsatisfactory" reviews in their research progress (e.g., LFSC 697) will be reviewed for dismissal from the ILS Program. The student’s Research Advisory Committee will review the matter and make a recommendation to the Program Director. If a Research Advisory Committee has not yet been formed, the student’s research advisor will perform the review and make the recommendation. If the Program Director determines that the student should be dismissed from the Program, the recommendation will be forwarded to the Dean of the Graduate School for consideration and action. If the Dean of the Graduate School chooses to dismiss a student from the University, as detailed in the Graduate Bulletin, the student may appeal the decision. Alternative actions include offering the student make-up work, probation with specified conditions, or no action.

**Comprehensive Examination**

Students must successfully complete a comprehensive examination administered by the student’s Research Advisory Committee. This examination can take place once the student's Committee and Plan of Study have both been approved by the Program Director. Students should take the comprehensive exam upon completion of all required didactic course work, usually no later than the end of the fourth semester of study. It may be written or oral (or both) and will focus on material covered in core and selected elective courses as well as fundamental knowledge relevant to the student’s research field.

A Dean's Representative may be requested for the exam, but is not required (see below). In the event that a committee member is unavailable for the examination, the student's research advisor may accept questions in advance from the committee member and present these questions to the student on behalf of the committee member. Committee members are required to complete the Comprehensive Examination Evaluation form (see Blackboard program site) and submit to the Program Director with the committee's evaluation and conclusion of "Pass" or "Fail" within TWO weeks of the completion of the exam. In the event of "Fail", the committee will provide feedback within ONE week as to how progress can be made in advance of the second attempt at the exam. The decision need not be unanimous but must reflect a consensus. If a decision cannot be reached by the Committee, the Research Advisor will consult with the Program Director to make a decision. Students may retake the comprehensive examination only once.
The student must notify the Program Director two weeks in advance of the date of the comprehensive exam (see Blackboard program site for approval form).

**Dissertation Proposal Examination**

Upon successful completion of the comprehensive examination, the student will work in concert with their Research Advisory Committee to develop and write a dissertation proposal (the format to be determined by the Committee in advance). Students are encouraged to solicit and incorporate feedback on preliminary drafts of their proposal prior to submission of the final draft to be defended. Upon approval by the student's research advisor, this proposal will then be orally defended by the student to the Research Advisory Committee. Successfully defending the proposal determines the research that will be generated and eventually defended by the student at their final dissertation examination. Students should have their proposal defense successfully completed BEFORE they conclude major steps towards chapter data collection and completion. Failure to do so may mean that any of the student's completed chapter work could be considered inappropriate as a contribution to the student's dissertation.

A Dean's Representative may be requested for the exam, but is not required (see below). In the event that a committee member is unavailable for the examination, the student's research advisor may accept questions in advance from the committee member and present these questions to the student on behalf of the committee member. After the defense, the student's advisor collects the Dissertation Proposal and Oral Defense Evaluation form (see Blackboard program site) from each of the Committee members for submission to the Program Director. This form indicates "Pass" or "Fail" and is signed by each member, and also presented to the student immediately following the defense. The decision need not be unanimous but must reflect a consensus. If a decision cannot be reached by the Committee, the Research Advisor will consult with the Program Director to make a decision. If the overall decision is "Fail", the advisor and student will discuss the evaluations for progress and decide on a second defense date. Students may retake the proposal examination only once.

The student must notify the Program Director two weeks in advance of the date of the oral proposal defense examination (see Blackboard program site for approval form).

Following the successful passing of the dissertation proposal examination, the student will turn in a completed Doctoral Candidacy form (see Blackboard program site), to be signed by their Research Advisor and the Program Director, and then approved by the Dean of the Graduate School. This document represents the program's approval of the student's proposed dissertation work to be completed.

**Dissertation Evaluation and Graduation**

Students shall prepare a written dissertation describing the completed research using the format approved by the Graduate School. The dissertation typically includes multiple chapters that build on the overall research goal of the dissertation. These chapters are typically suitable for journal publication, but their submission or publication in peer-reviewed journals, while encouraged, is
not required for the degree. These chapters are approved by the research advisor and Research Advisory Committee. An oral defense of the dissertation, under the direction of the Research Advisory Committee and open to the public, also is required.

A Dean's Representative may be requested for the oral exam, but is not required (see below). In the event that a committee member is unavailable for the examination, the student's research advisor may accept questions in advance from the committee member and present these questions to the student on behalf of the committee member. After the defense, the student's research advisor collects the Dissertation and Oral Defense Evaluation form (see Blackboard program site) from each of the Committee members for submission to the Program Director. This form indicates "Pass" or "Fail" and is signed by each member, and also presented to the student. The decision need not be unanimous but must reflect a consensus. If a decision cannot be reached by the Committee, the Research Advisor will consult with the Program Director to make a decision. If the Committee's overall decision is "Fail", the advisor and student will discuss the evaluations for progress and decide on a second defense date.

At the start of the semester of which the student plans to defend their dissertation and graduate, the student must notify the Program Director. At this time the student will apply to graduate following the directions of the Program Director in accordance of the University's guidelines to graduate. If at any time during that semester the student decides to not defend the dissertation and graduate that semester, the student must notify the Program Director of the desire to "cancel" the graduation application.

The student must notify the Program Director two weeks in advance of the date of the dissertation oral defense examination (see Blackboard program site for approval form).

Upon successful completion of all degree requirements, the student will turn in a completed Electronic Thesis/Dissertation form (see Blackboard program site), to be signed by their Research Advisory Committee and the Program Director. The student will also upload their dissertation to the Graduate School and complete necessary surveys (see website for information and direction). Only after the ETD is signed off, the dissertation is uploaded, and the surveys completed will the Program Director approve the student for graduation. Upon approval of this process by the Dean of the Graduate School, the student will graduate with the Ph.D. in Integrative Life Sciences.

**Dean’s Representative**

If desired by the student, the Program Director will appoint a Dean’s Representative to attend meetings related to any examination or defense. The representative will be provided with the same written materials provided to members of the Research Advisory Committee. The Dean’s Representative is a non-voting member of the committee, but may participate in committee discussions. The role of the Dean’s Representative is to assist the student and committee, provide information to the Program Director and Graduate Program Committee to assist in enhancing the program, answer procedural questions that arise during meeting, and to ensure that students and committee members work collaboratively and in a fair and respectful environment. Students
must notify the Program Director at least 10 working days in advance of meetings to provide sufficient time to schedule a Dean’s Representative.

**Travel Awards**

The Graduate School may provide travel awards on a first come, first served bases for students to attend and present at local, regional, national and international meetings. Invitations to apply for awards are sent directly to registered students. All students are strongly encouraged to apply. Pending the availability of funds, travel funds are available through the ILS Program to all registered students presenting a talk or poster at a local, regional, national or international meeting. The amount of funds to be available to each student request will be based on the number of students applying and the amount of funds available to the Program Director each year.

**Outline of Milestones**

Below is outline of milestones and necessary documents to complete. All documents are found on ILS Blackboard site available to students. Details for each step are found in preceding sections of this document.

1. Dissertation Committee (end of 2 semesters)
   - Document with committee members signatures, and approved by ILS Director
2. Plan of Study (end of 2 semesters)
   - Document with committee members signatures, and approved by ILS Director
3. Comprehensive Exam (written and/or oral...up to student's advisor and committee)
   - Document approving date/time by research advisor and ILS Director
   - Committee's evaluation sheets turned into ILS Director
4. Dissertation Proposal Defense (written and oral)
   - Document approving date/time by research advisor and ILS Director
   - Committee's evaluation sheets turned into ILS Director
   - Advanced to Candidacy document signed by student, research advisor, and ILS Director
5. Dissertation Defense (written and oral, must be completed by end of 8th year)
   - Document approving date/time by research advisor and ILS Director
   - Committee's evaluation sheets turned into ILS Director
   - ETD document signed by student, research advisor, committee, and ILS Director
Curriculum Requirements

These are requirements and info for the ILS degree with the concentration information to follow.

**ILS PhD**

The curriculum requires a minimum of 64 credits, typically distributed* as follows:
- 9 credit hours from 5 core courses listed below
- Minimum of 3 credit hours in an advanced statistics, advanced mathematics, or research design course
- Minimum of 9 credits in elective courses
- Minimum of 43 credit hours in directed research (LFSC 697)

**Core Courses**
- LFSC 630: Integrative Life Sciences Research (2 credits)
- LFSC 631: Student Seminar in Integrative Life Sciences (2 semesters; 2 credits total)
- LFSC 690: Research Seminar in Integrative Life Sciences (2 semesters; 2 credits total)
- Technologies Course (2 credits)
- Scientific Integrity (1 credit)

* As previously noted, students may waive requirements based on previous work completed.

**ILS PhD, concentration in Bioinformatics and Genome Sciences**

Curriculum and core courses are followed as above with additional required courses:
- BIOC 530: Biochemistry, Cell and Molecular Biology Module 1: Protein Structure and Function (2 credits)
- BIOC 531: Biochemistry, Cell and Molecular Biology Module 2: Basic Metabolism (1 credit)
- BIOC 532: Biochemistry, Cell and Molecular Biology Module 3: Central Dogma of Molecular Biology (1 credit)
- BNFO 601: Integrated Bioinformatics (3 credits)

**ILS PhD, concentration in Behavioral and Statistical Genetics**

Curriculum and core courses are followed as above with additional required courses:
- HGEN 611: Data Science I (3 credits, fulfills technologies course requirement)
- CCTR 702: Statistics for Genetic Studies I (3 credits, fulfills advanced stats requirement)
- CCTR 703: Statistics for Genetic Studies II (3 credits)
- HGEN 501: Introduction to Human Genetics (3 credits)
- HGEN 502: Advanced Human Genetics (3 credits)
- HGEN 610: Current Literature in Human Molecular Genetics (2 credits)
- HGEN 620: Principles of Human Behavioral Genetics (3 credits)
- EPID 646: Epidemiology of Psychiatric and Substance Use Disorders (3 credits)
Course Descriptions

LFSC 630: Integrative Life Sciences Research. Semester course; 2 credits. An orientation to integrative research in the life sciences from the molecular to ecosystem levels. The course includes instruction in proposal and committee assembly, grantsmanship and presentation skills. This course is required for all first year students in the first semester of study.

LFSC 631: Student Seminar in Integrative Life Sciences. Semester course; 1 credit. Presentation and discussion of research topics of current interest in the life sciences. These seminars are provided or generated by students in the program for peer-review and open discussion. This seminar is required for two semesters, but is available indefinitely after that.

LFSC 690: Research Seminar in Integrative Life Sciences. Semester course; 1 credit. Presentation and discussion of research topics of current interest in the life sciences. Students must attend and write reports on multiple seminars per semester, to be evaluated and returned to the student for feedback. Seminars can come from any department outside the student's main advisor's unit. This seminar is required for two semesters.

LFSC 697: Directed Research in Integrative Life Sciences. Semester course; 1-15 variable credits. May be repeated for credit. Directed research leading to the Ph.D. degree in Integrative Life Sciences. This course serves as the evaluation of research progress in the program.

Technologies Course. Semester course(s); at least 2 credits. This requirement can be satisfied by multiple 1 credit courses. The specific course taken will depend on the student’s research focus, and will be approved by the Research Advisory Committee and Program Director in the Plan of Study.

Scientific Integrity. Semester course, 1 lecture hour, 1 credit. A survey of contemporary issues relating to responsible conduct in research. Topics include academic integrity, mentoring, authorship and peer review, use of humans and animals in biomedical research, ownership of data, intellectual property, scientific recordkeeping, collaborative research, research misconduct, and genetic technology. The specific course taken will be approved by the Research Advisory Committee and Program Director in the Plan of Study.

Advanced Statistics, Mathematics, or Experimental Design. Students are required to take a minimum of one graduate-level course in advanced statistics, mathematics, or experimental design. The specific course taken will depend on the student’s research focus, and will be approved by the Research Advisory Committee and Program Director in the Plan of Study.

Elective Courses. The specific courses taken will depend on the student’s research focus, and will be approved by the Research Advisory Committee and Program Director in the Plan of Study. Courses from the many departments on both the Academic and Medical Center campuses are available to fulfill this requirement. Only three credits of Preparing Future Faculty (GRAD) courses will be accepted towards the credit hours of electives.