

Requirements for the Ph.D. Degree

Department of Anatomical Sciences and Neurobiology University of Louisville,
School of Medicine

General Program Requirements

Students should familiarize themselves with the general requirements for the Master's and Ph.D. Degrees as stated in the current University of Louisville Graduate Catalog (<http://graduate.louisville.edu/>). The award of a Doctor of Philosophy degree indicates that a student has attained mastery of a field and has demonstrated the capacity to perform independent scholarly research, including the ability to think critically. The doctoral degree is not awarded solely upon completion of a curriculum of courses, even though the student may have done superior work in them; rather, it is awarded in recognition of having both successfully completed coursework and demonstrating creative scholarship in the candidate's chosen field.

All Ph.D. students receiving financial support from the University of Louisville, including University Fellows and Graduate Assistants, must be enrolled as full-time students during the period for which they are receiving support. The minimum and maximum number of credit hours for full time study is 9 and 12, respectively, in the fall and spring semesters (6 and 12 for the summer). To be considered in good standing, a grade average of 3.0 or better must be maintained. The program faculty and unit dean monitor the GPA of every graduate student. A student must be in good standing to receive a degree. Students must be enrolled during the semester in which they wish to graduate.

Non-thesis M.S. degree requirements

All Ph.D. students must complete the requirements for the non-thesis M.S. degree, after which they will be considered a Ph.D. candidate. Detailed coursework requirements are described below. Up to 6 credits of earned graduate semester hours can be transferred upon request from other accredited institutions, as long as the course work was taken within the past three years and a grade of B or better was earned (transferred grades do not get calculated in the student's GPA). In addition to course work, students must complete a qualifying exam to become a PhD candidate.

Course Work

The Department of Anatomical Sciences and Neurobiology (ASNB) has the following requirements, which are in agreement with the requirements for the M.S. degree as set by the School of Interdisciplinary and Graduate Studies (SIGS):

Integrated Programs in Biomedical Sciences (IPIBS) Course Requirements: Students receiving a stipend from IPIBS must successfully complete all of the following courses within the School of Medicine:

	<u>credit hours</u>
Cell Biology (BIOC 667) or equivalent	3

ASNB Course Requirements: Students must earn at least 13 additional elective credits from the following list.

Courses:	Credit hours
Research Ethics (BIOC 630)	1
Fundamentals of Neuroscience (ASNB 602)*	4
Analytics in Biomedical Science (ASNB 622)	3

*(Students who have earned a B or higher in ASNB 502 as an undergraduate take ASNB 609 instead, plus 3 additional hours of elective credits)

In addition, students must take at least two 3 credit lab rotations:
(ASNB 618) – see description below

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Seminar: Anatomy Seminar (ASNB 606, 1 credit hour) must be taken for credit each semester prior to Master's candidacy.

Additional Electives: Additional courses (electives) within ASNB or graduate level courses in other departments may be taken during the first two years. The student should consult with his/her advisor on the selection of the appropriate electives.

	<u>credit hours</u>
*Developmental Neurobiology (ASNB 617)	3
*Molecular Neurobiology (ASNB 614)	4
*Synaptic Organization of the Brain (ASNB 666)	3
*Mammalian Sensory Systems (ASNB 630)	4
*Translational Neuroscience (NSCI 600)	3
Gross Anatomy (ASNB 601)	6.5
Human Embryology (ASNB 605)	3
Biochemistry I (Bioch/Che545) or equivalent	3
Introduction to Scientific Computing (ASNB 621) (summers only)	2
Biochemistry II (Bioch/Che547)	3
Cellular and Molecular Immunology (MBIO 658)	3
Physiology I (PHY 605)	3
Physiology II (PHY 606)	3

* These courses are offered once every two years. These courses are designed for students with a Neuroscience research emphasis.

Courses not on either the required or elective list can be substituted for courses listed following review and approval by the ASNB Graduate Committee.

Lab Rotations and Research Hours

Lab Rotations: Each student will complete two rotations in different laboratories prior to start of their third semester. Exceptions or the addition of a third rotation require approval from the ASNB Graduate Committee. The objectives of rotations in 2 labs are to expose the student to different approaches and areas of research, and to assist the student in choosing a laboratory for dissertation research. For each rotation, the student will register for the 3 credit Laboratory Rotation (ASNB 618) course, which is graded on a pass/fail basis.

Research Hours: Once students have chosen a specific laboratory for their dissertation work, they will sign a compact outlining the mutual responsibilities of the mentor and mentee. The advisor will send to the Director of Graduate Studies. Once a mentor(s) and home lab is chosen, research hours are taken as Original Investigation (ASNB 619), in which students earn a letter grade.

Advisory Committee

The advisory committee's primary role is to serve as a guiding and evaluative body for students pursuing a course of study and training that leads to the attainment of a Doctor of Philosophy degree. Throughout this academic journey, the committee assists the students in acquiring the necessary knowledge and skills essential for their doctoral achievement. While the course of study and training will include shared components applicable to all students, there will also be customized elements tailored to meet the specific needs and desires of each individual student. This personalized approach ensures that students receive a well-rounded education while addressing their unique interests and goals.

The committee must have a minimum of five members. The mentor (Principal Advisor) serves as chair. The majority of committee members must have a primary, joint or associate appointment in ASNB. At least one member must have a primary appointment in a department outside ASNB (this outside committee member must not have a joint appointment in ASNB) and can include a member of the Graduate Faculty from another University. The student, in conjunction with the advisor, should form a committee prior to the start of the second year. Once the committee is formed, the student will meet with the committee at least once per year. A Graduate Student Progress Report, completed by the student and advisor, must be reviewed annually by the student's committee. Student progress is then reported to the ASNB Graduate Program Director.

Academic Probation

Any student with a grade point average below 3.0 will be placed on academic probation until the student regains a 3.0 average or is dismissed. Students are ordinarily not permitted to continue on academic probation for more than one semester. Upon request of the student's graduate program, the unit dean may approve continuation beyond a single semester. A student who has received the grade of "C" or lower (in a course that is a degree requirement) may repeat that course upon the approval of the graduate program director and the unit dean. When a student repeats a course, the grade point average will be calculated on the basis of the last grade earned, although all previous grades will remain on the transcript.

Masters Candidacy

After completion of all course requirements, students must register for Masters Candidacy (MAST 600) and continue this registration each semester until the successful completion of his/her qualifying exam. This registration must be maintained year-round (fall, spring and summer). Once a student registers for MAST 600, he/she may not register for additional courses.

Qualifying Exam

The purpose of the qualifying exam is to assure that the student has sufficient knowledge and skills to begin a research project. The exam will be taken within two terms (summer term included) after the successful completion of required coursework but no later than the Spring semester of Year 3.

Each member of the student's Advisory Committee will prepare one question designed to assess the student's ability to integrate course material, demonstrate critical thinking, and evaluate the literature related to the student's area of interest. The student's mentor will submit all the questions (minimum of five) to the ASNB Graduate Committee. The ASNB Graduate Committee will review the questions and select three for distribution to the student. The student will have two weeks to complete two of the three questions (of their own choosing) and submit the answers electronically (pdf format) to the ASNB Graduate Committee. The exam is "open book" and must be written in the student's own words. The answers represent the student's unaided efforts and should NOT be edited or critiqued in any form by anyone other than the student, including the mentor, the student's committee, or other trainees in the program. The answer to each question should be no less than 10 pages and no more than 20 pages in length (not including references) using Arial font at 12 point in size, double-spaced, and 1" margins. The use of books and review articles is acceptable; however, a significant portion of the paper must be based on recent, primary sources in scientific journals.

The submitted answers will be evaluated by one member of the ASNB Graduate Committee plus one representative from the student's advisory committee, excluding the mentor. Each answer will be evaluated on a scale from 1 (poor) to 10 (outstanding) on mastery of basic background and conceptual material, familiarity with the literature in the field of study, and critical thinking about the cited works and scientific question. For each question, the reviewer's scores will be averaged. To pass the qualifying exam and continue in the Ph.D. program, the student must 1) receive a minimum total score of at least 12 out of 20 and 2) receive at least a score of 5 on each question. As an additional learning experience, a student who passes the exam with a total score that does not exceed 16, will be required to revise one or both questions to address the reviewer's comments. Revision of this document is not an exam so students are free and encouraged to use all available resources including the UofL writing center (<https://louisville.edu/writingcenter>). The revised question(s) will be returned to the Graduate Program Director within one week and then disseminated to the original reviewer's for evaluation of the revision(s). To facilitate re-review, the question(s) should be revised using "Track Changes".

A student who does not meet the passing requirements of a total score of at least 12 out of 20 and at least a score of 5 on each question will have one chance for remediation. The remedial examination must be completed no later than 6 months after the student completed the original examination. The exam will again be comprised of answering two questions in the same format; the third question that had been submitted to the student by the ASNB Graduate Committee that was not answered plus a new question. Failure after remediation will result in dismissal from the Ph.D. program.

Upon successful completion of the exam, an evaluation form stating the outcome of the exam will be completed and signed by each committee member and will become a permanent part of the student's record. A passing grade indicates that the student has completed the requirements for a M.S. degree. At this point the student becomes a doctoral candidate and must register for and maintain candidacy (DOCT 600) until the successful completion of his/her dissertation. This registration must be maintained year-

round (Fall, Spring and Summer). The statute of limitation for obtaining a Ph.D. degree at the University of Louisville is four years from the beginning of Doctoral Candidacy. University wide official maximums for fellowships and Graduate Assistantships are typically 6 years (Duration of Support: <https://catalog.louisville.edu/graduate/general-policies-procedures-requirements/>).

Research Proposal

The Research Proposal should be defended in the semester following successful completion of the Qualifying Exam but not later than the Fall semester of Year 4. Prior to writing the Research Proposal, the student will develop an outline of the proposed experiments in coordination with their advisor and then present this outline to their committee. It is at this point, prior to writing the Research Proposal that the committee should recommend any changes in the research plan, regarding, for example, the number of experiments, reducing the difficulty of experiments, or introducing experiments that may be more appropriate for addressing the research question. Once the committee is satisfied with the proposed experiments, the student will write a Research Proposal in the following general format*.

Specific Aims, Hypotheses and Experiments

This section will consist of a list of the proposed specific aims. Each Aim should include hypotheses to be tested and a brief description of the experiments that will be used to test these hypotheses.

Significance

Section two will be similar to and/or an expanded version of the Significance section of a National Institutes of Health grant proposal. This review should provide evidence that the student has a sufficient command of the background information relevant to the proposed research.

Experimental Design and General Methods

This section will consist of a detailed description of the experimental design as well as the methods that will be used to carry out the proposed experiments.

Expected Outcomes

This section will describe the expected results and how they will be interpreted.

Potential Problems

This section will describe any potential problems that could occur, how they might affect interpretation of their research results, and how the student will address any potential problems.

*All eligible students are encouraged to submit (in coordination with their advisor) an application for a National Institutes of Health Predoctoral National Research Service Award (F31) or a National Science Foundation Predoctoral Award. Therefore, the Research Proposal may be submitted in the format of a relevant application with the exception that the background and significance section should be expanded to include a more extensive literature review than permitted by the NIH or NSF page limitations.

Upon completion of the research proposal, the student will distribute a copy to each committee member, who will have no less than two weeks to read the proposal. ***Students must consider this two-week reading period when preparing the document and scheduling the proposal defense.*** The proposal defense itself will be chaired by the student's advisor. The defense will begin with an oral presentation, open to the public, in which the student will present an overview (approximately 40 min) of their research plan. The presentation will be followed by an oral defense to assess the students' readiness to conduct the proposed research. Non-committee members in the audience will have an opportunity to ask questions first. The general audience will then be dismissed, and the student will defend his/her proposal before the committee. Success or failure will be determined by the majority vote of the committee. A student who fails the proposal defense will have 2 months to retake the exam. Failure on the second attempt will result in dismissal from the program. Upon successful completion, a Proposal Defense Evaluation Form stating the outcome will be completed and signed by each committee member and will become a permanent part of the student's record.

Annual presentation of research progress

Ph.D. students who have passed their qualifying exam (Doctoral candidate) must present their research

accomplishments annually at the University of Louisville. This requirement can be fulfilled through various options: presenting during the Department's annual "Research Roundup" (10 minutes in length), defending their dissertation proposal, presenting during the Department's annual Neuroscience Seminar Series (30-50 minutes in length), or participating in the Kentucky Spinal Cord Injury Research Center's Seminar Series (30-50 minutes in length) or any other approved similar venue. While presentations at journal clubs and lab/committee meetings are encouraged, they cannot be used as a substitute for the annual presentation requirement. During their graduate career, students must present at least once during the Department's annual Neuroscience Seminar Series or the Kentucky Spinal Cord Injury Research Center's Seminar Series.

Dissertation Defense

Except for professional development activities, the Ph.D. candidate will focus exclusively on completing their research projects and writing a dissertation describing the results of their experiments. The candidate must complete all requirements for the degree of Doctor of Philosophy within four calendar years after passing the qualifying examination. It is expected that the dissertation should contain data sufficient for approximately three publishable manuscripts.

General guidance for organization of the dissertation include: 1) a general Introduction Chapter that presents the literature relevant to the overall dissertation topic and frames the questions addressed by the dissertation, 2) two or more Chapters that detail the research project; each with an Introduction, Methods, Results, and Discussion section, and 3) a General Discussion Chapter that integrates results from the various Chapters indicating the relationship of one to the other, as well as their overall contribution(s) to the field of study and future directions. Upon completion of the dissertation and approval of the advisor, the student can schedule his/her defense.

Two weeks before the defense date complete the ASNB request to schedule form (<https://louisville.edu/medicine/departments/anatomy/graduateprograms/current-students>) and turn it in to the departmental director of graduate studies. The information on this form is used by SIGS to announce your defense which is required for it to be official. Also, two-weeks before the defense, the student must distribute a copy of the Dissertation to each Dissertation Committee member. The committee will have two weeks to read the Dissertation prior to the scheduled defense.

The defense will consist of a public oral presentation (approximately 45 minutes in length) of the research completed during the student's graduate training. Non-committee members in the audience will be allowed to ask questions. The general audience will then be dismissed, and the student will defend their dissertation before the committee. Upon completion, a written report stating the outcome of the defense will be completed by each committee member and will become a permanent part of the student's record. The student should then complete any revisions requested by the committee during the dissertation defense. Approval by the majority of Dissertation Committee members will signify successful completion of the Ph.D. degree. Once revisions of the Dissertation are completed, and the cover page is signed, the student should prepare the Dissertation for submission to the University.

Electronic Format of Dissertation

Deadlines for the submission are published online in the schedule of classes. Students must follow The School of Interdisciplinary and Graduate Studies (SIGS) requirements for the format of their Doctoral Dissertation. The published *Guidelines for the Preparation and Processing of Theses/Dissertations* can be found at:

<https://louisville.edu/graduate/current-students/thesis-dissertation-information/thesis-dissertation-information>

Signature pages are also completed electronically, and the templates can be found at the above link. Any dissertation received by SIGS that does not adhere to their guidelines will be returned to the student. Students are responsible for submitting the dissertation in the correct format. If you have questions, contact Courtney Kerr in the graduate office.

Apply for Graduation

To graduate, students MUST apply for their degree via ULink during the semester when they complete their degree requirements. Note that registering for and participating in the commencement ceremony is NOT equivalent to graduation. Specific semester dates can be found at:

<https://louisville.edu/commencement/graduate-rsvp>. For any questions, please contact Courtney Kerr in the graduate office.