

ANATOMICAL SCIENCES AND NEUROBIOLOGY (PHD)

Doctor of Philosophy in Anatomical Science and Neurobiology

Unit: School of Medicine (<http://louisville.edu/medicine/>)(GM)

Department: Anatomical Science and Neurobiology (<http://louisville.edu/medicine/departments/anatomy/>)

Program Webpage (<http://louisville.edu/medicine/departments/anatomy/graduateprograms/>)

Academic Plan Code(s): ASNBPHD

Program Information

Our philosophy is to encourage academic excellence in the neurosciences within a framework of structure-function relationships at the molecular, cellular, and systemic levels. We strive to prepare students with sufficient background depth to excel in high tech cutting-edge translational (applied) research environments and the more traditional multi-disciplinary academic setting. We provide students with innovative approaches to important issues in neuroscience research including development, organization, and plasticity. Our research interests range from sensory and motor systems to therapeutic strategies for spinal cord injuries. In all approaches, we strive to integrate the latest teaching modalities while maintaining the time-honored advantages of hands-on, laboratory-based instruction.

The degree program is available to qualified individuals possessing a bachelor's degree from an accredited college or university. No specific undergraduate major is required, although some science background is required.

The PhD degree is offered to students who plan to pursue a career in research and/or teaching, in an academic institution or within the industry.

All degree programs require full-time study, and it is expected that while participating in these programs students will devote full-time effort toward completion of the degree requirements.

Students accepted into the PhD program will be considered for an IPIBS graduate student fellowship. The fellowship pays an annual stipend of \$33,000-\$35,000 in addition to payment of student tuition and health insurance.

Admission Requirements

All students wishing to apply must submit an application to the Graduate School, Graduate Admissions, with the following required documents:

- A formal application submitted to the Graduate School, Graduate Admissions (see website: louisville.edu/graduate/apply (<https://graduate.louisville.edu/admission/apply/>) for forms and directions)
- Application fee
- A minimum of two letters of recommendation
- Official transcripts of all college work
- A brief statement of purpose describing your interests and career goals.
- All international applicants whose native language is not English must submit Test of English as a Foreign Language (TOEFL/IELTS/Duolingo) scores. Students holding a bachelor's or advanced degree

from an accredited institution in the United States are exempt from this requirement.

Optional Documents

- Official scores on the Graduate record Exam (GRE) General Test
- Official scores on the Medical College Admission Test (MCAT)

Review of applications begins December 15th and continues until all positions are filled. Admission into the program is competitive, and applicants are encouraged to submit their applications early. All materials must be received by January 15th. All applications received on time are automatically considered for a fellowship, which provides a stipend, covers tuition and health insurance.

Program candidates are only admitted in the fall semester. Graduate program orientation begins August 1st (although note that some fall semester classes begin as early as mid-July).

Program Requirements

All students must complete the Anatomical Sciences and Neurobiology (ASNB) required courses, and students funded via the Integrated Programs in Biomedical Sciences (IPIBS) must complete the IPIBS required courses (listed below). All students must also complete at least sixteen (16) credit hours of ASNB core courses (listed below, at least one statistics course should be included). Additional elective coursework may be taken to enhance the student's individual program of study. Each student must complete a minimum of 30 total credit hours, of which sixteen (16) credit hours must be non-research courses in the major subject area.

At least one-half of the credits counted toward the degree must be 600-level courses or above (excluding research credit hours). Courses with course numbers, 500 to 599, open to both advanced undergraduate and graduate students, can be taken by graduate students for graduate credit (additional course requirements must be completed). Up to six (6) credit hours of earned graduate credit hours can be transferred upon request from other accredited institutions, as long as the coursework was taken within three years prior to the student's admission to the program (see transfer credit information within the graduate catalog) and a grade of B or better was earned.

After completing the required master's-level coursework, students enroll in either MAST 600 Master's Degree Candidacy or DOCT 600 Doctoral Candidacy while completing additional program requirements.

Coursework

| Code | Title | Hours |
|--|--|---------------------|
| <i>Integrated Programs in Biomedical Sciences (IPIBS) Required Courses</i> | | <i>Credit Hours</i> |
| BIOC 630 | Responsible Conduct of Research: Survival Skills and Research Ethics | 1 |
| BIOC 667 | Cell Biology (or equivalent) | 3 |
| <i>ASNB Required Courses</i> | | <i>Credit Hours</i> |
| ASNB 602 | Fundamentals of Neuroscience | 4 |
| ASNB 606 | Anatomy Seminar | 1 |

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|--------------------------------------|---|---------------------|
| ASNB 618 | Laboratory Rotation (must take at least two 3-credit lab rotations) | 6 |
| ASNB Core Courses | | Credit Hours |
| ASNB 601 | Gross Anatomy | 6.5 |
| ASNB 605 | Human Embryology | 3 |
| ASNB 610 | Neuroscience Methods | 1-2 |
| ASNB 617 | Seminar on Developmental Neurobiology ¹ | 3 |
| ASNB 614 | Molecular Neuroscience ¹ | 4 |
| ASNB 621 | Introduction to Scientific Computing | 2 |
| ASNB 622 | Analytics in Biomedical Science | 3 |
| ASNB 666 | Synaptic Organization of the Central Nervous System ¹ | 3 |
| ASNB 630 | Origin of Mammalian Sensory Systems and Comparative Neurobiology | 4 |
| ASNB 671 | General and Oral Histology | 5 |
| BIOC 545 | Biochemistry I | 3 |
| Sample Electives ² | | |
| PHST 500 | Introduction to Biostatistics for Health Sciences I | 3 |
| PHST 501 | Introduction to Biostatistics for Health Sciences II | 3 |
| CHEM 547 | Biochemistry II | 3 |
| MBIO 602 | Immunology | 3 |
| PHZB 605 | Systemic Physiology I | 5 |
| PHZB 606 | Systemic Physiology II | 5 |
| NSCI 600 | Translational Neurosciences | 3 |
| Candidacy | | |
| MAST 600 | Master's Degree Candidacy | 0 |
| DOCT 600 | Doctoral Candidacy | 0 |

¹ Offered on a rotational basis

² Additional courses (electives) within ASNB or graduate level courses in other departments may be taken. The student should consult with his/her advisor on the selection of the appropriate electives. A course in statistics is highly recommended.

Laboratory Rotations and Research Hours

Lab Rotations

Each student will complete two rotations in different laboratories prior to the 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 two 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 three (3) credit hour course Laboratory Rotation (ASNB 618) which is graded on a pass/fail basis. Once a student has completed a semester rotation in a given laboratory, an ASNB Rotation Report must be completed and submitted to the Graduate Program Director.

Research Hours

Once a mentor is chosen, research hours are taken as Original Investigation (ASNB 619), in which students earn a letter grade.

Advisory Committee

The purpose of the advisory committee is to act as the primary guiding and assessment body for the student in a course of study and training through which they will acquire the knowledge and skills required to earn the Doctor of Philosophy degree. The course of study and training will have components that are common for all students but may have others that are tailored to the particular needs and/or desires of individual students.

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 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.

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 Three.

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, double-spaced, not including references. 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 questions.

In order to pass the qualifying exam and continue in the PhD 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.

A student who does not meet these passing requirements will have one chance for remediation. The remedial examination must be completed

no later than six 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 PhD program. Students that pass the qualifying exam with a score between 12 and 16 will be asked to revise their answers according to reviewer concerns.

Upon successful completion of the exam, an evaluation form stating the outcome of the exam will be completed and will become a permanent part of the student's record. A passing grade indicates that the student has completed the requirements for an MS 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 PhD degree at the University of Louisville is four years after passing the qualifying exam. University-wide official maximums for Fellowships and Graduate Assistantships are typically six years.

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 Four. Prior to writing the Research Proposal, the student will develop an outline of the proposed experiments in coordination with their Mentor 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; 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 format of the Research Strategy Section of a National Institutes of Health Predoctoral National Research Service Award (F31) application.

Upon successful completion of the research proposal, the student will distribute a copy to each committee member, who will have two weeks to read the proposal. Students must consider this two-week reading period when preparing the document and scheduling the exam. The proposal defense will be chaired by the student's advisor, the exam will begin with an oral presentation, open to the public, in which the student will present an overview (approximately 40 minutes) of the research plan. The presentation will be followed by an oral defense to assess the student's readiness to conduct the proposed research and their knowledge of background information relevant to 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 majority vote of the committee. A student who fails to successfully defend their research proposal will have two months to remediate. Failure on the second attempt will result in dismissal from the program.

Upon successful completion of the proposal defense, a Proposal Defense 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.

All eligible students are encouraged to subsequently submit (in coordination with their advice) full applications for funding to the appropriate agency.

* 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.

Annual presentation of research progress

PhD students who have completed their coursework (MS and PhD candidates) must present their research accomplishments annually. This presentation should be 15-50 minutes in length, and time and location of the presentation should be formally announced to the department faculty, staff, and students at least two weeks prior to the planned presentation. This requirement can be met by presenting during the Department's annual "Research Roundup" (15 minutes in length), the students proposal defense, during the Department's annual Neuroscience Seminar Series (30-50 minutes in length), or during the Kentucky Spinal Cord Injury Research Center's Seminar Series (30-50 minutes in length) or similar approved venue. Presentations at journal clubs are encouraged, but cannot be used as a substitute for the annual presentation requirement. During the student's graduate career, they should present at least once during Department's annual Neuroscience Seminar Series (30-50 minutes in length), or during the Kentucky Spinal Cord Injury Research Center's Seminar Series (30-50 minutes in length).

Dissertation Defense

With the exception of their training in teaching, the PhD candidate who successfully defends their research proposal 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. Upon completion of a near final draft of their dissertation and prior to scheduling of their defense, the student must distribute a copy to each Dissertation Committee member. The committee will have two weeks to read a preliminary draft of the dissertation and give the approval to schedule a defense date or recommend major changes that need to be completed prior to scheduling a defense date.

Once the dissertation is approved to move forward by the committee, the student will schedule a Dissertation Defense and distribute an edited copy to each committee member. The Graduate School requires that an announcement of the defense be made at least two weeks prior to the scheduled date. 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 his/her 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.

Approval by the majority of Dissertation Committee members will signify successful completion of the PhD degree.