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.

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

- A formal application submitted to the Graduate School, Graduate Admissions (see website: louisville.edu/graduate/apply for forms and directions)
- Application fee
- A minimum of two letters of recommendation
- Official transcripts of all college work
- Official scores on the Graduate Record Examination (GRE) General Test
- 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) scores. Students holding a bachelor’s or advanced degree from an accredited institution in the United States are exempt from this requirement

Program candidates are only admitted in the fall semester (orientation begins the first Monday in August). Review of applications begins mid-

January and continues until all positions are filled. Admission into the program is competitive, and applicants are encouraged to submit their applications early. All applications are automatically considered for a fellowship, which provides a stipend and covers tuition and health insurance.

Program Requirements
All PhD students must complete the requirements for the non-thesis MS degree, after which they will be considered a PhD candidate.

A minimum of 30 credit hours is required for the master’s degree of which 15 credit hours must be in courses of 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 numbers from 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). In addition, up to 6 credit hours of earned graduate credit hours can be transferred upon request from other accredited institutions, as long as the coursework was taken three years prior to the students admission to the program (see transfer credit information within the graduate catalog) and a grade of B or better was earned (transferred grades do not get calculated in the student’s GPA).

Listed elective coursework may be taken a) to reach the minimum 30 credit hours required for the master’s degree component of the program or b) to enhance the student’s program (i.e., in addition to the 30 required credit hours).

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BIOC/CHEM 545</td>
<td>Biochemistry I (or equivalent)</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 630</td>
<td>Responsible Conduct of Research: Survival Skills and Research Ethics</td>
<td>1</td>
</tr>
<tr>
<td>BIOC 667</td>
<td>Cell Biology (or equivalent)</td>
<td>3</td>
</tr>
<tr>
<td>ASNB 602</td>
<td>Fundamentals of Neuroscience</td>
<td>4</td>
</tr>
<tr>
<td>ASNB 606</td>
<td>Anatomy Seminar</td>
<td>1</td>
</tr>
<tr>
<td>ASNB 610</td>
<td>Neuroscience Methods</td>
<td>1-2</td>
</tr>
<tr>
<td>ASNB 618</td>
<td>Laboratory Rotation (must take at least two 3-credit lab rotations)</td>
<td>6</td>
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</tbody>
</table>

Students must earn at least 9 additional credits by successfully completing any of the following Departmental core courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ASNB 601</td>
<td>Gross Anatomy</td>
<td></td>
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<tr>
<td>ASNB 605</td>
<td>Human Embryology</td>
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<tr>
<td>ASNB 617</td>
<td>Seminar on Developmental Neurobiology</td>
<td>1</td>
</tr>
<tr>
<td>ASNB 614</td>
<td>Molecular Neuroscience</td>
<td>1</td>
</tr>
<tr>
<td>ASNB 666</td>
<td>Synaptic Organization of the Central Nervous System</td>
<td>1</td>
</tr>
<tr>
<td>ASNB 671</td>
<td>General and Oral Histology</td>
<td></td>
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</tbody>
</table>
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 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 degree of Doctor of Philosophy. 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 Mentor, 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 Mentor, must be filed semi-annually (at the end of the fall and spring semesters) with the ASNB Graduate Program Director. Registration for courses is contingent on this filing.

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 Graduate Program Director. The ASNB Graduate Committee will review the questions and select three for distribution to the student. The student will have one week to complete two of the three questions (of their own choosing) and submit the answers electronically (pdf format) to the Graduate Program Director. 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 two members 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.

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 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 PhD 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 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 following general format.*

- **Literature Review and Significance**: Section one will be an extensive literature review (similar to an expanded Background and 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.
- **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.
- **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**: Upon 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 qualifying exam itself 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 the exam will have two months to retake the exam. Failure on the second attempt will result in dismissal from the program.

Upon successful completion of the exam, 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 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 classwork (MS and PhD candidates) must present their research accomplishments annually. This presentation should be 30-50 minutes in length, and time and location of the presentation should be formally announced to the department faculty, staff and students at least one week prior to the planned presentation. Presentations at journal clubs are encouraged, but cannot be used as a substitute for the annual presentation requirement.

Teaching requirements
Each PhD candidate must serve as a teaching assistant (TA) in at least one ASNB core course. The specific course will be chosen, based on available TA slots, by the student and his/her advisory committee.

Dissertation Defense
With the exception of their training in teaching, the PhD 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. 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.