

# PHARMACOLOGY AND NEUROSCIENCE

## Graduate Study in Pharmacology & Neuroscience

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Pharmacology & Neuroscience (<https://medschool.creighton.edu/departments/pharmacology-and-neuroscience/>)

The Department of Pharmacology and Neuroscience offers programs of study culminating in the Ph.D. and M.S. degrees. Upon successful completion of the chosen program, the individual will be prepared for careers in research and education in the field of Pharmacology & Neuroscience. Acquiring expertise in the broad field of pharmacology requires an interdisciplinary approach; and therefore, the student may choose to concentrate his or her studies in numerous specialized areas of pharmacology. These areas include:

- Neuropharmacology
- Autonomic pharmacology,
- Cardiovascular pharmacology
- Cancer pharmacology,
- Exocrine pharmacology
- Immunopharmacology
- Renal pharmacology
- Toxicology

Specific areas of interest include drug-receptor interactions, signal transduction, ion channel function, and molecular and tissue system approaches to studying receptors, signaling and gene function. It is important to note that the interdisciplinary nature of pharmacology and neuroscience offers the student a broad range of options for research endeavors and includes investigations of:

- Autism
- Asthma
- Cancer
- Drugs of Abuse
- Epilepsy
- Neurodegenerative Diseases
- Pain
- Pulmonary Hypertension
- Schizophrenia
- Teratogenicity of environmental toxins and pharmaceuticals.

The Department of Pharmacology and Neuroscience also has an affiliation with Boys Town Institute of Human Neuroscience (<https://www.boystownhospital.org/research/institute-human-neuroscience/>). This provides research opportunities for Creighton graduate students in fields of human neuroscience including:

- Imaging and Stimulation
- Brain Architecture
- Cognition

- Cortical Mapping
- Machine Learning
- Sensory Integration
- Motor Function and Learning
- Large-Scale Neural Networks

The neuroimaging techniques routinely used at Boys Town institute of Human Neuroscience include state-of-the-art magnetoencephalography, functional magnetic resonance imaging, optically-pumped magnetometry and machine learning. Ongoing research at Boys Town institute of Human Neuroscience also involves:

- Ageing
- Alzheimer's
- Development
- Down Syndrome
- Drugs of Abuse
- Environmental Toxins
- Hearing Loss
- Mental Health
- Physical Disabilities
- Therapeutic Interventions

### Mission Statement

The mission of the Department of Pharmacology & Neuroscience graduate programs is to create an intellectually rich environment in which students and trainees are able to develop fully their creative and scientific potential.

### Program Goals

The student will carry out the following objectives for completion of the graduate program in Pharmacology & Neuroscience:

1. Demonstrate an advanced knowledge of pharmacology and a detailed comprehension of the student's specialized field of pharmacology.
2. Illustrate critical and analytical thinking in studying literature, developing hypotheses, executing research, solving scientific problems, and interpreting results.
3. Effectively communicate research results and scientific information in an oral as well as verbal format to both scientific and lay audiences.
4. Demonstrate the ability to independently propose, defend and conduct research in pharmacology for the benefit of science and in the service to others.
5. Display ethical behavior with regard to professional conduct.
6. Exhibit skills that will educate and train others in the field of pharmacology.

### Admission Requirements

Factors taken into consideration during admission decisions (not necessarily listed in order of importance):

#### Educational Background:

Bachelor of Art or Science from an accredited college/university. Applicants should have some undergraduate training in the life sciences, but a STEM-based undergraduate degree is not required. In general, students with strong biology, chemistry, physics, engineering, computer science or mathematics backgrounds are most successful

and encouraged to apply. Opportunities to remedy deficiencies in basic undergraduate courses exist in the first year of graduate school.

#### Undergraduate Performance:

Ideally, the undergraduate record should be strong in all areas. However, evidence of ability to perform well in all science courses, particularly those stressing quantitative skills, is most important. Our program requires a minimum 3.0 GPA for admission.

#### Research Experience:

Research experience is not required; however, it is recommended as it demonstrates an experience-based understanding of and commitment to a research career.

#### Recommendations:

Strong statements of support from three persons in a position to evaluate the applicant's potential for success as a graduate student have significant impact on admissions decisions. Letters from instructors supervising research are strongly encouraged.

#### GRE scores:

GRE scores are not required and submission is optional. Use school code 6121 for this program.

#### Statement of Purpose:

The Statement of Purpose should be well-written, concise, and genuine. Overly vague statements may be detrimental. The Statement of Purpose may include discussion of career goals, motivation to attain a MS or PhD degree, or unique personal experiences that help the Committee better understand the applicant as an individual. Applicants should feel comfortable sharing extenuating circumstances that might address lapses in grades or continuous educational trajectory, but this is not necessary. The Statement of Purpose should articulate and give evidence of a strong commitment to research. Mention of specific, well-focused interests and descriptions of specific research experiences or activities are useful, but not essential, in applicant evaluation. The statement offers the applicant a unique opportunity to demonstrate critical thinking ability. It may be appropriate to discuss experiences unrelated to research or STEM. Experiences in athletics, student council, activism, volunteering, visual arts, music, and writing can demonstrate individuality, passion, and commitment to a topic, task, or job. Applicants are encouraged to provide any and all information that they feel supports their potential for success in scientific research and that informs the Committee of the contribution they would make to our community.

#### Interview:

A personal interview may be requested in addition to the above requirements. The interview may be conducted in-person or virtually.

## Application and Admission Timeline

All completed applications (which MUST include letters of recommendation) received through February 1<sup>st</sup> are guaranteed to be reviewed on this schedule for entrance for the fall semester. Applications received after the February 1<sup>st</sup> date will need to reapply for the following year.

December 1<sup>st</sup>: Review of completed applications begins.

December 15<sup>th</sup>: Application deadline.

January-March: Invited interviews for applicants.

January 15<sup>th</sup>-April 10<sup>th</sup>: Applicants are notified of admissions decision.

April 15<sup>th</sup>: Decision date for acceptance of admission offers by applicants.

August: Program Starts

## Degree Program in Pharmacology & Neuroscience

### Doctor of Philosophy (Ph.D.) Program

The objectives of this program are to prepare highly qualified students for careers in research and teaching in the field of pharmacology & neuroscience. Ph.D. candidates will be required to demonstrate a broad knowledge of the field of pharmacology and detailed expertise in their research area. Graduate studies in pharmacology will provide graduate students with a comprehensive educational program in pharmacology. During the program of studies, the graduate student will work closely with his or her mentor and department faculty to master the program goals. These goals include student demonstration of an advanced mastery of pharmacology & neuroscience as evidenced by the ability to critically judge research in the field, initiate scholarly activity based on current literature, and maintain the highest ethical and professional standards.

- Ph.D., Pharmacology & Neuroscience (<http://catalog.creighton.edu/graduate/graduate-programs-courses/pharmacology/pharmacology-phd/>)

### Master of Science (M.S.) Program

The M.S. program in Pharmacology & Neuroscience is an excellent method for students to receive additional preparation for pursuit of a M.D. or Ph.D. degree. The M.S. program emphasizes a combination of course work, laboratory experience and training in the scientific method.

For those students intending the M.S. as a terminal degree, the Objectives of the program include preparation of the student for the following career paths:

1. Teaching of Pharmacology and/or Neuroscience at the undergraduate level
  2. Participation in team research in universities, industry or government.
- M.S., Pharmacology & Neuroscience (<http://catalog.creighton.edu/graduate/graduate-programs-courses/pharmacology/ms-pharmacology-and-neuroscience/>)

#### **IDC 601. Responsible Conduct of Research. 1 credit.**

This required course for students in the graduate programs at Creighton University School of Medicine is designed to introduce fundamental concepts, principles and guidelines regarding scientific integrity in biomedical research. Through readings, lectures, and case discussion students are given an opportunity to reflect on ways in which they can help foster and maintain responsible conduct in research. They also become acquainted with existing regulations, guidelines, ethical themes and on-line resources regarding the ethics of their profession.

**IDC 625. Introduction to Biostatistics for the Biomedical Sciences. 3 credits.**

This course will provide instruction on the common statistical methods used in biomedical science and their correct application to the design and analysis of research study questions, in-class assignments will be given for each class session based specifically on the material covered during lecture. Students will be allowed to work together to complete assignments, but must complete and submit their own work for credit. One comprehensive final exam will be given to evaluate student learning throughout the semester.

**IDC 627. Research Methods. 3 credits.**

Study of modern experimental methods, instrumentation, and bioinformatics tools and approaches used in biomedical research. Major course components include detection, analysis, and genetic manipulation of nucleic acids, antibody-based experimental techniques, generation, detection, and analysis of recombinant proteins, microscopy, and various experimental model systems.

**IDC 701. Research Writing. 3 credits.**

This course will provide instruction on grant preparation and strategy, using the NIH R21 as a model. Content will consider alternative sources of grant funding and be relevant to all research grant applications. Emphasis will be placed on writing clear English.

**PHR 461. Integrative and Alternative Medicine. 1-8 credits.**

This Senior Elective is a critical survey of commonly employed complementary and alternative therapies.

**PHR 531. Topics in Pharmacology and Drug Discovery Journal Club. 1 credit. FA**

The most ground-breaking studies (classic through recent) in the field of pharmacology are discussed in a round-table format. Students will learn the basics of the scientific method, study design, experimental technique theory and general chemical principles, physiochemical properties and drug-receptor interactions used to derive structure-activity relationships for important drug classes and predict biological properties.

**PHR 532. Hot Topics in Neuroscience Journal Club. 1 credit. SP**

Continuation of PHR 531. P. DC.

**PHR 536. Drugs and Drug Targets. 2 credits.**

The course Drugs and Drug Targets offers a detailed exploration of fundamental concepts underlying drug action and provides foundational knowledge necessary to develop into a research scientist, educator or other position requiring understanding of drugs and drug targets. The class format will include didactic lectures with open discussions.

**PHR 537. Fundamentals of Neuroscience. 3 credits. FA, OD**

This course will provide a detailed exploration of cellular, molecular and systems neuroscience and provide foundational knowledge necessary to becoming a neuroscientist. The class format will include didactic lectures with open discussions and self-directed computer simulated learning activities.

**PHR 595. Directed Independent Study. 0-5 credits. FA, OD, SP, SU**

Supervised independent projects that may include laboratory work, assigned readings, research papers, etc. Available in autonomic pharmacology, cardiovascular pharmacology, exocrine pharmacology, and neuropharmacology. P. Undergraduate or Gr. stdg. and DC.

**PHR 597. Directed Independent Research. 1-4 credits. FA, OD, SP, SU**

Supervised independent research for motivated students to become involved in ongoing original research projects of the pharmacology faculty. P. Undergraduate or Gr. stdg. and DC.

**PHR 631. Medical Pharmacology I. 5 credits. FA**

Human pharmacology and therapeutics. Lectures, conferences, and demonstrations.

**PHR 632. Medical Pharmacology II. 5 credits. SP**

A continuation of Medical Pharmacology I.

**PHR 650. Introduction to Neuropharmacology. 3 credits. SP**

This course is designed as an introductory course in pharmacology and neuropharmacology for students who have majored in or who have professional interests in biology, chemistry, biochemistry, psychology, pre-health professions and pre-medicine. Pharmacology is more than the study of the therapeutic uses of drugs. It is a science which uses the basic concepts of biology and chemistry to determine how drugs affect the organism. Neuropharmacology applies the basic principles of pharmacology to the nervous system and the tissues and organs that the nervous system regulates. Pharmacology gives a unique perspective in understanding how cells, organ systems, and organisms function. Pharmacology uses a systematic approach to investigate drug mechanisms causing a biological event for therapeutic use—from the molecular level to the whole animal. These pharmacological approaches also allow us to study how biological systems fail to function, providing information on the etiology of disease. Pharmacology research is essential for the development, testing and clinical use of drugs to treat disease.

**PHR 667. Developmental Biology. 4 credits.**

This is the graduate course designation for the undergraduate course BIO 467. Students are expected to fulfill all of the requirements for the undergraduate course (including the laboratory). To fulfill the graduate component of this course, students will write a research review article throughout the semester under the supervision of Dr. Kristina Simeone (and their research PI) that bridges material learned in class and their research.

**PHR 711. Receptor and Molecular Pharmacology. 3 credits. AY, SP**

Exhaustive treatment of receptor and molecular pharmacology that considers historical development of concepts, radioligand receptor binding, drug-receptor interactions, receptor characterization and isolation, and signal transduction.

**PHR 715. Foundational Science. 4 credits. OD**

This intensive foundation course introduces the students to the scientific fields of cell and molecular biology, genetics, immunology and pharmacology.

**PHR 720. Fundamentals of Brain Imaging, Recording, and Stimulation. 3 credits.**

This course will provide an advanced introduction to common techniques/methods used in the primate brain for recording (e.g., multiunit recordings, electrocorticography, electroencephalography, and magnetoencephalography), imaging (e.g., magnetic resonance), and stimulating (transcranial magnetic stimulation, transcranial direct-current and alternating current stimulation). The class format will include didactic lectures with open discussions.

**PHR 750. Research Discussions In Pharmacology & Neuroscience. 1 credit. FA, SP, SU**

Students will meet with their course director once weekly to discuss laboratory research topics as assigned by the course director. Topics will usually be pertinent to the research activity of the course director. Instruction will be given through a combination of didactics, small group sessions, student presentations and independent study. P. DC.

**PHR 760. Research Rounds In Pharmacology & Neuroscience. 1-3 credits. FA, SP**

This course will teach students how to formally present their research progress and results, and will provide students with frequent feedback by faculty members and fellow students. P. DC.

**PHR 790. Research Laboratory Rotations. 1-5 credits. FA, OD, SP, SU**

Laboratory rotations in which graduate students perform or observe methods used in pharmacological research. The value of the method and its application to the research efforts of the pharmacology faculty are described in detail. P. DC.

**PHR 791. Pharmacology & Neuroscience Seminar. 1 credit. FA, SP**

Seminars in selected subjects for pharmacology & neuroscience graduate students.

**PHR 794. Special Topics in Pharmacology & Neuroscience. 1-4 credits. FA, OD, SP, SU**

**PHR 795. Directed Independent Study. 1-6 credits. FA, SP, SU**

**PHR 797. Master's Directed Independent Research. 1-6 credits. FA, SP, SU**

Supervised original research. P. DC.

**PHR 799. Master's Thesis. 1-6 credits. FA, SP, SU**

Review of the literature and research data; writing of the thesis. Student must register for this course in any term when engaged in formal preparation of the Master's thesis; however, six credit hours are the maximum applicable toward the degree. P. DC.

**PHR 897. Doctoral Directed Independent Research. 1-6 credits. FA, SP, SU**

Supervised original research. P. DC.

**PHR 899. Doctoral Dissertation. 1-6 credits. FA, SP, SU**

This investigative work is the principal area of research carried out by the candidate during doctoral studies. It is conducted under the direct supervision of the candidate's major adviser and dissertation committee in preparation for the doctoral dissertation. Twenty credit hours are the maximum applicable toward the degree. Students will register for this course during formal preparation of the doctoral dissertation. P. PHR 897.