# NEUROSCIENCE (PHD)

## Overview

The Neuroscience Training Program at the CU School of Medicine provides multidisciplinary PhD training covering the breadth of neurobiology. Hands-on research training in state-of-the-art laboratories and formal coursework in cellular and molecular neurobiology, systems, neural development, neuropharmacology, and biochemistry, propels students to competitive careers in the sciences.

## Admission Requirements

The Neuroscience application deadline is December 1.

**PRIORITY DEADLINE FOR INTERNATIONAL APPLICANTS IS NOVEMBER 1.**

Applications received by December 1 will be given first consideration for admission to the Fall Semester of the following year, but applications received subsequently may also be considered.

An application for admission must include the following:

- Graduate School on-line application (Includes resume, statement of purpose and research statement)
- A $50 (domestic) or $75 (international) non-refundable application fee. An application will not be processed without payment. Fee waivers are available for qualified applicants.
- Three (3) letters of recommendation
- TOEFL scores and financial support verification (international students)
- One (1) unofficial or official transcript of all academic work completed to date. An official transcript will be required following acceptance to matriculate into our program and must come from the issuing institution directly and sent either electronically or mailed to:

  Electronic Transcript(s): graduateadmissions@ucdenver.edu  
  Mailed Transcript(s): University of Colorado Denver  
  Graduate Admissions  
  Campus Box 163  
  PO Box 173364  
  Denver, CO 80217

**Exams**

The GRE is not required. International students must take the Test of English as a Foreign Language (TOEFL).

**Undergraduate Coursework**

An undergraduate degree or its equivalent is required. A baccalaureate degree in a biological science, chemistry, physics or engineering is recommended.

**GPA**

There is no absolute requirement for grade point average above that required by the graduate school, but successful applicants will generally have GPAs above 3.2 (A=4.0).

**Research Experience**

Research experience is strongly recommended.

## Degree Requirements

### First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>First Year</td>
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<tr>
<td>Fall</td>
<td></td>
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</tr>
<tr>
<td>BMSC 7806</td>
<td>Core I: Foundations in Biomedical Sciences</td>
<td>6</td>
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<tr>
<td>NRSC 7501</td>
<td>Introduction to Neuroscience</td>
<td>1</td>
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<tr>
<td>NRSC 7600</td>
<td>Cellular &amp; Molecular Biology</td>
<td>3</td>
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<tr>
<td>NRSC 7650</td>
<td>Research in Neuroscience</td>
<td>1-10</td>
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<tr>
<td>NRSC 7662</td>
<td>Survey of Neuroscience</td>
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<td>First Year</td>
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<td>Spring</td>
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<tr>
<td>NRSC 7610</td>
<td>Fundamentals of Neurobiology</td>
<td>3</td>
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<tr>
<td>NRSC 7615</td>
<td>Developmental Neurobiology</td>
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<td>NRSC 7650</td>
<td>Research in Neuroscience</td>
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<td>NRSC 7661</td>
<td>Grant Proposal Writing Workshop</td>
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<td>Summer</td>
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<td>NRSC 8990</td>
<td>Doctoral Thesis</td>
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### Second Year

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<tr>
<td>Fall</td>
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<tr>
<td>PHCL 7605</td>
<td>Responsible Conduct of Research</td>
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<td>NRSC 7650</td>
<td>Research in Neuroscience</td>
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<tr>
<td>BIOS 6606</td>
<td>Statistics for the Basic Sciences</td>
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<td>Year 2</td>
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<td>Spring</td>
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<td>NRSC 7650</td>
<td>Research in Neuroscience</td>
<td>1-10</td>
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<td>Select one course from the following:</td>
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<td>NRSC 7612 Nervous System Modeling with NEURON</td>
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<td>ELEC 5375 Engineering Neuroscience</td>
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<td>BIOE 5053 Optics &amp; Microscopy in Biomedical Research</td>
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<td>NRSC 7657 MATLAB for Neuroscientists</td>
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### MOLB 7950 - Informatics and Statistics for Molecular Biology

#### Summer

**Title:** Doctoral Thesis  
**Hours:** 1-10

**Total Hours:** 3-30

### Third Year & Beyond

#### Fall

**Course:** BMSC 7806 - Core I: Foundations in Biomedical Sciences  
**Hours:** 1-10

**Title:** Doctoral Thesis  
**Hours:** 1-10

**Total Hours:** 1-10

### Learning Objectives

The PhD program in Neuroscience trains graduate students to become proficient and successful investigators who are able to:

- Demonstrate a basic knowledge of central concepts in the biomedical sciences.
- Understand the current concepts in Neuroscience.
- Read and critically evaluate the scientific literature.
- Formulate hypotheses based on current concepts in the field and design, conduct, and interpret their own research projects.
- Present research results in peer-reviewed publications and in a dissertation.
- Communicate research results effectively through oral presentations at scientific seminars, conferences, and other venues.
- Write a competitive application for research funding.
- Develop ancillary skills, where necessary, to obtain positions outside of scientific research.

### Courses

**BIOE 5053 - Optics & Microscopy in Biomedical Research**  
(3 Credits)  
Graduate overview of optical imaging, ranging from classical microscopy to advanced non-linear techniques and includes theory, technology and applications in biomedical sciences. This will prepare students for developing and applying state-of-the-art optical imaging in their research. Cross-listed with BIOE 4053. Prereq: Grad standing or permission from the instructor. Max Hours: 3 Credits.  
Grading Basis: Letter Grade

**BIOS 6606 - Statistics for the Basic Sciences**  
(3 Credits)  
This course is designed for those wishing to obtain a basic understanding of statistics and its application in biological research. Students will develop statistical literacy and an ability to perform basic statistical analyses, basic graphical statistics, data summarizations, and estimation and inference using statistical software. Restrictions: Enrollment in UCD-AMC graduate program or permission of the instructor.  
Grading Basis: Letter Grade

**A-PUBH1 Graduate students and public health certificate students only.** Typically Offered: Fall.

**NRSC 7501 - Introduction to Neuroscience**  
(1 Credit)  
Introduction to study of the nervous system from the level of the brain to an understanding of how neurons are specialized for communication and information processing. This course is a prerequisite for NRSC 7600 series courses.  
Grading Basis: Letter Grade

**NRSC 7600 - Cellular & Molecular Biology**  
(3 Credits)  
A comprehensive, in-depth, discussion-based course intended for candidates for the Ph.D. in Neuroscience. Topics include ion channel structure and function, ionic basis of the resting and action potential, and the biochemistry and physiology of direct and synaptic transmission.  
Grading Basis: Letter Grade

**NRSC 7650 - Research in Neuroscience**  
(1-10 Credits)  
Research work in neuroscience. Prereq: Consent of instructor.  
Grading Basis: Letter Grade with IP

**NRSC 7662 - Survey of Neuroscience**  
(1 Credit)  
Designed to expose first year graduate students to current topics in neuroscience.  
Grading Basis: Letter Grade

**ELEC 5375 - Engineering Neuroscience**  
(3 Credits)  
In this course, mathematical models and data processing strategies will be introduced as well as other cutting-edge research techniques to help students understand how these techniques can be applied to solve modern neuroscience problems. Prereq: ELEC 3316 or graduate standing. Cross-listed with ELEC 4735 and NRSC 7674 (Anschutz Medical Campus course). Max Hours: 3 Credits.  
Grading Basis: Letter Grade

**MOLB 7950 - Informatics and Statistics for Molecular Biology**  
(4 Credits)  
This course covers the design and analysis of common molecular biology experiments with thorough coverage of statistical and informatic approaches to data analysis. The course begins with a “boot camp” that covers use of shell programming, R/R Studio, and Python scripting in bioinformatics. Pre-Req: MOLB-PhD or CSDV-PhD students only.  
Grading Basis: Letter Grade

**NRSC 7606 - Core I: Foundations in Biomedical Sciences**  
(6 Credits)  
Course will focus on the fundamental principles of biomedical sciences. Lectures and recitations/discussions will primarily address the basics of molecular biology, biochemistry, genetics, cell biology and energetic principles. Course is typically limited to biomedical science PhD and BSBT MS students. Previously offered as IDPT 7806

**NRSC 7674 - Core II: Engineering Neuroscience**  
(4 Credits)  
In this course, mathematical models and data processing strategies will be introduced as well as other cutting-edge research techniques to help students understand how these techniques can be applied to solve modern neuroscience problems. Prereq: ELEC 3316 or graduate standing. Cross-listed with ELEC 4735 and NRSC 7674 (Anschutz Medical Campus course). Max Hours: 3 Credits.  
Grading Basis: Letter Grade

**NRSC 7680 - Core III: Advanced Biomedical Research**  
(10 Credits)  
This course is designed for second year and higher graduate students to obtain the skills necessary to become proficient and successful investigators.  
Grading Basis: Letter Grade

**BMSC 7806 - Core I: Foundations in Biomedical Sciences**  
(6 Credits)  
Course will focus on the fundamental principles of biomedical sciences. Lectures and recitations/discussions will primarily address the basics of molecular biology, biochemistry, genetics, cell biology and energetic principles. Course is typically limited to biomedical science PhD and BSBT MS students. Previously offered as IDPT 7806

**Typically Offered: Fall.**
NRSC 7610 - Fundamentals of Neurobiology (3 Credits)
This course will provide basic knowledge on the structure and function of the nervous system. The lectures will be supplemented by discussion of primary research literature in neurobiology. Prereq: NRSC 7600 or equivalent at the discretion of the instructors.
Grading Basis: Letter Grade
Repeatable. Max Credits: 5.
A-GRAD Restricted to graduate students only.
Typically Offered: Spring.

NRSC 7615 - Developmental Neurobiology (3 Credits)
This course will cover fundamental principles regarding development of the nervous system. The format of the course will consist of lecture plus reading of primary literature. Prereq: IDPT 5004, NRSC 7600 & NRSC 7610.
Grading Basis: Letter Grade
A-GRAD Restricted to graduate students only.
Typically Offered: Spring.

NRSC 7661 - Grant Proposal Writing Workshop (1 Credit)
Course is practical workshop in grant-writing culminating in a mock review panel including course participants. Students will examine various proposal types/formats, then write their own proposal in the format of NRSA fellowship application. Restriction: Students with adequate neuroscience background. Prereq: NRSC 7610.
Grading Basis: Letter Grade
A-GRAD Restricted to graduate students only.
Typically Offered: Spring.

NRSC 7612 - Nervous System Modeling with NEURON (1 Credit)
The objective of this course is to introduce students to biophysically accurate modeling of single neurons and neuronal networks with NEURON simulation environment. Students will implement NEURON in a project of their choice, possibly related to their primary ‘wet’ research.
Grading Basis: Letter Grade
Typically Offered: Spring.

NRSC 7657 - MATLAB for Neuroscientists (2 Credits)
MATLAB is an accessible programming environment that is widely used by scientists and engineers and offers powerful tools for data acquisition and data analysis. Students will develop their own MATLAB programs that are relevant to their particular line of research.
Grading Basis: Letter Grade
Typically Offered: Summer.

PHCL 7605 - Responsible Conduct of Research (1 Credit)
The Department of Pharmacology in the University of Colorado School of Medicine organizes and offers an interactive course during the fall semester entitled "Responsible Conduct of Research". The course is designed to inform students, trainees and faculty to the NIH requirements for ethical and responsible research.
Grading Basis: Letter Grade
A-GRAD Restricted to graduate students only.
Typically Offered: Fall.

Please refer to the Graduate School Policies page (http://catalog.ucdenver.edu/cu-anschutz/schools-colleges-programs/graduate-school/#policies) for more information.