

NEUROSCIENCE

Director: Annemarie Shibata, Ph.D.

Department Office: Biology Department, Hixson-Lied Science Building, Room 422

The Neuroscience Program, housed within the Biology department, is a multidisciplinary program designed to provide an integrated, comprehensive, and investigatory learning experience that imparts a broad and strong understanding of the fundamental concepts and research principles that form the neurosciences.

Neuroscience is the study of 1) how the nervous system controls and responds to bodily functions and directs behavior; 2) how nervous system structure and function are determined by genes and the environment; and 3) how the brain serves as the foundation of the mind, awareness and thought. The Bachelor of Science with a major in Neuroscience is intended for students interested in pursuing careers in a variety of health professions and graduate programs, scientific research in academia and industry, or related life science careers.

The mission of the Neuroscience major is to deliver a comprehensive curriculum in neuroscience providing students with thorough understanding of neuroscience principles and modern application. This program will provide technical and intellectual skills for neuroscience and neuroscience related careers. Our role is also to work with colleagues across disciplines in the College of Arts and Sciences and Health and Professional Schools to develop students who understand what science contributes and what methodologies it necessitates. Our program will explain and reinforce how neuroscience contributes to our understanding of human behavior and will join with the Magis Core curriculum at Creighton to shape well-informed students/citizens.

Participating Departments and Faculty

Various faculty from the following departments participate in our multidisciplinary major: Biology, Psychology, Physics, Computer Science, Mathematics, Chemistry, Philosophy, and Pharmacology and Neuroscience.

Specific Requirements for Admission to the Neuroscience Major

- Admission to the B.S., Major in Neuroscience program requires sophomore standing, completion of General Biology lecture and laboratory series, General Chemistry lecture and laboratory series, and Introduction to Psychology courses, with a minimum GPA of 3.0 in those pre-requisites.

Course requirements (71 credits)

Pre-requisites and Support courses (31 credits)

Code	Title	Credits
Pre-requisite courses		
3.0 GPA in all of the following courses to be admitted to the program		
BIO 201	General Biology: Organismal and Population	3
BIO 202	General Biology: Cellular and Molecular	3
BIO 205	General Biology: Organismal and Population Laboratory	1
BIO 206	General Biology: Cellular and Molecular Laboratory	1
PSY 201	Introductory Psychology	3
CHM 203	General Chemistry I	3

CHM 204	General Chemistry I Laboratory	1
CHM 205	General Chemistry II	3
or CHM 285	Advanced General Chemistry II	
CHM 206	General Chemistry II Laboratory	1
or CHM 286	Chemical and Statistical Analysis Laboratory	

Support courses

Chemistry support

CHM 321	Organic Chemistry I	3
CHM 322	Organic Chemistry I Laboratory	1

Physics support

Choose 1 of the Physics course sequences below:

Option 1 (recommended for pre-medical, pre-health and pre-graduate program students)

PHY 201	General Physics for the Life Sciences	3
PHY 205	General Physics Laboratory I	1
PHY 202	General Physics for the Life Sciences II	3
PHY 206	General Physics Laboratory II	1

Option 2 (recommended for students interested in electives requiring calculus-based physics)

PHY 213	General Physics for the Physical Sciences I	3
PHY 205	General Physics Laboratory I	1
PHY 214	General Physics for the Physical Sciences II	3
PHY 206	General Physics Laboratory II	1

Option 3 (given approval from the Physics Department)

PHY 221	Advanced General Physics I: Modeling the Physical World	3
PHY 223	Project Physics Laboratory I	1
PHY 222	Advanced General Physics II: Modeling the Physical World	3
PHY 224	Project Physics Laboratory II	1

Neuroscience Core Requirements (28 credits)

Code	Title	Credits
All of the following:		
PSY 437	Behavioral Neuroscience	3
BIO 462	Neurobiology	3
BIO 463	Neurobiology Laboratory	1
PHR 350	Introduction to Neuropharmacology	3
PHL 424	Philosophy of Mind	3
NES 510	Neurophysiology Lab	2
NES 592	Neuroscience Senior Seminar	1
Select one of the following:		3

BIO 467 Developmental Biology

NES/BIO 464 Neurobiology of Disease

PHL 404 Bioethics and Society

PHL 425 Sciences, Ethics & Society

PHL 457 Biomedical Ethics: Philosophical and Theological Approaches

Select one of the following:

BIO 449 Physiology

PHA 404 Human Physiology (Follows Pharmacy School Schedule)

Select one of the following:

BIO 362 Cell Structure and Function

CHM 371	Biochemistry of Metabolism
---------	----------------------------

Select one of the following:

BIO 311	Biostatistics
PSY 370	Applying Research Methods and Statistics in Psychology
MTH 360	Elementary Probability and Statistics
MTH 361	Probability and Statistics in the Health Sciences

Electives: 4 courses

Code	Title	Credits
A minimum of 4 additional courses (12 hours) from any of the following groups:		12

Cellular and Organismal Neuroscience

NES 464	Neurobiology of Disease
NES 466	Pharmacology of Drugs and Abuse
NES 500	Introduction to Clinical Neuroscience
BIO 371	Animal Behavior
BIO 372	Animal Behavior Laboratory
BIO 467	Developmental Biology
BIO 567	Current Topics in Neuroscience

Behavioral Neuroscience

PSY 351	Psychopathology
PSY 361	Neuropsychology
PSY 431	Cognitive Psychology
or PSY 441	Cognitive Neuroscience
PSY 434	Learning: Basic Processes
PSY 436	Sensation and Perception

Physical Neuroscience

PHY 301	Modern Physics
PHY 302	Modern Physics Laboratory
PHY 303	Electronics Laboratory
PHY 351	Physics in Medicine
PHY 353	Introduction to Biological Physics
PHY 565	Radiation Biophysics
PHY 566	Physics of Medical Imaging I
PHY 567	Physics of Medical Imaging II

Computational Neuroscience

BIO 501	Bioinformatics
MTH 429	Advanced Linear Algebra
MTH 445	Advanced Differential Equations
MTH 448	Mathematics in Medicine and Life Sciences II
CSC 321	Data Structures
CSC 421	Algorithm Design and Analysis
CSC 550	Introduction To Artificial Intelligence
CSC 590	Special Topics

Philosophical Neuroscience

PHL 321	Epistemology
PHL 333	Philosophy Of The Human Sciences
PHL 334	Philosophy Of The Natural Sciences
PHL 342	Metaphysics

Research - Introduction to Research Design and Methods (Instructor Consent)

NES 297 Directed Research

Neuroscience Research Designation (Optional - Instructor Consent)

An equivalent of **two semesters** worth of directed research credit is required (NES 397, NES 497). Research of 0 credits may be taken if the student has reached 18hrs of course credit. The research designation will be met by submission of a written abstract and evaluation of a presentation (oral and/or written) of the research project at a local, regional, and/or national meetings for each semester of NES 397 or NES 497.

NES 397 Directed Independent Research (Extramural)	0 to 3 credits
NES 497 Directed Independent Research (Intramural)	0 to 3 credits

Courses**NES 297. Directed Research. 0-3 credits.**

An introduction to laboratory methods intended to prepare students for independent research. this course is only an addition to and not a substitution for any portion of the major requirement. This course may not be repeated; research students should enroll in NES 397 or 497 in subsequent semesters. No more than 12 semester hours of credit may be accrued in any combination of NES 297, 397, 493, 495, and 497. P. Instructor's Consent.

NES 397. Directed Independent Research (Extramural). 0-3 credits.

A program of independent study emphasizing laboratory or field research, intended for students working with mentors outside of the Biology department housing the Neuroscience major or the College of Arts and Sciences. The director of the Neuroscience serves as the instructor of record and oversees completion of course requirements by the student under the research supervision of the outside mentor. No more than 12 semester hours of credit may be accrued in any combination of NES 297, 397, 495, and 497. P. Instructor consent.

NES 464. Neurobiology of Disease. 3 credits. (Same as BIO 464; Meets Designated Ethics & Written Comm)

To understand neurological disease, its profession, and discover novel therapeutics requires in-depth knowledge of the cellular and molecular underpinnings of the disorders. Students will revisit concepts from pre-requisite courses but apply them to the function and activity of the brain and to circumstances where normal biology breaks down. P. Ethics; Contemporary Composition; BIO 202 and BIO 362.

NES 466. Pharmacology of Drugs and Abuse. 3 credits.

The course will introduce the psychopharmacology of drug abuse and addiction, and has a strong neuroscience orientation. An introduction to pharmacologic thought and basic principles will be provided. The acute and long-term effects of selected drugs of abuse on behavior, mood, cognition and neuronal function will be discussed. Studies with humans will be integrated with basic preclinical studies on the neurobiological basis of drug action and drug abuse. There will be detailed coverage of synaptic transmission and the distribution, regulation and integration of brain neurotransmitter systems. The focus is on addictive drugs, including: opiates (heroin, morphine, opium), sedative - hypnotics (alcohol, barbituates), anxiolytics (benzodiazepines), psychomotor stimulants (amphetamine, cocaine, nicotine), marijuana, hallucinogens (LSD, mescaline), hallucinogenic-stimulants (MDA, MDMA), and dissociative anesthetics (PCP). P. BIO 201, CHM 203, PSY 201, PSY 437.

NES 497. Directed Independent Research (Intramural). 0-3 credits.

A program of independent study emphasizing laboratory or field research, intended for students working with mentors within the Biology department housing the Neuroscience Program. The mentor acts as the instructor of record. No more than 12 semester hours of credit may be accrued in any combination of NES 297, 397, 495, and 497. P. Instructor's consent.

NES 500. Introduction to Clinical Neuroscience. 4 credits.

This course provides an introduction to the various diseases and injuries that affect the human nervous system, an introduction to the professions that work with neurologically impaired individuals and recent research into the treatment of these disorders. The topics covered will include the underlying pathology and mechanisms, the signs, symptoms and deficits, patient management, and the prognosis of selected diagnoses including (but not limited to) spinal cord injury, chronic traumatic encephalopathy, Alzheimer's disease, Parkinson's disease, bipolar disorder. Included will be a survey of the training and role of the various healthcare professions that address neurological impairments. Relevant research concerning the pathophysiology of nervous system disorders and the repair and regeneration of nervous system tissue will be introduced. P. BIO 462, BIO 463 or instructor consent.

NES 510. Neurophysiology Lab. 2 credits.

This laboratory course is focused on delivering extensive instruction and exploration of neurophysiology and neural basis of behavior with emphasis on the mastering of techniques used within the field of neuroscience to evaluate electrical activity and intracellular communication within the nervous system. The course is designed to build upon and allow for mastering of neurophysiology concepts and techniques learned in BIO 463, Neurobiology Laboratory. This team-taught course draws upon diverse expertise of instructors to deliver a comprehensive course using both invertebrate and vertebrate models for the study of neurophysiology. Students will use neuronal systems network modeling during hands-on laboratory activities and will be expected to apply the scientific method during the implementation and critical analysis of experiments involving model systems. Students will meet the designated writing component of the Magis Core curriculum by writing an independent grant proposal directed at testing a novel hypothesis in the field of neurophysiology. The grant proposal will serve as a mechanism to improve students' written communication, critical thinking and problem solving skills. P. BIO 462, BIO 463, Contemporary Composition.

NES 566. Pharmacology of Drugs and Abuse. 4 credits.

This course will introduce the psychopharmacology of drug abuse and addiction, and has a strong neuroscience orientation. An introduction to pharmacologic thought and basic principles will be provided. The acute and long-term effects of selected drugs of abuse on behavior, mood, cognition and neuronal function will be discussed. Studies with humans will be integrated with basic preclinical studies on the neurobiological basis of drug action and drug abuse. There will be detailed coverage of synaptic transmission and the distribution, regulation and integration of brain neurotransmitter systems. The focus is on addictive drugs, including: opiates (heroin, morphine, opium), sedative-hypnotics (alcohol, barbiturates), anxiolytics (benzodiazepines), psychomotor stimulants (amphetamine, cocaine, nicotine), marijuana, hallucinogens (LSD, mescaline), hallucinogenic-stimulants (MDA, MDMA), and dissociative anesthetics (PCP). P. BIO 201; CHEM 203; PSY 201; PSY 437; and Instructor consent.

NES 592. Neuroscience Senior Seminar. 1 credit.

This course covers in-depth reading and discussions on current neuroscience research topics. Students will learn to critically review current scientific papers. Students will be expected to select, read, present and lead discussions of scientific articles covering prevailing theories, concepts, ideas, and experimental techniques in neuroscience. This course will meet the Magis Core Designation for Oral Communication by recording and evaluating student presentations for accuracy of content, mastery of scientific discipline, effective oral delivery, and engagement of the audience. P. Oral Communication course; Senior Standing.