

NEUROBIOLOGY

neurobiology.northwestern.edu

The Department of Neurobiology offers a major in neuroscience, the study of the nervous system from the level of individual genes and proteins that control neural activity through mechanisms that govern complex human behavior and cognition. Although traditionally associated with biology and psychology, modern neuroscience is highly interdisciplinary and integrates approaches and ideas from many other areas, including chemistry, physics, mathematics, linguistics, communication sciences, computer science, and engineering. The interdisciplinary nature of neuroscience is reflected in the neuroscience curriculum, which provides

- A deep understanding of the structure and function of nervous systems and the mechanisms by which the brain generates behavior, as well as of the history, major ideas, and research approaches used in neuroscience
- Knowledge and experience in an allied field to develop interdisciplinary skills for diverse careers
- A strong foundation in principles of chemistry, mathematics, physics, and molecular biology, as well as practical knowledge in computer programming and statistics
- Laboratory coursework or independent laboratory research

Students interested in neuroscience should complete the chemistry and math courses and BIOL_SCI 201-0 Molecular Biology listed under related courses in their first year. NEUROSCI 202-0 Cellular and Molecular Neuroscience is taken as early as is practical followed by NEUROSCI 206-0 Systems and Behavioral Neuroscience before taking 300-level NEUROSCI courses. Neuroscience electives and allied field courses are listed on our website.

Students are strongly encouraged to meet with neuroscience advisers to develop a course plan that provides exceptional preparation for graduate study in neuroscience or a related field; for medical school; and for careers in science writing and journalism, patent law, science policy, education and outreach, and the pharmaceutical, biotech, and other industries.

Practical research experience is highly encouraged. See the department website for credit-bearing research opportunities with affiliated world-class faculty.

Programs of Study

- Neuroscience Major (<https://catalogs.northwestern.edu/undergraduate/arts-sciences/neurobiology/neuroscience-major/>)
- Neuroscience Second Major for ISP Students (<https://catalogs.northwestern.edu/undergraduate/arts-sciences/neurobiology/neuroscience-second-major-isp-students/>)

NEUROSCI 101-7 College Seminar (1 Unit) Small, writing and discussion-oriented course exploring a specific topic or theme, and introducing skills necessary to thriving at Northwestern. Not eligible to be applied towards a WCAS major or minor except where specifically indicated.

NEUROSCI 101-8 First-Year Writing Seminar (1 Unit) Small, writing and discussion-oriented course exploring a specific topic or theme, and focused on the fundamentals of effective, college-level written

communication. Not eligible to be applied towards a WCAS major or minor except where specifically indicated.

NEUROSCI 202-0 Cellular and Molecular Neuroscience (1 Unit)

Introduction to principles governing nervous system function at the cellular and molecular level. May not receive credit for both NEUROSCI 202-0 and BIOL_SCI 302-0. Prerequisites: BIOL_SCI 201-0 and must be a neuroscience major. *Natural Sciences Distro Area*

NEUROSCI 206-0 Systems and Behavioral Neuroscience (1 Unit)

Introduction to the organization and function of brain systems and their role in generating behavior. Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0. *Natural Sciences Distro Area*

NEUROSCI 303-0 Molecular Mechanisms of Neuropsychopharmacology (1 Unit)

Advanced seminar focusing on molecular mechanisms and aberrations of synaptic signal transduction and drugs that target them.

Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

NEUROSCI 304-0 Developmental Neurobiology (1 Unit)

Embryology and cellular/molecular mechanisms of nervous system development. Topics include patterning of the early embryo and nervous system, neurogenesis, neuronal differentiation and cell fate specification, axon guidance and wiring of neural circuits, and activity-, experience-, and sex-dependent neurodevelopment.

Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

NEUROSCI 308-0 Genetics of Human Behavior (1 Unit)

Covers the genetic determinants of human behavior. We discuss how "nature" (genes) and "nurture" contribute to shape individual behavior and explore the implications of this interaction, from philosophical and ethical aspects to medical and legal considerations.

Prerequisites: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

NEUROSCI 311-0 Biophysical Analysis of Neurons for ISP (1 Unit)

This course provides an introduction to neurobiology from an electrophysiological perspective, with an emphasis on ion channel biophysics, quantitative electrical properties of neurons, synaptic physiology, and sensory transduction. Its goal is to provide a basis for understanding how information is encoded, transmitted, and decoded in brains, as well as offer an introduction to reading scientific literature. Some facility with simple equations and graphing is suggested.

Prerequisite: Students must be an ISP or NEUROSCI major to enroll.

NEUROSCI 320-0 Animal Behavior (1 Unit)

Animal behavior from the neuroscience perspective. Neurobiological bases of foraging, communication, migration, predator-prey interactions, mating, and parental care.

Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

Natural Sciences Distro Area

NEUROSCI 324-0 Neurobiology of Biological Clocks and Sleep (1 Unit)

General properties of sleep and circadian rhythms; how sleep and the circadian clock regulate a number of diverse activities at the cell, organ, and organism levels. The importance of biological rhythms and sleep for human health and disease will be covered in the course. Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

NEUROSCI 325-0 Neurobiology of Stress, Adversity, and Resilience (1 Unit)

This is a writing-intensive course based on class lectures and discussion that draws from primary literature on the neurobiology of stress, stress susceptibility and resilience, to explore biological mechanisms by which adversity can influence mental health and other outcomes.

Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

NEUROSCI 326-0 Neurobiology of Learning and Memory (1 Unit)

This course examines how brain cells and neural circuits process experience to produce lasting changes in behavior. In depth discussion of original research findings, with a focus on the latest molecular, neural physiology, and behavioral studies. Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

NEUROSCI 350-0 Advanced Neurophysiology Laboratory (1 Unit)

Learn to record electrophysiological signals (action potentials and post synaptic potentials) from living neural systems using amplifiers and recording equipment commonly found in research labs around the world. Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0; and consent of instructor.

NEUROSCI 355-0 Neurogenetics of Behavior Laboratory (1 Unit)

Project-based laboratory investigating the genetic basis of behavior in a simple model system; molecular genetic techniques used in neurobiology. Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

NEUROSCI 357-0 Neuroanatomy Laboratory (1 Unit) Comparative anatomy and dissection to understand the functions of brain regions by comparing their structures across the major vertebrate classes. Includes clinical anatomy and case studies to understand the functions of brain regions by drawing connections between neurological symptoms and the localization of lesions. Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

NEUROSCI 360-0 Neuroscience of Brain Disorders (1 Unit)

Survey of brain disorders and differences such as neurodegenerative diseases, developmental disorders, narcolepsy, and migraine with a focus on molecular-genetic mechanisms. Trace progress from the laboratory to the clinic, evaluate the state of knowledge, and understand future directions. Prior review of basic genetics and molecular biology is strongly recommended.

Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

Natural Sciences Distro Area

NEUROSCI 365-0 Neurobiology of Prediction (1 Unit)

This course examines neurophysiological circuit mechanisms that allow prediction to emerge in brains of (mostly) non-human animals. Topics include probability and variance, anticipation of aversive and rewarding stimuli, temporal and spatial prediction, and how cellular-level studies inform complex questions of human prediction.

Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

NEUROSCI 370-0 Genetic and Circuit Analysis of Motivated Behavior (1 Unit)

Animals are programmed to behave strongly towards activities that satisfy our basic needs and enhance our chances of survival. This includes eating, drinking, sex, and social interaction. Focusing on neurobiology of eating, we will read scientific articles, learn about cutting edge experimental techniques, discuss concepts, and hone oral presentation skills.

Prerequisites: NEUROSCI 202-0 and NEUROSCI 206-0; or NEUROSCI 311-0 and NEUROSCI 206-0; or BIOL_SCI 302-0.

NEUROSCI 377-0 Neurobiology of Sensation and Perception (1 Unit)

Analysis of the key concepts underlying the neurobiological mechanisms of vision, hearing, taste, smell, touch, and pain. Neural pathways leading to perception and processing of stimuli will also be discussed.

Prerequisite: NEUROSCI 202-0 or NEUROSCI 311-0 or BIOL_SCI 302-0.

Natural Sciences Distro Area

NEUROSCI 390-0 Topics in Neuroscience (1 Unit) Special Topics in Neuroscience. Topics to be announced. Prerequisites vary. May be repeated for credit with different topic. May be used to fulfill a Neuroscience Group B elective or serve as an Biology Allied Field course.

NEUROSCI 398-0 Senior Thesis Seminar (1 Unit) Instruction in writing a scientific thesis, discussion of student projects, instructor and peer feedback on thesis drafts, and continued independent research. Required of seniors pursuing departmental honors, with approval of the director of undergraduate studies. *Advanced Expression*

NEUROSCI 399-0 Independent Study in Neuroscience (1 Unit)

Supervised laboratory or methods research with a faculty member. Research must be related to Neuroscience. Prerequisite: Must be a Neuroscience major, departmental permission required (see website for details.).