

# NEUROBIOLOGY

Courses offered by the Department of Neurobiology are listed under the subject code NBIO on the (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=NBIO&filter-catalognumber-NBIO=on>) Stanford Bulletin's (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=NBIO&filter-catalognumber-NBIO=on>) ExploreCourses web site (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=NBIO&filter-catalognumber-NBIO=on>).

## Graduate Program in Neurobiology

Graduate students in the Department of Neurobiology obtain the Ph.D. degree through the interdepartmental Neurosciences Ph.D. program (<http://exploreddegrees.stanford.edu/schoolofmedicine/neurosciences/#doctoraltext>). Accepted students receive funding for tuition and a living stipend. Applicants should familiarize themselves with the research interests of the faculty and, when possible, indicate their preference on the application form which is submitted directly to the Neurosciences Program.

Medical students also are encouraged to enroll in the Ph.D. program. The requirements of the Ph.D. program are fitted to the interests and time schedules of the student. Postdoctoral training is available to graduates holding Ph.D. or M.D. degrees, and further information is obtained directly from the faculty member concerned.

Research interests of the department include information processing in vertebrate retina; structure, function, and development of auditory and visual systems; development and regeneration in the central and peripheral nervous system; neural mechanisms mediating higher nervous system functions, including perception, learning, attention and decision making.

## Faculty

*Emeriti (Professors):* Denis Baylor, Eric I. Knudsen, Uel J. McMahan, Eric Shooter, Lubert Stryer

*Department Chair:* Thomas Clandinin

*Professors:* Stephen A. Baccus, Tirin Moore, William T. Newsome, Jennifer L. Raymond, Nirao Shah, Carla Shatz

*Associate Professors:* Lisa Giacomo, Andrew D. Huberman, Michael Z. Lin

*Assistant Professors:* Shaul Druckmann, Keren Haroush

*Adjunct Professors:* William Hurlbut

## Courses

### NBIO 101. Social and Ethical Issues in the Neurosciences. 2-3 Units.

Foundational scientific issues and philosophical perspectives related to advances in the study of brain and behavior. Implications of new insights from the neurosciences for medical therapy, social policy, and broader conceptions of human nature including consciousness, free will, personal identity, and moral responsibility. Topics include ethical issues related to genetic screening and editing, desire and addiction, criminal behavior, the biology of sexuality, fetal pain, aging and neurodegenerative disease, brain-computer interfaces, and neural enhancement and the human future. May be taken for 2 units without a research paper. Undergraduates must enroll in NBIO101. This course will NOT fulfill the Ways-ER requirement for spring 2021. Application required: <http://bit.ly/NBIOApplication>. Same as: NBIO 201

### NBIO 198. Directed Reading in Neurobiology. 1-18 Unit.

Prerequisite: consent of instructor. (Staff).

### NBIO 199. Undergraduate Research. 1-18 Unit.

Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

### NBIO 201. Social and Ethical Issues in the Neurosciences. 2-3 Units.

Foundational scientific issues and philosophical perspectives related to advances in the study of brain and behavior. Implications of new insights from the neurosciences for medical therapy, social policy, and broader conceptions of human nature including consciousness, free will, personal identity, and moral responsibility. Topics include ethical issues related to genetic screening and editing, desire and addiction, criminal behavior, the biology of sexuality, fetal pain, aging and neurodegenerative disease, brain-computer interfaces, and neural enhancement and the human future. May be taken for 2 units without a research paper. Undergraduates must enroll in NBIO101. This course will NOT fulfill the Ways-ER requirement for spring 2021. Application required: <http://bit.ly/NBIOApplication>. Same as: NBIO 101

### NBIO 206. The Nervous System. 6 Units.

Structure and function of the nervous system, including neuroanatomy, neurophysiology, and systems neurobiology. Topics include the properties of neurons and the mechanisms and organization underlying higher functions. Framework for general work in neurology, neuropathology, clinical medicine, and for more advanced work in neurobiology. Lecture and lab components must be taken together.

### NBIO 220. Machine Learning Methods for Neural Data Analysis. 3 Units.

With modern high-density electrodes and optical imaging techniques, neuroscientists routinely measure the activity of hundreds, if not thousands, of cells simultaneously. Coupled with high-resolution behavioral measurements, genetic sequencing, and connectomics, these datasets offer unprecedented opportunities to learn how neural circuits function. This course will study statistical machine learning methods for analysing such datasets, including: spike sorting, calcium deconvolution, and voltage smoothing techniques for extracting relevant signals from raw data; markerless tracking methods for estimating animal pose in behavioral videos; network models for connectomics and fMRI data; state space models for analysis of high-dimensional neural and behavioral time-series; point process models of neural spike trains; and deep learning methods for neural encoding and decoding. We will develop the theory behind these models and algorithms and then apply them to real datasets in the homeworks and final project. This course is similar to STATS215: Statistical Models in Biology and STATS366: Modern Statistics for Modern Biology, but it is specifically focused on statistical machine learning methods for neuroscience data. Prerequisites: Students should be comfortable with basic probability (STATS 116) and statistics (at the level of STATS 200). This course will place a heavy emphasis on implementing models and algorithms, so coding proficiency is required. Same as: CS 339N, STATS 220, STATS 320

### NBIO 227. Understanding Techniques in Neuroscience. 2 Units.

Students will learn to select and evaluate multidisciplinary techniques for approaching modern neuroscience questions. A combination of lectures and small group paper discussions will introduce techniques from molecular, genetic, behavioral, electrophysiological, imaging, and computational neuroscience. Students will be expected to complete homework assignments analyzing primary literature and attend optional laboratory demonstrations. Intended for graduate students, postdocs, and staff from any discipline; and for advanced undergraduates in the biosciences, engineering, or medicine.

**NBIO 228. Mathematical Tools for Neuroscience. 3 Units.**

Student-instructed. This course aims to equip biosciences graduate students with the fundamental skills in quantitative modeling and data analysis necessary for neuroscience research. It covers techniques including linear algebra, Fourier transforms, probability and statistics, signal detection, statistical inference, and information theory. The course is required for first-year students in the Neuroscience PhD program, and is open to other graduate students in the biosciences. Other students, including undergraduates, may enroll by special request.

**NBIO 254. Molecular and Cellular Neurobiology. 3-5 Units.**

For graduate students. Includes lectures for BIO 154. Cellular and molecular mechanisms in the organization and functions of the nervous system. Topics: wiring of the neuronal circuit, synapse structure and synaptic transmission, signal transduction in the nervous system, sensory systems, molecular basis of behavior including learning and memory, molecular pathogenesis of neurological diseases.

Same as: BIO 254

**NBIO 299. Directed Reading in Neurobiology. 1-18 Unit.**

Prerequisite: consent of instructor.

**NBIO 370. Medical Scholars Research. 4-18 Units.**

Provides an opportunity for student and faculty interaction, as well as academic credit and financial support, to medical students who undertake original research. Enrollment is limited to students with approved projects.

**NBIO 399. Graduate Research. 1-18 Unit.**

Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.