Committee on Neurobiology

Chair

- Daniel McGehee, Anesthesia and Critical Care

Professors

- Issam Awad, Neurological Surgery
- Edward Awh, Psychology
- Marlene Cohen, Neurobiology
- Harriet de Wit, Psychiatry and Behavioral Neuroscience
- Jean Decety, Psychology
- Ruth Anne Eatock, Neurobiology
- David Freedman, Neurobiology
- Christopher Gomez, Neurology
- William Green, Neurobiology
- Elizabeth Grove, Neurobiology
- Melina Hale, Organismal Biology and Anatomy
- Christian Hansel, Neurobiology
- Nicholas Hatsopoulos, Organismal Biology and Anatomy
- Leslie Kay, Psychology
- Richard P. Kraig, Neurology
- Yamuna Krishnan, Chemistry
- Daniel Margoliash, Organismal Biology and Anatomy
- Peggy Mason, Neurobiology
- Jason MacLean, Neurobiology
- James A. Mastrianni, Neurology
- John Maunsell, Neurobiology
- Deborah Nelson, Pharmacological and Physiological Sciences
- Eduardo Perozo, Biochemistry and Molecular Biology
- Nanduri Prabhakar, Medicine
- Brian Prendergast, Psychology
- Victoria Prince, Organismal Biology and Anatomy
- Clifton Ragsdale, Neurobiology
- Anthony T. Reder, Neurology
- Raymond P. Roos, Neurology
- S. Murray Sherman, Neurobiology
- Sangram Sisodia, Neurobiology
- Wei-Jen Tang, Ben May Department of Cancer Research
- V. Leo Towle, Neurology
- Edward Vogel, Psychology
- Joel Voss, Neurology
- Peter Warnke, Neurology
- Wei Wei, Neurobiology
- Ming Xu, Anesthesia and Critical Care
- Xiaoxi Zhuang, Neurobiology

Associate Professors

- Demet Arac, Biochemistry and Molecular Biology
- Robert Carrillo, Molecular Genetics and Cell Biology
- Ellie Heckscher, Molecular Genetics and Cell Biology
- Narayanan (Bobby) Kasthuri, Neurobiology
- Sarah Keedy, Psychiatry and Behavioral Neuroscience
- Paschalis Kratsios, Neurobiology

- Sarah London, Psychology
- Anne-Marie Oswald, Neurobiology
- Engin Özkan, Biochemistry and Molecular Biology
- Stephanie Palmer, Organismal Biology and Anatomy

Assistant Professors

- Alfredo Garcia, Medicine
- Stephanie Groman, Anesthesia and Critical Care
- Cassandra Hayne, Biochemistry and Molecular Biology
- Matthew Kaufman, Organismal Biology and Anatomy
- Monica Rosenberg, Psychology
- Mark Sheffield, Neurobiology
- Jai Yu, Psychology
- Zhuzhu Zhang, Human Genetics
- Xiaochang Zhang, Human Genetics

The Committee on Neurobiology is an interdepartmental committee designed to provide training and instruction for students interested in the biology of the nervous system, and to encourage communication and the exchange of ideas between faculty members and students interested in neurobiology. Recent technical and conceptual developments in neuroscience have produced remarkable growth in this field. The committee reflects this growth in its structure, having members from different departments whose research interests include a broad spectrum of approaches from the biochemical and molecular to the behavioral and comparative. The committee aims to provide broad training in technical and theoretical aspects of the neurosciences.

The Degree of Doctor of Philosophy

Students initially are admitted to the Division of the Biological Sciences and must meet divisional requirements. The progress of each student will be supervised during the first year by the Student Advising Committee until the student chooses a thesis advisor. Upon choosing a thesis advisor, an advisory committee chaired by a tenured faculty member who is not the student's thesis advisor is formed. The advisory committee consists of at least four faculty members with a majority being members of the Committee on Neurobiology. As a student's focus changes, the composition of the advisory committee may be modified.

Each student is required to take three core courses, two graded laboratory rotations and four electives (one of which has to be a quantitative course). Usually these courses will be taken during the first year and part of the second year. Required courses include a series of courses on cellular, developmental, and systems neurobiology. Elective courses focus on topics such as neuropharmacology, systems neurophysiology, development, physiology of ion channels and statistics.

During the first year, in addition to taking courses, students rotate through different laboratories. During the second year, the student completes the required coursework and writes a thesis proposal in NRSA format, to be defended before their advisory committee. For the purposes of the divisional requirements, this is the examination testing the candidate's qualifications for candidacy.

The original observations included in the final Ph.D. dissertation should be judged suitable for publication. The final oral examination for the Ph.D. degree consists of a public seminar and a private defense conducted by the advisory committee and by other such members of the University faculties as may be deemed suitable.

Neurobiology Courses

NURB 30107. Behavioral Neuroscience. 100 Units.
This course provides an introduction to neuroethology, examining brain activity relative to behaviors and organisms evaluated from an adaptive and evolutionary perspective. It starts with a brief introduction to classical ethology, and then develops a series of example animal model systems. Both invertebrate and vertebrate models are considered although there is a bias towards the latter. Many of these are "champion" species. There is a heavier demand for reading original data papers than typical in introductory graduate level courses. An integral part of the course is a series of assignments where you develop grant proposals describing novel science experiments in the animal models, thereby challenging your knowledge of the material and teaching aspects of scientific writing. In recent years there has been more computational material presented. The course is not available to undergraduates without prior approval of the instructor.
Instructor(s): D. Margoliash Terms Offered: Spring
Note(s): The course is not available to undergraduates without prior approval of the instructor.
Equivalent Course(s): CPNS 30107, PSYC 40107

NURB 31600. Survey of Systems Neuroscience. 100 Units.
This lab-centered course teaches students the fundamental principles of vertebrate nervous system organization. Students learn the major structures and the basic circuitry of the brain, spinal cord and peripheral nervous system. Somatic, visual, auditory, vestibular and olfactory sensory systems are presented in particular depth. A

highlight of this course is that students become practiced at recognizing the nuclear organization and cellular architecture of many regions of brain in rodents, cats and primates.
Instructor(s): Oswald, A. M. Terms Offered: Autumn
Prerequisite(s): NSCI 20100, NSCI 20111, NSCI 20130.
Note(s): Undergrads by consent only
Equivalent Course(s): CPNS 30116, ORGB 32500, NSCI 23500

NURB 31800. Cellular Neurobiology. 100 Units.
This course is concerned with the structure and function of the nervous system at the cellular level. The cellular and subcellular components of neurons and their basic membrane and electrophysiological properties will be described. Cellular and molecular aspects of interactions between neurons will be studied. This will lead to functional analyses of the mechanisms involved in the generation and modulation of behavior in selected model systems.
Instructor(s): R. A. Eatock, X. Zhuang, D. McGehee Terms Offered: Winter
Equivalent Course(s): CPNS 30000

NURB 32000. Intro To Faculty Research. 100 Units.
First-year students in Neurobiology and Computational Neuroscience are required to attend this chalk talk series where faculty members looking for rotating students present the research conducted in their labs.
Terms Offered: Autumn
Equivalent Course(s): CPNS 31900

NURB 32130. Psychoactive Drugs, the Brain and Behavior. 100 Units.
The goal of this course is for the students to understand how psychoactive drugs affect the brain and behavior. Understanding how these drugs work will provide students a window in the relationship between the brain and behavior. Understanding how drugs affect the brain and behavior will also enhance the students understanding of the relationship between psychoactive drugs/medications and society.
Instructor(s): H. de Wit, R. Lee, M. Xu, X. Zhuang Terms Offered: Winter
Prerequisite(s): For UG: NSCI 20101, NSCI 20111 and NSCI 20130
Equivalent Course(s): NSCI 22130

NURB 32300. Molecular Principles of Nervous System Development. 100 Units.
This elective course provides an overview of the fundamental questions in developmental neurobiology. It is based on primary research papers and highlights key discoveries in vertebrate and invertebrate animals that advanced our understanding of nervous system development. Topics covered, among others, will include neural stem cells, neuronal specification and terminal differentiation, and circuit assembly. Dogmas and current debates in developmental neurobiology will be discussed, aiming to promote critical thinking about the field. This advanced-level course is open to upper level undergraduate and graduate students and combines lectures, student presentations, and discussion sections. Neuroscience major undergrads need to have completed the Fundamentals of Neuroscience sequence.
Instructor(s): P. Kratsios, C. Martineau Terms Offered: Spring
Prerequisite(s): For undergrads: NSCI 20110, 20120, 20130 and a basic understanding of Genetics, or "BIOS 20187" (Fundamentals of Genetics) is recommended, but not required.
Equivalent Course(s): DVBI 32300, CPNS 32300, NSCI 22300

NURB 32400. Synaptic Physiology. 100 Units.
This course covers the basic principles of synaptic transmission and plasticity using a combination of lecture and discussion of primary literature. Lecture topics cover membrane electrical phenomena that lead to release of neurotransmitter presynaptically, as well as the physiological consequences of postsynaptic receptor activation. Paper discussions, which make up ~ 2/3 of the course, are centered on two major topics: 1) The molecular machinery controlling synaptic vesicle exocytosis and recycling, and 2) Synaptic plasticity covering LTP, LTD, Metaplasticity, Spike-timing dependent plasticity and Homeostatic plasticity. There is significant emphasis on the connections between the various forms of synaptic modification and behavior.
Instructor(s): D. McGehee Terms Offered: Autumn
Prerequisite(s): Upper undergrads by consent of instructor
Equivalent Course(s): NSCI 23400

NURB 32900. Perspectives in Drug Abuse. 100 Units.
It is a broad overview course about drug abuse, that is appropriate for graduate students as well as undergraduates. It includes lectures on epidemiology, genetics, neurobiology, experimental methods, policy and treatment, as well as lectures on several specific drug classes. Lectures are by Dr. de Wit and by other invited faculty members, and students are required to present and discuss recent published papers during classes.
Instructor(s): H. de Wit Terms Offered: Spring
Equivalent Course(s): NSCI 21800, BIOS 24135

NURB 33400. Genetic Approaches in Neurobiology. 100 Units.
This course is more technique oriented. The goal is to give a good coverage of different genetic approaches as well as different aspects of neurobiology. Topics are organized by genetic approaches as the following: 1) Transgenic. 2) Gene targeting. 3) Gene replacement. 4) Conditional knockout. 5) Genetic and optical control of neural activity. 6) Transgenic facilitated imaging. 7) Forward genetics and genetic screening. The selection of a

variety of papers throughout the course aims to cover different neural pathways, neurotransmitters, receptor/channel types, signaling pathways, and functional implications (learning, memory, addiction, development etc). Specific emphasis will be on the integration of molecular, cellular and systems level approaches in understanding behavior. Lecture time will be devoted to the genetic approaches. Students will present and discuss papers. We will have 2-3 papers each lecture.
Instructor(s): X. Zhuang Terms Offered: Spring

NURB 33480. Neurogenetics. 100 Units.
This course introduces human and mouse genetics through the lens of neurological disorders. It starts with genetic concepts and the principles of genetic approaches, followed by human genetic studies of neocortex development and original findings in repeat expansion diseases. We will discuss concurrent concepts in genetic diagnosis and therapeutic strategies. This course is open to graduate and upper-level undergraduate students. It combines lectures and discussion sections.
Instructor(s): X. Zhang Terms Offered: Spring
Prerequisite(s): BIOS 20187, NSCI 20101, or consent of instructor
Equivalent Course(s): NSCI 23480, HGEN 33480

NURB 33500. Protein Structure and Functions in Medicine. 100 Units.
This course explores how molecular machinery works in the context of medicine (vision, fight or flight, cancer, and action of drugs). We first explore the physical and biochemical properties of proteins in the context of cellular signaling. We then examine how proteins and other cellular components make up the signal transduction pathway of humans and conduct their biological functions. The course engages students to strengthen their scientific communication and teaching skills via the in-class podcast, oral examinations, computer-aided structural presentations, student lectures, and discussions.
Instructor(s): W-J. Tang Terms Offered: Spring
Prerequisite(s): Three quarters of a Biological Sciences Fundamentals sequence. Biochemistry strongly recommended.
Equivalent Course(s): CABI 31900, BIOS 21349

NURB 33600. Experimental Design in Motor Control Research. 100 Units.
Motor control research examines how animals move. Aims of motor control studies range widely from exploring fundamental principles of motor systems and evolved specializations in animal models, to understanding and improving motor function in disease and injury, to increasing athletic performance. In this course, we will examine experimental design in research through the lens of motor control studies.
Instructor(s): M. Hale Terms Offered: Autumn
Equivalent Course(s): CPNS 33600

NURB 33760. Sensitive Periods: How the Timing of Experience Alters Its Effect. 100 Units.
Sensitive periods are defined as phases in life when experience has the most effect on a particular brain system. Typically occurring during development, experience during sensitive periods has long-term implications for sensory processing, affective development, cognitive processes, and production of complex learned behavior such as language. We will combine an investigation of biological underpinnings with behavioral consequences of sensitive periods and ask questions such as: How are sensitive periods defined during development? Are sensitive periods for a variety of behaviors different or the same? How does experience intersect with the brain to encode and modify a sensitive period? Can we re-open sensitive periods after their normal end - and do we want to?
Instructor(s): S. London Terms Offered: Winter
Equivalent Course(s): PSYC 43760, CHDV 43760

NURB 34600. Neurobiology of Disease I. 100 Units.
This graduate-level, 100-unit course has an unusual format aimed at fostering lively discussion and interaction. There will be 10 meetings spread at 1-month intervals over the winter, spring and fall quarters. Each meeting will focus on a topic such as Epilepsy, Alzheimer's, or Autism, and feature a brief introduction (by a student) and chalk talks by two faculty, one on clinical aspects of the disease and one on basic research approaches. The student's grade is based on the presentation at one meeting and participation across all meetings.
Instructor(s): Garcia, A. Terms Offered: Autumn Spring Winter
Note(s): Class meets on the 3rd Wednesday of the month; 100 credits given after 3 quarters attendance.
Equivalent Course(s): CPNS 34600

NURB 34810. Neurons and Glia: A Cellular and Molecular Perspective. 100 Units.
This course will be an interactive, in-depth analysis of the cell biology of neurons and glia. We will learn and discuss the latest techniques used, for example, to study the structure and function of neuronal proteins. In this way we will illuminate the central concepts that define our understanding of the cell and molecular biology of neurons and glia. The course will consist of lectures and critical reading of contemporary literature.
Instructor(s): R. Carrillo; W. Green Terms Offered: Spring
Prerequisite(s): Neuroscience Majors: NSCI 20101-20130 (Fundamental Neuroscience Sequence) Biological Sciences Majors: NSCI 20101-20130, or three quarters of a Biological Sciences Fundamentals Sequence
Equivalent Course(s): NSCI 23810, BIOS 24251

NURB 36050. Principles of Data Science and Engineering for Laboratory Research. 100 Units.
The quantity of data gathered from laboratory experiments is constantly increasing. This course will explore the latest concepts, techniques and best-practice to create efficient data analysis pipelines. We will focus on the python ecosystem. By the end of the course, you are expected to be able to apply appropriate tools to streamline your own data analysis.
Instructor(s): J. Yu Terms Offered: Autumn
Prerequisite(s): Familiarity with coding in python.
Equivalent Course(s): PSYC 46050, CPNS 36050

NURB 37700. Talking Neuroscience. 100 Units.
This course is designed to help students effectively prepare for and deliver student talks. This course is required for all students who are participating in Student Seminars for the first time. Each enrolled student will be required to meet with the faculty one week prior to their seminar to receive feedback on the structure of their talk. A group discussion of the strengths and weaknesses of each presentation will be held after every seminar.
Equivalent Course(s): CPNS 37700

NURB 38800. Neuroscience Ethics. 100 Units.
Neuroscience Senior Ethics class: compulsory for Neurobiology and Computational Neuroscience PhD students in their 4th and/or 5th year (to fulfill BSD ethics requirement). The course, offered every other year, is directed by the graduate programs chairs, and consists of 4 sessions with invited speakers to be held in May (first four Tuesdays).
Instructor(s): D. McGehee Terms Offered: Spring
Equivalent Course(s): CPNS 38800

NURB 39900. Readings: Neurobiology. 300.00 Units.
Subject matter for individual tutorial-based study is selected through prior consultation and is given under the guidance of a faculty member. The student and faculty member must indicate at time of registration whether the course will be taken on a letter grade or pass/fail basis.

NURB 40100. Rsch: Neurobiology. 300.00 Units.
The student conducts original investigation under the direction of a faculty member. The research is presented and defended as a dissertation in candidacy for the degree of Doctor of Philosophy.

NURB 70000. Advanced Study: Neurobiology. 300.00 Units.
Advanced Study: Neurobiology