

Detailed Listing of Neuroscience-Related Courses

Each student in the Neuroscience Program is required to take 3 lecture courses chosen from three broad categories: (A) Cellular, Molecular & Developmental Neuroscience; (B) Systems and Computational Neuroscience; and (C) Cognition, Brain and Behavior. Students can either take one graduate level course from each category, or three graduate level courses chosen from two areas, plus a selected advanced undergraduate course from the third area.

Students also take 3 additional graduate-level seminar and/or lecture courses, typically in Years 3 and 4. These can be chosen from all relevant graduate-level classes in any department (e.g. Molecular & Cell Biology, Chemistry, Psychology, Electrical Engineering and Computer Science). Some commonly chosen lecture courses are listed below, under **Other Neuroscience-Related Lecture Courses**. Commonly chosen seminar courses are listed under **Neuroscience-Related Seminar Courses**. For a complete course listing, search the UC Berkeley course catalog at <http://catalog.berkeley.edu>.

Category A. Cellular, Molecular and Developmental Neuroscience

MCB C261/NEUROSC C261: **Advanced Cellular Neurobiology**. Molecular basis of cellular function. Topics covered include membrane physiology, ion channel and neurotransmitter receptor physiology, synaptic physiology and plasticity, sensory transduction.

MCB C263/NEUROSC C263: **Advanced Developmental Neurobiology**. Current research problems in the embryonic and post-embryonic development of invertebrate and vertebrate nervous systems.

MCB 200: **Advanced Biochemistry and Molecular Biology**. Structural, functional, and genetic characteristics of prokaryotic and eukaryotic cells and their viruses, macromolecular syntheses, regulation of gene expression, chromosome organization, cell signaling, proliferation, and differentiation.

MCB 230: **Advanced Cell Biology**. Topics in cell biology.

MCB 231: **Advanced Stem Cell and Developmental Biology**. Principles of animal development in vertebrates and invertebrates. Induction, localization, patterning mutants, axis formation, regional gene expression, and cell interactions.

MCB 240. **Advanced Genetic Analysis**. Genetic analysis as applied to eukaryotic organisms, including yeast, nematodes, *Drosophila*, mice and humans. Isolation and analysis of mutations, gene mapping, suppressor analysis, chromosome structure, control of gene expression, and developmental genetics.

MCB C160/NEUROSC C160: **Introduction to Neurobiology**. Advanced undergraduate course. Analysis of nervous system function from molecules to simple circuits to complex networks and higher brain functions. Includes brain development and learning and memory.

Category B. Systems and Computational Neuroscience Courses

IB 245 and 245 L: **Functional Neuroanatomy and Lab**. Gross and microscopic structure and development of the mammalian nervous system. Lab includes histological examination of the human nervous system and gross dissection of the human brain.

MCB C262/NEUROSC C262: **Advanced Topics in Systems Neuroscience**. Current research problems in systems-level neuroscience, and experimental and computational techniques. Topics vary yearly.

Psychology 210C: Proseminar on **Cognition, Brain, and Behavior**. Survey of biological psychology focused on sensation and perception.

Psychology C213: **Stress Effects on Brain and Behavior**. Multidisciplinary approach to concept of stress. The impact of stress, hormones, and experience on neurons, brain function, and behavior.

Psych 298Z: **Neuronal mechanisms of learning and memory**. Cellular and neural systems-level mechanisms for learning, memory, and plasticity in developing and adult nervous systems. Includes various forms of learning and memory, addiction, and learning mechanisms related to cognitive processes.

Vision Science 298: **Neural Computation**. Introduction to the theory of neural computation, including the major theoretical frameworks and models used in neuroscience and psychology. Provides hands-on experience in using these models.

Category C. Cognition, Brain and Behavior Courses

Psychology 117: **Human Neuropsychology**. Advanced undergraduate course. Psychological approaches to neuropsychiatric disease and disability, including mental disorders, behavior changes following human brain injury and disease, and mental subnormality. Nervous system models and basic research are considered.

Psychology C127: **Cognitive Neuroscience**. Advanced undergraduate course. The neurological basis of cognition, including perception, attention, memory, language, motor control, executive control, and emotion. Findings from brain-injured patients, neurophysiological research in animals, and normal cognitive processes in humans studied with functional Magnetic Resonance Imaging (fMRI), electroencephalography (EEG), and transcranial magnetic stimulation (TMS).

Psychology 210A: Proseminar on **Cognition, Brain, and Behavior**. Survey of biological psychology focused on cognitive neuroscience.

Psychology 210D: Proseminar on **Learning and Memory**. Survey on biological psychology focused on learning and memory.

Psychology 211: **Hormones and Behavior**: The effects of hormones on mammalian reproductive behaviors. Includes sexual differentiation, parental behavior, seasonal reproduction, and hormonal effects on non-reproductive processes including eating, social behavior, learning and memory.

Psychology 214: **Functional MRI Methods**. Overview of functional MRI methodology. Includes basic physics of fMRI, the nature of BOLD fMRI signal, the spatial and temporal resolution of fMRI, experimental design, and statistical techniques. Includes hands-on experience performing an fMRI experiment and analyzing the data.

Psychology 240A: Proseminar on **Biological, Cognitive, and Language Development**. Development of the nervous system and behavior. Biological focus includes neurogenesis, synaptogenesis, cell death and synapse elimination, and genetic and experiential determinants of neural development. Cognitive focus includes development of knowledge from infancy through childhood and across multiple domains including physics, biology, math, and psychology. Includes language acquisition and review of phonology, syntax, and morphology.

Public Health Public Health 217D: **Biological and Public Health Aspects of Alzheimer's Disease**. Survey of Alzheimer's disease (AD) from a biological and public health perspective. Includes clinical and neuropathological features, genetics and molecular biology, epidemiology, diagnosis, treatment and ethics of AD. Students read original research papers in medicine, neuroscience, and epidemiology.

Other Neuroscience-Related Lecture Courses

Psychology 205A-205B: **Data Analysis**. Methods, design issues and problems of data analysis, from pure experimental research to field studies. Focus on ANOVA, multiple regression and correlation.

EECS 221A: **Linear System Theory**. Concepts and properties of linear systems. Includes state-space and input-output representation, controllability, observability, minimality, state and output-feedback, stability, observers, characteristic polynomial, Nyquist test.

EECS 226A: **Random Processes in Systems**. Probability, random variables, random processes. Includes filtering of wide sense stationary processes, spectral density, Wiener and Kalman filters. Markov processes and Markov chains. Gaussian, birth and death, Poisson and shot noise processes, elementary queueing analysis, detection of signals in Gaussian and shot noise, and elementary parameter estimation.

EECS 229: **Information Theory and Coding.** Fundamental bounds of Shannon theory and their application. Source and channel coding theorems. Galois field theory, algebraic error-correction codes. Cryptographic systems.

Stat 241A: **Statistical Learning Theory.** Includes classification, regression, clustering, dimensionality, reduction, and density estimation. Mixture models, hierarchical models, factorial models, hidden Markov, and state space models, Markov properties, and general probabilistic inference. Nonparametric methods including decision trees, kernel methods, neural networks, and wavelets.

Stat 248: **Analysis of Time Series.** Includes frequency-based techniques of time series analysis, spectral theory, linear filters, estimation of spectra and transfer functions, design, system identification, vector-valued stationary processes, and model building.

Neuroscience-Related Seminar Courses

Seminar courses are small, highly interactive courses (5-15 students) focused on specific current research topics, led by a faculty member who is a leading researcher in the field. Topics change yearly, and often several sections, covering different topics, are offered each semester.

MCB 290. **Graduate Seminar.** Selected research topics in molecular and cell biology. Past topics have included: molecular and cellular mechanisms of touch and pain; neural correlates of behavior; The neural basis of perception; gene transfer to the nervous system; motor control; from synaptic pharmacology to consciousness; topics in synaptic pharmacology; topics in systems neuroscience.

Psychology 290's: **Graduate Seminar.** Selected research topics in cognition, brain and behavior. Past topics have included: neural bases of circadian rhythms; the science of sleep; advanced topics in vision research.

Vision Science 298's: **Graduate Seminar.** Past topics have included: advanced topics in color vision; statistics and data modeling; advanced topics in neural computation.

EECS 290's: **Advanced Topics in Electrical Engineering.** Current topics of research interest in electrical engineering. Past topics have included: advanced topics in control.

Special Training Courses

NEUROSC 290. **Neuro Student Research Presentations.** This course teaches effective techniques for scientific research presentations. Students develop and present a research talk describing their research rotation projects. Required of all first year students.

NEUROSC 294. **Student Journal Club and Research Presentations.** Presentation and discussion of ongoing thesis research projects and published literature, by program students.

MCB 293C. **Ethics in Research.** Overview and discussion of issues in ethics of conducting research. Required of all first year students appointed on NIH Training Grants.