NEUROSCIENCES

Courses offered by the Neurosciences Program are listed under the subject code NEPR on the Stanford Bulletin's ExploreCourses web site.

Master of Science in Neurosciences

The Neurosciences IDP does not offer a terminal M.S. degree. An M.S. degree may only be pursued in combination with a doctoral degree from another department within the University or with an advanced degree from one of the University's professional schools.

Students interested in pursuing the M.S. must meet with the Neurosciences IDP Program Director and provide an unofficial Stanford transcript as well as a Statement of Purpose for adding the M.S. degree.

The Neurosciences IDP does not offer a coterminal master's degree.

Requirements

- Courses used for the Neurosciences M.S. may not be double-counted to meet the requirements of a Ph.D. degree.
- All courses used for the Neurosciences M.S. must be taken for a letter grade and passed with a 3.0 (B) or better.
- Course requirements must be completed before the student applies for Terminal Graduate registration (TGR) Status

Students from other Stanford Ph.D. or professional degree programs may elect to take the M.S. degree in Neurosciences when they have met the following requirements:

1. Completion of a minimum of 45 unduplicated units of neurosciences course work, including the following Neuroscience courses or approved substitutes:

		Units
NEPR 202	Neurosciences Development Core	2
NEPR 203	Neuroscience Systems Core	2
NEPR 204	Neuroscience Molecular Core	2
NEPR 205	Neurosciences Anatomy Core	2
NEPR 207	Neurosciences Cognitive Core	2
NEPR 208	Neuroscience Computational Core	2
NEPR 213	Neurogenetics Core	2
NEPR/ COMPMED 201	Neuro-Cellular Core	2
NEPR 214/ NENS 207	Neuroscience Core Curriculum: Translational Neuroscience	2
NEPR 212	Responsible Conduct of Neuroscience Research	1

2. At least 3 quarters of MCP 300: Neuroscience Journal Club and Professional Development Series
3. A minimum of four (4) upper-level neuroscience courses that may be selected based on the interests and needs of the student with prior approval of the Program Director
4. A Stanford statistics course such as STATS 216: Introduction to Statistical Learning, or petition to receive credit for a different Stanford course
5. In addition to required coursework, students pursuing the M.S. in Neurosciences must sit for a Qualifying Exam that includes a written proposal for a thesis project and oral examination.
6. Students must also complete the proposed thesis project.

Doctor of Philosophy in Neurosciences

University requirements for the Ph.D. are described in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" section of this bulletin.

The interdepartmental Neurosciences Program offers instruction and research opportunities leading to a Ph.D. in Neurosciences. The requirements for a Ph.D. degree follow those of the University and in addition are tailored to fit the background and interests of the student. Qualified applicants should, where possible, apply for the predoctoral fellowships in open competition, especially those from the National Science Foundation.

Admissions

Applications are made through the Graduate Admissions (http://gradadmissions.stanford.edu) web site and are due in early December each year. Applicants should familiarize themselves with the research interests of the faculty and indicate their preferences clearly on the application form. Admitted students are notified from early March through mid-April. Accepted students receive an award covering tuition, a basic health plan, and a living stipend.

Course Requirements

Since students enter with differing backgrounds, and the labs in which they may elect to work cover several different disciplines, the specific program for each student is developed individually with an advisory committee. Students rotate through at least three labs during the first year while taking core modules. Passing of a comprehensive oral qualifying examination given by the student's advisory committee must be taken by the end of the second year, and is required for admission to Ph.D. candidacy. The student is required to present a Ph.D. dissertation, which is the result of independent investigation contributing to knowledge in an area of neuroscience, and to defend his or her dissertation in a University oral examination, which includes a public seminar. Students must also publish a first-author paper in a major scientific journal and submit a written dissertation prior to completing the Ph.D. degree.

Medical students may participate in this program provided they meet the prerequisites and satisfy all the requirements of the graduate program as listed above. The timing of the program may be adjusted to fit their special circumstances.

Students Enrolled Starting Autumn 2015 and Later

- Stanford Intensive Neuroscience (SIN) Boot Camp
- Nine (9) Neuroscience Core Modules:
  a. NEPR 202 Neurosciences Development Core
  b. NEPR 203 Neuroscience Systems Core
  c. NEPR 204 Neuroscience Molecular Core
  d. NEPR 205 Neurosciences Anatomy Core
  e. NEPR 207 Neurosciences Cognitive Core
  f. NEPR 208 Neuroscience Computational Core
  g. NEPR 213 Neurogenetics Core
  h. NEPR 201 Neuro-Cellular Core (same as COMPMED 201 Neuro-Cellular Core)
  i. NEPR 214 Neuroscience Core Curriculum: Translational Neuroscience (same as NENS 207 Neuroscience Core Curriculum: Translational Neuroscience)
- NEPR 212 Responsible Conduct of Neuroscience Research
- Nine (9) quarters of NEPR 300/MCP 300 Neuroscience Journal Club and Professional Development Series
- Statistics Course (STATS 216 Introduction to Statistical Learning or similar)

- Four (4) advanced level courses

Students Enrolled Starting Autumn 2014 and Earlier

- Introduction to Neurobiology (NBIO 206 The Nervous System or equivalent).
- Nine (9) quarters of NBIO 300/NEPR 300/MCP 300 Neuroscience Journal Club and Professional Development Series
- Five (5) advanced level courses within - and at least one course in each of - the following three areas:

1. Systems, Computational, Cognitive and Behavioral Neuroscience. Courses at this level focus on the computations performed by neural circuits and the role such computations play in behavior, perceptions, and plasticity. Students can expect to learn how neurons: Organize circuits into larger functional units; Represent and transform information; Produce myriad movement; and Subserve higher-level processing related to perception, reasoning and learning. Predominant methods in this area include modeling single cells and circuits, design of behavioral paradigms, and statistical analysis of behavioral and electrophysiological data.

Courses offered this academic year that can fulfill this include:

- COMPMED 207 Comparative Brain Evolution
- NBIO 258 Information and Signaling Mechanisms in Neurons and Circuits
- NENS 220 Computational Neuroscience
- PSYCH 202 Cognitive Neuroscience
- PSYCH 204A Human Neuroimaging Methods
- PSYCH 232 Brain and Decision Making
- PSYCH 251 Affective Neuroscience
- PSYCH 266 Current Debates in Learning and Memory

Courses offered in previous years that fulfilled this requirement include:

- NBIO 218 Neural Basis of Behavior
- NBIO 220 Central Mechanisms in Vision-based Cognition
- NENS 205 Neurobiology of Disease Seminar

2. Cellular, Molecular and Developmental Neuroscience. Courses in this area address fundamental mechanisms that enable cells of the nervous system to develop, function in adulthood, change during learning and memory, and/or malfunction in disease states. Students can expect to learn core concepts in: Cell-cell communication; Intracellular signal transduction; Transcriptional and translational control; mRNA and protein trafficking; Membrane biophysics; and Cell motility. Dominant methods include molecular biology, genetics, cell biology, electrophysiology, and subcellular or multicellular imaging.

Courses offered this academic year that can fulfill this include:

- BIO 214 Advanced Cell Biology/BIOC 224 Advanced Cell Biology/MCP 221 Advanced Cell Biology
- BIO 254 Molecular and Cellular Neurobiology
- BIOS 200 Foundations in Experimental Biology
- GENE 221 Current Issues in Aging
- NBIO 254 Molecular and Cellular Neurobiology
- NBIO 258 Information and Signaling Mechanisms in Neurons and Circuits
- PSYCH 204B Human Neuroimaging Methods

Courses offered in previous years that fulfilled this requirement include:

- MCP 216 Genetic Analysis of Behavior (NBIO 216)
- NBIO 216 Genetic Analysis of Behavior (MCP 216)
- BIO 217 Neuronal Biophysics
- COMPMED 215 Synaptic Properties and Neuronal Circuits
- MCP 256 How Cells Work: Energetics, Compartments, and Coupling in Cell Biology/MCP 156 How Cells Work: Energetics, Compartments, and Coupling in Cell Biology
- NBIO 218 Neural Basis of Behavior
- NBIO 220 Central Mechanisms in Vision-based Cognition

3. Translational Neuroscience. Courses in this area address fundamental concepts in studying disorders of the human brain and the peripheral nervous system and their treatment. Students can expect to learn about basic themes in: Pathophysiological mechanisms; Modeling of human diseases; Approaches to designing diagnoses and treatments; Implementing diagnoses and treatments. The courses highlight studies of human diseases that use genetics, molecular biology, psychological testing, and functional imaging.

Courses offered this academic year that can fulfill this include:

- BIO 267 Molecular Mechanisms of Neurodegenerative Disease / NENS 267 Molecular Mechanisms of Neurodegenerative Disease
- GENE 210 Genomics and Personalized Medicine / DBIO 220 Genomics and Personalized Medicine

Courses offered in previous years that fulfilled this requirement include:

- CSB 278 Systems Biology
- IMMUNOL 285 Brain and the Immune System
- NENS 205 Neurobiology of Disease Seminar

The previously-approved courses from outside the Neuroscience core listed below can satisfy the remaining elective requirements:

- BIO 217 Neuronal Biophysics
- BIO 222 Exploring Neural Circuits
- BIO 230 Molecular and Cellular Immunology
- BIO 245 Ecology and Evolution of Animal Behavior
- BIO 258 Developmental Neurobiology
- BIOC 224 Advanced Cell Biology/BIO 214 Advanced Cell Biology/MCP 221 Advanced Cell Biology
- BIOE 291 Principles and Practice of Optogenetics for Optical Control of Biological Tissues
- BIOE 332
- BIOS 200 Foundations in Experimental Biology
- BIOS 210 Axonal Transport and Neurodegenerative Diseases
- BIOS 241 Dissecting algorithms for RNA Sequencing
- COMPMED 207 Comparative Brain Evolution
- COMPMED 215 Synaptic Properties and Neuronal Circuits
- CS 221 Artificial Intelligence: Principles and Techniques
- CS 229 Machine Learning
- CSB 210 Cell Signaling
- DBIO 201 Development and Disease Mechanisms
- DBIO 210 Developmental Biology

- EE 263 Introduction to Linear Dynamical Systems/CME 263 Introduction to Linear Dynamical Systems
- MCP 221 Advanced Cell Biology/BIO 214 Advanced Cell Biology/BIOC 224 Advanced Cell Biology
- MCP 222 Imaging: Biological Light Microscopy
- NENS 267 Molecular Mechanisms of Neurodegenerative Disease/BIO 267 Molecular Mechanisms of Neurodegenerative Disease
- PSYCH 204 Computation and cognition: the probabilistic approach
- RAD 227 Functional MRI Methods/BIOPHYS 227 Functional MRI Methods

The previously-approved courses from outside the Neuroscience core listed below satisfied the remaining elective requirements:

- BIO 222 Exploring Neural Circuits
- CS 379 Interdisciplinary Topics
- IMMUNOL 285 Brain and the Immune System
- MUSIC 257 Neuroplasticity and Musical Gaming
- NENS 204 Stroke Seminar

Other courses not listed here can satisfy program requirements with prior approval of the Program Director.

Director: Anthony J. Ricci (Edward C. and Amy H. Sewall Professor in the School of Medicine and, Professor, by courtesy, of Molecular and Cellular Physiology)

Anesthesia: Rona Giffard, Gregory Scherrer, Sean Mackey, David Yeomans

Applied Physics: Surya Ganguli

Bioengineering: Kwabena Boahen, Karl Deisseroth

Biology: Xiaoke Chen, Russ Fernald, H. Craig Heller, Ron Kopito, Liqun Luo, Susan McConnell, Robert Sapolsky, Mark Schnitzer, Carla Shatz, Kang Shen

Comparative Medicine: Paul Buckmaster, Corrina Darian-Smith, Shaul Hestrin

Computer Science: Fei-Fei Li

Developmental Biology: Seung Kim, David Kingsley, Matthew Scott

Electrical Engineering: Krishna Shenoy

Genetics: Anne Brunet, Aaron Gitler

Microbiology and Immunology: Helen Blau

Molecular and Cellular Physiology: Axel Brunger, Miriam Goodman, Brian Kobilka, Richard Lewis, Daniel Madison, Merritt Maduke, Thomas Sudhof

Neurobiology: Stephen Baccus, Ben Barres, Thomas Clandinin, Lisa Giocomo, Eric Knudsen, Michael Lin, Tirin Moore, William Newsome, Jennifer Raymond

Neurology and Neurological Sciences: Katrin Andreasson, Marion Buckwalter, Yoon-Jae Cho, May Han, Ting-Ting, Huang, Jun Ding, John Huguenard, Frank Longo, Michelle Monje-Deisseroth, Josef Parvizi, Kathleen Poston, Thomas Rando, Richard Reimer, Tony Wyss-Coray, Yanmin Yang

Neurosurgery: E.J. Chichilnisky, Jun Ding, Theo Palmer, Giles Plant, Gary Steinberg, Xinnan Wang, Heng Zhao

Ophthalmology: Jeffrey Goldberg, Y. Joyce Liao

Otolaryngology: Alan Cheng, Stefan Heller, Mirna Mustapha, Anthony Ricci

Pathology: Isabella Graef, Bingwei Lu, Marius Wernig

Psychiatry and Behavioral Sciences: Lu Chen, Luis de Lecea, Firdaus Dhabhar, David Lyons, Robert Malenka, Vinod Menon, Karen Parker, Allan Reiss, Lea Williams, Jamie Zeitzer

Psychology: Justin Gardner, Ian Gotlib, Kalanit Grill-Spector, James Gross, Brian Knutson, James McClelland, Anthony Norcia, Russell Poldrack, Anthony Wagner, Brian Wandell

Radiology: Gary Glover

Courses

NEPR 201. Neuro-Cellular Core. 2 Units.
Focuses on fundamental aspects of cellular neurophysiology. Topics include exploration of electrophysiological properties of neurons, synaptic structure and function and synaptic plasticity. The course consists of didactic lectures and student-led discussions of classical papers. Incorporates simulation program Neuron. Enrollment restricted to students enrolled in Neurosciences Graduate Program.
Same as: COMPMED 201

NEPR 202. Neurosciences Development Core. 2 Units.
For first-year Neurosciences graduate students; open to other graduate students as space permits with preference given to Neuroscience students. Introductory course covers all aspects of nervous system development, from cell fate determination, axon guidance, synapse development and critical periods to neurodevelopmental diseases. The goal is to understand what kinds of questions are asked in developmental neurobiology and how researchers use different tools and model systems to answer these questions. Overview of neural development, experimental approaches, and model organisms; signaling pathways regulating neural development; neural stem cell and neurogenesis during embryonic and adult life.

NEPR 203. Neuroscience Systems Core. 2 Units.
Open to first-year neuroscience graduate students and to other qualified students by permission of the instructors. Introduction to encoding and processing of information by neural systems. Focus is on sensory and motor circuits.

NEPR 204. Neuroscience Molecular Core. 2 Units.
For first-year Neurosciences graduate students; open to other graduate students as space permits with preference given to Neuroscience students. Course provides an overview of molecular neuroscience by focusing on a few selected key topics, such as molecular neuroscience methods, voltage-gated ion channels, synaptic transmission, neuronal gene expression, and signal transduction pathways.

NEPR 205. Neurosciences Anatomy Core. 2 Units.
For first-year Neuroscience graduate students; open to other graduate students as space permits with preference given to Neuroscience students. Focus is on fundamentals of the functional architecture of the human brain. Covers spinal cord, brainstem, thalamus, cerebellum, basal ganglia, frontal lobe, parietal lobe, occipital lobe, temporal lobe, and insula as well as the major white matter tracts. Students learn the anatomical connections of their assigned brain region and build a brain model.

NEPR 207. Neurosciences Cognitive Core. 2 Units.
For first-year Neurosciences graduate students; open to other graduate students as space permits with preference given to Neuroscience students. Focus is on several domains of cognitive function where cognitive neuroscience approaches have been successfully applied across many different model systems from mice to monkeys to humans: attention, decision-making, and memory.

NEPR 208. Neuroscience Computational Core. 2 Units.
For first-year Neurosciences graduate students; open to other graduate students as space permits with preference given to Neurosciences students. Introduces students to computational and theoretical methods in neuroscience. Emphasis on what questions are important, and how those questions can be answered with quantitative methods. Topics range from cellular/molecular to cognitive, and emphasizes similarity and differences of methods across neural scales.

NEPR 212. Responsible Conduct of Neuroscience Research. 1 Unit.
Enrollment restricted to Neurosciences IDP students. Responsible conduct of research and ethics as it relates to research in neuroscience. Topics are in accord with NIH guidelines. Each topic has guest lecturers with specific insight into the particular topic.

NEPR 213. Neurogenetics Core. 2 Units.
For first-year Neurosciences graduate students; open to other graduate students as space permits with preference given to Neurosciences students. Intensive introduction to genetics. Classical and modern genetics with an emphasis on their application to neurosciences research. Topics include: model organisms, genetic screens, genome editing, genetically-encoded tools, GWAS, next-generation sequencing, epigenetics, genetic interactions, human genetics, and neurological disease genetics. Interactive class with student-led discussions, presentations, and group work, including next-generation sequencing workshops and data analysis tutorials. Limited enrollment.

NEPR 214. Neuroscience Core Curriculum: Translational Neuroscience. 2 Units.
Emphasis on basic and preclinical research in selected categories of neurological disease, and understanding how these discoveries are being translated into therapies. Readings include primary scientific literature in mechanisms of disease and translational approaches and selected current reviews. Enrollment limited to 20 students. For first year Neuroscience graduate students, open to other graduate students as space permits with preference given to Neurosciences students .
Same as: NENS 207

NEPR 280. Neuroscience Journal Club and Professional Development Series. 1-2 Unit.
Neuroscience Journal Club and Professional Development Series New description: Required of Neurosciences Ph.D. students in Autumn, Winter, and Spring of the first three years of study. Recent papers in neuroscience literature presented by graduate student.
Same as: MCP 300

NEPR 299. Directed Reading in Neurosciences. 1-18 Unit.
Prerequisite: consent of instructor.

NEPR 399. Graduate Research. 1-18 Unit.
StudenInvestigations sponsored by individual faculty members.
Prerequisite: consent of instructor.

NEPR 801. TGR Project. 0 Units.
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NEPR 802. TGR Dissertation. 0 Units.
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