

Neuroscience (NEU)

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Graduate Program Director: Lonnie Wollmuth, Life Sciences Building Room 520, (631) 632-8630

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Degree awarded: Ph.D. in Neuroscience

The graduate program in Neuroscience, in the College of Arts and Sciences, offers doctoral training in the rapidly expanding field of neuroscience. Through coursework and independent research, students are trained to approach research problems in neuroscience with a broad perspective. Expertise in the areas of molecular and biochemical control of development, properties of receptors and ion channels in relation to cellular physiology, the cellular basis of integrative functions, and the structural basis for communication among neurons are available to all students in the program. Graduate students will receive in-depth research training in molecular, biochemical, physiological, behavioral, or anatomical sciences. In addition the program offers unique opportunities to draw from one or more of these disciplines through multidisciplinary, cosponsored research projects. A program of highly interactive faculty and students provides an exciting focus for research training.

Facilities

Program faculty are located in the Life Sciences Building, Centers for Molecular Medicine, and Health Sciences Center on the Stony Brook campus and at Brookhaven National Laboratory and the Cold Spring Harbor Laboratory. Molecular facilities provide for analysis of protein and DNA biochemistry, including microsequencing, peptide mapping, synthesis of oligonucleotides and peptides, cellular transfection, and production of transgenic animals. Wide-ranging facilities for cellular and integrative electrophysiology exist for studies on dissociated neurons, brain slice preparations, neurons *in situ*, and genetically engineered cells in culture. Imaging facilities permit anatomical reconstruction, fluorescence measurements, and the use of ion-sensitive indicators on both conventional and confocal microscopes. An image analysis core is linked to a scanning and transmission electron microscopy facility.

Admission

Students are expected to fulfill basic requirements of the Graduate School: a bachelor's degree from a recognized university, a grade point average corresponding to B or higher, evidence of the capacity to do satisfactory graduate work as evidenced by scores on the Graduate Record Examination (GRE), and the recommendations of three former instructors. In addition, all international students must score a minimum of 600 on the Test of English as a Foreign Language (TOEFL). The program in Neuroscience has the following additional requirements: one year of calculus, physics, and chemistry, and demonstrated proficiency in biological sciences. Deficiencies in the program requirements do not preclude admission and special consideration will be made to promising applicants.

Faculty

Distinguished Professors

Mendell, Lorne M., Ph.D., 1965, Massachusetts Institute of Technology: Functional effects of neurotrophins in pain and segmental reflex pathways.

Professors

Adams, Paul R., Ph.D., 1974, University of London, England: Models of synaptic learning; neocortical design.

Brink, Peter,³ Ph.D., 1976, University of Illinois: Electrotonic synapses.

Evinger, Leslie Craig, Ph.D., 1978, University of Washington: Motor control and learning; movement disorders.

Frohman, Michael,² Ph.D., M.D., 1985, University of Pennsylvania: Regulation of exocytosis and cell shape by signaling proteins.

Halegoua, Simon, Ph.D., 1978, Stony Brook University: Neuronal growth factor signaling and the control of phenotype and survival.

Levine, Joel M., Ph.D., 1980, Washington University: Molecular biology of nerve regeneration; nerve-glia interactions.

Matthews, Gary G., Ph.D., 1975, University of Pennsylvania: Cellular and molecular neurobiology of the retina.

McKinnon, David, Ph.D., 1987, Australian National University: Molecular control of neuron firing properties.

McLaughlin, Stuart,³ Ph.D., 1967, University of British Columbia, Canada: Biophysics of signal transduction.

Morin, Lawrence P.,⁴ Ph.D., 1974, Rutgers University: Neural control of mammalian circadian rhythms.

Role, Lorna, Ph.D., 1981, Harvard University: Neurobiology and pathology of cortico-lymbic circuits.

Yazulla, Stephen, Ph.D., 1971, University of Delaware: Synaptic circuitry of the vertebrate retina.

Associate Professors

Anderson, Brenda J.,⁵ Ph.D., 1993, University of Illinois: Neuroanatomical and metabolic plasticity.

Evinger, Marian J.,¹ Ph.D., 1978, University of Washington: Neural regulation of gene expression; cholinergic intracellular signaling pathways.

Kernan, Maurice, Ph.D., 1990, University of Wisconsin: Drosophila mechanosensory transduction; differentiation of sensory cilia and sperm.

Kritzer, Mary, Ph.D., 1989, Yale University: Sex differences in cortical microcircuitry.

Sirotkin, Howard, Ph.D., 1996, Albert Einstein College of Medicine: Molecular genetics of vertebrate neural patterning.

Solomon, Irene C.,³ Ph.D., 1994, University of California, Davis: Neural control of respiratory motor output and fast oscillatory rhythms.

Talmage, David A.,² Ph.D., 1981, University of Minnesota: Neuregulin signaling and synaptic homeostasis.

Tsirka, Styliani-Anna E.,² Ph.D., 1989, University of Thessaloniki: Neuronal-microglial interactions in the physiology and pathology of the central nervous system.

Wollmuth, Lonnie, *Graduate Program Director*, Ph.D., 1992, University of Washington: Molecular mechanisms of synaptic transmission.

Assistant Professors

Colognato, Holly,² Ph.D., 1999, Rutgers University: Molecular mechanisms that control oligodendrocyte function during nervous system development and during disease.

Adjunct Faculty

Cline, Hollis,⁷ Ph.D., 1985, University of California, Berkeley: Molecular control of neuronal plasticity.

Dewey, Stephen L.,⁶ Ph.D., 1985, University of Iowa: Medical imaging and functional neurotransmitter interactions in substance abuse.

Dubnau, Josh,⁷ Ph.D., 1995, Columbia University: Genetic dissection of memory in *Drosophila*.

Enikolopov, Grigori,⁷ Ph.D., 1978, Academy of Russia: Nitric oxide; neuron differentiation; survival.

Gifford, Andrew N.,⁶ Ph.D., 1989, St. Andrews University, Scotland: Pharmacology of brain receptors and neurotransmitter release.

Huang, Z. Josh,⁷ Ph.D., 1994, Brandeis University: Development and plasticity of the neocortical GABAergic circuits.

Mainen, Zachary,⁷ Ph.D., 1995, University of California, San Diego: Neural coding and computations underlying rodent olfactory-guided behavior.

Peña, Louis,⁶ Ph.D., 1991, University of California, Los Angeles: Cellular and molecular mechanisms of radiation sensitivity; nuclear medicine imaging of neurological disorders.

Thanos, Peter,⁶ Ph.D., 1997, Eastern Virginia Medical School: Behavioral neuropharmacology and neuroimaging of addiction (including alcohol, drugs, and food) and ADHD.

Tully, Tim,⁷ Ph.D., 1981, University of Illinois: Genetic basis of memory.

Zador, Anthony,⁷ M.D., Ph.D., 1994, Yale University: How does the cortex solve the cocktail party problem?

Zhong, Yi,⁷ Ph.D., 1991, University of California, Berkeley: Neurogenetics.

Number of teaching, graduate, and research assistants, Fall 2007: 32

1) Primary appointment with Pediatrics

2) Primary appointment with Pharmacology

3) Primary appointment with Physiology and Biophysics

4) Primary appointment with Psychiatry

5) Primary appointment with Psychology

6) Primary appointment with Brookhaven National Laboratory

7) Primary appointment with Cold Spring Harbor Laboratory

Degree Requirements**Requirements for the M.A. Degree**

The graduate program in Neuroscience normally does not accept a student whose goal is an M.A. degree. In exceptional instances, a student already in the program may be awarded an M.A. degree upon completion of an approved course

of study, including 30 graduate credit hours, a preliminary examination, a research thesis, and the minimum requirements of the Graduate School.

Requirements for the Ph.D. Degree**A. Course Requirements**

1. Core courses in neuroscience (BNB 561, BNB 562, BNB 563, BNB 564). A four-semester series taught by members of the program; the student is introduced to a broad variety of topics. These will be taken in the fall and spring semesters of the first and second years.

2. Laboratory Rotations in Neuroscience (BNB 555). A two-semester course in the fall and spring semesters of the first year. Students conduct research rotations in laboratories of three program members and present oral reports on their research.

3. Writing Neuroscience (BNB 551). This course is taught in the fall semester of the first year. It provides training in the basics of scientific communication, with a strong emphasis on writing and revision. Practical exercises are designed to give experience and feedback in commonly needed aspects of scientific writing.

4. Advanced Neurobiology and Behavior Seminar (BNB 697). Seminar presentations delivered by faculty, students, associates, and visiting speakers.

5. Electives. At least two additional graduate-level courses in various biological, physical, or mathematical sciences must be selected by the student in consultation with the student's advisor. Students may take additional elective courses if they desire.

B. Comprehensive Examination

At the end of the second year of study, each student must take a comprehensive examination. The examination consists of the preparation and defense of a written proposal in the area and on the topic in which the student expects to do their thesis research.

C. Advancement to Candidacy

The faculty will recommend a student to the Graduate School for advancement to candidacy upon satisfactory completion of all course requirements and the comprehensive examination.

D. Ph.D. Dissertation

A dissertation that constitutes an

original and significant contribution to the field of neuroscience is required for the Ph.D. The work must be of a quality acceptable for publication in a recognized scientific journal. At the end of the first year, students normally initiate a dissertation research program in a program faculty's laboratory. After advancement to candidacy, the student and advisor will assemble an advisory committee to guide the dissertation research. Upon completion of the dissertation research, the student will present a seminar based on the dissertation. Following this the student will be given an oral examination on the dissertation research and related areas by the dissertation committee.

E. Teaching Requirements

To gain experience in teaching, the program requires that all students serve as teaching assistants during the first two years of study. Usually, TA assignments are to courses taught by the program faculty. Assignments are made to minimize impact on research productivity in the second year of study.

F. Residence Requirement

The University requires at least two consecutive semesters of full-time study. The demands of the course of study necessitate a longer period of residence.

G. Academic Standing

All students must maintain a 3.0 grade point average at all times. Due to the importance of BNB 561-564 as the basis for advanced study in Neuroscience, students who have a grade of less than a B in these courses must repeat them satisfactorily prior to taking the comprehensive examination. Any student who fails to receive a grade of B or better in more than one required course will be reviewed for possible termination from the program. Research (BNB 599 and 699) is graded on a satisfactory/unsatisfactory basis. Any student who receives a grade of U in a research course will be reviewed for possible termination from the program.

Courses

BNB 531 Advanced Neurobiology

Advanced seminar course centered around a topic to be determined. Examples include neurochemistry, membrane biophysics, neuronal plasticity, synaptic mechanisms, molecular neurobiology, developmental neurobiology. Students are expected to read original literature and deliver oral presentations of material.

Prerequisite: Permission of instructor
Fall, 3 credits, ABCF grading

BNB 551 Writing Neuroscience

Seminar course for doctoral students in Neuroscience providing practical instruction in written communication in Neuroscience. Topics include writing effective abstracts, cover letters, figure captions, and grant-specific aims, among others.

Prerequisite: Admission to graduate program in Neuroscience or permission of instructor
1-2 credits, ABCF grading

BNB 552 Neurobiological Techniques

A series of laboratory exercises designed to give students hands-on experience in the basic laboratory techniques of contemporary neuroscience. Includes intracellular and extracellular recording, neuronal tissue culture, neuroanatomical techniques, and integrative physiology.

Fall, every year, 2 credits, ABCF grading

BNB 555 Laboratory Rotations in Neuroscience

Course for doctoral students in Neuroscience in which students participate in three formal laboratory rotations in program faculty laboratories during the first year. Students make oral presentations for each rotation. Instruction is provided in how to organize and present material in a seminar format, including the proper use of visual aids. Enrollment restricted to students in the graduate program in Neuroscience.

Fall and spring, 1-3 credits, S/U grading
May be repeated once for credit

BNB 560 Laboratory in Neuroanatomy

This course consists of a series of laboratory exercises and supplemental lectures providing an overview of the structural organization of the nervous system. The mammalian nervous system and its sensory, motor, and cognitive components are emphasized. Laboratories include examination of whole brains and histological sections, and some hands-on experience with basic neuroanatomical techniques. Computer programs illustrating the three-dimensional and circuit organization of the human brain are also used.

Prerequisites: BIO 334 or equivalent and permission of instructor
Fall, 2 credits, ABCF grading

BNB 561 Introduction to Neuroscience I

First of a two-semester core course introducing students to basic principles of neuroscience. The major focus is cellular and molecular neuroscience. Topics covered include the ionic basis of resting potentials and electrical excitability, the structure, function and molecular biology of voltage- and ligand-gated ion channels, exocytosis, cellular

networks, and gene regulation.

4 credits, ABCF grading

BNB 562 Introduction to Neuroscience II

Second of two-semester core course introducing students to basic principles of neuroscience. The major focus is systems neuroscience. Topics covered include analyses of all major sensory systems, motor systems, and systems mediating higher order, cognitive functions in the nervous system.

4 credits, ABCF grading

BNB 563 Advanced Topics in Neuroscience I

This course includes one to three separate modules taught by different faculty on focused topics in neuroscience, typically focusing on synaptic plasticity and development.

1-3 credits, ABCF grading

BNB 564 Advanced Topics in Neuroscience II

This course includes one to three separate modules taught by different faculty on focused topics in neuroscience.

Spring, 1-3 credits, ABCF grading

BNB 565 Developmental Neuroscience

A modular course introducing concepts in the development of the nervous system. Topics can include neuroembryology, neuronal differentiation, synapse formation, and specificity and plasticity of connections in vertebrates and invertebrates.

Fall, 1 credit, ABCF grading

BNB 599 Research

Original investigation undertaken with supervision of a member of the staff.

Fall and spring, 1-12 credits, S/U grading

May be repeated for credit

BNB 655 Neuropharmacology

An advanced course for graduate students interested in developing an understanding of neuropharmacology and research on this topic. Following a general introduction to the nerve cell structure, synaptic and chemical transmission, three themes receptors, receptors as channels, and G-protein-coupled receptors are developed. Recent advances in cell and molecular biology provide the framework for instruction and discussion. This course is offered as both HBH 655 and BNB 655.

Prerequisites: Admission to graduate Health Sciences Center program

Spring, even years, 3 credits, ABCF grading

BNB 697 Advanced Neurobiology and Behavior Seminar

Seminar presentations delivered by faculty, associates, students, and visiting speakers.

Fall and spring, 1 credit, S/U grading

May be repeated for credit

BNB 699 Dissertation Research On Campus

Original investigations undertaken as part of the Ph.D. program under the supervision of the dissertation committee.

Prerequisite: Must be advanced to candidacy (G5); major portion of research must take place on SB campus, at Cold Spring Harbor, or at Brookhaven National Lab

Fall, spring, and summer, 1-9 credits,

S/U grading

May be repeated for credit

BNB 700 Dissertation Research Off Campus—Domestic

Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place off campus, but in the U.S. and/or U.S. provinces (Brookhaven National Lab and Cold Spring Harbor Lab are considered on campus); all international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor

Fall, spring, and summer, 1-9 credits, S/U grading

May be repeated for credit

BNB 701 Dissertation Research Off Campus—International

Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place outside the U.S. and/or U.S. provinces; domestic students have the option of the health plan and may also enroll in MEDEX; international students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed; international students who are not in their home country are charged for the mandatory health insurance (if they are to be covered by another insurance plan, they must file a waiver by the second week of classes; the charge will only be removed if the other plan is deemed comparable); all international students must receive clearance from an International Advisor

Fall, spring, and summer, 1-9 credits,

S/U grading

May be repeated for credit

BNB 800 Summer Research

0 credit, S/U grading

May be repeated for credit