Neuroscience

AN INTERDEPARTMENTAL MAJOR

Professor: *Beltz (Director)*

Associate Professor: *Tetel*

Assistant Professor: *Conway, Gobes, Wiest*

Senior Instructor in Neuroscience Laboratory: *Paul*[A1]

Neuroscience Advisory Committee: *Cameron (Biology), Ducas (Physics), Hildreth (Computer Science), Keane (Psychology), Kolodny (Chemistry)*

Neuroscience explores how the nervous system develops and how it functions to generate behavior, emotion and cognition. Neuroscience is highly interdisciplinary, integrating biology, psychology, chemistry, physics and computer science. Exploring the complexity of the nervous system requires analyses at multiple levels. Neuroscientists investigate how genes and molecules regulate nerve cell development and function (cellular/molecular neuroscience), explore how neural systems produce integrated behaviors (behavioral neuroscience), seek to understand how neural substrates create mental processes and thought (cognitive neuroscience) and use mathematics and computer models to comprehend brain function (computational neuroscience). In studying how the brain and nervous system function normally and during disease states, neuroscientists also hope to better understand devastating neurological and psychiatric disorders.

Goals for the Major

Create a cohesive and supportive interdepartmental community

Foster an excitement for neuroscience and an understanding of applications of neuroscience discoveries to everyday life

Appreciate the ethical complexities involved in the pursuit and application of knowledge about the brain and cognition

Cultivate an understanding of the relationships among disparate subfields that comprise neuroscience, including cellular and molecular, cognitive, computational and systems neuroscience

Develop the ability to read and critically evaluate the neuroscience literature

Acquire confidence and fluency with oral and written communication

Generate a facility with the major experimental methods and techniques used by neuroscientists, including

–electrophysiology

–computational modeling

–neurochemistry

–neuropharmacology

–neuranatomy

–genomics

–behavioral approaches

Master analytical and statistical methods critical to the evaluation of experimental data

Encourage an environment supportive of student involvement in neuroscience research

We anticipate that fulfillment of these goals will provide the intellectual and technical skills necessary for the successful pursuit of graduate school, medical school and careers in neuroscience-related fields.

NEUR 100 Brain, Behavior, and Cognition: An Introduction to Neuroscience
Tetel, Beltz, Paul, Gobes
This course will provide a broad introduction to neuroscience, focusing on examples and approaches from cellular and molecular, cognitive, behavioral, systems and computational neuroscience. The lecture aspect of the course will be accompanied by a 70-minute practicum in which students will engage directly in experimental neuroscience.

Prerequisite: Open only to first years and sophomores, or by permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall, Spring Unit: 1.0

NEUR 200 Neurons, Networks, and Behavior with Laboratory
Conway, Paul, Helluy (Biological Sciences)
This course will build on basic concepts in neuroscience. Current issues will be examined within a broad framework that includes examples and readings in cellular and molecular, cognitive, behavioral and computational neuroscience. Topics such as sensory systems, learning, memory, and cognition will be covered. The accompanying laboratory is designed to expose students to basic methods and experimental approaches in neuroscience.

Prerequisite: 100 and BISC 110 or permission of instructor. Not open to first-year students.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall, Spring Unit: 1.25

NEUR 250 Research or Individual Study

Prerequisite: By permission of instructor.

Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 250H Research or Individual Study

Prerequisite: By permission of instructor.
Distribution: None
Semester: Fall, Spring Unit: 0.5

NEUR 250G Group Research in Neuroendocrinology

An introduction to the literature and research methods in Neuroendocrinology, with particular emphasis on how hormones work in the brain to regulate behavior and physiology. Students will learn how to ask and address fundamental questions in neuroendocrine research by conducting literature searches and critically reading and evaluating original research articles in neuroendocrinology. Students will be exposed to current methods in neuroendocrinology, including behavioral analyses, neuroanatomy, analysis of protein expression in brain protein -protein interaction assays. Individual and group laboratory projects will be offered.

Prerequisite: Open to sophomores by permission of instructor
Distribution: None
Semester: N/O Unit: 1.0

NEUR 300 Capstone Seminar in Neuroscience

Beltz, Gobes

In this capstone seminar for neuroscience majors, students will give group presentations of articles on cutting edge areas of neuroscience research. The authors of these articles will be invited to campus to present their research and meet with the class. Some of the topics to be discussed include: developmental neuroscience, computational and systems neuroscience, cognitive neuroscience, learning and memory and neurodegenerative disorders. In addition, careers in neuroscience will be discussed.

Prerequisite: 200. Open only to junior and senior neuroscience majors.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall Unit: 1.0

NEUR 306/BISC 306 Principles of Neural Development with Laboratory

Beltz, Paul

This course will discuss aspects of nervous system development and how these relate to the development of the organism as a whole. Topics such as neural induction, neurogenesis, programmed cell death, axon guidance, synaptogenesis and the development of behavior will be discussed, with an emphasis on the primary literature and critical reading skills. Laboratory sessions focus on a variety of methods used to define developing neural systems. *Students may register for either NEUR 306 or BISC 306 and credit will be granted accordingly.*

Prerequisite: 200 or BISC 216 or permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Spring Unit: 1.25

NEUR 315/BISC 315 Neuroendocrinology with Laboratory

Tetel

Hormones act throughout the body to coordinate basic biological functions such as development, differentiation and reproduction. This course will investigate how hormones act in the brain to regulate physiology and behavior. We will study how the major neuroendocrine axes regulate a variety of functions, including brain development, reproductive physiology and behavior, homeostasis and stress. The regulation of these functions by hormones will be investigated at the molecular, cellular and systems levels. Laboratory experiments will explore various approaches to neuroendocrine research, including the detection of hormone receptors in the brain and analysis of behavior. *Students may register for either NEUR 315 or BISC 315 and credit will be granted accordingly.*

Prerequisite: 200, or both BISC 110/112 and BISC 203, or permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall Unit: 1.25

NEUR 320 Vision and Art with Laboratory

Conway, Jones (MIT)

This course investigates the form and function of the visual system and the cultural and historical products that are engaged with it. Our goal is to explore the art, science, and culture of seeing. We will examine the nature of the visual stimulus and the physiological mechanisms that trigger perception. In parallel, we will explore how such processes drive the practice of art at different times and in different cultures. The course will employ experimental investigations of your own visual system, guided analysis of art objects, exercises in making art, field trips, examinations of illusions, and inquiries into machine vision. The interdisciplinary nature of the course requires an advanced level of participation, commitment, and self-directed learning culminating in a final project of your own design. The course will consist of lectures to be held at MIT on one evening per week, and laboratory exercises held at Wellesley during one three-hour session per week.

Prerequisite: 100 or by permission of instructor. Not open to first year students.
Distribution: Natural and Physical Science or Arts, Music, Theatre, Film, Video
Semester: Fall Unit: 1.25

NEUR 325 Neurobiology of Sleep, Learning & Memory

Gobes

Although we spend a major part of our lives sleeping, we understand surprisingly little about sleep and dreaming. In this course we will discuss recent advances made in the field of neuroscience of sleep. Course topics include basic neurobiology of sleep (what is sleep, how is it regulated) as well as specialized discussions of sleep-related learning & memory investigated in different model systems. Lectures will introduce the different topics, followed by student presentations of the primary literature. Assignments are given to train writing skills and to give students the opportunity to explore their favorite topic in more detail.

Prerequisite: 100 and 200. Open only to juniors and seniors, or by permission of instructor.
Distribution: Natural and Physical Science or Arts, Music, Theatre, Film, Video
Semester: Spring Unit: 1.0

NEUR 332 Advanced Topics in Neuroscience

NOT OFFERED IN 2011-12.

Prerequisite: 200 or by permission of the instructor. Not open to first year students.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: N/O Unit: 1.0

NEUR 335 Computational Neuroscience with Laboratory

Wiest

The electrical activities of neurons in the brain underlie all of our thoughts, perceptions, and memories. However, it is difficult to measure these neural activities experimentally, and also difficult to describe them precisely in ordinary language. For this reason, mathematical models and computer simulations are increasingly used to bridge the gap between experimental measurements and hypothesized network function. This course will focus on the use of mathematical models and computer simulations to describe the functional dynamics of neurons in a variety of animals. Topics will range from single neuron biophysics to the analysis of circuits thought to underlie sensory perception and memory. Topics will be introduced by background lectures, followed by student-led presentations of primary literature and construction of a computer model of the system studied. Lab will introduce students to computer programming of mathematical models in MATLAB and the neuron-simulator NEURON.

Prerequisite: 200 and calculus at the level of MATH 115, or by permission of instructor. No programming experience is required.
Distribution: Natural and Physical Science or Mathematical Modeling
Semester: N/O Unit: 1.25

NEUR 350 Research or Individual Study

Prerequisite: Open by permission to juniors and seniors.
Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 350H Research or Individual Study

Prerequisite: Open by permission to juniors and seniors.
Distribution: None
Semester: Fall, Spring Unit: 0.5

NEUR 350G Group Research in Neuroendocrinology

An introduction to the literature and research methods in Neuroendocrinology, with particular emphasis on how hormones work in the brain to regulate behavior and physiology. Students will learn how to ask and address fundamental questions in neuroendocrine research by conducting literature searches and critically reading and evaluating original research articles in neuroendocrinology. Students will be exposed to current methods in neuroendocrinology, including behavioral analyses, neuroanatomy, analysis of protein expression in brain protein-protein interaction assays. Individual and group laboratory projects will be offered.

Prerequisite: Open to juniors and seniors by permission of instructor
Distribution: None
Semester: N/O Unit: 1.0

NEUR 360 Senior Thesis Research

Prerequisite: By permission of the Program. See Academic Distinctions.
Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 370 Senior Thesis

Prerequisite: 360 and permission of the Program.
Distribution: None
Semester: Fall, Spring Unit: 1.0

Requirements for the Major

The major in neuroscience offers three areas of concentration: cellular and molecular neuroscience, cognitive neuroscience, and systems and computational

neuroscience. Students are expected to achieve competence in two of these three areas. The major must include the following core courses: NEUR 100, 200 and 300, BISC 110 or 112 and PSYC 205. Majors must elect three 200-level courses from at least two different areas of concentration: Cellular and molecular neuroscience: BISC 219, 220, CHEM 211, 221 or 222; Cognitive neuroscience: PSYC 214, 215, 216, 217, 218; Systems and computational neuroscience: CS 232, MATH 215, PHYS 216, 222. Note that these 200-level courses have specific prerequisites that must be satisfied. Majors must also elect three 300-level courses from at least two different areas of concentration, at least one of which must be a laboratory course: Cellular and molecular neuroscience: NEUR/BISC 306, NEUR/BISC 315, BISC 302, [CHEM 306 (only when neuroscience-related topics)]; Cognitive neuroscience: PSYC 301, 304R, 314R, 316, 318, 319, 328; Systems and computational neuroscience: NEUR 320, NEUR 335, CS 332. Any other 300-level courses must be specifically approved by the Director. NEUR 332 (NOT OFFERED IN 2011-12) will count towards the major in whatever concentration reflects the topic in that year. NEUR 250, 250G, 250H, 350, 350G, 350H, 360 and 370 do not count towards the minimum major. A minimum of eight courses towards the major requirements must be taken at Wellesley. Additional information is also available on the Web at http://www.wellesley.edu/neuroscience/major_complete.html.

For students who entered the College in the fall of 2008, the major in neuroscience is the same as for those entering later, but excludes BISC 110 or 112.

Normally no more than three units in neuroscience taken at other institutions may be counted towards the major.

Transfer Credit

To obtain Wellesley credit for any neuroscience course taken at another institution, preliminary approval must be obtained from the director of the program prior to enrolling in the course. In general, courses taken at two-year colleges will not be accepted. These restrictions apply to courses taken after enrollment at Wellesley. Transfer students wishing to obtain credit for courses taken prior to enrollment at Wellesley should consult the program director.

Honors

The only route to honors in the major is writing a thesis (NEUR 360/370) and passing an oral examination. To be admitted to the thesis program, a student must have a grade point average of at least 3.5 in all work in the major field above the 100-level. The department may petition on her behalf if her grade point average in the major is between 3.0 and 3.5. Projects may be supervised by members of the various departments associated with the major. Students considering the senior thesis option are advised to consult with the director of the program during the fall of their junior year. See Academic Distinctions.

Graduate Study

Students wishing to attend graduate school in neuroscience are strongly encouraged to take CHEM 211/212, CS 112, MATH 115/116 and physics through PHYS 106 or PHYS 108. PHYS 210 may also be of interest.