NEUROSCIENCE (BI-CO)

Department Website:
https://www.haverford.edu/neuroscience

The desire to understand human and animal behavior in terms of nervous system structure and function is longstanding. Historically, researchers and scholars have approached this task from a variety of disciplines, including medicine, biology, psychology, philosophy, and physiology. The field of neuroscience emerged as an interdisciplinary approach, combining techniques and perspectives from these disciplines, as well as emerging fields such as computation and cognitive science, to yield new insights into the workings of the nervous system and behavior.

The Major and Minor in Neuroscience advance two overlapping but distinct sets of learning goals, which are explained in turn below.

Learning Goals

Neuroscience Major

The **major** in Neuroscience allows students to pursue an in-depth study of the nervous system and behavior across disciplines. Students should consult with the Neuroscience Director or any member of the faculty advisory committee in order to declare the major.

The goals of the major include enabling students to gain:

- Training in cognate disciplines that are fundamental to the study of neuroscience
- An in-depth understanding of the organization of the nervous system and its relation to categories of behavior such as motor control, sensation and perception, motivational states, and higher cognition.
- fluency with the many levels at which the nervous system can be studied, including molecular, cellular, systems, behavioral and cognitive neuroscience levels.
- an ability to closely examine and critically evaluate primary research on specialized, advanced neuroscience topics.
- an appreciation of the interdisciplinary nature of neuroscience and the allied disciplines that inform the study of mind, brain, and behavior.
- Experience with neuroscience laboratory skills and the design and analysis of neuroscience experiments.

Neuroscience Minor

The **minor** in Neuroscience allows students with any major to pursue interests in behavior and the nervous system across disciplines. Students should consult with the Neuroscience Director or any member of the faculty advisory committee in order to declare the minor.

The goals of the minor include enabling students to gain:

- a basic understanding of the organization of the nervous system and its relation to categories of behavior such as motor control, sensation and perception, motivational states, and higher cognition.
- an appreciation of and fluency with the many levels at which the nervous system can be studied, including molecular, cellular, systems, behavioral and cognitive neuroscience levels.
- an appreciation of the interdisciplinary nature of neuroscience and the allied disciplines that inform the study of mind, brain, and behavior.
- an ability to closely examine and critically evaluate primary research on specialized, advanced neuroscience topics.

Haverford's Institutional Learning Goals are available on the President's website, at http://hav.to/learninggoals.

Major Requirements

- Introduction to Neuroscience (1 credit)
  - NEUR H100
- Foundational Science Courses (4 credits)
  - 1 semester of General Chemistry (CHEM H111, CHEM H113, CHEM H115, CHEM B103)
  - 1 semester of Introductory Biology (BIOL H200, BIOL B110 or BIOL B111)
  - 1 semester of Introductory Psychology (PSYC H100 or PSYC B105)
  - 1 semester of Statistics (PSYC H200, PSYC B205; MATH H103 or MATH H203, MATH B104, or ECON H203)
- Upper-level Neuroscience Courses with Breadth Requirement (4 credits)
  - Students must take 4 credits of upper-level neuroscience courses
  - Upper-level Neuroscience courses are divided into three categories: Cellular/Molecular, Behavioral/Systems, and Cognitive. Students must take courses from at least two of the three categories to fulfill the breadth requirement. At least one of the four upper-level credits must be at the 300-level or above.
  - A list of approved courses and their categories is linked from the Neuroscience website.

- Laboratory Coursework in Neuroscience (1 credit)
  - In order to gain hands-on experience with some of the tools, methods, and paradigms of Neuroscience, majors are required to take 1 credit of neuroscience laboratory coursework. This can be accomplished in several ways (e.g., 2 half-credit psych labs, 1 full-credit psych lab, 1 full-credit neuroscience SuperLab).
  - A list of approved laboratory courses is linked from the Neuroscience website.
- Thesis or Capstone in Neuroscience (1 credit)
  - To culminate their experience as a Neuroscience major, students are required to complete one course of thesis or capstone work. This may take the form of a 2-semester laboratory thesis project or a 1-semester capstone course.

Minor Requirements
- One "gateway" course from the following list:
  - NEUR H100 (Introduction to Neuroscience)
  - PSYC H217 (Behavioral Neuroscience)
  - PSYC B218 (Behavioral Neuroscience)
  - BIOL B202 (Neurobiology)
- Five additional credits, beyond the gateway course, with these constraints:
  - Three of the five credits must come from the list of approved upper-level neuroscience courses.
  - Two of the five credits must come from the list of approved allied courses.
  - At least one of the credits must be at the 300-level or higher.
  - One of the five credits may come from supervised senior research in neuroscience.
  - No more than two of the six minor credits may come from institutions outside of the Bi-Co.
  - No more than two of the six minor credits may be double-counted towards a major.

Faculty at Haverford
Laura Been
Associate Professor of Psychology; Director of Neuroscience

Emily Black
Visiting Assistant Professor of Neuroscience

Rebecca Compton
Professor of Psychology

Robert Fairman
Professor of Biology

Dustin Haskell
Visiting Assistant Professor of Neuroscience

Roshan Jain
Associate Professor and Chair of Biology

Patrese Robinson-Drummer
The Prockop Assistant Professor of Neuroscience

Faculty at Bryn Mawr
Laura Grafe
Assistant Professor of Psychology

Cora E. Mukerji
Assistant Professor of Psychology

Yeon Soon Shin
Assistant Professor of Psychology

Anjali Thapar
Professor of Psychology

Alison I. Weber
Assistant Professor of Biology

NEUR H100 INTRODUCTION TO NEUROSCIENCE (1.0 Credit)
Emily Black
Division: Natural Science
Domain(s): C: Physical and Natural Processes
euroscience is an interdisciplinary field that seeks to understand the structure and functions of the nervous system. This course includes topics on the broad history of behavioral neuroscience, parts of the nervous system, and a cursory overview of imaging/recording/histology. We also cover basic neurophysiology/chemistry of action potentials and neurotransmission (with some neurobiology of drug effects). Lastly, we explore sensorimotor processing (i.e. reflex arcs), basic sensory transduction and neuroanatomy of perception (sensory pathways from periphery to primary sensory cortex). Prerequisite(s): This course is not open to students who have previously taken HC Psych 217, HC Psych 260, or BMC Psych 218
(**Offered:** Fall 2024, Spring 2025)

NEUR H305 NEUROBIOLOGY OF SUBSTANCE USE DISORDERS (1.0 Credit)
Emily Black
Division: Natural Science
Domain(s): C: Physical and Natural Processes
This seminar will use peer-reviewed literature to explore how different experimental approaches are used to model and measure substance use disorders on a behavioral and neurobiological level. In addition to understanding the neurobiological effects of substances such as opiates, stimulants, and alcohol, we will also be examining societal and political implications of substance use disorders. Pre-requisite(s): Prior Completion of NEUR 100 or PSYC H217/ PSYC B218 is required. Completion or concurrent enrollment in Psyc 200 is recommended.

Lottery Preference: Priority to senior neuroscience majors, followed by junior neuroscience majors, followed by psychology or biology majors and neuroscience minors.
(**Offered:** Fall 2024)

NEUR H357 FEMINIST NEUROSCIENCE (1.0 Credit)
Division: Natural Science
Domain(s): B: Analysis of the Social World; C: Physical and Natural Processes
As societal conceptions of gender and sex change, so to do scientific approaches to neuroendocrinology (the study of hormones and the brain) and sex differences research. In this seminar, we will trace the history of this scientific field before placing it in conversation with feminist and queer theories. Students will utilize close reading, writing, and presentation techniques to consider sociological concepts and reframings of neuroscience.
Crosslisted: NEUR. Pre-requisite(s): Psychology 217: Behavioral Neuroscience or BMC equivalent Lottery Preference: 1) Senior psychology majors and senior neuroscience majors, 2) Junior psychology majors and junior neuroscience majors, 3) Senior psychology minors and senior neuroscience minors, 4) Junior psychology minors and junior neuroscience minors, and 5) all other students by class (senior, junior, sophomore; no first-years)

NEUR H398 SR THESIS NEUROSCIENCE (1.0 Credit)
Emily Black, Laura Been, Rebecca Compton, Robert Fairman, Roshan Jain
Sr Thesis Neuroscience
(**Offered:** Fall 2024, Spring 2025)

NEUR H399 NEUROSCIENCE SENIOR CAPSTONE (1.0 Credit)
Rebecca Compton
This course will survey empirical studies from several subdisciplines within the field of neuroscience (eg behavioral, cognitive, computational, molecular, etc) that advance our understanding of the brain. Through exposure to a diversity of approaches, it is hoped that students will be reminded that the boundaries that define the disciplines of neuroscience are blurred, and that it is the language of all these subdisciplines, that continue the advance of modern neuroscience. Each section of the course (defined by a given subdiscipline and relevant empirical articles) will culminate with a visit from a current researcher in that subdiscipline whose studies continue to advance our understanding of the brain. The visiting researcher will lead an in-class discussion about their research, as well as the path they took to get to their current position.

(**Offered:** Spring 2025)

NEUR H480I INDEPENDENT STUDY (0.5 Credit)
Patrese Robinson-Drummer
(**Offered:** Spring 2025)

CHEM H111 CHEMICAL STRUCTURE AND BONDING (1.0 Credit)
Clyde Daly, Gordon Peterson, Kelly Matz
Division: Natural Science; Quantitative
Domain(s): C: Physical and Natural Processes
Structure and bonding in molecules starting from nuclear and electronic structure of atoms. This course introduces the theories of chemical bonding that rationalize and predict the structures and bulk properties of molecules and materials. It also introduces modern instrumental and computational methods used to study chemical structure and bonding. Three lectures and one lab period per week required.
(**Offered:** Fall 2024)

CHEM H113 INTENSIVE: CHEMICAL STRUCTURE AND BONDING (1.0 Credit)
Kelly Matz, Theresa Gaines
Division: Natural Science; Quantitative
Domain(s): C: Physical and Natural Processes
Structure and bonding in molecules starting from nuclear and electronic structure of atoms. This course introduces the theories of chemical bonding that rationalize and predict the structures and bulk properties of molecules and materials. It also introduces modern instrumental and computational methods used to study chemical structure and bonding. This is a more intensive offering of CHEM 111 designed for students with little or no experience in chemistry. Prerequisite(s): Placement by the Chemistry Department.
(**Offered:** Fall 2024)

BIOL H200 EVOLUTION, GENETICS & GENOMICS (1.0 Credit)
Eric Miller, Jessica Comstock, Lee Dietterich, Nancy Maas, Shirley Lang
Division: Natural Science
Domain(s): C: Physical and Natural Processes
Three hours of lecture and one laboratory period per week. A one-year course in cellular and molecular biology, Biology 200 considers the cell as a unit of biological activity. Biology 200A discusses the gene as a storehouse of biological information, the flow and transmission of genetic information, and genomics in the context of evolution, as well as the cellular context in which these processes occur. The laboratory introduces the student to cell and molecular biology, genetics and biochemistry. Enrollment per lab section is limited to 28. Preference for a specific lab section will be

given to students preregistering for that lab section; students who do not preregister will be assigned on a space available basis. When two sections of the lecture component are offered one lecture section will be limited to 50. Four sections, limited to 35. Prerequisite(s): The prerequisite for Biology 200A is successful completion, with a grade of 2.0 or higher, of a one credit Natural Science course (which includes a laboratory experience) at Haverford, Bryn Mawr or Swarthmore, or instructor consent (**Offered:** Fall 2024)

BIOL H201 MOLECULES, CELLS, & ORGANISMS (1.0 Credit)
Geoffrey Hutinet, Kristen Whalen, Nancy Maas, Roshan Jain, Shirley Lang
Division: Natural Science
Domain(s): C: Physical and Natural Processes
Three hours of lecture and one laboratory period per week. An introduction to biochemistry and cell biology. Topics include the major macromolecules of the cell, their synthesis and breakdown, and a discussion of cellular structures and physiology. The laboratory introduces the student to cell and molecular biology and biochemistry. Enrollment per lecture section is limited to 35. Enrollment per lab section is limited to 24. Preference for a specific lab section will be given to students preregistering for that lab section; students who do not preregister will be assigned on a space available basis. Prerequisite(s): BIOL H200 with a grade of 2.0 or higher, or instructor consent (**Offered:** Spring 2025)

BIOL B202 NEUROBIOLOGY (1.0 Credit)
Division: Natural Science
Domain(s): C: Physical and Natural Processes
An introduction to the nervous system and its broad contributions to function. The class will explore fundamentals of neural anatomy and signaling, sensory and motor processing and control, nervous system development and examples of complex brain functions. Lecture three hours a week. Prerequisite: One semester of BIOL 110-111 or permission of instructor.
(**Offered:** Spring 2025)

MATH H103 INTRODUCTION TO PROBABILITY AND STATISTICS (1.0 Credit)
Division: Natural Science; Quantitative
Domain(s): C: Physical and Natural Processes
Basic concepts and methods of elementary probability and quantitative reasoning, with practical applications. Topics include: sample average and standard deviation, normal curves, regression, expected value and standard error, confidence intervals and hypothesis tests. Crosslisted: Mathematics, Statistics Prerequisite(s): Not open to

students who have (a) placed into 121 or higher, (b) taken 118 or higher, (c) taken any other introductory statistics class at Haverford or Bryn Mawr, (d) received a score of 4 or 5 on the AP Statistics exam

MATH H203 STATISTICAL METHODS AND THEIR APPLICATIONS (1.0 Credit)
Lynne Butler
Division: Natural Science; Quantitative
Domain(s): C: Physical and Natural Processes
An introduction to statistical methods used to analyze data in the natural and social sciences. It covers descriptive statistics, the binomial and normal distributions, expected value and variance, confidence intervals and hypothesis testing, comparison of two samples, regression, and analysis of variance. A required computer lab, using R, is taught alongside this course. Crosslisted: Mathematics, Statistics Prerequisite(s): MATH 118 or higher, placement into MATH 121 or higher, or instructor consent. Students who have taken another introductory statistics course at Haverford or Bryn Mawr may only enroll in STAT 203 with instructor consent
(**Offered:** Fall 2024)

ECON H203 STATISTICAL METHODS IN ECONOMICS (1.0 Credit)
Richard Ball
Division: Quantitative; Social Science
Domain(s): B: Analysis of the Social World
Foundations of statistical inference and data analysis. Three class hours and two lab hours. Prerequisite(s): ECON 104, 105, or 106; Completion of Math 105 or Math 118 at Haverford College (or a comparable course in calculus at another college), or placement into Math 121 or higher.
(**Offered:** Fall 2024)

PSYC H100 FOUNDATIONS OF PSYCHOLOGY (1.0 Credit)
Jennifer Lilgendahl, Marilyn Boltz, Peiyao Chen
Division: Social Science
Domain(s): B: Analysis of the Social World; C: Physical and Natural Processes
An introduction to the study of mind and behavior. Topics include biological, cognitive, personality, abnormal, and social psychology, as well as a general consideration of the empirical approach to the study of behavior. This course is a prerequisite for most other 200 and 300 level psychology courses. However, in most cases, this prerequisite may be met with an AP Psychology score of 4 or 5 or IB Psychology credit. Prerequisite(s): Students with AP Psychology credit from high school (and a score of 4 or 5 on the AP exam) have the option to waive the Foundations course and enroll in upper-level courses; this should be done only after

consultation with a faculty member in the Psychology Department. Students are welcome to take PSYCH 100 even if they have AP Psychology credit from high school (and a score of 4 or 5 on the AP exam).
(**Offered:** Fall 2024, Spring 2025)

PSYC H200 RESEARCH METHODS AND STATISTICS (1.0 Credit)
Laura Been, Mikayla Carson, Ryan Lei
Division: Quantitative; Social Science
Domain(s): B: Analysis of the Social World
A general overview of the research methods used in psychological science along with training in the statistical methods used in the field. Activities focus on designing research studies, collecting data, data analysis, and presenting results through written assignments. Prerequisite(s): PSYC 100 or PSYC B105 or Psychology AP Score of 4 or instructor consent Enrollment Limit: 35 Lottery preference(s): (1) Psychology majors, (2) Neuroscience majors, sophomores, (3) seniors, (4) juniors, (5) first-year students,A general overview of the experimental method and its use in the psychological study of behavior, coupled with in-depth treatment of statistics as applied to psychology research. Lab exercises focus on designing experiments, collecting data, applying statistical methods (using a data analysis software package), and presenting data through written assignments. 90 minutes of lab per week required in addition to lecture. Prerequisite(s): PSYC 100 or PSYC B105 or Psychology AP Score of 4 or instructor consent.
(**Offered:** Fall 2024, Spring 2025)

PSYC B205 RESEARCH METHODS AND STATISTICS (1.0 Credit)
Yeon Soon Shin, Staff
Division: Quantitative; Social Science
Domain(s): B: Analysis of the Social World
An introduction to research design, general research methodology, and the analysis and interpretation of data. Emphasis will be placed on issues involved with conducting psychological research. Topics include descriptive and inferential statistics, research design and validity, analysis of variance, and correlation and regression. Each statistical method will also be executed using computers. Lecture three hours, laboratory 90 minutes a week.
(**Offered:** Fall 2024, Spring 2025)

PSYC H217 BEHAVIORAL NEUROSCIENCE (1.0 Credit)
Rachel Herman
Division: Natural Science
Domain(s): B: Analysis of the Social World; C: Physical and Natural Processes
Interrelations between brain, behavior, and subjective experience. The course introduces students to physiological psychology through consideration of current knowledge about the mechanisms of mind and behavior. Crosslisted: Psychology, Biology Prerequisite(s): Any one of the following or instructor consent: PSYC 100, PSYC B105, BIOL H123, BIOL H124, BIOL H128, BIOL H129, NEUR H100, Psychology AP Score 4 Enrollment Limit: 35 Lottery Preference(s): 1) Psych majors, neuroscience majors, and neuroscience minors, 2) sophomores, 3) other juniors and seniors,Interrelations between brain, behavior, and subjective experience. The course introduces students to physiological psychology through consideration of current knowledge about the mechanisms of mind and behavior. Crosslisted: Psychology, Biology Prerequisite(s): Any one of the following or instructor consent: PSYC 100, PSYC B105, BIOL H123, BIOL H124, BIOL H128, BIOL H129, Psychology AP Score 4
(**Offered:** Spring 2025)