NEUROSCIENCE (NEUR)

Faculty

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The program in Neuroscience offers students an interdisciplinary major representing biology, psychology, animal behavior, chemistry, mathematics, biomedical engineering, and physics. The Neuroscience major is intended to give students opportunities through coursework and research experience to study the nervous system and its development and influence on behavior (broadly defined). Our faculty are active and productive scholars who involve students in their research programs, and thus we view research experience as a key aspect to the learning process.

The Neuroscience major is offered within the bachelor of science degree program. All students are strongly encouraged to participate as volunteers in research with faculty in their laboratories or through independent studies and honors theses. Faculty interests and facilities include cell and molecular wet labs, electroencephalography for studying brain activity and cognitive/affective and perceptual processes, animal behavior labs for studying behavior and development in vertebrates (we house four species of primates, as well as rats, fish, turtles, mice, prairie voles, and bats), and invertebrates (e.g., flies and honey bees). We also have facilities for studying vision, cognition, and hormones and behavior. Students who succeed in neuroscience will be well-equipped to go on to graduate study in neuroscience, biology, psychology, and medicine, as well as to work in a variety of other disciplines including fields relating to biotechnology, pharmaceuticals, or medical instrumentation.

Bachelor of Science in Neuroscience

The **Bachelor of Science major** in Neuroscience requires 18 courses. Introductory and intermediate courses are in several thematic clusters, including foundations in psychology and biology, behavioral and cognitive sciences, quantitative analysis, and allied lab sciences. Four advanced electives are chosen from a specified list of advanced neuroscience courses that build on this foundation.

Program Requirements		
Foundations		4
PSYC 100	Introduction to Psychology	
BIOL 205	Introduction to Molecules and Cells	
BIOL 206	Organismal Biology	
BIOL 207	Genetics	
Neuroscience Core		2
NEUR 253	Cellular and Molecular Neurobiology	
NEUR 254	Behavioral Neuroscience	
Behavioral & Cognitive Sciences		2
Select two of the following:		
LING 230	Psycholinguistics	
PSYC 203	Learning	
PSYC 204	Human Cognition	
PSYC/NEUR 217	Psychopharmacology	
PSYC/NEUR 248	Developmental Psychobiology	
PSYC 252	Sensation and Perception	
Quantitative		2
MATH 201	Calculus I	
MATH 216	Statistics I	
or PSYC 215	Psychological Statistics	
Cognate Lab Sciences		4
CHEM 205 & CHEM 211	Principles of Chemistry and Organic Chemistry I	
PHYS 211 & PHYS 212	Classical and Modern Physics I and Classical and Modern Physics II	
Advanced Neuroscience Electives		4
Choose four advanced electives. [1,2]		
NEUR/PSYC 305	Developmental Psychopathology	
NEUR/PSYC 312	Biopsychology of Appetite and Obesity	

NEUR/PSYC 313	Researching Behavioral Neuroscience
NEUR 319	Topics in Neuroscience
NEUR/PSYC 322	Clinical Neuroscience
NEUR/BIOL 332	Developmental Neurobiology
NEUR/PSYC 340	Advanced Behavioral Neuroscience
NEUR/PSYC 344	Developmental Brain Research
NEUR/PSYC 348	Behavioral Pharmacology
NEUR 360	Honors Thesis
NEUR/BIOL 363	Receptors of Biological Membranes
NEUR/PSYC 368	Social Neuroscience
NEUR 399	Undergraduate Research
BIOL 318	Principles of Physiology
BIOL 328	Endocrinology
BIOL/ANBE 342	Neuroethology
BMEG 441	Neural Signals and Systems
CHEM 351	Biochemistry I
LING 325	Language and the Brain
LING 330	Advanced Topics in Psycholinguistics
PSYC 286	Advanced Methods Developmental Psychobiology
PSYC 290	Advanced Methods in Biopsychology
PSYC 292	Advanced Methods in Sensation and Perception
PSYC 293	Advanced Methods in Learning
PSYC 294	Advanced Methods in Human Cognition
PSYC 318	Cognitive Aging
PSYC 324	Advanced Psychological Statistics
PSYC 339	Psychology of Music
PSYC 349	Cognitive Neuroscience
PSYC 352	Face Perception

1 No more than one of the 200-level Psychology Research Methods courses (PSYC 286, PSYC 290, PSYC 292, PSYC 293, PSYC 294) may count toward the four advanced electives.

2 Students are encouraged to become involved in independent research. However, no more than one credit for research experience (NEUR 399 Undergraduate Research or NEUR 360 Honors Thesis) may count toward the four advanced courses required for the major.

Students need not choose any specific course of study or concentration within neuroscience. However, students with interests in particular aspects of the field of neuroscience are encouraged to consult with program faculty and their academic adviser to select courses that match their interests and goals.

The recommended sequence for the Neuroscience Bachelor of Science major is as follows:

First Year

First Semester	Credits	Second Semester	Credits
BIOL 205	1	BIOL 206	1
PSYC 100[1]	1	CHEM 211	1
CHEM 205	1	Behavioral/Cognitive Science cluster[2]	1
	3		3

Sophomore

First Semester	Credits	Second Semester	Credits
NEUR 253	1	NEUR 254	1
BIOL 207	1	MATH 216	1
	2		2

Junior

First Semester	Credits	Second Semester	Credits
PHYS 211[4]	1	PHYS 212	1
MATH 201	1	Advanced Neuroscience elective[5]	1

Behavioral/Cognitive Science Cluster[2]	1		
	3		2
Senior			
First Semester	**Credits**	**Second Semester**	**Credits**
Advanced Neuroscience elective[5]	1	Advanced Neuroscience elective[5]	1
		Advanced Neuroscience elective[5]	1
	1		2

Total Credits: 18

1. Students entering with AP credit for PSYC 100 may opt to take MATH 201 in the first semester or may take an additional course in the first semester for the College Core Curriculum.
2. See the above list of courses that count in the Behavioral/Cognitive Sciences cluster.
3. Students who wish to study abroad either semester of their junior year should consult with their academic adviser regarding options for timing of the PHYS 211-212 sequence.
4. See the above list of courses that count as advanced neuroscience electives.

Writing in the Major

Neuroscience students will satisfy the requirement of writing in the major by completing BIOL 205 and BIOL 206. These foundational courses include direct instruction in writing skills and assigned readings from a text on scientific writing. Students complete multiple drafts of scientific lab reports using feedback on preliminary drafts, and have opportunities to discuss their writing during the revision process. Students may further develop writing skills in the discipline by selecting advanced courses that include additional writing instruction. All of the advanced electives, PSYC 286, PSYC 290, PSYC 292, PSYC 293, and PSYC 294, include a focus on writing scientific reports, and most of the 300-level courses include a substantial writing component.

Study Abroad

Students are encouraged to study abroad in conjunction with the major or to explore interests outside the major, or both. Students who are considering studying abroad should consult with their academic adviser early to determine the ideal timing. With sufficient advance planning, rearrangement of the suggested course sequence can enable study abroad in either semester of the junior year or the first semester of the senior year.

Formal Presentation Experience

Students in the NEUR major will satisfy the formal presentation requirement by completing NEUR 253 Cellular and Molecular Neurobiology . Other courses in the major offer further instruction and assessment of formal presentations or leading discussions. Students who are interested in gaining further instruction on presentations might consider taking one or some of the following courses:

ANBE/BIOL 342	Neuroethology	1
NEUR 248	Developmental Psychobiology	1
NEUR/PSYC 305	Developmental Psychopathology	1
NEUR 312	Biopsychology of Appetite and Obesity	1
NEUR/PSYC 348	Behavioral Pharmacology	1
PSYC 318	Cognitive Aging	1
PSYC 339	Psychology of Music	1
PSYC 349	Cognitive Neuroscience	1

Information Literacy

Neuroscience students will satisfy their information literacy requirement by completing BIOL 205 Introduction to Molecules and Cells and NEUR 253 Cellular and Molecular Neurobiology . Students may also satisfy their information literacy requirement by completing independent research for credit (NEUR 399 Undergraduate Research or NEUR 360 Honors Thesis). In all these experiences, students receive direct instruction on gathering and assimilation of scientific literature through a variety of search mechanisms, including, for example, PubMed, Web of Science, and PSYCinfo.

Culminating Experience

The Culminating Experience in the Neuroscience major has two components. Both will be completed by all students in the major.

1. ***Engaging in original scientific investigation*** through direct practice in the process of scientific discovery, either through independent research or in an advanced course. This portion may be satisfied by one of the options listed here:
   a. *Complete a supervised research project in neuroscience or a closely related topic*. The research experience can be at Bucknell or elsewhere as long as it is supervised by someone with relevant scholarly expertise. The research may be during the academic year or summer, and may be for course credit or not, as long as it satisfies these criteria set forth by the faculty: an empirical project in which the student collects and analyzes

original data to test a hypothesis, and a written report or other scholarly presentation that connects the results to the existing scholarly literature. Each year, the Neuroscience program director will survey students' involvement in such projects. Students planning to complete this component away from Bucknell should consult the program director to ensure their project satisfies the requirements.

b. *Complete an advanced course that includes a research component.* As one of the four advanced neuroscience electives, one course must include substantial experience with collecting and analyzing original data, and interpreting and reporting the results. These courses include PSYC 286, PSYC 290, PSYC 292, PSYC 293, PSYC 294, and select 300-level courses with a lab or research component. Each year the program director will publicize a list of courses that satisfy this requirement.

c. Complete an Honors Thesis (NEUR 360).

2. ***Engagement in the scholarly community:*** The Neuroscience Visiting Speaker Series is organized annually by program faculty. In conjunction with each visiting speaker, a faculty member convenes a seminar meeting with students that includes reading, discussion, and writing on the topic in preparation for the speaker's visit. Students will complete this portion of the Culminating Experience by participating in at least four of these during the course of the senior year.

Majors in Neuroscience will:

1. Understand the structure and function of the nervous system.
2. Understand the neural bases of behavior from a variety of theoretical perspectives.
3. Understand how the nervous system is manipulated, measured or modeled to understand its processes.
4. Acquire a broad background in the natural sciences and a basic understanding of psychological principles.
5. Understand the processes through which scientific information is derived, evaluated, and communicated.

Courses

NEUR 100. Introduction to Neuroscience. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
A survey of the study of the nervous system and its structure and function, ranging from molecular analyses of neurons to electrical and other correlates of human cognition.

NEUR 217. Psychopharmacology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4
Psychopharmacology, the study of drugs that affect behavior, begins with an appreciation for neurochemical, pharmacological and behavioral principles in order to understand actions and effects of therapeutic compounds and addictive substances, the two major categories of psychopharmacological drugs. Prerequisite: PSYC 100 or BIOL 205. Crosslisted as PSYC 217.

NEUR 248. Developmental Psychobiology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Addresses development in humans from conception through adolescence with some comparative analysis with non-humans. Emphasis on both normal and atypical cognitive, neuropsychological and neurobiological development. Prerequisite: PSYC 100 or NEUR 100. Crosslisted as PSYC 248.

NEUR 250. Biopsychology. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Biological bases of behavior and their relationship to motivation, learning, and perception. Prerequisite: one of the following: NEUR 100, PSYC 100, BIOL 206, ANBE 266 or permission of the instructor. Crosslisted as PSYC 250.

NEUR 253. Cellular and Molecular Neurobiology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:3
A course focused on the molecular and cellular mechanisms that drive the firing and wiring of neurons. Topics of emphasis include excitable membrane physiology, synaptic transmission, plasticity and learning, and sensory transduction. The required co-requisite laboratory component provides hands-on neurophysiology experience with live animal models. Prerequisite: BIOL 205. Crosslisted as BIOL 375.

NEUR 254. Behavioral Neuroscience. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Study of the the functions of the nervous system underlying behavioral, psychological, and cognitive processes in humans and animals. This course assumes prior knowledge in the fundamentals of cellular/molecular neuroscience. Prerequisites: NEUR 253.

NEUR 305. Developmental Psychopathology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Addresses the behavioral phenotypes of a variety of neurodevelopmental and neuropsychiatric disorders in the context of theories and processes of normal development. Genetic and neurobiological underpinnings of disorders are discussed. Prerequisites: NEUR 248 or PSYC 248 or permission of the instructor. Crosslisted as PSYC 305 and PSYC 605.

NEUR 312. Biopsychology of Appetite and Obesity. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Reading and discussion of scholarly research on the neural, physiological, and endocrine signals that influence the psychology of appetite, food reward, eating behavior, and obesity in humans and animal models. Prerequisite: PSYC 250 or NEUR 250 or NEUR 254. Crosslisted as PSYC 312 and PSYC 612.

NEUR 313. Researching Behavioral Neuroscience. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Following a general orientation to behavioral genetics and pharmacology using mice, we will conduct group experiments. Each student will then develop and conduct an independent research project. Prerequisites: PSYC 215 or MATH 216 and PSYC 250 or NEUR 255 or permission of instructor. Crosslisted as PSYC 313 and PSYC 613 and NEUR 613.

NEUR 319. Topics in Neuroscience. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3; Repeatable
Occasional seminars on selected topics of current interest in neuroscience. Prerequisites: permission of the instructor may be required depending on the course topics and only open to juniors and seniors.

NEUR 321. Neuroethics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Students will consider ethical, moral, legal and social implications that come from a growing ability to understand, predict, and change human behavior. In a seminar format we'll consider right and wrong use of neuroscientific knowledge in clinical settings, law and criminal justice, national defense, economics, business and education. Crosslisted as PSYC 321.

NEUR 322. Clinical Neuroscience. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Through case studies, guest lectures, and review of primary literature this course will explore fundamental mechanisms that underlie diseases and disorders of the brain and central nervous system. Prerequisites: PSYC 250 or NEUR 250. Open to Biology, Neuroscience, and Psychology majors. Crosslisted as PSYC 322 and PSYC 622.

NEUR 332. Developmental Neurobiology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Recitation:1
Primary literature-based senior seminar on topics in developmental neurobiology. Prerequisites: BIOL 205, BIOL 207, and either BIOL 206 or NEUR 100, junior or senior status, and permission of the instructor. Crosslisted as BIOL 332 and BIOL 632.

NEUR 340. Advanced Behavioral Neuroscience. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Advanced study of the relationship between the brain and behavior. Seminar discussion of complex problems in the field of behavior neuroscience including genetics, mood disorders, drug abuse, cognition and consciousness. Prerequisite: PSYC 250 or NEUR 254 or permission of the instructor. Crosslisted as PSYC 340 and PSYC 640 and NEUR 640.

NEUR 344. Developmental Brain Research. 1 Credit.
Offered Spring Semester Only; Lecture hours:3; Repeatable
Students learn a variety of assessment techniques in developmental neuropsychology and neuroscience (including EEG) and conduct quantitative research culminating in written and oral reports. Crosslisted as PSYC 344 and PSYC 644 and NEUR 644. Prerequisite: permission of the instructor.

NEUR 348. Behavioral Pharmacology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Focus on drugs that affect the nervous system, drugs of abuse, therapeutic drugs, drug action, behavioral changes as a result of long-term drug use, animal models and human studies. Prerequisites: PSYC 250 or NEUR 254 or BIOL 205 and permission of the instructor. Crosslisted as PSYC 348 and PSYC 648.

NEUR 360. Honors Thesis. 1 Credit.
Offered Both Fall and Spring; Lecture hours:Varies,Other:15; Repeatable
Prerequisite: permission of the department and permission of the instructor.

NEUR 363. Receptors of Biological Membranes. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A course focused on the receptors and channels that function in biological membranes. The primary research literature will be used to explore the molecular bases of cellular communication, neuronal connectivity, and sensory transduction. Prerequisites: BIOL 205 and either BIOL 206 or NEUR 253. Crosslisted as BIOL 363 and BIOL 663.

NEUR 368. Social Neuroscience. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:1
Study of the brain basis of social behaviors such as bonding and attachment, parental behavior, play, social cognition, and the benefits of social support. We will investigate what is known about social function in the brains of species that have evolved to be social species, including humans. Crosslisted as PSYC 368 and PSYC 668.

NEUR 399. Undergraduate Research. .5-2 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:Varies; Repeatable
Research on any aspect of neuroscience. Research topics may be posed by students or faculty. Prerequisite: permission of the instructor.

NEUR 3NT. NEUR Non-traditional Study. 1-2 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies
Non-traditional study course in neuroscience. Prerequisite: permission of the instructor.

NEUR 400. Senior Seminar in Neuroscience. .25 Credits.
Offered Spring Semester Only; Lecture hours:1
NEUR majors may elect to attend a lecture series in the spring semester to satisfy the Culminating Experience requirement. Students will prepare written reactions to each seminar, graded as pass/fail. Prerequisites: senior status and NEUR majors and permission of the instructor.