NEUROSCIENCE (NEUR)

Faculty

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How does the nervous system interact with the ways that human and non-human animals think, feel, communicate, develop and behave? This is a core question that brings together a diverse faculty of active scholars at Bucknell who teach courses across the neuroscience curriculum and conduct high-quality research with students. Neuroscience is an interdisciplinary major with course offerings from biology, psychology, animal behavior, linguistics, chemistry, mathematics, physics and biomedical engineering. The neuroscience major is intended to give students opportunities through coursework and research experiences to study the nervous system and its development and influence on behavior (broadly defined). Our faculty are productive scholars who involve students in their research programs; 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 identify a faculty mentor and join them in conducting research as volunteers or as mentored, independent research students. Faculty interests vary in terms of topics, model systems and research methods: our research facilities include cell and molecular wet labs, tools for studying brain activity and perceptual processes, behavior labs for studying behavior and development in vertebrates (e.g., rats, fish, turtles, mice, prairie voles, bats and non-human primates), and invertebrates (e.g., flies and honeybees). We also have facilities for studying human vision, addiction, cognition, language, hormones, and how the brain remembers and processes music. Students who succeed in neuroscience will be well-equipped to go on to graduate study in neuroscience, biology, psychology or medicine, as well as to work in a variety of disciplines, including careers 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. The Culminating Experience is designed to provide students with research experiences.

Program Requirements		
Foundations		**4**
BIOL 201	Biological Inquiries and Observations	
BIOL 203	Integrated Concepts in Biology Fall	
BIOL 204	Integrated Concepts in Biology Spring	
PSYC 100	Introduction to Psychology	
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	
LING/PSYC 237	Introduction to Language Development	
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	Neurodevelopmental Disorders	
NEUR 310/PSYC 341/BIOL 301	Neurophysiology of Wellbeing	
NEUR/PSYC 312	Biopsychology of Appetite and Obesity	
NEUR/PSYC 313	Researching Behavioral Neuroscience	
NEUR 319	Topics in Neuroscience	
NEUR/PSYC 321	Neuroethics	
NEUR/PSYC 322	Clinical Neuroscience	
NEUR/BIOL 332	Developmental Neurobiology	
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 Engineering	
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 with interest 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, as there are no predetermined tracks within the major.

The recommended sequence for the neuroscience bachelor of science major is as follows:

First Year			
First Semester	**Credits**	**Second Semester**	**Credits**
PSYC 100[1]	1	BIOL 201	1
CHEM 205	1	CHEM 211	1
		MATH 201	1
	2		**3**
Sophomore			
First Semester	**Credits**	**Second Semester**	**Credits**
NEUR 253	1	NEUR 254	1
BIOL 203	1	BIOL 204	1

MATH 216	1	Behavioral/Cognitive Sciences Cluster[2]	1
	3		**3**

Junior

First Semester	Credits	Second Semester	Credits
Advanced Neuroscience elective[4]	1	Advanced Neuroscience elective[4]	1
PHYS 211[3]	1	PHYS 212	1
Behavioral/Cognitive Science Cluster [2]	1		
	3		**2**

Senior

First Semester	Credits	Second Semester	Credits
Advanced Neuroscience elective[4]	1	Advanced Neuroscience elective[4]	1
NEUR 400[5]	0	NEUR 400[5]	0
	1		**1**

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 of Arts & Sciences 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-PHYS 212 sequence.
4. See the above list of courses that count as advanced neuroscience electives.
5. All students will take NEUR 400 in either fall or spring semester of their senior year.

Writing in the Major

Neuroscience students will satisfy the requirement of writing in the major by completing BIOL 203 Integrated Concepts in Biology Fall and BIOL 204 Integrated Concepts in Biology Spring. 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 Advanced Methods Developmental Psychobiology, PSYC 290 Advanced Methods in Biopsychology, PSYC 292 Advanced Methods in Sensation and Perception, PSYC 293 Advanced Methods in Learning and PSYC 294 Advanced Methods in Human Cognition, 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
LING 230	Psycholinguistics	1
LING 325	Language and the Brain	1
NEUR/PSYC 248	Developmental Psychobiology	1
NEUR/PSYC 305	Neurodevelopmental Disorders	1
NEUR/PSYC 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
PSYC 352	Face Perception	1

Information Literacy

Neuroscience students will satisfy their information literacy requirement by completing BIOL 203 Integrated Concepts in Biology Fall 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 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, 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 and enrolling in NEUR 400 Senior Seminar in Neuroscience.

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 101. Introduction to Neuroscience. 1 Credit.
Offered Summer Session Only; Lecture hours:3
An introduction to ideas, concerns, methods and applications in the field of neuroscience as students explore ways that our growing understanding of the nervous system intersects with technology, medicine, and law to impact human existence. Prerequisite: permission of the instructor. Only for BCCSP students.

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 permission of the instructor. 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. Crosslisted as PSYC 248.

NEUR 253. Cellular and Molecular Neurobiology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:3
In this course, we will cover the molecular and cellular mechanisms that drive neuronal function, and include topics such as excitable membrane physiology, synaptic transmission, plasticity and learning. The laboratory provides an evaluation of laboratory techniques relevant to neuroscience and analysis of papers. Crosslisted as BIOL 375.

NEUR 254. Behavioral Neuroscience. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Recitation:1
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. Prerequisite: NEUR 253.

NEUR 305. Neurodevelopmental Disorders. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Examines the genomic, neural, and environmental bases that underlie the development of children with developmental disabilities, including autism spectrum disorders, intellectual disabilities, and specific genetic/genomic syndromes. Takes a developmental psychopathology perspective, highlighting the reciprocal nature of the study of typical and atypical development. Prerequisites: NEUR 248/PSYC 248 and instructor permission. Crosslisted as PSYC 305 and PSYC 605.

NEUR 310. Neurophysiology of Wellbeing. 1 Credit.
Offered Occasionally; Lecture hours:3,Recitation:1
We will investigate the neurophysiological systems involved in wellbeing and stress including the autonomic nervous system, the gut-brain axis, and the endocrine system. For this investigation, we will read, analyze, and discuss primary and secondary literature on these topics. Crosslisted as PSYC 341 and PSYC 641.

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 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 254 or permission of instructor. Crosslisted as NEUR 613 and PSYC 313 and PSYC 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 and PSYC 621.

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 254. Open to Biology, Neuroscience, and Psychology majors. Crosslisted as PSYC 322 and PSYC 622.

NEUR 332. Developmental Neurobiology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
Developmental neurobiology with a laboratory section. Topics include: neural cell identity determination and differentiation; axon growth and target selection; formation and plasticity of neural connections; behavioral development. Crosslisted as BIOL 332 and BIOL 632.

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. 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. 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. 0 Credits.
Offered Spring Semester Only; Lecture hours:.5,Other:.5
NEUR majors may elect to attend a lecture series in the fall or 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.