

# Neuroscience (NEUR)

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, 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 in research with faculty, as volunteers 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 17 courses (12 basic courses, plus five required 300-level courses). The students choose these five courses from a specified list of advanced neuroscience courses. One of the five can be chosen from a list of related courses as described below.

Of the 17 total courses taken by neuroscience majors, the following 12 courses are required:

### Program Requirements

NEUR 100	Introduction to Neuroscience	1
BIOL 205	Introduction to Molecules and Cells	1
BIOL 207	Genetics	1
NEUR/PSYC 250	Biopsychology	1
NEUR 253	Neural Cell Biology	1
CHEM 211 & CHEM 212	Organic Chemistry I and Organic Chemistry II	2
MATH 201	Calculus I	1
MATH 216	Statistics I	1
Select one of the following:		1
NEUR 248	Developmental Psychobiology	
PSYC 203	Learning	
PSYC 204	Human Cognition	
PSYC 252	Sensation and Perception	
BIOL 206	Organismal Biology	
PHYS 211 & PHYS 212	Classical and Modern Physics and Classical and Modern Physics	2
<b>Electives</b>		
Five advanced neuroscience electives <sup>1,2</sup>		5

<sup>1</sup> Advanced neuroscience electives must be chosen from the courses listed in Category I and Category II with a minimum of two from Category I and two from Category II. One credit of Independent Research, or one course from the neuroscience-related electives list can also be counted as one of the five. NEUR 399 Undergraduate Research is counted as lab credit course. Neuroscience-related research credit may be earned in ANBE, BIOL, CHEM, NEUR, or PSYC. See the Neuroscience Program Director for permission.

<sup>2</sup> Students are encouraged to become involved in independent study research, such as NEUR 399 Undergraduate Research; however, only one undergraduate research credit can be counted toward the five additional courses required for the major.

## Category I

BIOL 320	Seminar	1
BIOL 324	Neurophysiology	1
BIOL/NEUR 332	Developmental Neurobiology	1
BIOL 342	Neuroethology	1

BMEG 441	Neural Signals and Systems	1
NEUR 348	Behavioral Pharmacology	1

## Category II

PSYC 305	Developmental Psychopathology	1
PSYC 318	Cognitive Aging	1
PSYC 339	Psychology of Music	1
PSYC 340	Behavioral Neuroscience	1
PSYC 349	Human Neuropsychology	1
PSYC 352	Face Perception	1

## Neuroscience-related Courses

### General Neuroscience-related Courses

ANBE 391	Research	1
BIOL 318	Principles of Physiology	1
BIOL 328	Endocrinology	1
BIOL 337	Biology of Aging	1
BMEG 300	Biotransport I	1
BMEG 409	Fabrication and Experimental Design	.5
BMEG 461	Brain, Mind and Culture	1
CHEM 375	Undergraduate Research	1
CHEM 376	Undergraduate Research	1
NEUR 344	Developmental Brain Research	1
NEUR 399	Undergraduate Research	1
PSYC 324	Advanced Psychological Statistics	1
PSYC 329	Undergraduate Research	1

### Courses Reflect Interests In Cell and Molecular Neuroscience

BIOL 304	Biology of Cancer	1
BIOL 322	Physiological Mechanisms	1
BIOL 327	Molecular Biology	1
BIOL 331	Functional Genomics	1
BIOL 339	Developmental Biology	1
BIOL 340	Biochemical Methods	1
BIOL 347	Virology	1
BIOL 352	Cell Biology	1
CHEM 351	Biochemistry I	1

### Courses Recommended but Not Required

BIOL 327	Molecular Biology	1
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Select one of the following:

CHEM 201 & CHEM 202	General Chemistry and General Chemistry	
CHEM 221 & CHEM 231	Inorganic Chemistry I and Analytical Chemistry	
MATH 202	Calculus II	1

Students need not choose any specific course of study or concentration within neuroscience. However, students with interests in particular aspects of the neuroscience major may consider choosing among courses that reflect these interests, such as cognitive and behavioral neuroscience or cellular and molecular neuroscience. Students interested in pursuing such interests should consult with their adviser on how best to accomplish their goals.

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

### First Year

First Semester	Credits	Second Semester	Credits
NEUR 100		1 PSYC 250	1

BIOL 205	1	MATH 216	1
MATH 201	1		
	<b>3</b>		<b>2</b>
<b>Sophomore</b>			
<b>First Semester</b>	<b>Credits</b>	<b>Second Semester</b>	<b>Credits</b>
CHEM 211		1 CHEM 212	1
BIOL 207		1 NEUR 248, PSYC 203, PSYC 204, PSYC 252, or BIOL 206	1
NEUR 253		1 One 300-level advanced neuroscience elective	
	<b>3</b>		<b>2</b>
<b>Junior</b>			
<b>First Semester</b>	<b>Credits</b>	<b>Second Semester</b>	<b>Credits</b>
PHYS 211		1 PHYS 212	1
One 300-level advanced neuroscience elective		One 300-level advanced neuroscience elective	
	<b>1</b>		<b>1</b>
<b>Senior</b>			
<b>First Semester</b>	<b>Credits</b>	<b>Second Semester</b>	<b>Credits</b>
One 300-level advanced neuroscience elective		One 300-level advanced neuroscience elective	
	<b>0</b>		<b>0</b>

Total Credits: 12

We recommend that students who come to Bucknell with Advanced Placement (AP) credit in calculus begin their CHEM sequence in the first semester of the first year.

## Writing in the Major

Neuroscience students will satisfy the writing in the major requirement by completing BIOL 205 Introduction to Molecules and Cells. In BIOL 205 Introduction to Molecules and Cells students are given direct instruction by the professor and through assigned readings from a text on scientific writing. Students will submit sections of four laboratory reports describing the results and conclusions from their experiments. Students will receive feedback on preliminary drafts of each report and will be given an opportunity to discuss their drafts as they prepare their final submissions.

## Formal Presentation Experience

Students in the NEUR major will satisfy the formal presentation requirement by completing NEUR 253 Neural Cell Biology. Other NEUR courses also offer instruction on, 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
BIOL 320	Seminar	1
BIOL 324	Neurophysiology	1
NEUR 248	Developmental Psychobiology	1
NEUR/PSYC 305	Developmental Psychopathology	1
NEUR/PSYC 348	Behavioral Pharmacology	1
PSYC 203	Learning	1
PSYC 315	Language Development	1
PSYC 318	Cognitive Aging	1
PSYC 339	Psychology of Music	1

## Information Literacy

Neuroscience students will satisfy their information literacy requirement by completing BIOL 205 Introduction to Molecules and Cells and NEUR 253 Neural Cell Biology. Students may also satisfy their information literacy requirement by completing an independent study (NEUR 399 Undergraduate Research). Students who want their independent study credit to count toward the NEUR major should be prepared to document how their independent study addresses some aspect of neuroscience so as to warrant 300-level NEUR credit. In all these experiences students receive direct instruction on the gathering and assimilation of scientific literature through a variety of search mechanisms, including, for example, PubMed, Medline and PSYCinfo.

## Culminating Experience

Neuroscience seniors will satisfy their Culminating Experience requirement through any one of the following activities:

- Registering for Independent Research NEUR 399 Undergraduate Research in their senior year (for a minimum of .5 credit). Students who do so will be graded on their participation and competency throughout the semester and will also be required to submit a written laboratory report based on their practical experiences. As noted above, the content of the independent study should be directly related to some aspect of neuroscience.
- Students will have the opportunity to register for NEUR 400 Senior Seminar in Neuroscience – a seminar series – (.25 credit) in the spring semester of their senior year. This seminar series will require attendance at no fewer than four lectures. For example: attending lectures given by invited speakers from Biology, Chemistry, Physics or Psychology would fulfill this requirement. Attendance will be mandatory and students will be required to submit a written summary/reaction of each lecture, which will be graded by the members of the NEUR faculty.

## Faculty

**Director:** Peter G. Judge

**Affiliated Faculty:** Mitchell I. Chernin, Elizabeth A. Capaldi Evans, Judith E. Grisel, Andrea R. Halpern, Peter G. Judge, James E. Lavine, Heidi Lorimor, Aaron Mitchel, Kevin P. Myers, Marie C. Pizzorno, Ruth Tincoff, Joseph V. Tranquillo, T. Joel Wade

**Coordinating Committee:** David W. Evans, Elizabeth C. Marin, Kathleen C. Page, Jennifer Rice Stevenson, Eric S. Tillman

## Courses

**NEUR 100. Introduction to Neuroscience. 1 Credit.**

**Offered Either Fall or Spring; 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 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. Neural Cell Biology. 1 Credit.**

**Offered Fall Semester Only; Lecture hours:3**

A core course for neuroscience focused on structure/function relationships in neural cells. Basic protein biochemistry, ion channel activity, protein receptors, cell signaling, electrical properties and response patterns will be emphasized. Recommended for sophomores. Prerequisites: BIOL 205 and PSYC 250 and permission of the instructor.

**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 and permission of the instructor. Crosslisted as PSYC 305.

**NEUR 313. Researching Behavioral Neuroscience. 1 Credit.**

**Offered Both Fall and Spring; Lecture hours:3**

Following a general orientation to behavioral genetics and pharmacology, including basic techniques of mouse handling, we will conduct group experiments. In addition, each student will develop and conduct an independent research project. Prerequisites: PSYC 215 or MATH 216 and PSYC 250 or an applied research methods course and permission of the instructor. May be crosslisted as PSYC 313.

**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: BIOL 205, BIOL 207 and NEUR 100, junior or senior status and permission of the instructor.

**NEUR 330. Neuroscience of Addiction. 1 Credit.**

**Offered Fall Semester Only; Lecture hours:3**

A study of the changes in neurocircuitry and neurobiology that occur in the brain due to drugs of abuse and addiction. Prerequisites: NEUR 100 and BIOL 205 or permission of the instructor.

**NEUR 332. Developmental Neurobiology. 1 Credit.**

**Offered Spring Semester Only; Lecture hours:3, Other: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.

**NEUR 340. 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. Crosslisted as PSYC 340. Prerequisite: PSYC 250 or permission of the instructor.

**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. 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 BIOL 205 and permission of the instructor. Crosslisted as PSYC 348.

**NEUR 360. Honors Thesis. 1 Credit.****Offered Both Fall and Spring; Lecture hours:Varies,Other:15; Repeatable**

Prerequisite: permission of the department.

**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.