NEUROSCIENCE AND BEHAVIOR

Overview and Contact Information

The program in neuroscience and behavior is intended for students with strong, integrative interests in both biological sciences and psychology and in the biological bases of behavior.

See Also

 Cognitive Neuroscience (http://catalog.mtholyoke.edu/areas-study/ cognitive-neuroscience/)

Contact Information

Kenneth Colodner, Chair Jill Pietrantonio, Academic Department Coordinator

105 Clapp Laboratory

413-538-2611

https://www.mtholyoke.edu/academics/find-your-program/neuroscienceand-behavior (https://www.mtholyoke.edu/academics/find-yourprogram/neuroscience-and-behavior/)

Learning Goals

1. Components of the Nervous System

Learn the underlying developmental, physiological, anatomical, and functional components of the nervous system, including an understanding of their evolutionary origins, and link the electrochemical behavior of nerve cells and synapses, sensorimotor processes, and circuit-level processes to cognitive and behavioral outcomes.

2. Biological and Chemical Foundations

Understand the fundamental molecular, chemical, genetic, and cellular components of the natural world and practice basic biology and chemistry laboratory techniques for measuring these phenomena.

3. Research Design and Data Analysis

Develop experimental design, quantitative reasoning, and technical skills to ethically design, implement, analyze, and communicate original research questions in the natural and behavioral sciences.

4. Experimentation and Evaluation of Primary Literature

Analyze and critique primary literature leading to the construction of novel hypotheses, and design relevant laboratory-based and field experiments using various neuroscience-specific techniques.

5. Becoming a Citizen Scientist

Develop communication and collaboration skills aimed at becoming an ethically responsible and inclusive member of the scientific community. This includes cultivating effective communication skills in oral, written, and visual formats, in addition to working to promote diversity, equity, and inclusion in group settings.

Faculty

This area of study is administered by the Neuroscience and Behavior Committee:

Katherine Binder, William R. Kenan, Jr. Professor of Psychology

Mara Breen, Professor of Psychology and Education

Kenneth Colodner, Associate Professor of Neuroscience and Behavior

Kathryn McMenimen, Associate Professor of Chemistry

Jared Schwartzer, Associate Professor of Psychology and Education; Director of the Science Center

André White, Associate Professor of Biological Sciences, Teaching Fall Only

Travis Hodges, Assistant Professor of Psychology

Marta Sabariego, Assistant Professor of Neuroscience and Behavior

Requirements for the Major

A minimum of 48 credits:

Code	Title C	redits
Required Core Cu	rriculum	
NEURO-100	Introduction to Neuroscience and Behavior	4
CHEM-150	General Chemistry: Foundations	4
or CHEM-160	Integrated Introduction to Biology and Chemistry	
CHEM-202	Organic Chemistry I	4
NEURO-221	Research Techniques in Neuroscience	4
PSYCH-204	Research Methods in Psychology	4
NEURO-246	Cognitive Neuroscience	4
or NEURO-254	Psychopharmacology	
or NEURO-256	Hormones and Behavior	
BIOL-200	Introductory Biology II: How Organisms Develop	4
BIOL-210	Molecular Genetics	4
or BIOL-220	Cell Biology	
An appropriate pre course	erequisite to qualify for the quantitative inference	
A course in quant	itative inference:	4
PSYCH-201	Statistics	
or STAT-242	Intermediate Statistics	
Two of the followi	ng laboratory-based courses at the 300 level:	8
BIOCH-312	Chemistry of Biomolecules (with BIOCH-318 lab)	
or CHEM-31	Chemistry of Biomolecules	
BIOL-307	Vertebrate Anatomy	
BIOL-321AD	Conference Course: 'Substance Use Disorder: Addiction and Drug Memory Formation'	
BIOL-321BE	Conference Course: 'Inquiries in Behavioral Ecology'	
BIOL-333	Neurobiology	
BIOL-328	Human Physiology	
COMSC-334	Artificial Intelligence	
COMSC-341NL	Topics: 'Natural Language Processing'	
NEURO-324	Cellular and Molecular Neuroscience	
NEURO-336	Systems Neuroscience	
NEURO-395	Independent Study (4 credits)	
PSYCH-350BN	Lab in Biological Bases of Behavior. 'Laboratory in Behavioral Neuroscience'	n
PSYCH-350ET	Lab in Biological Bases of Behavior. 'Ethology'	

PSYCH-340CL	Laboratory in Perception and Cognition: 'Cognition
	and Literacy'

A fo	third 300-level course from the preceding list, or from the ollowing:		4
	CHEM-312	Chemistry of Biomolecules	
	or BIOCH-31	Chemistry of Biomolecules	
	NEURO-309	Topics in Neuroscience and Behavior	
	NEURO-331	Glial Cells in Health and Disease	
	NEURO-338	Mobilizing the Hippocampus	
	PSYCH-349AM	Seminar in Perception and Cognition: 'Art, Music, and the Brain'	
	PSYCH-349LT	Seminar in Perception and Cognition: 'Language and Thought'	
	PSYCH-359CN	Seminar. Biological Bases of Behavior. 'Clinical Neuroscience'	
To	otal Credits		48

Other Requirements

• The three required courses at the 300 level must span at least two departments or programs.

Additional Specifications

- Students who declare a neuroscience and behavior major automatically fulfill the College's "outside the major" requirement.
- There are sometimes opportunities for Neuroscience and Behavior students to work on an individual basis with a Neuroscience and Behavior faculty member. Students are encouraged to discuss this option with any member of the program.

Course Offerings

NEURO-100 Introduction to Neuroscience and Behavior

Fall and Spring. Credits: 4

This comprehensive survey course explores the brain and the biological basis of behavior. We will examine the anatomy of the nervous system and the unique properties of the cells that make up the brain. We will discuss the mechanisms by which individual brain cells communicate with each other, and how networks of cells underlie more complex processes such as perception, learning, memory, and behavior. *Applies to requirement(s): Math Sciences*

K. Colodner, M. Sabariego

Restrictions: This course is limited to first-years and sophomores. Coreq: NEURO-100L.

NEURO-221 Research Techniques in Neuroscience

Fall. Credits: 4

This course will introduce students to modern techniques utilized in neuroscience research. Students will learn the underlying principles of an array of techniques spanning the fields of cellular/molecular, behavioral, and cognitive neuroscience. In lab, students will perform experiments that demonstrate these skills firsthand. Emphasis will be placed on the tools necessary to implement these studies, proper experimental design, and the critical interpretation of generated data. *Applies to requirement(s): Math Sciences*

K. Colodner

Restrictions: This course is offered to neuroscience majors only.; Course limited to sophomores, juniors and seniors Prereq: NEURO-100. Coreq: NEURO-221L.

NEURO-246 Cognitive Neuroscience Fall. Credits: 4

Cognitive psychologists investigate the features and functions of the human mind through behavioral techniques; neuroscientists explore the physiology of the human brain. Cognitive Neuroscience lies at the intersection of these disciplines, and asks questions like: How are memories represented in the brain? Is our brain pre-prepared to learn language and if so, how? How does the average human brain still outperform most face recognition software? This course explores the cognitive and neural processes that support vision, attention, language, memory, and music. It introduces basic neuroanatomy, functional imaging techniques, and behavioral measures of cognition. *Crosslisted as: PSYCH-246*

Applies to requirement(s): Social Sciences

M. Breen

Prereq: PSYCH-100, NEURO-100, or AP Psychology.

Notes: This course counts in the cognitive or biol bases area of the Psychology major.

NEURO-254 Psychopharmacology

Fall. Credits: 4

Psychopharmacology focuses on the impact that drugs (both illicit and prescription) have on the brain, neurocircuitry, and behavior. Students will explore the underlying neurotransmitter systems of the brain and discover how substances influence nervous system function including the experience of pain, sleep, emotional states, motivation, addiction, and mental health. The course will bridge concepts in chemistry, biology, psychology, and neuroscience by highlighting major drug classes and their underlying mechanisms of action. Additional discussions will focus on the economic, social, and political aspects of the drug market, as well as ethics and legalities of the drug industry. *Crosslisted as: PSYCH-254*

Applies to requirement(s): Social Sciences J. Schwartzer

Prereq: PSYCH-100, NEURO-100, or AP Psychology.

NEURO-256 Hormones and Behavior

Fall. Credits: 4

Does the idea of Finals Week stress you out? Have you ever felt hungry or thirsty? Is our biology to blame when people cheat on their partners? From mental health and hunger to sexual motivation and aggression, our hormones dictate many of our basic choices and ultimately control how we interact with our world. This course will explore how hormones communicate with our brain to influence behaviors such as sexual attraction and reproduction, parental care, and social behavior. Special emphasis will be placed on the underlying biology and role of the nervous system in regulating hormone levels.

Crosslisted as: PSYCH-256

Applies to requirement(s): Social Sciences T. Hodges

Prereq: PSYCH-100, NEURO-100, or AP Psychology.

NEURO-295 Independent Study

Fall and Spring. Credits: 1 - 4 The department Instructor permission required.

NEURO-309 Topics in Neuroscience and Behavior

NEURO-309ND Topics in Neuroscience and Behavior. 'Analysis of Neural Data'

Spring. Credits: 4

Neuroscience addresses big questions about the mind by studying the structure and function of the brain – questions like: How do we remember, learn, and make decisions? Why do we feel emotions and experience consciousness? What causes mental illness? This increasingly means analyzing datasets that are large, complex, high dimensional, and time varying. Neural data analysis employs a unique set of concepts and approaches drawing on statistics, mathematics, physics, and computer science. In this course, we will apply these techniques to real neural datasets through hands-on activities and a final independent project. Possible topics include statistical modeling of neuronal spiking data; analysis of high-dimensional data with spatial structure (e.g., EEG, fMRI); and techniques in time series analysis (e.g., autoregressive modeling, time-frequency decomposition, network connectivity, causality). *Crosslisted as: STAT-344ND*

Applies to requirement(s): Math Sciences

B. Pittman-Polletta

Prereq: STAT-242.

Advisory: Students who have completed courses in allied fields on research methods (e.g., PSYCH-204 and NEURO-221) or computational and mathematical techniques (e.g., COMSC-335 and PHYS-205) may also be qualified. Contact the instructor to discuss.

NEURO-309NE Topics in Neuroscience and Behavior. 'Neuroethics' Spring. Credits: 4

Neuroethics draws on the tools of philosophical analysis to investigate the role of neuroscience in our personal, social, and ethical lives. This class will look at the ethics of neuroscientific interventions such as cognitive enhancement, mind reading, and lie detection. We will examine how the neurosciences might inform philosophical discussions about human nature, personality, and ethics. In addition, we will look at the evidential role of neuroscientific evidence and how neuroscience technologies such as fMRI have influenced our thinking about the mind/ brain and person.

Crosslisted as: PHIL-334NE, PSYCH-359NE

Applies to requirement(s): Humanities L. Sizer

Prereq: 8 credits from the Philosophy department or 4 credits from Philosophy and 4 credits from Neuroscience and Behavior.

NEURO-309SE Topics in Neuroscience and Behavior: 'Philosophy and Science of Emotion'

Fall. Credits: 4

This course is an interdisciplinary investigation of the nature of emotions and their influences on our thoughts and actions. While we will draw from a variety of disciplines, the nature and motivations of the inquiry are philosophical. We will consider. what are emotions? Are they bodily responses? Thoughts? Feelings? What roles do cultures play in shaping our emotions? What functions do emotions serve? We will examine evidence and arguments offered by philosophy, psychology, neuroscience, anthropology and evolutionary theory, and consider how these perspectives do or don't inform each other, as well as how they can help us understand the nature of emotions.

Crosslisted as: PHIL-350SE, PSYCH-359SE

Applies to requirement(s): Humanities

Other Attribute(s): Writing-Intensive

L. Sizer

Prereq: 8 credits in Philosophy or Neuroscience and Behavior, or 4 credits in each.

NEURO-324 Cellular and Molecular Neuroscience

Not Scheduled for This Year. Credits: 4

This course will explore cellular and molecular mechanisms of nervous system development and function through lectures, laboratory exercises, and the critical analysis of primary literature. Topics include synapse formation and synaptic transmission, neuronal-glial interactions, the molecular basis of behavior, and applied genetic engineering techniques. *Applies to requirement(s): Math Sciences K. Colodner*

Prereq: NEURO-221 or BIOL-230.

Notes: This course meets the 300-level laboratory-based course requirement for the Neuroscience and Behavior major.

NEURO-331 Glial Cells in Health and Disease *Fall. Credits:* 4

This course will explore the "other" cells in your brain, the glial cells. While neuronal cells receive most of the attention, glial cells are now recognized as essential players in normal brain physiology. Through the critical analysis of primary literature, we will highlight recent advances in glial cell biology and discuss how the various glial cell subtypes (astrocytes, microglia, myelinating cells, etc.) contribute to the healthy and diseased brain. We will examine the glial contribution to a variety of disorders (e.g. multiple sclerosis, spinal cord injury, neurodegenerative diseases, etc.) as we cultivate a better understanding of these often overlooked brain cells. *Applies to requirement(s): Math Sciences*

K. Colodner

Restrictions: This course is offered to neuroscience majors only. Prereq: NEUR0-221.

NEURO-336 Systems Neuroscience

Spring. Credits: 4

This course will cover the functioning of neural circuits in the brain and how they give rise to cognition and behavior. Using primary literature and activities, students will delve into current topics in systems neuroscience. Labs will provide exposure and training in common neuroscience techniques, practice in thinking like a scientist, and an appreciation for how basic research can lead to major advances in the treatment of disease.

Applies to requirement(s): Math Sciences Other Attribute(s): Speaking-Intensive

M. Sabariego

Restrictions: This course is offered to neuroscience majors only. Prereq: NEURO-100 and NEURO-221. Coreq: NEURO-336L.

Notes: Open to Neuroscience majors only for the first week of pre-registration; open to Psychology and Biology majors after the first week.

NEURO-338 Mobilizing the Hippocampus

Spring. Credits: 4

This course will provide a research site to investigate the functions of the hippocampal brain region to then embody that learning through choreographic structures. In particular, students will use dance expression to aid the understanding of complex neuroscience topics, and apply neuroscience knowledge to deepen creative expression. "Mobilizing the hippocampus" will help to bridge a gap between science and art, serving as a tool to stimulate a heightened understanding of both disciplines.

Crosslisted as: DANCE-338

Applies to requirement(s): Meets No Distribution Requirement B. Diewald, M. Sabariego

Restrictions: This course is open to juniors and seniors; This course is limited to Dance and Neuroscience majors.

NEURO-342 Mapping the Brain: A Hands-on Introduction to Connectomics

Spring. Credits: 4

Connectomics is an emerging neuroscience subfield that aims to make detailed synaptic connectivity maps of the entire brain. This course will provide a comprehensive overview of this growing field, and allow students to actively engage with actual volumetric connectomic datasets. Students will be guided through active learning exercises that explore these datasets using cutting edge software and tools. We will engage with brain volumes from several species, and we will highlight the similarities and differences between synaptic connectivity across organisms. We will also explore current successes and limitations facing the field, as students gain a better understanding of how ultrastructural studies inform neuroscientists about how the brain works.

Applies to requirement(s): Math Sciences K. Colodner

Prereq: NEURO-221.

NEURO-395 Independent Study

Fall and Spring. Credits: 1 - 8 The department Instructor permission required.

Courses Approved to Count for the Neuroscience and Behavior Major

Code	Title	Credits	
Biochemistry			
BIOCH-312	Chemistry of Biomolecules	4	
BIOCH-318	Laboratory Techniques in Protein Biochemistry	1	
Biological Science	es		
BIOL-200	Introductory Biology II: How Organisms Develop	o 4	
BIOL-210	Molecular Genetics	4	
BIOL-220	Cell Biology	4	
BIOL-307	Vertebrate Anatomy	4	
BIOL-321AD	Conference Course: 'Substance Use Disorder: Addiction and Drug Memory Formation'	4	
BIOL-321BE	Conference Course: 'Inquiries in Behavioral Ecology'	4	
BIOL-328	Human Physiology	4	
BIOL-333	Neurobiology	4	
Chemistry			
CHEM-150	General Chemistry: Foundations	4	
CHEM-160	Integrated Introduction to Biology and Chemist	ry 4	
CHEM-202	Organic Chemistry I	4	
CHEM-312	Chemistry of Biomolecules	4	
Computer Science	e		
COMSC-334	Artificial Intelligence	4	
COMSC-341NL	Topics: 'Natural Language Processing'	4	
Dance			
DANCE-338	Mobilizing the Hippocampus	4	
Music			
MUSIC-321AM	Advanced Interdisciplinary Topics: 'Art, Music a the Brain'	ind 4	
Neuroscience & Behavior			
NEURO-100	Introduction to Neuroscience and Behavior	4	
NEURO-221	Research Techniques in Neuroscience	4	

NEURO-246	Cognitive Neuroscience	4
NEURO-254	Psychopharmacology	4
NEURO-256	Hormones and Behavior	4
NEURO-309ND	Topics in Neuroscience and Behavior. 'Analysis of Neural Data'	4
NEURO-309NE	Topics in Neuroscience and Behavior. 'Neuroethics'	4
NEURO-309SE	Topics in Neuroscience and Behavior. 'Philosophy and Science of Emotion'	4
NEURO-324	Cellular and Molecular Neuroscience	4
NEURO-331	Glial Cells in Health and Disease	4
NEURO-336	Systems Neuroscience	4
NEURO-338	Mobilizing the Hippocampus	4
NEURO-342	Mapping the Brain: A Hands-on Introduction to Connectomics	4
NEURO-395	Independent Study	1-8
Philosophy		
PHIL-350SE	Topics in Philosophy: 'Philosophy and Science of Emotion'	4
Psychology		
PSYCH-201	Statistics	4
PSYCH-204	Research Methods in Psychology	4
PSYCH-246	Cognitive Neuroscience	4
PSYCH-254	Psychopharmacology	4
PSYCH-256	Hormones and Behavior	4
PSYCH-340CL	Laboratory in Perception and Cognition: 'Cognition and Literacy'	4
PSYCH-340SP	Laboratory in Perception and Cognition: 'Speech'	4
PSYCH-349AD	Seminar in Perception and Cognition: 'Adult Literacy'	4
PSYCH-349AM	Seminar in Perception and Cognition: 'Art, Music, and the Brain'	4
PSYCH-349LT	Seminar in Perception and Cognition: 'Language and Thought'	4
PSYCH-350BN	Lab in Biological Bases of Behavior: 'Laboratory in Behavioral Neuroscience'	4
PSYCH-350ET	Lab in Biological Bases of Behavior: 'Ethology'	4
PSYCH-359CN	Seminar. Biological Bases of Behavior. 'Clinical Neuroscience'	4
PSYCH-359MD	Seminar: Biological Bases of Behavior: 'Symptoms and Mechanisms of Major Depressive Disorder'	4
PSYCH-359SE	Seminar: Biological Bases of Behavior: 'Philosophy and Science of Emotion'	4
Statistics		
STAT-242	Intermediate Statistics	4
STAT-344ND	Seminar in Statistics and Scientific Research: 'Analysis of Neural Data'	4

Laboratory-Based Courses at the 300 Level Approved to Count for the Neuroscience and Behavior Major

Code	Title	Credits
Biochemistry		
BIOCH-318	Laboratory Techniques in Protein Biochemistry	1

Biological Sciences			
BIOL-307	Vertebrate Anatomy	4	
BIOL-321AD	Conference Course: 'Substance Use Disorder. Addiction and Drug Memory Formation'	4	
BIOL-321BE	Conference Course: 'Inquiries in Behavioral Ecology'	4	
BIOL-328	Human Physiology	4	
BIOL-333	Neurobiology	4	
Computer Science	2		
COMSC-334	Artificial Intelligence	4	
COMSC-341NL	Topics: 'Natural Language Processing'	4	
Neuroscience & B	ehavior		
NEURO-324	Cellular and Molecular Neuroscience	4	
NEURO-336	Systems Neuroscience	4	
NEURO-342	Mapping the Brain: A Hands-on Introduction to Connectomics	4	
NEURO-395	Independent Study	1-8	
Psychology			
PSYCH-340CL	Laboratory in Perception and Cognition: 'Cognition and Literacy'	4	
PSYCH-340SP	Laboratory in Perception and Cognition: 'Speech'	4	
PSYCH-350BN	Lab in Biological Bases of Behavior: 'Laboratory in Behavioral Neuroscience'	4	
PSYCH-350ET	Lab in Biological Bases of Behavior. 'Ethology'	4	