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
Mara Breen, Chair (Fall 2022)
Kenneth Colodner, Chair (Spring 2023)
Dianne Baranowski, Academic Department Coordinator

105 Clapp Laboratory
413-538-2611
https://www.mtholyoke.edu/academics/find-your-program/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.

Faculty
This area of study is administered by the Neuroscience and Behavior Committee:
Katherine Binder, William R. Kenan, Jr. Professor of Psychology, On Leave 2022-2023
Gary Gillis, Norman Wait Harris and Emma Gale Harris Foundation Professor of Biological Sciences, On Leave 2022-2023
Mara Breen, Associate Professor of Psychology and Education
Kenneth Colodner, Associate Professor of Neuroscience and Behavior, Teaching Spring Only
Kathryn McMenimen, Associate Professor of Chemistry
Jared Schwartz, Associate Professor of Psychology and Education; Director of the Science Center
Marta Sabariego, Assistant Professor of Neuroscience and Behavior, Teaching Fall Only
André White, Assistant Professor of Biological Sciences
Bethany Jones, Visiting Lecturer in Neuroscience and Behavior

Requirements for the Major
A minimum of 48 credits:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>NEURO-100</td>
<td>Introduction to Neuroscience and Behavior</td>
<td>4</td>
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<tr>
<td>CHEM-150</td>
<td>General Chemistry: Foundations of Structure and Reactivity</td>
<td>4</td>
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<tr>
<td>or CHEM-160</td>
<td>Integrated Introduction to Biology and Chemistry</td>
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<tr>
<td>CHEM-202</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>NEURO-221</td>
<td>Research Techniques in Neuroscience</td>
<td>4</td>
</tr>
<tr>
<td>PSYCH-204</td>
<td>Research Methods in Psychology</td>
<td>4</td>
</tr>
<tr>
<td>NEURO-246</td>
<td>Cognitive Neuroscience</td>
<td>4</td>
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<tr>
<td>or NEURO-254</td>
<td>Psychopharmacology</td>
<td></td>
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<tr>
<td>BIOL-200</td>
<td>Introductory Biology II: How Organisms Develop</td>
<td>4</td>
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<tr>
<td>BIOL-230</td>
<td>Molecular Genetics and Cell Biology</td>
<td>4</td>
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</tbody>
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An appropriate prerequisite to qualify for the quantitative inference course

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>PSYCH-201</td>
<td>Statistics</td>
<td>4</td>
</tr>
<tr>
<td>or STAT-242</td>
<td>Intermediate Statistics</td>
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</table>

Two of the following laboratory-based courses at the 300 level: 8

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>BIOCH-311</td>
<td>Protein Biochemistry and Cellular Metabolism (with BIOCH-318 lab)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL-307</td>
<td>Vertebrate Anatomy</td>
<td>4</td>
</tr>
<tr>
<td>BIOL-315</td>
<td>Behavioral Ecology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL-321AD</td>
<td>Conference Course: 'Substance Use Disorder: Addiction and Drug Memory Formation'</td>
<td>4</td>
</tr>
<tr>
<td>BIOL-333</td>
<td>Neurobiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL-328</td>
<td>Human Physiology</td>
<td>4</td>
</tr>
<tr>
<td>COMSC-334</td>
<td>Artificial Intelligence</td>
<td>4</td>
</tr>
<tr>
<td>COMSC-341NL</td>
<td>Topics: 'Natural Language Processing'</td>
<td>4</td>
</tr>
<tr>
<td>NEURO-324</td>
<td>Cellular and Molecular Neuroscience</td>
<td>4</td>
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<tr>
<td>NEURO-336</td>
<td>Systems Neuroscience</td>
<td>4</td>
</tr>
<tr>
<td>NEURO-395</td>
<td>Independent Study (4 credits)</td>
<td>4</td>
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<tr>
<td>PSYCH-350BN</td>
<td>Lab in Biological Bases of Behavior: 'Laboratory in Behavioral Neuroscience'</td>
<td>4</td>
</tr>
<tr>
<td>PSYCH-340CL</td>
<td>Laboratory in Perception and Cognition: 'Cognition and Literacy'</td>
<td>4</td>
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A third 300-level course from the preceding list, or from the following: 4

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</thead>
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<tr>
<td>BIOL-338</td>
<td>Evolution and Human Sexual Behavior</td>
<td>4</td>
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</tbody>
</table>
CHEM-312 Chemistry of Biomolecules

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

NEURO-331 Gial Cells in Health and Disease

PSYCH-349AM Seminar in Perception and Cognition: 'Art, Music, and the Brain'

PSYCH-349LT Seminar in Perception and Cognition: 'Language and Thought'

PSYCH-359GE Seminar in Biological Bases of Behavior: 'Neuroscience and Psychology of Sex and Gender'

PSYCH-359CN Seminar: Biological Bases of Behavior: 'Clinical Neuroscience'

Total Credits 48

Other Requirements

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

Additional Specifications

- Students planning postgraduate study in a related discipline or in medicine are urged to participate in independent laboratory research within either or both departments.
- Students who declare a neuroscience and behavior major automatically fulfill the College's "outside the major" requirement.

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

NEURO-221 Research Techniques in Neuroscience

Spring. 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; This course is limited to sophomores and juniors.
Prereq: NEURO-100 and PSYCH-201 (or equivalent). Coreq: NEURO-221L.

NEURO-246 Cognitive Neuroscience

Spring. 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

Spring. 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. Schwartz
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-309LM Topics in Neuroscience and Behavior: 'Neurobiology of Learning and Memory'

Fall. Credits: 4
How are memories represented in our brain? Why do we remember some types of information better than others? The journey of information from the world into our long-term memory involves a fascinating series of neurobiological events, from changes in synaptic structure to altered functional connectivity between hippocampus and cortex. This process is shaped by factors including emotion and sleep. Further, once stored, memories continue to morph over time with reactivation and new learning. This course will trace this journey at both the molecular and systems neuroscience levels, leading to a holistic understanding of the neurobiology supporting learning and memory.
Applies to requirement(s): Math Sciences
Other Attribute(s): Speaking-Intensive
B. Jones
Prereq: NEURO-100 and BIOL-230.
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
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
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-100 and BIOL-230 (or BIOL-220).
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
Not Scheduled for This Year. 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: NEURO-100 and BIOL-230.

NEURO-336 Systems Neuroscience
Fall. 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 PSYCH-204. 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-341 Advances in Neuroscience
Not Scheduled for This Year. Credits: 4
Neuroscience is a rapidly changing field. This seminar will prepare students for the next generation of neuroscience while also providing the foundation for important principles that have guided the field during the last few decades. In particular, using primary literature to guide the discussion, this class will examine topical subjects of modern neuroscience that are shaping our understanding of how the brain works.
Applies to requirement(s): Math Sciences
K. Colodner
Restrictions: This course is offered to neuroscience majors only.
Prereq: BIOL-230 and PSYCH-204.
NEURO-395 Independent Study
Fall and Spring. Credits: 1 - 8
The department
Instructor permission required.