NEUROSCIENCE

Neuroscience is one of the fastest growing interdisciplinary fields of study, combining biology, chemistry, computer science, psychology, physics, mathematics and philosophy.

ABOUT THE PROGRAM

The neuroscience program at Hope College is founded on one of its greatest strengths – its research program – and promotes the process of discovery and inquiry-based learning. Students trained in neuroscience go on to successful careers in medicine, clinical psychology, scientific research, pharmacy, public health, science advocacy, law, and public policy.

Neuroscience students at Hope have been very successful in gaining admission to graduate programs in neuroscience and clinical psychology, dental school and other professional health programs. Many of our students also have been successful in gaining employment immediately after graduation as research technicians in both academic and industrial settings.

MAJORS

The vision of the Neuroscience Major program is to teach students the fundamental principles of neuroscience in the context of a research-focused curriculum so that each student will be well prepared to pursue a career in the field of neuroscience, cognitive psychology or an allied health field. Neuroscience students are broadly trained in the foundational disciplines of biology, psychology, chemistry and statistics while also providing depth in training at multiple levels of neuroscience in four neuroscience courses: 1) Intro to Neuroscience, 2) Neurochemistry and Neuropharmacology, 3) Neuroanatomy and Neurophysiology and 4) Cognitive Psychology/Neuroscience. Students then have the opportunity to tailor their major by selecting 1) the most appropriate cognate courses in computer science, engineering, physics and philosophy and 2) upper level biology or psychology courses, which best suite their specific career goals. Finally, students have the opportunity to apply their foundational knowledge to novel problems in neuroscience in a collaborative research capstone experience in their junior or senior year.

DEGREE REQUIREMENTS FOR BACHELOR OF ARTS IN NEUROSCIENCE

In order to maximize student’s interdisciplinary training, we offer a Bachelor of Arts in Neuroscience. The B.A. in neuroscience requires completion of 63-67 credits. As noted above, students have several options within the curriculum to tailor their degree program to fit their specific interests. Therefore, it is important that all students considering a major in neuroscience talk with a faculty member in the Neuroscience program as early as possible when planning their degree program.
Fundamental Disciplinary Courses (24-28 credits):

- PSY 100 – Introduction to Psychology, 4 credits
- PSY 200 – Research Methods, 4 credits
- MATH 311/312 – Statistical methods/Applied Statistics, 4 credits
- BIOL 105/107 – General Biology I, 4 credits
- BIOL 106/108 – General Biology II, 4 credits
- CHEM 103 – Introduction to Biological Chemistry, 4 credits
- Or CHEM 125/126/127/128 – General Chemistry I, 8 credits
- Or CHEM 131/132 – Accelerated General Chemistry I, 4 credits

Important Considerations:

1. Students interested in pursuing graduate studies in cellular, molecular, or systems neuroscience or professional studies in a health-related field should take the following to fulfill admission requirements for their intended post-graduate program:
   - the General Chemistry series, either CHEM 125/126, 127/128 OR CHEM 131/132. Sophomore students with prior experience in high school chemistry are encouraged to enroll in CHEM 131/132.
   - one year of Organic Chemistry, CHEM 221/255, 231/256
   - at least one semester of Biochemistry, CHEM 311

2. Those students intending to seek advanced degrees in clinical psychology or other cognitive-related disciplines should consider taking CHEM 103.

3. Some neuroscience graduate programs may also require Calculus, MATH 131

4. Students who choose not to take Calculus should take MATH 311/312 after they have completed Research Methods or the General Biology Series.

Required Core Neuroscience/Psychology Courses (23 credits)

- NSCI 211 – Introduction to Neuroscience, 4 credits
- NSCI 312 – Neuroanatomy and Neurophysiology, 4 credits
- NSCI 335 – Neurochemistry and Disease, 4 credits
- PSY 340 – Cognitive Psychology, 4 credits
- NSCI 411 – Advanced Neuroscience Research I, 4 credits
- NSCI 412 – Advanced Neuroscience Research II, 3 credits
Advanced Psychology, Biology or Neuroscience Electives (Choose 8 credits from the following):

- BIOL 221 – Human Physiology, 4 credits
- BIOL 355 – Developmental Biology, 4 credits
- BIOL 348/349 – Cell Biology and lab, 4 credits
- BIOL 370 – Animal Behavior, 4 credits
- BIOL/PSY 395 – Psychoneuroimmunology, 4 credits
- BIOL 442 – Advanced Topics in Animal Physiology, 4 credits
- PSY 310 – Behavior Disorders, 4 credits
- PSY 325 – Health Psychology, 4 credits
- PSY 395 – Sleep Seminar, 2 credits

Important Considerations

1. Students wishing to take BIOL 355, 348/349, 370 or 442 must have taken the Introductory Biology Sequence, BIOL 105/106, 107/108.
2. Students may apply 1-4 credits of BIOL 490, CHEM 490, PSY 490, NSCI 490, Independent Research Credit toward this elective.

Physics/Engineering/Computer Science Elective (Choose 4 credits from the following):

- BIOL 318 – Mathematical Biology, 4 credits
- CSCI 195 – Introduction to Programming with Python / BIO 195 Introduction to Bioinformatics (two 1/2 semester courses, taken as a sequence for 4 credits total)
- CSCI 225 – Software Design and Implementation, 4 credits
- PHYS 122/142 – General Physics II, 4 credits*
- PHYS 106/8 – College Physics II, 4 credits*
- ENGS 140 – Introduction to Electrical Circuits, 2 credits
- ENGS 295 – Introduction to Engineering Computing, 2 credits
- ENGS 382 – Bioelectric Systems, 2 credits

Important Considerations

1. *PHYS 106/108 has a prerequisite of PHYS 105/107 and PHYS 122/142 has a prerequisite of PHYS 121/141.
2. Students interested in pursuing professional studies in a health-related field are highly recommended to take one year of physics. Some neuroscience graduate programs require one year of physics.
3. Those students interested in computational neuroscience are highly encouraged to take the CSCI 195/BIOL 195 courses or CSCI 225.

**PHILOSOPHY ELECTIVE (CHOOSE 4 CREDITS FROM THE FOLLOWING):**

- PHIL 325 – Philosophy of the Mind, 4 credits
- PHIL 360 – Philosophy of Science, 4 credits
- PHIL 295 – Medical Ethics, 4 credits

**MINORS**

The neuroscience minor is structured on the existing disciplinary course infrastructures. The minor consists of a total of 23 credit hours, combining three core neuroscience courses listed below with flagged courses from multiple disciplines, thus allowing students to tailor their own specialized program to match their interests.

The core courses will consist of:

- NSCI 211 – Introduction to Neuroscience, 4 credits
- NSCI 411 – Advanced Neuroscience Research I, 4 credits
- NSCI 412 – Advanced Neuroscience Research II, 3 credits

In addition to the core courses, students are required to take 12 credits of flagged courses, only 8 of which may be taken in the student’s major department and satisfy the requirements for the student’s major. These courses include:

**BIOLOGY:**

- BIOL 221 – Human Physiology, 4 credits
- BIOL 335 – Neurochemistry and Disease, 4 credits
- BIOL 348 – Advanced Topics in Cell Biology, 4 credits
- BIOL 355 – Developmental Biology, 4 credits
- BIOL 370 – Animal Behavior, 4 credits
- BIOL/PSY 395 – Psychoneuroimmunology, 4 credits
- BIOL 442 – Advanced Topics in Animal Physiology, 4 credits
CHEMISTRY:

- CHEM 335 – Neurochemistry and Disease, 4 credits

ENGINEERING:

- ENGS 140 – Introduction to Electrical Circuits, 2 credits
- ENGS 240 – Electrical Circuits, 2 credits
- ENGS 351 – Signal Analysis and Communications, 3 credits
- ENGS 382 – Bioelectrical Systems, 4 credits

NEUROSCIENCE:

- NSCI 312 – Neuroanatomy and Neurophysiology, 4 credits

nursing:

- NURS 320 – Pathophysiology, 4 credits
- NURS 325 – Psychiatric Mental Health Theory and Practicum, 3 credits

PHILOSOPHY

- PHIL 325 – Philosophy of Mind, 4 credits
- PHIL 360 – Philosophy of Science, 4 credits

PSYCHOLOGY

- PSY 310 – Behavior Disorders, 4 credits
- PSY 325 – Health Psychology, 4 credits
- PSY 340 – Cognitive Psychology, 4 credits
- PSY 395 – Sleep Seminar, 2 credits
- PSY 395 – Learning and Learning Strategies, 4 credits
- PSY/BIOL 395 – Psychoneuroimmunology, 4 credits

Important Considerations:

1. Students with majors outside of psychology are strongly encouraged to take PSY 100 (Introduction to Psychology) to fulfill their Social Science I General Education Requirement. This class will prepare them for the upper-level flagged courses offered through the psychology department.
2. Students with 1) majors outside of biology and 2) who are interested in taking a flagged course in biology are strongly encouraged to take BIO 221 Human Physiology as their flagged course in neuroscience.

3. Students can receive credit for taking BIO 221 or BIO 442, but not for both classes.

4. Students must take NSCI 411 and NSCI 412 in the same academic year.

5. Students should attempt to take as many of their flagged courses as possible prior to enrolling in NSCI 411.
COURSES

NEUROSCIENCE

NSCI 195 - Studies in Neuroscience
A course offered in response to student and instructor interest. Topics are not generally covered in the regular course listings. Course may be taken multiple times if topics are different.
Credits Awarded: 1-4
Terms Offered: As Needed
Prerequisites: Permission of instructor

NSCI 211 - Introduction to Neuroscience
This interdisciplinary course covers basic information from biology, chemistry, psychology, and philosophy that is relevant for understanding the nervous system and its role in behavior. Topics include structure and function of neurons, brain anatomy, sensory and motor systems, and the neuroscience of motivation, emotion, sleep, memory, language, and consciousness. Laboratory projects expose students to research methods in neuroscience, including monitoring the activity of individual neurons and recording physiological responses from humans. Three hours of lecture plus one 3-hour lab session per week.
Credits Awarded: 4
Terms Offered: Fall, Spring
Attribute: Natural Science I with lab (NSL)

NSCI 295 - Studies in Neuroscience
A topical lecture, seminar, or laboratory course designed to supplement the regular course offerings in neuroscience. Course may be taken multiple times if topics are different.
Credits Awarded: 1-4
Terms Offered: As Needed

NSCI 312 - Neuroanatomy and Neurophysiology
This course is focused on structure/function relationships of the vertebrate nervous system, using a systems-based approach. After a brief overview of neuroanatomy principles, students will study the physiology and functional anatomy of motor control, somatosensory function, pain, vision, audition, olfaction, vestibular function, memory, reward and emotion. This course will use clinical cases in order to emphasize how the fundamental neuroanatomy and neurophysiological principles relate to the human nervous system function.
Credits Awarded: 4
Terms Offered: Fall, Spring
Prerequisites: NSCI 211 or equivalent, Or, Biol 105 and Biol 106, Biol 107 or equivalent, Biol 108 or equivalent
Attribute: Natural Science I with lab (NSL)

NSCI 335 - Neurochemistry and Disease
The biochemistry of the brain and how it influences nervous system function, specifically of motor and cognitive processes, will be studied. The relationship between altered neurochemical activity and disease states will be explored using a case study approach. The laboratory component will introduce several neurochemistry techniques and a novel neurochemistry research project. Lecture, 3 hours per week; laboratory, one 3-hour session per week. Cross-listed with Biol 335 and Chem 335.
Credits Awarded: 4
Terms Offered: Spring, Even Years
Prerequisites: Biol 105 and Biol 106, Biol 107 or equivalent, Biol 108 or equivalent, Or, Chem 311 or NSCI 211
Attribute: Natural Science I with lab (NSL)
**NSCI 390 - Independent Study in Neuroscience**

A special course to allow students to study an area of neuroscience not included in the regular curriculum or an in-depth study of a selected neuroscience topic.

- **Credits Awarded:** 1-4
- **Terms Offered:** Fall, Spring
- **Prerequisites:** NSCI 211 or equivalent, Permission of instructor

**NSCI 395 - Studies in Neuroscience**

A topical lecture, seminar, or laboratory course designed to supplement the regular course offerings in neuroscience. Course may be taken multiple times if topics are different.

- **Credits Awarded:** 1-4
- **Terms Offered:** As Needed
- **Prerequisites:** NSCI 211 or equivalent

**NSCI 411 - Advanced Neuroscience Research I**

An interdisciplinary course in which students with different academic majors work together as a team to complete a self-designed neuroscience research project supervised by the instructor. This course is the first half of the capstone project for the Neuroscience minor program. Students will read and discuss primary research literature, write a formal research proposal, then design and conduct a study on a neuroscience topic. One 3-hour lab session plus 3 hours of discussion per week.

- **Credits Awarded:** 4
- **Terms Offered:** Fall
- **Prerequisites:** NSCI 211 or equivalent

**NSCI 412 - Advanced Neuroscience Research II**

This is the second semester of the capstone project for the neuroscience minor program. In this course, students with different academic majors work together as a team to complete the self-designed neuroscience research project that was initiated in NSCI 411. Students will continue to examine and discuss the relevant neuroscience literature, finish any remaining data collection and data analysis, and prepare a formal scientific report and research presentation. Three hours of discussion per week.

- **Credits Awarded:** 3
- **Terms Offered:** Spring
- **Prerequisites:** NSCI 411

**NSCI 490 - Research in Neuroscience**

This course is designed to give students majoring in neuroscience a chance to do research in an area in which they have a special interest. Requires permission of the instructor with whom the student will work.

- **Credits Awarded:** 0-2
- **Terms Offered:** Fall, Spring
- **Prerequisites:** NSCI 211 or equivalent, Permission of instructor

**NSCI 493 - Independent Study in Neuroscience**

Course provides opportunity for a junior or senior neuroscience major to engage in an independent study project in an area in which the student has special interest.

- **Credits Awarded:** 1-4
- **Terms Offered:** As Needed
- **Prerequisites:** NSCI 211 or equivalent, Permission of Instructor
NSCI 495 - Advanced Studies in Neuroscience
A special course, sometimes taught as a seminar, which deals with a specific area of neuroscience at an advanced level. May be repeated for credit under different topics.
Credits Awarded: 1-4
Terms Offered: As Needed
Prerequisites: NSCI 211 or equivalent, Permission of instructor

NSCI 499 - Internship in Neuroscience
This program provides practical experience for students and is usually done off-campus. It requires formal application and permission of the department chairperson. The student will write a report or give an oral department seminar presentation following the internship experience.
Credits Awarded: 1-4
Terms Offered: Fall, Spring, Summer
Prerequisites: NSCI 211 or equivalent, Permission of department chair

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