

NEUROSCIENCE

Department Website: <http://neuroscience.uchicago.edu/undergraduate> (<http://neuroscience.uchicago.edu/undergraduate/>)

PROGRAM OF STUDY

Neuroscience is concerned with the function of nervous systems. The sheer scope of neuroscience necessitates numerous scientific approaches to achieve understanding of sensation, perception, cognition, and behavior. Consequently, students in the major are provided with access to a wealth of scientific variety, including biology, psychology, physics, chemistry, computer science, engineering, mathematics, statistics, and medicine. Neuroscience faculty at the University of Chicago have expertise in all of these areas and are distributed across the Biological Sciences, Social Sciences, and Physical Sciences Divisions.

The bachelor of arts (BA), bachelor of science (BS), and BS with honors degrees in neuroscience provide a broad foundation in understanding neural function from the perspective of molecules, cells, circuits, systems, organisms, and species. The BA degree provides thorough study in the field of neuroscience while allowing flexibility in elective choice. The BS and BS honors degrees offer a more intensive program of study that includes individual research. Students who wish to incorporate neuroscientific literacy into their degree but have primary interest in other fields can choose to obtain a minor in neuroscience.

SUMMARY OF REQUIREMENTS FOR THE MAJOR IN NEUROSCIENCE

The major curriculum includes nine required neuroscience courses, which provide a comprehensive overview of the field. Students must also take neuroscience electives, which may include up to two neuroscience-related electives. Neuroscience electives increase a student's knowledge of neural systems, while neuroscience-related electives are included to provide students with tools or context to enhance understanding of neural systems. Elective courses can be selected either to achieve breadth, i.e., broad exposure to many topics, or for depth in a particular area of neuroscience. Students who wish to major in neuroscience are strongly encouraged to declare the major in their second year.

Program Requirements: BA – Nine required neuroscience courses beyond the general education requirement (which should begin in the first year), plus a minimum of seven electives are required for a BA.

Program Requirements: BS – Nine required neuroscience courses beyond the general education requirement (which should begin in the first year), plus a minimum of 10 electives. Enrollment in faculty-supervised research for elective credit culminating in a poster presentation and thesis submission are also required for a BS.

Program Requirements for BS with Honors – The honors program expands on the program requirements for the BS by requiring a minimum GPA plus a summer of full-time research and three quarters of faculty-supervised research for elective credit in the student's fourth year. In the Spring Quarter of their fourth year, BS with Honors students will submit a thesis and present their research in a public forum. Interested majors must apply for admittance into the honors program in their third year.

GRADING

All courses used to satisfy prerequisites and requirements must be taken for quality grades. Students must pass each course in the Fundamental Neuroscience Sequence (NSCI 20100-20140) with a C or higher. Students are also required to pass general education courses with an average GPA of 2.0 or higher to continue in the program.

GENERAL EDUCATION REQUIREMENTS FOR THE MAJOR

To satisfy the general education requirements, students must take 200 units of Biological Sciences, 200 units of Mathematics, and 200 units of Chemistry from the selected list of general education courses for the neuroscience major (see General Education Table).

BACHELOR OF ARTS DEGREE IN NEUROSCIENCE

The basic degree in neuroscience is the BA. To qualify for a BA, students must minimally satisfy the general education requirements and complete the neuroscience required courses (900 units), 500 units of neuroscience elective courses, and 200 units of neuroscience or neuroscience-related elective courses as listed in the table below.

MAJOR: BACHELOR OF ARTS REQUIRED COURSES

NSCI 20101	Foundations of Neuroscience	100
NSCI 20111	Cellular Neurophysiology	100
NSCI 20130	Systems Neuroscience	100
NSCI 20140	Sensation and Perception	100
PHYS 12100-12200	General Physics I-II (or higher) *	200
NSCI 20100	Neuroscience Laboratory	100

STAT 22000	Statistical Methods and Applications *	100
CHEM 11300 or CHEM 12300	Comprehensive General Chemistry III *	100
At least five Neuroscience electives **		500
No more than two Neuroscience-related electives ^		200
Total Units		1600

* Credit may be granted by examination.

^ May also include additional neuroscience electives

** While students may register for multiple quarters of NSCI 29700 Reading and Research in Neuroscience, only one may be counted toward major requirements.

INDEPENDENT RESEARCH

By their third year, students majoring in neuroscience are strongly encouraged to participate in research with a faculty member. This can take many forms, including internships, fellowships, and research for elective credit. See also BS and Honors in Neuroscience. For more information on research opportunities, visit (<https://neuroscience.uchicago.edu/research-opportunities/>) the undergraduate major website. (<https://neuroscience.uchicago.edu/research-opportunities/>)

BACHELOR OF SCIENCE DEGREE IN NEUROSCIENCE

Students can earn a bachelor of science in neuroscience (<https://neuroscience.uchicago.edu/bachelor-science/>) by completing the neuroscience required courses (900 units), 200 units of neuroscience or related elective courses, and 800 units of neuroscience elective courses, which must include one to three quarters of faculty-supervised NSCI 29100 Neuroscience Thesis Research culminating in a written thesis and poster presentation. When enrolled in the neuroscience thesis elective, BS students will be required to attend a minimum of one BS student mentoring meeting each quarter. The thesis and poster will be evaluated by faculty in addition to the faculty thesis supervisor. Note that Neuroscience Thesis Research (NSCI 29100) must be completed before the final quarter of the student's graduating year to allow sufficient time to prepare the written document and presentation. The additional neuroscience electives and thesis work require approval by the office of the director of undergraduate studies and the thesis adviser.

MAJOR: BACHELOR OF SCIENCE REQUIRED COURSES

NSCI 20101	Foundations of Neuroscience	100
NSCI 20111	Cellular Neurophysiology	100
NSCI 20130	Systems Neuroscience	100
NSCI 20140	Sensation and Perception	100
PHYS 12100-12200	General Physics I-II (or higher) *	200
NSCI 20100	Neuroscience Laboratory	100
STAT 22000	Statistical Methods and Applications *	100
CHEM 11300 or CHEM 12300	Comprehensive General Chemistry III *	100
At least eight Neuroscience electives **		800
No more than two Neuroscience-related electives ^		200
Total Units		1900

* Credit may be granted by examination.

** Must include one to three courses of NSCI 29100, NSCI 29101, NSCI 29102 Neuroscience Thesis Research or NSCI 29200, NSCI 29201, NSCI 29202 Neuroscience Honors Thesis Research

^ May also include additional neuroscience electives

HONORS IN NEUROSCIENCE

The BS with honors is an extension of the BS and is targeted toward students with a particularly strong interest in research. To obtain honors in neuroscience, students must have a minimum GPA of 3.5 in the major and a cumulative GPA of 3.25 to apply for the honors program. This level of achievement must be maintained throughout the academic year corresponding to the thesis submission. Applications for the honors program will be reviewed by a faculty examining committee. A faculty sponsor (<https://neuroscience.uchicago.edu/faculty/>) and approved topic must be identified before applying.

The honors program begins with 10 weeks of full-time research during the Summer Quarter between the student's third and fourth years. This continues with research as a graded elective research course (NSCI 29200, NSCI 29201, and NSCI 29202 Neuroscience Honors Thesis Research) during Autumn, Winter, and Spring Quarters of the fourth year, which culminates in a public talk and a written thesis. The thesis and public talk

will be evaluated by a faculty thesis committee. A stipend is provided during the summer research component of the honors program. As part of the research course work, honors students participate in weekly classes in which they share their research with each other and supervising faculty, and receive guidance on formulating testable hypotheses, experimental design, report writing, and oral presentations. They also receive training in the responsible conduct of research. Experimental research may not be credited toward honors in more than one major.

MINOR IN NEUROSCIENCE

The minor in neuroscience is intended to provide neuroscientific literacy for students whose primary interest lies in other fields. The minor requires that students meet the general education requirements in the biological or physical sciences plus MATH 13100-13200 Elementary Functions and Calculus I-II. Students are strongly encouraged to take STAT 22000 Statistical Methods and Applications (or higher) and NSCI 20140 Sensation and Perception for two of the four electives, if these courses have not already been taken to fulfill major requirements. No course in the neuroscience minor can count toward the student's major(s) or other minors, nor can it count toward general education requirements.

REQUIRED COURSES FOR THE MINOR IN NEUROSCIENCE

NSCI 20101	Foundations of Neuroscience	100
NSCI 20111	Cellular Neurophysiology	100
NSCI 20130	Systems Neuroscience	100
Four Neuroscience electives*		400
Total Units		700

* Neuroscience-related electives do not count.

MINOR IN COMPUTATIONAL NEUROSCIENCE

This minor is intended to provide literacy in computational neuroscience and is for students who are interested in mathematical approaches applied to neural systems. Students electing this minor must have completed, or placed out of, the equivalent of a year of collegiate-level calculus and meet the general education requirement in the biological or physical sciences. No course in the computational neuroscience minor can count toward the student's major(s) or other minors, nor can it count toward general education requirements.

Summary of Requirements for the Minor in Computational Neuroscience

BIOS 26210-26211	Mathematical Methods for Biological Sciences I-II	200
NSCI 20101	Foundations of Neuroscience *	100
NSCI 23700	Methods in Computational Neuroscience	100
NSCI 24000	Modeling and Signal Analysis for Neuroscientists	100
Total Units		500

* Neuroscience majors must meet with the NSCI advisors to discuss an appropriate course equivalent.

DOUBLE MAJORS

Students interested in double majoring in neuroscience and (1) biological sciences or (2) psychology must meet with the NSCI advisors to discuss restrictions, as there is a limit of seven courses that can be double counted. Please email neuromajor@uchicago.edu to receive information on restrictions for double counting courses.

SAMPLE PROGRAM

Neuroscience is a unique and broad field that allows students to plan their undergraduate career in a variety of ways. Below is a [sample](#) plan for when to take NSCI required courses:

Year 1: Biological Sciences, Chemistry and Mathematics General Education Courses

Year 2: NSCI 20101, NSCI 20111, NSCI 20130, PHYS 12100-12200 General Physics I-II

Year 3: NSCI 20100 and/or NSCI 20140, Electives, Research Opportunities, STAT 22000

Year 4: NSCI 20100 and/or NSCI 20140, Electives, Research Opportunities, STAT 22000

ELECTIVES

NEUROSCIENCE ELECTIVES (no fewer than five)

NSCI 20500	Neuroanatomy	100
NSCI 20510	Evolution and the Nervous System	100
NSCI 21000	Social Neuroscience	100
NSCI 21015	Biological Psychology	100

NSCI 21100	Photons to Consciousness: Cellular and Integrative Brain Functions	100
NSCI 21400	Biological Clocks and Behavior	100
NSCI 21600	Attention and Working Memory in the Mind and Brain	100
NSCI 21750	Ethics through a Neurobiological Lens	100
NSCI 21800	Perspectives in Drug Abuse	100
NSCI 21900	Neuropharmacology	100
NSCI 22010	Neuroscience of Consciousness	100
NSCI 22015	Cognitive Psychology	100
NSCI 22110	Molecular and Translational Neuroscience	100
NSCI 22300	Molecular Principles of Nervous System Development	100
NSCI 22355	Observing Proteins in Action: How to Design and Build Your Own Instruments	100
NSCI 22400	Neuroscience of Seeing	100
NSCI 22450	Conquest of Pain	100
NSCI 22460	Anatomy of Selected Brain Circuits	100
NSCI 22500	Neuroscience of Communication	100
NSCI 22535	The Psychology and Neurobiology of Stress	100
NSCI 23400	Synaptic Physiology	100
NSCI 23500	Survey of Systems Neuroscience	100
NSCI 23700	Methods in Computational Neuroscience	100
NSCI 24000	Modeling and Signal Analysis for Neuroscientists	100
NSCI 29100	Neuroscience Thesis Research	100
NSCI 29101	Neuroscience Thesis Research II	100
NSCI 29102	Neuroscience Thesis Research III	100
NSCI 29200	Neuroscience Honors Thesis Research	100
NSCI 29201	Neuroscience Honors Thesis Research II	100
NSCI 29202	Neuroscience Honors Thesis Research III	100
NSCI 29700	Reading and Research in Neuroscience	100
CMSC 25025	Machine Learning and Large-Scale Data Analysis *	100
CMSC 25400	Machine Learning *	100

* Non-NSCI courses listed here require prior approval from the department. Inquiries and petitions may be submitted to neuromajor@uchicago.edu. (neuromajor@uchicago.edu)

RELATED ELECTIVES (no more than two)

BIOS 20172	Mathematical Modeling for Pre-Med Students	100
BIOS 20173	Perspectives of Human Physiology	100
BIOS 20175	Biochemistry and Metabolism	100
BIOS 20187	Fundamentals of Genetics	100
BIOS 20188	Fundamentals of Physiology	100
or BIOS 20191	Integrative Physiology	
BIOS 20189	Fundamentals of Developmental Biology	100
or BIOS 20190	Principles of Developmental Biology	
BIOS 20200	Introduction to Biochemistry	100
BIOS 20234	Molecular Biology of the Cell	100
BIOS 20235	Biological Systems	100
BIOS 20236	Biological Dynamics	100
BIOS 20242	Principles of Physiology	100
BIOS 26210	Mathematical Methods for Biological Sciences I	100
BIOS 26211	Mathematical Methods for Biological Sciences II	100
CMSC 12100-12200	Computer Science with Applications I-II	200
CMSC 15100-15200	Introduction to Computer Science I-II	200
CMSC 15400	Introduction to Computer Systems	100
CMSC 16100-16200	Honors Introduction to Computer Science I-II	200
CMSC 25300	Mathematical Foundations of Machine Learning	100

LING 27010	Psycholinguistics	100
MATH 23500	Markov Chains, Martingales, and Brownian Motion	100
PHYS 12300	General Physics III	100
or PHYS 13300	Waves, Optics, and Heat	
STAT 32940	Multivariate Data Analysis via Matrix Decompositions	100

GENERAL EDUCATION TABLE

GENERAL EDUCATION

One of the following BIOS sequences:*		200
BIOS 20186	Fundamentals of Cell and Molecular Biology [†]	
Plus one of the following:		
BIOS 20153	Fundamentals of Ecology and Evolutionary Biology	
BIOS 20151	Introduction to Quantitative Modeling in Biology (Basic)	
BIOS 20152	Introduction to Quantitative Modeling in Biology (Advanced)	
BIOS 20187	Fundamentals of Genetics	
BIOS 20188	Fundamentals of Physiology	
OR		
BIOS 20170 & BIOS 20171	Microbial and Human Cell Biology and Human Genetics and Developmental Biology [#]	
OR		
BIOS 20234-20235-20236	Molecular Biology of the Cell; Biological Systems; Biological Dynamics**	
One of the following two-course MATH sequences:		200
MATH 13100-13200	Elementary Functions and Calculus I-II	
MATH 15100-15200	Calculus I-II [*]	
MATH 16100-16200	Honors Calculus I-II	
One of the following two-course CHEM sequences:		200
CHEM 10100 & CHEM 10200	Introductory General Chemistry I and Introductory General Chemistry II	
CHEM 11100-11200	Comprehensive General Chemistry I-II	
CHEM 12100 & CHEM 12200	Honors General Chemistry I and Honors General Chemistry II	
Total Units		600

[†] The neuroscience major general education requirement in the biological sciences can be fulfilled by courses in the Biological Sciences Fundamentals Sequences (BIOS 20186 to 20190) without the Biological Sciences prerequisites (BIOS 20153-20151/20152) unless a student pursues a double major in Biological Sciences. However, all students in the sequence will be expected to possess the mathematical modeling competencies and basic coding in R covered in BIOS 20151/BIOS 20152 and BIOS 20153.

^{*} Credit may be granted by examination.

[#] BIOS 20171 must be taken concurrently with BIOS 20172.

^{**} Students with a score of 4 or 5 on the Advanced Placement Biology exam may use their AP credit to meet the general education requirement in the biological sciences if the first three quarters of the Advanced Biology sequence are completed.

NEUROSCIENCE COURSES

NSCI 20100. Neuroscience Laboratory. 100 Units.

This course has three components in series, representing (1) molecular neuroscience, (2) cellular electrophysiology, and (3) computation and psychophysics. The course meets one afternoon each week for four hours of laboratory time, including a didactic introduction. Students will be graded on their laboratory reports. Instructor(s): J. Maunsell; E. Heckscher; M. McNulty Terms Offered: Winter Prerequisite(s): NSCI 20111. Must be a Neuroscience Major

NSCI 20101. Foundations of Neuroscience. 100 Units.

This course is an introduction to the broad field of neuroscience. This is a lecture-based course that aims to introduce undergraduate students to concepts and principles that explain how the nervous system is built and how it functions. Examples of thematic areas covered in lectures include: (a) cellular anatomy of the nervous system, (b) development and evolution of the nervous system, (c) sensory systems, (d) motor systems, (e) cognition and behavior.

Instructor(s): D. Freedman, P. Kratsios, M. Sheffield Terms Offered: Autumn

Equivalent Course(s): PSYC 24450, BIOS 24101

NSCI 20111. Cellular Neurophysiology. 100 Units.

This course describes the cellular and subcellular properties of neurons, including passive and active electrophysiological properties, and their synaptic interactions. Readings are assigned from a general neuroscience textbook.

Instructor(s): M. Sheffield, W. Wei Terms Offered: Winter

Prerequisite(s): NSCI 20101, AND MATH 13100, or MATH or MATH 15100, or MATH or MATH 16100. Or consent of instructor

Equivalent Course(s): BIOS 24111

NSCI 20130. Systems Neuroscience. 100 Units.

This course covers vertebrate and invertebrate systems neuroscience with a focus on the anatomy, physiology, and development of sensory and motor control systems. The neural bases of form and motion perception, locomotion, memory, and other forms of neural plasticity are examined in detail. We also discuss clinical aspects of neurological disorders.

Instructor(s): J. MacLean Terms Offered: Spring

Prerequisite(s): NSCI 20101, NSCI 20111 or consent of instructors

Equivalent Course(s): PSYC 24010, BIOS 24130

NSCI 20140. Sensation and Perception. 100 Units.

What we see and hear depends on energy that enters the eyes and ears, but what we actually experience-perception-follows from human neural responses. This course focuses on visual and auditory phenomena, including basic percepts (for example, acuity, brightness, color, loudness, pitch) and also more complex percepts such as movement and object recognition. Biological underpinnings of perception are an integral part of the course.

Instructor(s): K. Ledoux Terms Offered: Winter

Equivalent Course(s): PSYC 20700

NSCI 20500. Neuroanatomy. 100 Units.

This course is part of the Study Abroad Neuroscience program in Paris, France. In this course, we will use an understanding of development in order to understand the neuroanatomy of the adult vertebrate nervous system. This understanding will be solidified by dissections of mammalian, fish and bird brains as well as a trip to see myriad brains at the Muséum national d'histoire naturelle. In the second half of the course, neuroanatomical adaptations specific to particular animals will be examined in the context of critical environmental and ecological factors. Examples include postural control in sloths, vision in marine animals and raptors, and the control of muscles of facial expression across mammalian species.

Instructor(s): P. Mason Terms Offered: TBD. Paris Study Abroad Neuroscience Program

Prerequisite(s): Enrollment into the Paris Study Abroad Program

NSCI 20510. Evolution and the Nervous System. 100 Units.

Evolutionary neuroscience has traditionally focused on the neural bases of animal behavior (neuroethology) and employed the methods of comparative anatomy, cellular neurophysiology and behavioral neuropsychology. This course will approach neuroethology from a modern evolutionary perspective, one that integrates findings from genomics, molecular developmental biology and paleontology with insights from neuroethology. Our exploration will include the controversies over the evolutionary origin of neurons and centralized brains, the independent solutions across taxa to processing ecologically important sensory information, and recent insights into the evolution of the neocortex.

Instructor(s): C. Ragsdale Terms Offered: Winter

NSCI 21000. Social Neuroscience. 100 Units.

Social species, by definition, create emergent organizations beyond the individual - structures ranging from dyads and families to groups and cultures. Social neuroscience is the interdisciplinary field devoted to the study of neural, hormonal, cellular, and genetic mechanisms, and to the study of the associations and influences between social and biological levels of organization. The course provides a valuable interdisciplinary framework for students in psychology, neuroscience, behavioral economics, and comparative human development. Many aspects of social cognition will be examined, including but not limited to attachment, attraction, altruism, contagion, cooperation, competition, dominance, empathy, isolation, morality, and social decision-making.

Instructor(s): J. Decety Terms Offered: Autumn

Equivalent Course(s): PSYC 22350, CHDV 24137, CHDV 22350, ECON 21830, HLTH 22350

NSCI 21015. Biological Psychology. 100 Units.

What are the relations between mind and brain? How do brains regulate mental, behavioral, and hormonal processes; and how do these influence brain organization and activity? This course introduces the anatomy, physiology, and chemistry of the brain; their changes in response to the experiential and sociocultural environment; and their relation to perception, attention, behavioral action, motivation, and emotion.

Instructor(s): B. Prendergast, L. Kay Terms Offered: Winter

Prerequisite(s): Some background in biology and psychology.

Note(s): This course does not meet requirements for the Biological Sciences Major.

Equivalent Course(s): CHDV 20300, BIOS 29300, PSYC 20300

NSCI 21100. Photons to Consciousness: Cellular and Integrative Brain Functions. 100 Units.

This course uses the visual system as a model to explore how the brain works. We begin by considering the physical properties of light. We then proceed to consider the mechanism of sensory transduction, cellular mechanisms of neuron to neuron communication, the operation of small neural networks, strategies of signal detection in neuron networks, and the hierarchical organization of cortical function. We conclude with visually guided behavior and consciousness.

Instructor(s): E. Schwartz Terms Offered: Winter

Prerequisite(s): NSCI 20111

Equivalent Course(s): BIOS 24136

NSCI 21400. Biological Clocks and Behavior. 100 Units.

This course will address physiological and molecular biological aspects of circadian and seasonal rhythms in biology and behavior. The course will primarily emphasize biological and molecular mechanisms of CNS function, and will be taught at a molecular level of analysis from the beginning of the quarter. Those students without a strong biology background are unlikely to resonate with the course material.

Instructor(s): B. Prendergast Terms Offered: Spring

Prerequisite(s): A quality grade in PSYC 20300 Introduction to Biological Psychology. Additional biology courses are desirable. Completion of Core biology will not suffice as a prerequisite.

Equivalent Course(s): PSYC 21750, BIOS 24248, HLTH 21750

NSCI 21510. Fundamentals of Synapses. 100 Units.

In this course, students will learn about the fundamentals of synapses, from molecular analysis to structure and function. Marine and aquatic models have historically provided a unique opportunity to investigate synaptic function due to the large size of their neurons, including the synaptic connections. Today, these synapse models are used to study basic principles of neuron-to-neuron communication (synaptic transmission), as well as disease mechanisms. In addition to lectures and discussions of key literature, this course will feature hands-on laboratory-based exercises in molecular genetics, imaging and physiology of synapses, as well as independent "discovery" projects to explore new topics in synapse biology.

Instructor(s): J. Morgan, J. Rosenthal Terms Offered: Spring

Prerequisite(s): Acceptance into the MBL Neuroscience Spring Quarter Program

NSCI 21520. A Deep Dive into the Cell and Molecular Biology of the Brain. 100 Units.

This course will be an interactive analysis of the cell biology of neurons and glia. Central questions include how do the unique morphologies of neurons and glia shape their cell biology and how do we use different techniques to examine these cells. Other topics include: structure and function of neuronal proteins, membrane excitability, the functions of different glia types, and signaling pathways in synapse formation and development. The course will span three weeks at the Marine Biological Laboratory. Mornings will consist of lectures and critical reading/discussion of the primary literature. In the afternoon, students will perform hands-on experiments on different lab projects that put into practice the concepts and techniques discussed in class.

Instructor(s): W. Green, R. Carrillo Terms Offered: Spring

Prerequisite(s): Acceptance into the MBL Neuroscience Spring Quarter Program

NSCI 21530. DYNAMIC CAMOUFLAGE: Behavior, Visual Perception and Neural Skin Patterning in Cephalopods. 100 Units.

This course takes an integrative approach to understanding a neurally controlled system of dynamic defense against visual predators. Camouflage is a widespread form of defense throughout the animal kingdom in every known habitat - land or sea. In the oceans, cephalopods (cuttlefish, octopus, squid) have evolved a sophisticated sensorimotor system called Rapid Adaptive Coloration, which can instantaneously change their total body appearance within a fraction of a second to range from highly camouflaged to startlingly conspicuous for a wide range of behaviors. The forms and functions of this dynamic system will be teased apart in integrative fashion in a top-down approach from ecology to organismal biology to organs, tissues and cells. The course touches on neural anatomy, sensation, visual perception (including psychophysics) and animal behavior. There are also applied biology aspects of this system that will be presented as well.

Instructor(s): R. Hanlon Terms Offered: Spring

Prerequisite(s): Acceptance into the MBL Neuroscience Spring Quarter Program

NSCI 21600. Attention and Working Memory in the Mind and Brain. 100 Units.

This course will provide a broad overview of current work in psychology and neuroscience related to attention and working memory. We will discuss evidence for sharp capacity limits in an individual's ability to actively monitor and maintain information in an "online" mental state. Readings will be primarily based on original source articles from peer-reviewed journals, with a focus on behavioral and neural approaches for measuring and understanding these basic cognitive processes.

Instructor(s): E. Vogel Terms Offered: Winter

Prerequisite(s): PQ: NSCI 20110 (Fundamental Neuroscience) is required for Neuroscience majors only.

Equivalent Course(s): PSYC 33830, PSYC 23820

NSCI 21610. Neuroanatomy of Cranial Nerves and Nuclei. 100 Units.

This hands-on laboratory course will cover the cranial nerves and their associated nuclei. The logic of cranial nerves, cranial nuclei, suprabulbar control, and thalamic projections will be described. The logic of predicting symptoms associated with lesions in these pathways will be explained. Students will learn how to understand

and predict the clinical consequences of interruptions along cranial nerve pathways. Classes will consist of short lectures interspersed with examination and drawing of slides of stained brain sections using projection microscopes. There will be two field trips to local collections of brains and anatomical specimens.

Instructor(s): P. Mason Terms Offered: Autumn

Prerequisite(s): Enrollment into the Paris Study Abroad Program

NSCI 21625. Cognitive Neuroscience in Humans and Rodents. 100 Units.

This course examines how complementary research in humans and rodents informs our understanding of cognition and the brain. We will explore fundamental questions in cognition that include how we learn from reward, how we form and update mental maps, how we give rise to and process emotions, and why we sleep. You will learn the experimental methods used in each species to tackle these questions. At the end of the course you will appreciate the complementary research across species that were indispensable in advancing our understanding of how the brain gives rise to cognition

Instructor(s): A. Bakkour, J. Yu Terms Offered: Spring

Equivalent Course(s): PSYC 24451

NSCI 21750. Ethics through a Neurobiological Lens. 100 Units.

This class surveys a range of ethical dilemmas as viewed from a neurobiological perspective. Using their working knowledge of functional neuroanatomy, students will be expected to understand and articulate the reasoning behind multiple viewpoints for each topic. Then, students will be asked to discuss a particular case study that revolves around the week's topic, and write a one-page summary of what they learned from the week's discussion. For a final project, students will study one of the dilemmas presented or one of their own choosing.

Instructor(s): P. Mason Terms Offered: Spring

Prerequisite(s): At least one course in the Neuroscience Major Fundamental Sequence (NSCI 20101, OR NSCI 20111, OR NSCI 20130)

Equivalent Course(s): BIOS 28105

NSCI 21800. Perspectives in Drug Abuse. 100 Units.

It is a broad overview course about drug abuse, that is appropriate for graduate students as well as undergraduates. It includes lectures on epidemiology, genetics, neurobiology, experimental methods, policy and treatment, as well as lectures on several specific drug classes. Lectures are by Dr. de Wit and by other invited faculty members, and students are required to present and discuss recent published papers during classes.

Equivalent Course(s): BIOS 24135, NURB 32900

NSCI 21900. Neuropharmacology. 100 Units.

This is a one quarter course that will explore neuronal pharmacology. Both the autonomic and central nervous system will be examined. The course has a clinical orientation. The course starts with an overview of the nervous system. In this section, we will explore the cellular aspects of neurons and their basic membrane and electrophysiological properties as well cellular and molecular aspects of synaptic transmission. The majority of the course will explore different neurotransmitter systems and drugs that interact with these systems.

Instructor(s): A. Fox Terms Offered: Spring

Prerequisite(s): NSCI 20101, NSCI 20111

Equivalent Course(s): BIOS 24140

NSCI 22010. Neuroscience of Consciousness. 100 Units.

Consciousness has been considered one of great mysteries in human existence. In this course, we will begin by trying to define the term and consider the so-called "hard" and "easy" problems of consciousness. A brief history of ancient civilizations' views on mental experience will be discussed. We will then go over basic neuroscientific concepts and methods that are being used to study the neural correlates of consciousness. We will explore different states of consciousness and disruptions of consciousness in human patients. We will touch on the related problems of intentionality and free will. Finally, we will discuss prevailing scientific theories of consciousness.

Instructor(s): Hatsopoulos, Nicholas Terms Offered: Autumn

Prerequisite(s): NSCI 20101

NSCI 22015. Cognitive Psychology. 100 Units.

Viewing the brain globally as an information processing or computational system has revolutionized the study and understanding of intelligence. This course introduces the theory, methods, and empirical results that underlie this approach to psychology. Topics include categorization, attention, memory, knowledge, language, and thought.

Instructor(s): M. Rosenberg Terms Offered: Spring

Equivalent Course(s): EDSO 20400, PSYC 20400

NSCI 22110. Molecular and Translational Neuroscience. 100 Units.

This lecture/seminar course explores the application of modern cellular and molecular techniques to clarify basic mechanisms that underlie neural development, synaptic transmission, protein trafficking, and circuit function and the dysfunction of these fundamental processes that results in neurodevelopmental disorders and age-associated neurological diseases.

Instructor(s): S. Sisodia Terms Offered: Winter

Prerequisite(s): Neuroscience Fundamental Series (NSCI 20101-20130)

Equivalent Course(s): BIOS 24143

NSCI 22130. Psychoactive drugs, the Brain and Behavior. 100 Units.

The goal of this course is for the students to understand how psychoactive drugs affect the brain and behavior. Understanding how these drugs work will provide students a window in the relationship between the brain and behavior. Understanding how drugs affect the brain and behavior will also enhance the students understanding of the relationship between psychoactive drugs/medications and society.

Instructor(s): H. de Wit, R. Lee, M. Xu, X. Zhuang Terms Offered: Winter

Prerequisite(s): For UG: NSCI 20101, NSCI 20111 and NSCI 20130

Equivalent Course(s): NURB 32130

NSCI 22300. Molecular Principles of Nervous System Development. 100 Units.

This elective course provides an overview of the fundamental questions in developmental neurobiology. It is based on primary research papers and highlights key discoveries in vertebrate and invertebrate animals that advanced our understanding of nervous system development. Topics covered, among others, will include neural stem cells, neuronal specification and terminal differentiation, and circuit assembly. Dogmas and current debates in developmental neurobiology will be discussed, aiming to promote critical thinking about the field. This advanced-level course is open to upper level undergraduate and graduate students and combines lectures, student presentations, and discussion sections. Neuroscience major undergrads need to have completed the Fundamentals of Neuroscience sequence.

Instructor(s): E. Grove, P. Kratsios Terms Offered: Spring

Prerequisite(s): For undergrads: NSCI 20110, 20120, 20130 and a basic understanding of Genetics, or "BIOS 20187" (Fundamentals of Genetics) is recommended, but not required.

Equivalent Course(s): DVBI 32300, NURB 32300, CPNS 32300

NSCI 22355. Observing Proteins in Action: How to Design and Build Your Own Instruments. 100 Units.

New insights into cell function are now possible using technologies that resolve single molecules. However, as devices become more complicated, we are often faced with three questions: What is it that our instruments actually measure; how can we change the instrument to see a new behavior; and, how do we analyze the data to get the greatest insight? We will learn how to answer these questions by designing, building, and using our own electrical and optical instruments, making measurements, and then analyzing the results. Membrane proteins play an essential role in the behavior of all cells. We will study membrane protein channels in synthetic membranes, host cells, and giant axons from squid collected in the waters surrounding the MBL. The movement of electrical charge produced by conformational changes will be correlated with both the current passing thru single channels and structural information obtained from light and electron microscopy. The course will proceed from simple measurements to student-designed projects.

Instructor(s): E. Schwartz, F. Bezanilla, E. Perozo Terms Offered: Autumn, L. September term.

Note(s): This course will be given at Marine Biological Laboratory, Woods Hole, Massachusetts

Equivalent Course(s): BIOS 27721

NSCI 22400. Neuroscience of Seeing. 100 Units.

This course focuses on the neural basis of vision, in the context of the following two questions: 1. How does the brain transform visual stimuli into neuronal responses? 2. How does the brain use visual information to guide behavior? The course covers signal transformation throughout the visual pathway, from retina to thalamus to cortex, and includes biophysical, anatomical, and computational studies of the visual system, psychophysics, and quantitative models of visual processing. This course is designed as an advanced neuroscience course for undergraduate and graduate students. The students are expected to have a general background in neurophysiology and neuroanatomy.

Instructor(s): W. Wei, J. Maunsell, M. Sherman, S. Shevell Terms Offered: Autumn

Prerequisite(s): NSCI 20111 or BIOS 24110 or consent of instructor

Equivalent Course(s): PSYC 24133, PSYC 34133, CPNS 34133, BIOS 24133, NURB 34133

NSCI 22450. Conquest of Pain. 100 Units.

This course examines the biology of pain and the mechanisms by which anesthetics alter the perception of pain. The approach is to examine the anatomy of pain pathways both centrally and peripherally, and to define electrophysiological, biophysical, and biochemical explanations underlying the action of general and local anesthetics. We discuss the role of opiates and enkephalins. Central theories of anesthesia, including the relevance of sleep proteins, are also examined.

Instructor(s): K. Ruskin Terms Offered: Winter

Prerequisite(s): Three quarters of a Biological Sciences Fundamentals Sequence, CHEM 2200-22100-22200 or BIOS 20200 and prior course in neurobiology or physiology is recommended.

Equivalent Course(s): BIOS 24217

NSCI 22460. Anatomy of Selected Brain Circuits. 100 Units.

The course will provide an introduction to the anatomy and function of specific brain circuits. Students will participate in the dissection of brains of select species via videoconference to step wise uncover and describe gross-anatomical connectivity patterns of brain areas involved in cognition, learning, emotion and movement control. We will use histological and microscopic techniques to visualize and describe circuits and specific types of neurons within these circuits. The course will further introduce students to the latest EM/histological reconstruction techniques.

Instructor(s): C. Hansel, B. Kasthuri Terms Offered: Spring
Prerequisite(s): NSCI 20101, NSCI 20130 or consent of instructor

NSCI 22535. The Psychology and Neurobiology of Stress. 100 Units.

This course explores the topic of stress and its influence on behavior and neurobiology. Specifically, the course will discuss how factors such as age, gender, and social context interact to influence how we respond to stressors both physiologically and behaviorally. The course will also explore how stress influences mental and physical health.

Instructor(s): G. Norman Terms Offered: Spring

Note(s): This course does not meet the requirements for the Biological Sciences Major.

Equivalent Course(s): PSYC 25750, BIOS 29271, CHDV 25750

NSCI 22870. Neural Interfaces for Restoration and Augmentation. 100 Units.

The objective of this course is to survey the science and engineering that underlie Brain-Machine Interfaces (BMIs). This course will discuss a variety of neural interfaces to restore sensory or motor function. I will describe the neural systems and the hardware and algorithms involved, and explore the general principles that guide attempts to read signals directly from the nervous system to drive extra-corporeal devices, bypassing the muscles, and write signals back in to restore sensation, bypassing native sensory transduction. I will leverage BMI experiments taking place in Chicagoland (including UChicago) for live demonstrations of BMIs in action.

Instructor(s): S. Bensmaia Terms Offered: Autumn

Prerequisite(s): NSCI 20101

Equivalent Course(s): CPNS 32870, NURB 32870

NSCI 23400. Synaptic Physiology. 100 Units.

This course covers the basic principles of synaptic transmission and plasticity using a combination of lecture and discussion of primary literature. Lecture topics cover membrane electrical phenomena that lead to release of neurotransmitter presynaptically, as well as the physiological consequences of postsynaptic receptor activation. Paper discussions, which make up ~ 2/3 of the course, are centered on two major topics: 1) The molecular machinery controlling synaptic vesicle exocytosis and recycling, and 2) Synaptic plasticity covering LTP, LTD, Metaplasticity, Spike-timing dependent plasticity and Homeostatic plasticity. There is significant emphasis on the connections between the various forms of synaptic modification and behavior.

Instructor(s): D. McGehee Terms Offered: Winter

Prerequisite(s): Upper undergrads by consent of instructor

Equivalent Course(s): NURB 32400

NSCI 23500. Survey of Systems Neuroscience. 100 Units.

This lab-centered course teaches students the fundamental principles of vertebrate nervous system organization. Students learn the major structures and the basic circuitry of the brain, spinal cord and peripheral nervous system. Somatic, visual, auditory, vestibular and olfactory sensory systems are presented in particular depth. A highlight of this course is that students become practiced at recognizing the nuclear organization and cellular architecture of many regions of brain in rodents, cats and primates.

Instructor(s): Oswald, A. M. Terms Offered: Autumn

Prerequisite(s): NSCI 20130. For Biological Sciences majors: Three quarters of a Biological Sciences fundamentals sequence

Note(s): Undergrads by consent only

Equivalent Course(s): ORGB 32500, NURB 31600, CPNS 30116

NSCI 23700. Methods in Computational Neuroscience. 100 Units.

Topics include (but are not limited to): relating neural data to behavior, Signal Detection theory, models of vision and artificial neural networks, Information Theory, Generalized Linear Models, dimensionality reduction, classification, and clustering.

Instructor(s): M. Kaufman Terms Offered: Winter, L.

Prerequisite(s): For Neuroscience Majors: NSCI 20130, BIOS 26210 and BIOS 26211 which must be taken concurrently, or consent of instructor.

Equivalent Course(s): BIOS 24231, PSYC 24231, CPNS 34231

NSCI 24000. Modeling and Signal Analysis for Neuroscientists. 100 Units.

The course provides an introduction into signal analysis and modeling for neuroscientists. We cover linear and nonlinear techniques and model both single neurons and neuronal networks. The goal is to provide students with the mathematical background to understand the literature in this field, the principles of analysis and simulation software, and allow them to construct their own tools. Several of the 90-minute lectures include demonstrations and/or exercises in Matlab.

Instructor(s): W. van Drongelen Terms Offered: Spring, L.

Prerequisite(s): Undergraduates: Biology Major - BIOS 26210 and 26211, or consent of instructor. Neuroscience Major - NSCI 20130, BIOS 26210 and 26211, or consent of instructor.

Equivalent Course(s): BIOS 24408, CPNS 32111

NSCI 29100. Neuroscience Thesis Research. 100 Units.

Scholar or Research Thesis.

Instructor(s): Staff Terms Offered: Autumn, Spring, Summer, Winter

Prerequisite(s): By consent of instructor and approval of major director.

NSCI 29101. Neuroscience Thesis Research II. 100 Units.

Second quarter of scholarly or research thesis that follows NSCI 29100

Instructor(s): Staff Terms Offered: Autumn Spring Summer Winter

Prerequisite(s): NSCI 29100, and consent of instructor, and approval of major director.

NSCI 29102. Neuroscience Thesis Research III. 100 Units.

Third quarter of scholarly or research thesis for BS students

Instructor(s): Staff Terms Offered: Autumn Spring Summer Winter

Prerequisite(s): NSCI 29101, and consent of instructor, and approval of major director.

NSCI 29200. Neuroscience Honors Thesis Research. 100 Units.

Scholar or Research Thesis.

Instructor(s): Staff Terms Offered: Autumn, Spring, Summer, Winter

Prerequisite(s): By consent of instructor and approval of major director. Open to Neuroscience majors who are candidates for honors in Neuroscience.

NSCI 29201. Neuroscience Honors Thesis Research II. 100 Units.

Second quarter of BS Honors student thesis research

Instructor(s): Staff Terms Offered: Autumn Spring Summer Winter

Prerequisite(s): NSCI 29200, and consent of instructor, and approval of major director. Open to Neuroscience majors who are candidates for honors in Neuroscience.

NSCI 29202. Neuroscience Honors Thesis Research III. 100 Units.

Third quarter of BS Honors student thesis research

Instructor(s): Staff Terms Offered: Autumn Spring Summer Winter

Prerequisite(s): NSCI 29201, and consent of instructor, and approval of major director. Open to Neuroscience majors who are candidates for honors in Neuroscience.

NSCI 29700. Reading and Research in Neuroscience. 100 Units.

BA Students can do reading and research in an area of neuroscience under the guidance of a faculty member. A written report is required at the end of the quarter.

Instructor(s): Staff Terms Offered: Autumn Spring Summer Winter

Prerequisite(s): By consent of instructor and approval of NSCI Undergraduate Director.

Note(s): Must be a Bachelor of Arts student. Students are required to submit the College Reading & Research form.

