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.

Students completing the Neuroscience major will be able to:

1. **Explain core principles of neuroscience**, including neuroanatomy, neurophysiology, and neuronal signaling, and their integration at the systems level.
2. **Describe the neural bases of behavior**, linking brain function to observable actions and decision-making.
3. **Explain the neural mechanisms underlying perception, memory, and cognition**.
4. **Describe cellular and molecular processes in the nervous system**, including gene expression, protein synthesis, and intracellular signaling, and their roles in development, plasticity, and disease.
5. **Apply fundamental neuroscience research methods**, including experimental design, data collection, and analysis using contemporary techniques.
6. **Use quantitative and statistical approaches** to analyze data and interpret experimental results.
7. **Critically evaluate neuroscience research**, including the interpretation of primary scientific literature.

The bachelor of arts (BA), bachelor of science (BS), and bachelor of science with honors (BSH) 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 BSH 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, 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 20101, NSCI 20111, NSCI 20130, NSCI 21600, and NSCI 20100) 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 bachelor of arts (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 21600	Attention and Working Memory in the Mind and Brain	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	Comprehensive General Chemistry III *	100
or CHEM 12300	Honors General Chemistry III	
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 the undergraduate major website. (https://neuroscience.uchicago.edu/research-opportunities/)

Bachelor of Science Degree in Neuroscience

To earn a bachelor of science in neuroscience (https://neuroscience.uchicago.edu/bachelor-science/), students must complete 900 units of required neuroscience courses, 800 units of neuroscience elective courses, and 200 units of either neuroscience- or related-elective courses. The elective coursework must include one to three quarters of faculty-supervised NSCI 29100 Neuroscience Thesis Research OR one quarter of NSCI 29103 Neuroscience Bachelor of Science Scholarly Research Thesis, culminating in a written thesis and poster presentation. NSCI 29100 or NSCI 29103 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 thesis and poster will be evaluated by a committee made up of Neuroscience faculty members. BS students are also required to attend BS Thesis course meetings each quarter, beginning the quarter that they enroll in NSCI 29100. Note that if a student wishes to carry out thesis work with a non-Neuroscience Institute-listed faculty member, the student must contact the Director of Undergraduate Studies (neuromajor@uchicago.edu) for approval prior to submitting the thesis proposal.

MAJOR: BACHELOR OF SCIENCE REQUIRED COURSES		
NSCI 20101	Foundations of Neuroscience	100
NSCI 20111	Cellular Neurophysiology	100
NSCI 20130	Systems Neuroscience	100
NSCI 21600	Attention and Working Memory in the Mind and Brain	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	Comprehensive General Chemistry III *	100
or CHEM 12300	Honors General Chemistry III	
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, or NSCI 29103 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 apply for the neuroscience honors program, students must have a minimum GPA of 3.5 in the major and a cumulative GPA of 3.25. This level of achievement must then 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 Neuroscience Institute–listed faculty sponsor and approved topic must be identified before applying.

The honors program begins with 10 weeks of full-time, on-campus research during the Summer Quarter between the student's third and fourth years. A stipend is provided during the summer research component of the honors program. Honors students will continue their 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. 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. Students graduate with a minor in neuroscience by completing NSCI 20101 Foundations of Neuroscience, NSCI 20111 Cellular Neurophysiology, and NSCI 20130 Systems Neuroscience, as well as four neuroscience electives. Students pursuing the minor are not required to complete the general education requirements of the Neuroscience major. Instead, students must meet the general education requirements in the biological **OR** physical sciences, plus MATH 13100-13200 Elementary Functions and Calculus I-II (or higher), prior to declaring the minor.

Students are strongly encouraged to take STAT 22000 Statistical Methods and Applications (or higher) and NSCI 21600 Attention and Working Memory in the Mind and Brain 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. In order to declare a minor in Neuroscience, students must request a Consent to Complete a Minor Program (https://college.uchicago.edu/sites/default/files/documents/College%20Dean%20of%20Students/Minor%20Consent%20Form.pdf) form from their College adviser and submit the completed form to neuromajor@uchicago.edu for review and approval.

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

The Computational Neuroscience minor provides a rigorous foundation in the mathematical and computational approaches used to study the brain, integrating methods from mathematics, statistics, computer science, and physics. Students develop quantitative skills in computational modeling, neural data analysis, and theory. For Neuroscience majors, it strengthens the link between data and mechanism. For non-majors, it offers a quantitative entry point into neuroscience. The minor prepares students for careers in neuroscience, biomedical engineering, artificial intelligence, and related fields.

Students pursuing the Computational Neuroscience minor are not required to complete the general education requirements of the Neuroscience major. Instead, students must meet the general education requirements in the biological **OR** physical sciences, plus MATH 13100-13200 Elementary Functions and Calculus I-II (or higher). 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. In order to declare a minor in Computational Neuroscience, students must request a Consent to Complete a Minor Program (https://college.uchicago.edu/sites/default/files/documents/College%20Dean%20of%20Students/Minor%20Consent%20Form.pdf) form from their College adviser and submit the completed form to neuromajor@uchicago.edu for review and approval.

SUMMARY OF REQUIREMENTS FOR THE MINOR IN COMPUTATIONAL NEUROSCIENCE

NSCI 20101	Foundations of Neuroscience *	100
No fewer than three of the following courses:		300
NSCI 21820	Introduction to Python for Biologists & Neuroscientists	
NSCI 22950	Computational Modeling of Biological Brain Circuits	
NSCI 23110	Introduction to Computational Neuroscience	
NSCI 24000	Modeling and Signal Analysis for Neuroscientists	
BIOS 26210	Mathematical Methods for Biological Sciences I	
BIOS 26211	Mathematical Methods for Biological Sciences II	
No more than one of the following courses:		100
CMSC 25025	Machine Learning and Large-Scale Data Analysis	
CMSC 25400	Machine Learning	
DATA 21300	Models in Data Science	
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 biological sciences, psychology, or cognitive science are limited to double counting seven courses between the majors. Please email neuromajor@uchicago.edu with additional questions about 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, PHYS 12200

Year 3: NSCI 20100 and/or NSCI 21600, Electives, Research Opportunities, STAT 22000

Year 4: NSCI 20100 and/or NSCI 21600, Electives, Research Opportunities, STAT 22000

Electives

NEUROSCIENCE ELECTIVES * (no fewer than five)

NSCI 20510	Evolution and the Nervous System	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 21510	Fundamentals of Synapses	100
NSCI 21515	Introduction to Imaging for Biological Research	100
NSCI 21520	A Deep Dive into the Cell and Molecular Biology of the Brain	100
NSCI 21530	Dynamic Camouflage: Behavior, Visual Perception and Neural Skin Patterning in Cephalopods	100
NSCI 21620	Structure, Circuits and Development of the Forebrain	100
NSCI 21630	Spinal Cord and Brainstem Neuroanatomy & Disability	100
NSCI 21710	Introduction to Machine Learning for Biology	100
NSCI 21750	Ethics through a Neurobiological Lens	100
NSCI 21811	Building the Brain	100
NSCI 21820	Introduction to Python for Biologists & Neuroscientists	100
NSCI 21825	Constructing consciousness: How do we go from matter to mind?	100
NSCI 21900	Neuropharmacology	100
NSCI 22010	Neuroscience of Consciousness	100
NSCI 22015	Cognitive Psychology	100

NSCI 22130	Psychoactive Drugs, the Brain and Behavior	100
NSCI 22140	Neurobiology and Psychosocial Aspects of Psychopathology	100
NSCI 22200	The Gut-Brain Axis	100
NSCI 22300	Molecular Principles of Nervous System Development	100
NSCI 22415	Introduction to Learning and Memory	100
NSCI 22420	The Neuroscience of Memory and its Disorders	100
NSCI 22440	Neurobiological Mechanisms of Psychiatric Disorders	100
NSCI 22450	Conquest of Pain	100
NSCI 22455	Human Neuroimaging	100
NSCI 22460	Anatomy of Selected Brain Circuits	100
NSCI 22470	The Effects of Exercise on the Brain and Cognition	100
NSCI 22535	The Psychology and Neurobiology of Stress	100
NSCI 22550	Hippocampus and the Neural Basis of Space and Memory	100
NSCI 22600	Cognition and Overcoming its Limits	100
NSCI 22950	Computational Modeling of Biological Brain Circuits	100
NSCI 23110	Introduction to Computational Neuroscience	100
NSCI 23125	Foundations of Neurolinguistics	100
NSCI 23400	Synaptic Physiology	100
NSCI 23480	Neurogenetics	100
NSCI 23810	Neurons and Glia: A Cellular and Molecular Perspective	100
NSCI 23815	Advanced Topics in Human Neuroimaging	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 29103	Neuroscience Bachelor of Science Scholarly Research Thesis	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
DATA 21300	Models in Data Science **	100

* If a course with an NSCI course code does not appear on this list, please email neuromajor@uchicago.edu to confirm the course's elective status.

** 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
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 21402	Biomedical Imaging	100
BIOS 26210	Mathematical Methods for Biological Sciences I	100
BIOS 26211	Mathematical Methods for Biological Sciences II	100
CMSC 14100	Introduction to Computer Science I	100

CMSC 14200	Introduction to Computer Science II	100
CMSC 25300	Mathematical Foundations of Machine Learning	100
DATA 21100	Mathematical Methods for Data Science I	100
DATA 21200	Mathematical Methods for Data Science II	100
LING 27010	Introduction to Psycholinguistics	100
LING 27050	Linguistic Perspectives on Language Disorders	100
MATH 23500	Markov Chains, Martingales, and Brownian Motion	100
PHYS 12300	General Physics III	100
or PHYS 13300	Waves, Optics, and Heat	
PSYC 22350	Social Neuroscience	100
PSYC 25500	Cognitive and Social Neuroscience of Aging	100

General Education Table

GENERAL EDUCATION ‡		
One of the following BIOS sequences:*		200
BIOS 20186	Fundamentals of Cell and Molecular Biology †	
BIOS 20151	Introduction to Quantitative Modeling in Biology	
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 taking BIOS 20186 without the Biological Sciences prerequisites (BIOS 20153-20151), unless a student pursues a double major in Biological Sciences.

* Credit may be granted by examination.

\# BIOS 20171 must be taken concurrently with BIOS 20172.

** Any two of these three courses may be used. 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.

‡ To avoid double counting, students who minor in BIOS, CHEM, or MATH must work with the minor-granting program to identify appropriate course substitutions for those courses counting toward the NSCI major's general education requirements.

Neuroscience Courses

NSCI 20100. Neuroscience Laboratory. 100 Units.
This laboratory-based course emphasizes the collection, analysis, and interpretation of neuroscience data. Students perform experiments using techniques such as psychophysics, electrophysiology, genetics, and optogenetics. A weekly lecture provides conceptual background that supports a four-hour laboratory section. Evaluation is based on laboratory submissions and in-class quizzes.
Instructor(s): J. Maunsell; M. McNulty; Z. Zhang Terms Offered: Winter
Prerequisite(s): Neuroscience Fundamentals sequence (NSCI 20101-NSCI 20130), 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. McNulty 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 Terms Offered: Winter
Prerequisite(s): NSCI 20101 AND MATH 13100, MATH 15100, or MATH 16100 or consent of instructor
Equivalent Course(s): BIOS 24111, PSYC 24470

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 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
Prerequisite(s): NSCI 20101 and NSCI 20130, or consent of instructor
Equivalent Course(s): ORGB 30510

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): J. Yu Terms Offered: Winter
Prerequisite(s): Some background in biology and psychology.
Equivalent Course(s): CHDV 20300, 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): Recommended: NSCI 20101
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): HLTH 21750, PSYC 21750, BIOS 24248

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): Second-year standing or greater (or by consent) and acceptance into the Spring Quarter Program at MBL.
Equivalent Course(s): BIOS 27753

NSCI 21515. Introduction to Imaging for Biological Research. 100 Units.
Many breakthroughs in science have been made possible by revolutionary advances in our ability to visualize biological processes, and recent progress in microscopy has led to important breakthroughs in understanding life at the molecular, cellular, and organismal level. In this course, we will introduce the students to basic techniques in microscopy, starting with an opportunity for students to build their own simple microscopes, and then proceeding all the way to using state-of-the-art confocal, light sheet, and electron microscopes. Students will explore the challenges of sample preparation, of imaging processes in living cells, and in the computational analysis of imaging data. Throughout the course, students will be able to design their own experiments, and undertake a student-designed research project.
Instructor(s): Wolff, C., Kerr, L. Terms Offered: Spring
Prerequisite(s): Second-year standing or greater (or by consent) and acceptance into the Spring Quarter Program at MBL.
Equivalent Course(s): BIOS 27724

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): Second-year standing or greater (or by consent) and acceptance into the Spring Quarter Program at MBL.
Note(s): E.
Equivalent Course(s): BIOS 27752

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. Awh and E. Vogel Terms Offered: Winter
Prerequisite(s): PQ: NSCI 20101 (Foundations of 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 21620. Structure, Circuits and Development of the Forebrain. 100 Units.
The forebrain is the largest division in the brains of mammals and birds. This course will address its structure as a laboratory exercise with slides and computer image supplementation. Our study of forebrain circuitry and development will draw on primary research papers and comprehensive reviews, and the rich research resources of the Parisian neuroscience community. Our survey will include thalamus, hypothalamus, the amygdala, and the basal ganglia, but our focus will be on the largest structure in our brains, the neocortex.
Instructor(s): C. Ragsdale Terms Offered: Autumn
Prerequisite(s): Enrollment into the Paris Study Abroad Program
Equivalent Course(s): COGS 25518

NSCI 21630. Spinal Cord and Brainstem Neuroanatomy & Disability. 100 Units.
This course is part of the Study Abroad Neuroscience program in Paris, France. In this course, we will learn the neuroanatomy of spinal and cranial nerves, the spinal cord, and brainstem. Learning will be hands-on using glass slides of stained brain tissue. Laboratory exercises will be used to illustrate principles of neurological function. Along the way, we will examine the impact of neural dysfunction on a person's life. Outings to pathological museums will expose students to the display of human remains from persons with or without neurological anomaly; discussions regarding the ethics of such displays will ensue.
Instructor(s): P. Mason Terms Offered: Autumn
Prerequisite(s): Enrollment into the Paris Study Abroad Program
Equivalent Course(s): COGS 25519

NSCI 21710. Introduction to Machine Learning for Biology. 100 Units.
Machine learning techniques are essential in many fields of biology that rely on large amounts of data. This course is intended to introduce key concepts in this field and illustrate their applications to biological questions. Students will learn about methods for supervised and unsupervised learning; regression and classification algorithms, and dimensionality reduction approaches. With every method we will emphasize model selection and validation on real data sets. Computational labs are an integral part of the course for students to work on applying these methods using R in the Quarto document system.
Instructor(s): D. Kondrashov Terms Offered: Winter
Prerequisite(s): BIOS 20151, BIOS 20172 or BIOS 20236. STAT 22000 or equivalent.
Note(s): L. CB.
Equivalent Course(s): BIOS 26122

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 21811. Building the Brain. 100 Units.
This course describes fundamental principles of how brains grow up from the perspective of the basic organizational unit of brains, the cell. We will detail development from the very earliest events in zygotes to post-natal refinement of synaptic connections years after birth. We will endeavor to understand how principles of neural development were discovered, abandoned, and re-discovered using the lens of history and biography. We will accomplish these goals with readings of primary literature, discussions of the tools used to discover these principles, and debates on the temerity of declaring that these principles exist.
Instructor(s): B. Kasthuri Terms Offered: Autumn
Prerequisite(s): NSCI 20101 or instructor consent

NSCI 21820. Introduction to Python for Biologists & Neuroscientists. 100 Units.
This course is an introduction to Python for biology and neuroscience students. The objective of this course is to teach you the building blocks of Python in a fun and interactive way. You will learn the core python concepts and fundamentals to start applying them to various research problems in biology and neurology. We will step through problems drawn from biology and neurology using interactive JupyterLab notebooks. By the end of the course, you will be able to i) think through different data structures and know when to apply what, ii) develop

comfort in utilizing key Python libraries for biological and/or neuroscience datasets, iii) design a basic Python framework to tackle a specific research problem and execute it, and iv) develop a good foundation to learn more advanced Python. No prior knowledge of Python is expected or required. You will use your own laptop for this class.
Instructor(s): Autumn: M. Walsh, Spring: A. Venkat Terms Offered: Autumn Spring
Note(s): CB. Students who have taken introductory computer science courses (CMSC 13100, 14200, 14300 OR 14400) cannot also count BIOS 26123 in the Biological Sciences major.
Equivalent Course(s): BIOS 26123

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 will 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): S. Heald, Autumn; M. Berman, Spring Terms Offered: Autumn 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 22140. Neurobiology and Psychosocial Aspects of Psychopathology. 100 Units.
The term "psychopathology" refers to a complex collection of constructs that we, in the Western world, have separated along diagnostic boundaries as defined in the Diagnostic and Statistics Manual (DSM-5). Understanding the assessment, etiology, and treatment of different psychological conditions requires a nuanced appreciation of the interacting genetic, neurobiological, developmental, social, and cognitive factors that contribute in varying degrees to the expression of mental illness. The purpose of this course is to provide students with an in-depth understanding of the biopsychosocial model of psychopathology, and its application to five domains of mental illness (depression/anxiety, substance use disorders, psychotic disorders, eating disorders, and posttraumatic stress disorder). Additionally, students will learn contemporary research methods for testing novel hypotheses about the causes and treatments of these conditions.
Instructor(s): M. Erickson Terms Offered: Winter
Prerequisite(s): NSCI 20101, or instructor consent. (It is recommended that students have also taken PSYC 20200 and PSYC 20300).

Equivalent Course(s): PSYC 22140

NSCI 22200. The Gut-Brain Axis. 100 Units.
This seminar course will take a deep dive into research exploring interactions between the gut microbiome and the brain, with a particular emphasis on the cellular and molecular neurophysiological mechanisms that underlie those interactions. Through class discussions of selected papers and critical analyses of primary data, students will develop insights into the relationships between the gut microbiome and brain development, synaptic plasticity, neuroinflammation, mental health, and neurodegenerative disease, among other areas. Students will also be prompted to consider the strengths and limitations of different methods used to study the gut-brain axis and propose future research directions using those (or related) methods. During many class sessions, students will work in small groups to prepare for and/or take turns leading discussions on assigned papers. Didactic instruction will be limited to establishing or expanding the conceptual foundation necessary to understand and carefully evaluate the assigned readings. At the end of the quarter, students will be asked to submit a short research proposal investigating questions on the gut-brain axis motivated and informed by their discussions and review of the literature.
Instructor(s): M. McNulty Terms Offered: Spring
Prerequisite(s): NSCI 20101, NSCI 20111, and NSCI 20130; Must be a Neuroscience major.

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): P. Kratsios, C. Martineau 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): NURB 32300, CPNS 32300, DVBI 32300

NSCI 22415. Introduction to Learning and Memory. 100 Units.
This course examines basic questions in learning and memory. We discuss the historical separation and division of these two areas as well as the paradigmatic differences in studying learning and memory. We also discuss basic research methods for investigating learning and memory and survey established and recent research findings, as well as consider several different kinds of models and theories of learning and memory. Topics include skill acquisition, perceptual learning, statistical learning, working memory, implicit memory, semantic vs. episodic memory, and memory disorders.
Instructor(s): A. Bakkour Terms Offered: Autumn
Equivalent Course(s): EDSO 23800, PSYC 23800

NSCI 22420. The Neuroscience of Memory and its Disorders. 100 Units.
This course examines cognitive-neuroscience theories concerning brain mechanisms that support the ability to remember and how disruption of these mechanisms produces clinical memory disorders. We will discuss three major concepts through which modern research on memory is organized: the concept of distinct brain systems that support memory (memory systems), the concept of brain reorganization as the biological basis of memories (neuroplasticity and the engram), and the concept that memories actively change over time (consolidation and forgetting). For each of these concepts, we will discuss the historical development, evaluate relevant neuroscience research, and explore implications for understanding memory impairments caused by neurological disorders such as Alzheimer's disease, brain trauma, epilepsy, and others.
Instructor(s): J. Voss Terms Offered: Spring
Prerequisite(s): NSCI 20101, NSCI 20111 and NSCI 20130. Or consent of instructor.

NSCI 22440. Neurobiological Mechanisms of Psychiatric Disorders. 100 Units.
Within popular culture, a few neurotransmitters have become infamous for their influence in a wide range of behaviors, including in emotion, attention, addiction, movement, and memory. These neuromodulators, dopamine, serotonin, and norepinephrine, are all derived from amino acids and belong to a group of neurotransmitters called monoamines. Disruption of monoamine signaling is implicated in neurological and psychiatric disorders such as Parkinson's, schizophrenia, depression and anxiety. In this class we will investigate monoamines from the molecular level, studying the mechanisms underlying how they are synthesized and influence neuron function, to the systems level, examining their role in shaping neuronal population activity and behavior. We will engage with primary literature and case studies to expand our understanding of how these molecules influence brain function. By the end of this course, you will have fundamental knowledge of how monoamines influence neural activity and behavior, experience engaging with findings central to our understanding of monoamine function, and opportunities to apply this understanding to answer scientific and health related questions.
Instructor(s): C. Heer Terms Offered: Spring
Prerequisite(s): NSCI 20101, NSCI 20111, and NSCI 20130, or instructor consent

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 human and sheep brains to 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 Terms Offered: Spring
Prerequisite(s): NSCI 20101, NSCI 20130 or consent of instructor

NSCI 22470. The Effects of Exercise on the Brain and Cognition. 100 Units.
The human body has evolved to be in motion, generating a complex interplay between physical and cognitive performance. During our evolutionary history, we cultivated cognitively demanding foraging patterns that relied on an expanded capacity for not only motor coordination and aerobic output, but also memory, spatial navigation, and executive function. Physiological adaptation to the stress of physical activity confers benefits to brain health and enhances the efficiency of neural circuits in ways that mirror its benefits to the musculoskeletal and cardiovascular systems. This course will explore the effects of exercise on learning and memory and investigate mechanisms proposed to underlie these benefits at the molecular, cellular, and systems levels. We will also consider exercise as medicine for maintaining metabolic and neurological health with age. This course is open to upper level undergraduate and graduate students and will focus on critical discussion of the primary literature. Each class will include a student-driven discussion of an original research article, a conversation about related findings, and an overview of upcoming topics. We will focus on studies that use animal models to discover the mechanisms behind the benefits of exercise to brain health and cognitive function and on randomized controlled trials in humans.
Instructor(s): C. Martineau Terms Offered: Autumn
Prerequisite(s): NSCI 20101, NSCI 20111, and NSCI 20130, or instructor consent.

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
Equivalent Course(s): CHDV 25750, PSYC 25750

NSCI 22550. Hippocampus and the Neural Basis of Space and Memory. 100 Units.
Our everyday experiences greatly shape who we are as individuals. The multitudes of information in these experiences, including information about the surrounding environment, the sequence of events, and who was there, all must be meaningfully combined to allow for proper navigation through the event and stored in our memories for later recall. In this course we will take a look at the hippocampus, a sea horse shaped region at the center of our brains, and examine its role in episodic memory and spatial navigation. This will include covering topics such as synaptic plasticity, place cells, sleep and replay events, and other current topics in the hippocampal field. By the end of the course you will have fundamental knowledge of hippocampal function, experience engaging with findings central to our understanding of the hippocampus, and opportunities to communicate complex neuroscience topics.
Instructor(s): C. Heer Terms Offered: Winter
Prerequisite(s): NSCI 20101, NSCI 20111, and NSCI 20130, or instructor consent.

NSCI 22600. Cognition and Overcoming its Limits. 100 Units.
The brains of humans and animals are remarkably flexible. We can juggle many tasks, sort through a barrage of information vying for our attention, become an expert in a vocation or hobby of choice, and remember a large amount of information while responsibly forgetting that which is unimportant. But cognition also has limited capacity, and humans expend a lot of effort trying to enhance that capacity in health and disease. This course will examine the neural mechanisms that enable and limit cognitive processes like learning, memory and decision making. We will also study behavioral and clinical efforts to enhance cognition in health and disease. These topics are very active areas of research, with new discoveries published every week. We will therefore focus on the primary literature. Each class will contain a discussion of an original research article, a wider ranging conversation about related issues and findings, and an overview of the next topics. We will focus on studies that use animal models to relate the activity of neurons to cognition and on behavioral and imaging work in humans. Students will gain experience reading and critiquing original research, presenting research findings to their peers, relating current research to a body of knowledge, and, through a culminating project, using writing or another medium to communicate neuroscience findings to a broad audience.
Instructor(s): M. Cohen Terms Offered: Spring
Prerequisite(s): NSCI 20101-NSCI 20130, or consent of instructor
Equivalent Course(s): PSYC 22620

NSCI 22950. Computational Modeling of Biological Brain Circuits. 100 Units.
This course will introduce students to neural circuit models as used in cellular and systems neuroscience research. Topics will include: single-neuron models (e.g, integrate and fire, Hodgkin-Huxley); synaptic dynamics;

network models for memory, attention, and decision-making; large-scale circuit models for EEG and fMRI; and data-driven circuit models.
Instructor(s): J. Jaramillo Terms Offered: Winter
Prerequisite(s): NSCI 20101; MATH 13100 or MATH 15100 or MATH 16100; Familiarity with coding in Python is recommended.

NSCI 23110. Introduction to Computational Neuroscience. 100 Units.
The size and complexity of neuroscience datasets has drastically increased over the past two decades, and with it the need for computational methods to analyze and model those datasets. This course will introduce students to the mathematical basis and implementation of major classes of computational neuroscience methods, as well as examples from the primary literature for how they are applied for neuroscientific discovery. We will cover topics that include but are not limited to regression and generalized linear models, dimensionality reduction, classification, and clustering. The course will include lectures, hands-on coding exercises in Python and student-led presentations of research papers.
Instructor(s): L. Pinto Terms Offered: Autumn
Prerequisite(s): NSCI 20101; Familiarity with linear algebra; Familiarity with coding, preferably in Python.

NSCI 23125. Foundations of Neurolinguistics. 100 Units.
This course will explore the cognitive and neural bases underlying language comprehension and production. Class topics will draw on historic and contemporary research invoking a range of neuroimaging techniques to examine how sound, meaning, and structure are processed in the brain. Students will also explore how theories about the computations and representations underlying human language can inform, and be informed by, the biological constraints imposed by the nervous system. Prior knowledge of neuroscience is not required, but familiarity with linguistic and psychological concepts may be beneficial.
Instructor(s): Lai, Melinh Terms Offered: Autumn
Equivalent Course(s): PSYC 25010, LING 25001, COGS 25001

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: Autumn
Prerequisite(s): Upper undergrads by consent of instructor
Equivalent Course(s): NURB 32400

NSCI 23480. Neurogenetics. 100 Units.
This course introduces human and mouse genetics through the lens of neurological disorders. It starts with genetic concepts and the principles of genetic approaches, followed by human genetic studies of neocortex development and original findings in repeat expansion diseases. We will discuss concurrent concepts in genetic diagnosis and therapeutic strategies. This course is open to graduate and upper-level undergraduate students. It combines lectures and discussion sections.
Instructor(s): X. Zhang Terms Offered: Spring
Prerequisite(s): BIOS 20187, NSCI 20101, or consent of instructor
Equivalent Course(s): NURB 33480, HGEN 33480

NSCI 23810. Neurons and Glia: A Cellular and Molecular Perspective. 100 Units.
This course will be an interactive, in-depth analysis of the cell biology of neurons and glia. We will learn and discuss the latest techniques used, for example, to study the structure and function of neuronal proteins. In this way we will illuminate the central concepts that define our understanding of the cell and molecular biology of neurons and glia. The course will consist of lectures and critical reading of contemporary literature.
Instructor(s): R. Carrillo; W. Green Terms Offered: Spring
Prerequisite(s): Neuroscience Majors: NSCI 20101-20130 (Fundamental Neuroscience Sequence) Biological Sciences Majors: NSCI 20101-20130, or three quarters of a Biological Sciences Fundamentals Sequence
Equivalent Course(s): NURB 34810, BIOS 24251

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.
Note(s): CB.

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 29103. Neuroscience Bachelor of Science Scholarly Research Thesis. 100 Units.
This course enables students to earn a Neuroscience Bachelor of Science degree by completing a scholarly BS thesis. Guided by Dr. Carolyn Martineau, students will conduct a literature review of primary sources on an approved topic in neuroscience. Their task is to develop and articulate new perspectives and hypotheses. Students are required to submit and present their thesis in their final quarter and must adhere to all the regulations of the Reg-BS thesis program. This course cannot be taken in addition to the NSCI 29100-29102 Thesis Research courses.
Instructor(s): Staff Terms Offered: Autumn
Prerequisite(s): Instructor consent required.

NSCI 29200. Neuroscience Honors Thesis Research. 100 Units.
Scholar or Research Thesis.
Instructor(s): Staff Terms Offered: Autumn
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: 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: Spring
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.