

# NEUROSCIENCE & BEHAVIOR (NS&B)

## **NS&B149 Neuroethology: Sensory Basis of Animal Orientation and Navigation**

This course is about the sensory and neuronal processes underlying the ability of animals to orient in and move through their environments. We will consider the basic functions of sensory and nervous systems that underlie the remarkable abilities of animals to orient themselves in personal space, move through their home range, and move through the world in long-distance migrations and in homing. Animals from invertebrates through fish, birds, and mammals will be considered. The format of the course will be seminar/discussion and some lectures with heavy student participation. The course is intended for first-year students with high school-level courses in at least two of the following: biology, chemistry, or physics.

Offering: **Host**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL149**

Prereq: **None**

## **NS&B210 Research Methods in Cognition**

This course will examine the experimental method as a means of gaining knowledge about human cognition. Students in this course will learn about general research methods in cognitive psychology related to experimental design, understanding and interpreting research, and ethical issues involved in research with human subjects. Classic research paradigms in cognitive psychology will be explored through the use of interactive demonstrations and in-class experiments.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC210**

Prereq: **PSYC105**

## **NS&B213 Behavioral Neurobiology**

This course will introduce the concepts and contemporary research in the field of neuroscience and behavior. The course is intended for prospective neuroscience and behavior majors (for whom it is required) and for biology and psychology majors who wish a broad introduction to neuroscience. The initial few weeks will be devoted to fundamental concepts of neuroanatomy and neurophysiology. Subsequent classes will deal in-depth with fundamental problems of nervous system function and the neural basis of behavior, including neurotransmitter systems; organization of the visual system and visual perception; the control of movement; neurological and neuropsychiatric disorders; the neuroendocrine system; control of autonomic behaviors such as feeding, sleep, and temperature regulation; the stress response; and language, learning, and memory. Experimental results from a variety of species, including humans, will be considered.

Offering: **Host**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL213, PSYC240**

Prereq: **None**

## **NS&B215 Research Methods: Behavioral Methods in Animal Research**

This is a research methods course that provides an understanding of the different approaches to animal research, particularly those using rodent models. It provides students with an understanding of the different techniques employed

by researchers and the questions they address. This course provides students with HANDS-ON EXPERIENCE WITH ANIMAL RESEARCH USING RODENT MODELS. Students will learn how to handle and inject rats and will also get a sense of how to design a behavioral experiment, including the use of control groups and counterbalancing. The course will follow a lecture/discussion/lab format where students will learn about different forms of conditioning (operant/classical) and how these apply to various behavioral tasks such as operant responding, autoshaping, decision-making, locomotion testing, etc. (see readings for more examples). One class each week will take place in the lab to provide students with hands-on experience with rats and the testing apparatuses. Students will be assigned a rat for the semester that they will use to collect and analyze data during lab classes. This will be combined with regular class discussion of research articles dealing with each topic, including some of the earlier reports and more recent applications. The focus of the course will be on trying to prepare students to design and carry out behavioral/animal research in a laboratory setting.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC215**

Prereq: **PSYC105 OR [NS&B213 or BIOL213 or PSYC240]**

## **NS&B220 Cognitive Psychology**

Cognitive psychology, a major branch in the field of psychology, is the scientific study of human adult mental processes. The goal of this course is to provide a broad introduction to the issues, methods, and phenomena that characterize the field. These will be brought to life with selected examples of influential empirical studies and, occasionally, practical applications. In seeking constraints on theories of how the mind works, we will draw primarily on studies of adult human behavior (e.g., reaction time, task accuracy), individuals with localized brain damage (e.g., visual agnosia), and measures of brain activity (e.g., as inferred using fMRI techniques). Computer models and nonhuman animal studies will also be considered. Broad topics will include attention, perception, memory, knowledge, reasoning, and decision making. The course is lecture-based but will incorporate discussions, demonstrations, video, and group activities.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC220**

Prereq: **PSYC105**

## **NS&B221 Human Memory**

This course is designed to provide students with an in-depth overview of the different human memory systems revealed by empirical research in the fields of cognitive psychology and cognitive neuroscience. The different systems include procedural memory, working memory, perceptual memory, semantic memory, and episodic memory.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC221**

Prereq: **PSYC105 OR [PSYC220 or NS&B220] OR [NS&B213 or BIOL213 or PSYC240] OR [PSYC222 or NS&B222]**

## **NS&B222 Sensation and Perception**

This course explores our perceptual systems and how they create and shape our experience of the world around us. We will consider the neurophysiology of perceptual systems as well as psychological approaches to the study of perception, covering all of the human senses with a special emphasis on vision. Class demonstrations will introduce students to interesting perceptual phenomena.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC222**

Prereq: **PSYC105 OR [NS&B213 or BIOL213 or PSYC240]**

#### **NS&B224 Hormones, Brain, and Behavior**

Hormones coordinate the anatomical, physiological, and behavioral changes necessary for developmental, seasonal, and diurnal transition in animals. These molecules have profound effects on the development of the brain and on adult brain function. How do hormones orchestrate brain assembly and the expression of specific behaviors? How do behavior, social context, and the environment influence hormone secretion? This course will provide a critical survey of our understanding of the relationship between endocrinology, the brain, and behavior in a variety of animal systems. Select topics include insect metamorphosis; sexual differentiation of the vertebrate brain and behavior; reproductive and aggressive behavior in birds, lizards, and rodents; song learning and song production in birds; and the effects of hormones on sexual behavior and cognitive function in primates, including humans. The exploration of a variety of systems will provide students with an appreciation of the ways in which the relationships between hormones and behavior vary across species, as well as the extent to which these relationships are conserved.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL224**

Prereq: **[NS&B213 or BIOL213 or PSYC240] OR [BIOL182 or MB&B182]**

#### **NS&B225 Cognitive Neuroscience**

This course provides an introduction to cognitive neuroscience--the study of how the brain enables the mind. We will begin with an overview of the neural substrates of cognition and the tools for understanding the structure and function of the human brain. Then we will cover neural processes that support sensory perception and attention, memory, motor control, language, executive control, and emotional and social functioning. We will also discuss mechanisms of brain evolution, development, and repair, and their implications for various diseases and disorders.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **PSYC225**

Prereq: **PSYC105 OR [NS&B213 or BIOL213 or PSYC240]**

#### **NS&B227 Motivation and Reward**

This course will focus on motivation and reward, providing students with a background in and understanding of the various theories and approaches to studying the topic of motivation, including an introduction to some of the history and the current advances in the field. The course uses animal and human research to try to unravel the brain areas and neurotransmitter systems involved in different forms of reward, including food, sex, and drugs, and examine cases of disordered motivation such as drug addiction, obesity, and disordered gambling.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **PSYC227**

Prereq: **PSYC105 OR [NS&B213 or BIOL213 or PSYC240]**

#### **NS&B228 Clinical Neuropsychology**

This introductory course will examine the relationship between brain functioning and cognition, behavior, and emotion through the study of human brain disorders. The course will begin with a brief overview of basic human

regional neuroanatomy, followed by an exploration of neuropsychological assessment and intervention (its history, rationale, goals, and procedures). These topics will provide a foundation for the discussion of more specific topics in neuropsychology (e.g., traumatic brain injury, dementia, psychiatric disorders, cerebrovascular disorders, seizure disorders, learning disabilities, autism) and the role that neuropsychologists play in the evaluation and treatment of individuals with these disorders.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC228**

Prereq: **PSYC105 OR [NS&B213 or BIOL213 or PSYC240]**

#### **NS&B239 Functional Anatomy of the Human Brain**

A mass of tissue the consistency of firm jello and weighing about 2.5 pounds in the adult human, the brain is an organ that controls nearly every function of the body. It also enables the highest cognitive functions of humans such as learning and memory, thinking, consciousness, and aesthetic appreciation. Its malfunction results in a variety of diseases, including senility, mood disorders, and motor dysfunctions. This course will examine in some detail the complex organization of the brain and how it performs some of its basic functions. The course will be of special interest to premed students; NS&B, biology, and psychology majors; and anyone simply interested in how the brain works.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL239, PSYC239**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B243 Neurohistology**

The aim of this course is to study the microscopic structure of the nervous system. Structural and functional relationships between neurons and glia, as well as the organization of major brain regions (cortex, hippocampus, and cerebellum) will be examined. In addition to traditional histological preparations, modern techniques including confocal microscopy and immunohistochemistry will be studied and performed. Laboratory exercises will include the preparation and visualization of microscopic slides using a variety of techniques. While this course will focus on mammalian nervous system, skills learned in this course will be applicable in a variety of research models.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL243**

Prereq: **[NS&B213 or BIOL213 or PSYC240] OR [MB&B181 or BIOL181]**

#### **NS&B245 Cellular Neurophysiology**

This neurophysiology course is mostly a study of how neurons send, receive, and integrate the signals that produce nervous system activity. Using the tools of electrophysiology (the electrical recording and manipulation of neurons), we can better understand synaptic plasticity, neuronal oscillations, and network activity. In the last module of the course, students will use their knowledge of a diversity of voltage-gated channels, neurotransmitter systems, and neuron categories to better understand the neurophysiology of epileptic seizures and sensorimotor systems and locomotion. We will also examine articles about human-machine interfaces that are being developed in the diagnosis and treatment of epilepsy as well for the restoration of motor activity and somatosensation.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL245, BIOL599**

Prereq: [NS&B213 or BIOL213 or PSYC240]

#### **NS&B247 Laboratory in Neurophysiology**

The course is designed to teach techniques and offer independent research experience. Students study living nervous systems and measure the electrical signals at the heart of nervous system function. In the first part, experiments include intracellular recordings of rest and action potentials, synaptic transmission, sensory coding and integration in simple nervous systems. Students learn surgical and electrophysiological recording techniques working with invertebrate and cold-blooded vertebrate animals including crayfish, mollusks (*Aplysia*), leeches, fish, and amphibians. In the second part of the course, students will use these techniques in novel, independent research projects.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL247**

Prereq: **[(NS&B213 or BIOL213 or PSYC240) AND (BIOL182 or MB&B182)]**

#### **NS&B250 Laboratory in Cellular and Behavioral Neurobiology**

The goals of the course are to introduce students to a number of contemporary laboratory techniques in neuroscience and behavior. The laboratory introduces students to experimental method and techniques including neuroanatomy, immunohistochemistry, primary neuronal and astrocyte cell culture methods, analyses of electrical activity in the brain, and behavioral analyses of learning, memory, social behavior, and social dominance in inbred strains of mice.

Students will learn to analyze experimental data and write a series of laboratory reports on the experiments done during class. In addition, students will write a term paper related to one of the experimental approaches.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL250, NS&B555**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B252 Cell Biology of the Neuron**

Neuronal cell biology is an important and fast-moving field. The brain cannot be understood without first elucidating the properties and functions of its component neurons. This course will focus on cell biological studies of the nervous system. We will explore the structure and function of neurons, synapses, and circuits. Using both text books and primary literature, we will examine the basic cell biological mechanisms that underlie the formation, function, and plasticity of neurons and circuits. Areas studied will include polarity, synapse formation, synaptic transmission, intracellular transport, plasticity, and regeneration.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL252**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B254 Comparative Animal Behavior**

This course explores the scientific study of animal behavior. All animals face similar challenges and we will examine the common, and sometimes unique, behavioral strategies used to meet these challenges. There are two sorts of questions one might ask about the behavior of a given individual or species. First, how is that behavior executed? Second, why is that behavior, rather than another, exhibited? What is the adaptive significance of the behavior? To fully understand the behavior of any organism, both sorts of questions must be addressed. This course will introduce students to the many ways these questions are grappled with for a wide range of organisms. As such, this course will

provide an overview of mechanistic, ecological, and evolutionary explanations of behavior.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL254**

Prereq: **[BIOL182 or MB&B182] OR [BIOL196 or MBB196] OR [NS&B213 or BIOL213 or PSYC240]**

#### **NS&B257 Neurogenetics**

Genes are the basic functional units of heredity. This course is an introduction to the study of genes and their role in shaping neuronal structure, neuronal function, and behavior. We will learn about classic and modern approaches used to probe the relationship between genes and behavior, with a focus on studies using model organisms (e.g., flies, mice, worms). We will discuss the molecular genetics of neurological disorders with high heritability and the use of genetic tools to treat these conditions, and we will consider the ethics surrounding treatment and diagnosis of these disorders. Student assessment will include short written responses, in-class quizzes, and exams.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **BIOL257**

Prereq: **BIOL181 AND BIOL182**

#### **NS&B280 Applied Data Analysis**

In this project-based course, you will have the opportunity to answer questions that you feel passionately about through independent research based on existing data. You will develop skills in generating testable hypotheses, conducting a literature review, preparing data for analysis, conducting descriptive and inferential statistical analyses, and presenting research findings. The course offers one-on-one support, ample opportunities to work with other students, and training in the skills required to complete a project of your own design. These skills will prepare you to work in many different research labs across the University that collect empirical data. It is also an opportunity to fulfill an important requirement in several different majors.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-QAC**

Identical With: **QAC201, SOC257, GOVT201, PSYC280**

Prereq: **None**

#### **NS&B299 Waves, Brains, and Music**

Pressure waves bounce against the ear, and we create perceptions called sounds from them. We organize sounds to make music, making more waves, and the cycle goes forward. This course will provide an introduction to the fraction of these phenomena that can be measured and analyzed, focusing on the mathematics of signal analysis, auditory physiology, and the physiology of musical perception and production. Periodic waveforms include musical tones and the voltage fluctuations that can be measured from brains. The first third of this course (waves) is an introduction to the quantitative analysis of periodic waveforms, with the goal that the student will have a better understanding of how to interpret the analysis of both musical sounds and neuronal recordings. The second part of the course (brains) examines the known mechanical processes (physiology) by which the mammalian brain analyzes the periodic waveforms that we interpret as sound. The third part of the course uses these lessons to examine original research articles about the neuroscience of music, that is, how neuronal networks produce musical perception.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL299**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

**NS&B303 Receptors, Channels, and Pumps: Advanced Topics in Membrane Protein Structure and Function**

Membrane proteins constitute one-third of all cellular proteins and one-half of current drug targets, but our understanding of their structure and function has been limited in the past by technological obstacles. In spite of this, the past 10 years have yielded a wealth of new membrane protein structures that have helped to uncover the mechanistic underpinnings of many important cellular processes. This class will examine some of the new insights gained through the various techniques of modern structural biology. We will start with a general review of membrane properties, structural techniques (e.g., x-ray crystallography, EM, NMR), and protein structure analysis. We will then look at common structural motifs and functional concepts illustrated by different classes of membrane proteins. Students will read primary literature sources and learn how to gauge the quality and limitations of published membrane protein structures. These tools will be generally applicable to evaluating soluble protein structures as well.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **MB&B303, MB&B523**

Prereq: **(CHEM251 AND CHEM252 AND [MB&B208 or BIOL208])**

**NS&B316 Schizophrenia and Its Treatment: Neuroscientific, Historical, and Phenomenological Perspectives**

The goal of this seminar will be to critically investigate the concept of schizophrenia as a unitary disease construct, from historical, neuroscientific, and phenomenological approaches, and the implications of these views for our understanding of treatment of the disorder. How are we to make sense of a psychiatric disorder that has changed so substantially in definition over time, with wide interindividual difference in symptom expression and functional outcome, a wide array of competing theories regarding etiology and biological mechanisms, and correspondingly diverse treatment interventions? We will engage these questions through three separate units that will evaluate the disorder from three different levels of analysis: (1) readings in the history of psychiatry and the perspective they cast on schizophrenia as a unitary disease concept; (2) an analysis of contemporary work in neuroimaging and experimental cognition in the disease and the current status of creating a coherent account of neurocognitive mechanisms of the disease, as well as a neurocognitive approach to novel interventions; and (3) new work on understanding the experience of the disease from first-person accounts and the systematic analysis of these accounts as a window to understanding heterogeneity in the disease and novel approaches for therapy.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC316**

Prereq: **None**

**NS&B317 Neuroethics**

Ethics, or morality, is one of the complex features of human behavior. This course will explore "Neuroethics" from two perspectives: (1) the neuroscience of ethics (i.e., the role of the human brain in ethical or moral behavior) and (2) the ethics of neuroscience (i.e. the ethical implications of manipulating the brain). The first perspective will relate to the premise that human morality is embodied in and operates based on the principles of the functional architecture of the brain, in particular, the cerebral cortex. The course will examine the organization and neural networks, especially of the association cortices (prefrontal Cortex: ventromedial, dorsolateral and orbitofrontal cortex; the cingulate cortex;

temporal association cortex; and the inferior and superior parietal lobes). The course will review studies on the development of moral values in children and their neural underpinnings, leading to studies of the functions of the adult brain in moral or ethical decision-making. Topics such as the neural basis of resolving the "Trolley Problem," neuroeconomics, altruism, poverty, forgiveness, and compassion will provide the basis for this discussion. We will evaluate from a neuroscience perspective questions such as determinism and free will, and the sense of "self"--ideas that have played a significant role in ethical theories. Based on this body of knowledge, we will look at emerging ethical issues arising from technological developments that allow for manipulating the normal and diseased brain. A variety of questions will be examined, including brain imaging and privacy; enhancement of normal brain function through chemical, electrical, and electromagnetic stimulation; implanted neural interfaces; restoring brain damage; and neuroscience and the law.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Prereq: **[NS&B225 or PSYC225] OR [NS&B213 or BIOL213 or PSYC240]**

**NS&B323 Biochemistry of Neurodegenerative Disease**

Broadly defined, neurodegenerative disease occurs when a specific class of neuron dies and thus fails in its biological action. In this course, we will delve into the many different, intricate ways neuron death can occur and cause disease. From the chemistry of neurotransmitters, aggregation of proteins, and the collapse of neuromuscular junctions, many areas of the neurobiology can go awry.

The focus of the course will be on understanding the complex interplay of small molecules and proteins that keep neurons healthy and functional. In this course, we will use current primary literature and lecture to understand the varied topics. This course aims to improve skills in reading and analysis of primary literature as well as the written and oral presentation of scientific findings.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **CHEM323**

Prereq: **BIOL181 AND CHEM252**

**NS&B325 Stem Cells: Basic Biology to Clinical Application**

This course will cover recent advances in stem cell biology, including tissue-specific and pluripotent stem cells. Clinical applications will be covered and we will examine the ethics and politics as well as the science of this emerging field.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL325**

Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182])**

**NS&B328 Chemical Senses**

The least well understood of the senses, chemical sensation, is key to survival and behavior of many species. This course covers the structure and function of sensory neurons in both the gustatory and olfactory systems, as well as in chemosensory irritation. We will examine coding of sensory information to understand how higher cortical areas interpret stimuli. We will look at a variety of animal models and discover common organizing principles across phyla. Emphasis will be placed on the cell biology of these systems. Students will participate in reading, analyzing, and presenting recent studies from different areas within chemical sense to highlight recent findings and where the emphasis in chemosensory research is focused.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL328**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B329 Neural Costs of War**

This course focuses on stress reactions that result because of exposure to war, combat, and related atrocities. You will learn about the diagnosis of PTSD, including its development and history. There is a strong emphasis on the neural and cognitive mechanisms for stress-related psychopathology and the overlap of psychological and neural systems with the damaging effects of traumatic brain injury. While interactions of these mechanisms with social and cultural processes are considered, the primary emphasis is on the neural and cognitive mechanisms. To be fully prepared for this course, students should have a solid grounding in neuroscience and behavior, as well as basic psychopathology.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **SBS-PSYC**

Identical With: **PSYC329**

Prereq: **None**

#### **NS&B341 Psychology of Human Memory**

This seminar course is designed to provide students with an in-depth exploration of the psychological science of human memory. We will examine current issues and theories in human memory research and the methods by which human memory is explored. Both classic and contemporary research findings from the disciplines of cognitive psychology, cognitive neuroscience, and neuropsychology will be brought together to paint a picture of the current understanding of human memory. Topics to be covered include different memory systems and frameworks (e.g., working memory, semantic memory, episodic memory), remembering and forgetting (e.g., phenomenal experience of remembering, various mechanisms of forgetting), reality/source monitoring (e.g., memory attributions, true and false memories), the influence of emotional and social factors on memory (e.g., social remembering), and memory in clinical populations.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **SBS-PSYC**

Identical With: **PSYC341**

Prereq: **None**

#### **NS&B342 Music Perception and Cognition**

This course provides an overview of the perceptual, cognitive, and neural bases of performing, composing, and listening to music. Topics include acoustics and biological processing of sound; theories and empirical research on pitch, rhythm, harmony, melody, timbre, and orchestration; similarities and differences between music and language; evolution and development of musical ability; and special populations in musical functions. Meetings each week will include laboratory demonstrations and exercises in experiment design and data analysis.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC342**

Prereq: **None**

#### **NS&B343 Muscle and Nerve Development**

This course will examine the structure and function of muscle cells, the development of muscle cell identity, the development of motor neurons, and the interactions between nerve and muscle that lead to a functioning neuromuscular system. The primary focus will be on vertebrate model systems such as chick,

mouse, and fish. We will also examine human diseases, including muscular dystrophies and other neuromuscular disorders.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL343, NS&B543, BIOL543**

Prereq: **BIOL218 OR ([BIOL182 or MB&B182] AND [BIOL212 or MB&B212]) OR ([BIOL182 or MB&B182] AND [NS&B213 or BIOL213 or PSYC240]) OR ([BIOL196 or MBB196] AND [BIOL212 or MB&B212]) OR ([BIOL196 or MBB196] AND [NS&B213 or BIOL213 or PSYC240])**

#### **NS&B345 Developmental Neurobiology**

Near the top of the list of unsolved mysteries in biology is the enigma of how the brain constructs itself. Here is an organ that can make us feel happy, sad, amused, and in love. It responds to light, touch, and sound; it learns; it organizes movements; it controls bodily functions. An understanding of how this structure is constructed during embryonic and postnatal development has begun to emerge from molecular-genetic, cellular, and physiological studies. In this course, we will discuss some of the important events in building the brain and explore the role of genes and the environment in shaping the brain. With each topic in this journey, we will ask what the roles of genes and the environment are in forming the nervous system. We will also discuss developmental disorders resulting from developmental processes that have gone astray. This is a reading-intensive seminar course emphasizing classroom discussions, with readings from a textbook and the primary scientific literature.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL345, NS&B545, BIOL545**

Prereq: **(NS&B213 AND MB&B181 AND BIOL182) OR (NS&B213 AND MB&B181 AND BIOL196) OR (NS&B213 AND MBB195 AND BIOL182) OR (NS&B213 AND MBB195 AND BIOL196)**

#### **NS&B347 Mammalian Cortical Circuits**

The mammalian cortex is where conscious perception and thought is generated, but the mechanistic details governing those processes are not well known. Studies of those circuits have revealed a heterogeneity of neuronal classes in the cortex and their proposed roles in these processes. Detailed wiring diagrams of local and long-distance cortical circuits are emerging, colored with dynamic connections that are helping us understand the cortex with these reverse-engineering strategies. Almost all of the readings for this course will be taken from the recent primary literature; areas of the cortex that will be studied include sensory cortex as well as studies of hippocampal cortical circuits.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL347**

Prereq: **BIOL252 OR NS&B252 OR BIOL245 OR NS&B245**

#### **NS&B348 Origins of Knowledge**

In this course we will discuss in depth a selection of current topics in cognitive development, centering on questions concerning the origins of knowledge. (What kinds of knowledge do we possess even very early in life? How does that knowledge change over time?) We will examine these questions within specific subject areas such as object perception, space perception, number understanding, and understanding of other minds, surveying evidence from different stages of human individual development as well as evidence from nonhuman species.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **SBS-PSYC**

Identical With: **PSYC348**

Prereq: **None**

#### **NS&B351 Neurobiology of Learning and Memory**

Animals as varied as sea slugs and humans display a number of types of learning, ranging from the capacity to acquire species-specific behavior to the ability to form arbitrary associations. Just as varied are the philosophies governing the choice of how to best study the neurobiology of learning and memory. Through lectures, class discussion, student presentations, and a critical reading of the primary literature, the advantages and disadvantages of these various approaches will be investigated. While the specific focus of this class will be on learning and memory, other ways in which the brain learns will also be explored. Normal brain ontogeny relies to some extent on invariant cues in the animal's environment, making this process somewhat analogous to learning. In fact, the neural substrates for learning are likely to be a subset of the basic steps used during brain development. Moreover, the developmental rules guiding brain assembly place constraints on the what, how, and when of brain function and learning. Therefore, this course will also cover select topics in basic developmental neurobiology.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL351**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B353 Neurobiology of Neurological Disorders**

This course aims to provide a foundation in the underlying mechanisms of neurological and psychiatric disorders. We will explore through lectures and readings of primary literature a number of important neurological and psychiatric diseases, including autism, schizophrenia, Alzheimer's disease, mental retardation, epilepsy, and Parkinson's disease. This course focuses on the fundamental molecular and cellular mechanisms that underlie neurological disorders and is designed to engage students who wish to study basic aspects of brain function.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL353, PSYC353**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B356 Neurodevelopmental Disorders**

This course aims to provide a foundation in the underlying mechanisms of neurodevelopmental disorders. We will explore through lectures and readings of primary literature a number of important neurological and psychiatric diseases, including genetic disorders such as Down syndrome, Fragile X, and Williams syndrome; spectrum disorders such as autism and fetal alcohol syndrome; ADHD, Tourettes, cerebral palsy, and some motor disorders including developmental coordination disorder, stereotypic movement disorder, sensory integration disorder, and neonatal hypoxia. This course focuses on the fundamental molecular and cellular mechanisms that underlie neurological disorders and is designed to engage students who wish to study basic cellular aspects of brain function.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL356, PSYC356**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B357 Sex and Gender: From Synapse to Society**

From movies like "Think Like a Man" to songs like "God Made Girls," from federal policies to gender reveal parties, much of our experience is defined by an ideology of gender dichotomy and an endorsement of fundamental sex differences in behavior. But does science agree? The field of neuroscience is bursting with research that both supports and questions inherent differences in the brains and behavior of men and women. In this course we will be taking an open and critical look at this scientific literature. We will begin by clarifying what it means, biologically, to be male/female, determine the limits to these definitions and evaluate how these biological elements (genes/hormones/anatomy) interact with our environment and society to influence our behavior and gender identity. Additionally, we will evaluate nonhuman animal and human data regarding sex differences in behaviors (e.g., aggression, verbal communication) and neuropathological states (e.g., addiction, autism spectrum disorder). Student assessment will include effortful and active participation, short written responses, one long response paper, in-class quizzes, and a final presentation.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **BIOL357**

Prereq: **(BIOL182 AND NS&B213) OR PSYC240**

#### **NS&B360 Calderwood Seminar in Public Writing: Neuroplasticity and the Brain**

This course will examine structural and functional neuroplasticity. Structural plasticity refers to the brain's ability to change its physical structure as a result of learning and experience. The ability to reorganize itself by forming new connections, strengthening existing connections, or pruning away old synaptic connections is regulated by our environment, both within the body and the external world. We'll examine critical periods in development when sensory experiences change and sculpt the wiring of the brain, learn how the birth of new neurons changes across the lifespan, and how adult neurogenesis is altered by the microbes within us, physical exercise, stress, and neuropsychiatric disorders. We'll also learn about the promise of stem cell therapies for enhancing brain repair and plasticity after brain injuries. Several guest lecturers who are prominent neuroscientists working in the field of adult neurogenesis will be invited to speak to the class about their research in the field of neuroplasticity. This course will follow a model developed in Calderwood seminars taught at Wellesley College and is writing-intensive. After the basic material is introduced, class sessions will be workshop-based. Students will prepare for class by reading scientific papers and reviews on the topic and will submit short writing assignments on the topic. In class, we will discuss the topic and analyze the experimental approaches and findings. Students will have extensive opportunities for feedback and writing revisions through discussions with the professor, a course writing tutor, and in-class writing workshops.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **BIOL360**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**

#### **NS&B383 Advanced Research in Learning and Memory**

This advanced research course is designed to allow students to conduct supervised research in the area of human learning and memory. Students will become familiar with both classic and contemporary studies in memory and undertake a semester-long experimental research project that seeks to answer a current question in the field of memory research either individually or as a group. Students will get to work on all aspects of the research project, including reviews of the background literature; generation of research ideas; the design, conduct, and analysis of a study; and a write-up of research findings in a journal-article format.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **SBS-PSYC**

Identical With: **PSYC383**

Prereq: **None**

#### **NS&B390 Experimental Investigations into Reading**

Experienced readers can easily recognize thousands of words. The mental dictionaries of these readers are efficiently organized to allow rapid and seemingly effortless word recognition. There are still many unanswered questions about the processes involved in visual word recognition. In this class, students will work together with the instructor to design and carry out an experimental investigation relating to reading and word recognition. The semester will provide students with a chance to integrate all aspects of the experimental process: idea formation, experimental design, data collection and analysis, interpretation, write-up, and presentation.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC390**

Prereq: **None**

#### **NS&B392 Behavioral Methods in Affective Neuroscience**

This research methods course teaches experimental design and methods in experimental psychopathology using tools to conduct behavioral research in cognitive-affective neuroscience. Course material includes studies from the contemporary psychopathology research literature, with a focus on emotion interactions. Methods taught will vary by semester and individual research projects and will include statistical procedures (e.g., repeated measures ANOVA), tools for conducting research and analyzing data (e.g., computer programming for stimuli presentation and data processing), and neuroimaging techniques (e.g., event-related potential). There is high expectation that those enrolled in this course will take initiative to extend their learning to areas for which they have specific interests related to the course objectives. Students are also expected to work independently.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC392**

Prereq: **None**

#### **NS&B393 Advanced Research in Cognition and Neuropsychiatric Illness**

Students in this advanced undergraduate research course will work in teams on novel and ongoing research studies focused on understanding neurocognitive dysfunction and its treatment in neuropsychiatric illness. Students will be matched to a research project and will participate in different aspects of this research including background literature review, acquiring elementary skills in neurocognitive and symptom assessment, and collecting and/or analyzing extant data using SPSS. Students may also be involved in learning cognitive training procedures.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC393**

Prereq: **None**

#### **NS&B398 Advanced Research in Auditory Cognitive Neuroscience**

This course provides in-depth training on the methods of auditory cognitive neuroscience. We will review contemporary studies in auditory cognitive neuroscience, specifically in speech, language, and music. Students will design

and implement a group project, learn to analyze the data, and write up the results in an end-of-term paper.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC398**

Prereq: **None**

#### **NS&B399 Lab in Gambling, Drugs, and Junk Food**

This intensive laboratory course provides in-depth training on the experimental methods of behavioral neuroscience of motivation and reward and provides students with HANDS-ON EXPERIENCE WITH ANIMAL RESEARCH USING RODENT MODELS. The capstone of the course is to give students the opportunity to carry out an independent group ANIMAL RESEARCH PROJECT in the lab, which may require a heavier time commitment for the duration of the experiment (including some research over the weekends). Students will LEARN HOW TO HANDLE RATS in a behavioral neuroscience research setting and how to measure reward and motivation using diverse apparatuses such as operant (Skinner) boxes or conditioned place preference chambers; students will also develop their writing and presentation skills. In addition, we will review contemporary studies with a particular focus on gambling, diet-induced obesity, and drug addiction. Some of the models examined in more detail will focus on the role of reward uncertainty and decision-making in gambling, the individual differences in the attraction to reward cues in subjects prone to obesity vs. those who are resistant (with a particular emphasis on prenatal and developmental exposure to high-fat diets), and, finally, the individual differences in the resistance to adverse consequences in models of intense desire and addiction.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-PSYC**

Identical With: **PSYC399**

Prereq: **None**

#### **NS&B401 Individual Tutorial, Undergraduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

#### **NS&B402 Individual Tutorial, Undergraduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

#### **NS&B407 Senior Tutorial (downgraded thesis)**

Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: **Host**

Grading: **A-F**

#### **NS&B408 Senior Tutorial (downgraded thesis)**

Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: **Host**

Grading: **A-F**

#### **NS&B409 Senior Thesis Tutorial**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

#### **NS&B410 Senior Thesis Tutorial**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B411 Group Tutorial, Undergraduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B412 Group Tutorial, Undergraduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B420 Student Forum**

Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.

Offering: **Host**

Grading: **Cr/U**

**NS&B421 Undergraduate Research, Science**

Individual research projects for undergraduate students supervised by faculty members.

Offering: **Host**

Grading: **OPT**

**NS&B422 Undergraduate Research, Science**

Individual research projects for undergraduate students supervised by faculty members.

Offering: **Host**

Grading: **OPT**

**NS&B423 Advanced Research Seminar, Undergraduate**

Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B424 Advanced Research Seminar, Undergraduate**

Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B466 Education in the Field, Undergraduate**

Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.

Offering: **Host**

Grading: **OPT**

**NS&B491 Teaching Apprentice Tutorial**

The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.

Offering: **Host**

Grading: **OPT**

**NS&B492 Teaching Apprentice Tutorial**

The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.

Offering: **Host**

Grading: **OPT**

**NS&B501 Individual Tutorial, Graduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B502 Individual Tutorial, Graduate**

Topic to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B503 Selected Topics, Graduate Sciences**

Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.

Offering: **Host**

Grading: **OPT**

**NS&B509 Neuroscience Journal Club I**

Presentation and discussion of current research articles in the field of neuroscience.

Offering: **Crosslisting**

Grading: **Cr/U**

Credits: **0.25**

Gen Ed Area: **None**

Identical With: **BIOL509**

Prereq: **None**

**NS&B510 Neurosciences Journal Club II**

Presentation and discussion of current research articles in the field of neuroscience.

Offering: **Crosslisting**

Grading: **Cr/U**

Credits: **0.25**

Gen Ed Area: **None**

Identical With: **BIOL510**

Prereq: **None**

**NS&B543 Muscle and Nerve Development**

This course will examine the structure and function of muscle cells, the development of muscle cell identity, the development of motor neurons, and the interactions between nerve and muscle that lead to a functioning neuromuscular system. The primary focus will be on vertebrate model systems such as chick, mouse, and fish. We will also examine human diseases, including muscular dystrophies and other neuromuscular disorders.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL343, BIOL543, NS&B343**

Prereq: **BIOL218 OR ([BIOL182 or MB&B182] AND [BIOL212 or MB&B212]) OR ([BIOL182 or MB&B182] AND [NS&B213 or BIOL213 or PSYC240]) OR ([BIOL196 or MBB196] AND [BIOL212 or MB&B212]) OR ([BIOL196 or MBB196] AND [NS&B213 or BIOL213 or PSYC240])**

**NS&B545 Developmental Neurobiology**

Near the top of the list of unsolved mysteries in biology is the enigma of how the brain constructs itself. Here is an organ that can make us feel happy, sad, amused, and in love. It responds to light, touch, and sound; it learns; it organizes movements; it controls bodily functions. An understanding of how this structure is constructed during embryonic and postnatal development has begun to emerge from molecular-genetic, cellular, and physiological studies. In this course, we will discuss some of the important events in building the brain and explore the role of genes and the environment in shaping the brain. With each topic in this journey, we will ask what the roles of genes and the environment are in forming the nervous system. We will also discuss developmental disorders resulting from developmental processes that have gone astray. This is a reading-intensive seminar course emphasizing classroom discussions, with readings from a textbook and the primary scientific literature.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL345, NS&B345, BIOL545**



Prereq: **(NS&B213 AND MB&B181 AND BIOL182) OR (NS&B213 AND MB&B181 AND BIOL196) OR (NS&B213 AND MBB195 AND BIOL182) OR (NS&B213 AND MBB195 AND BIOL196)**

**NS&B549 Advanced Research Seminar, Graduate**

Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B550 Advanced Research Seminar, Graduate**

Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**

Grading: **OPT**

**NS&B555 Laboratory in Cellular and Behavioral Neurobiology**

The goals of the course are to introduce students to a number of contemporary laboratory techniques in neuroscience and behavior. The laboratory introduces students to experimental method and techniques including neuroanatomy, immunohistochemistry, primary neuronal and astrocyte cell culture methods, analyses of electrical activity in the brain, and behavioral analyses of learning, memory, social behavior, and social dominance in inbred strains of mice.

Students will learn to analyze experimental data and write a series of laboratory reports on the experiments done during class. In addition, students will write a term paper related to one of the experimental approaches.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL250, NS&B250**

Prereq: **[NS&B213 or BIOL213 or PSYC240]**